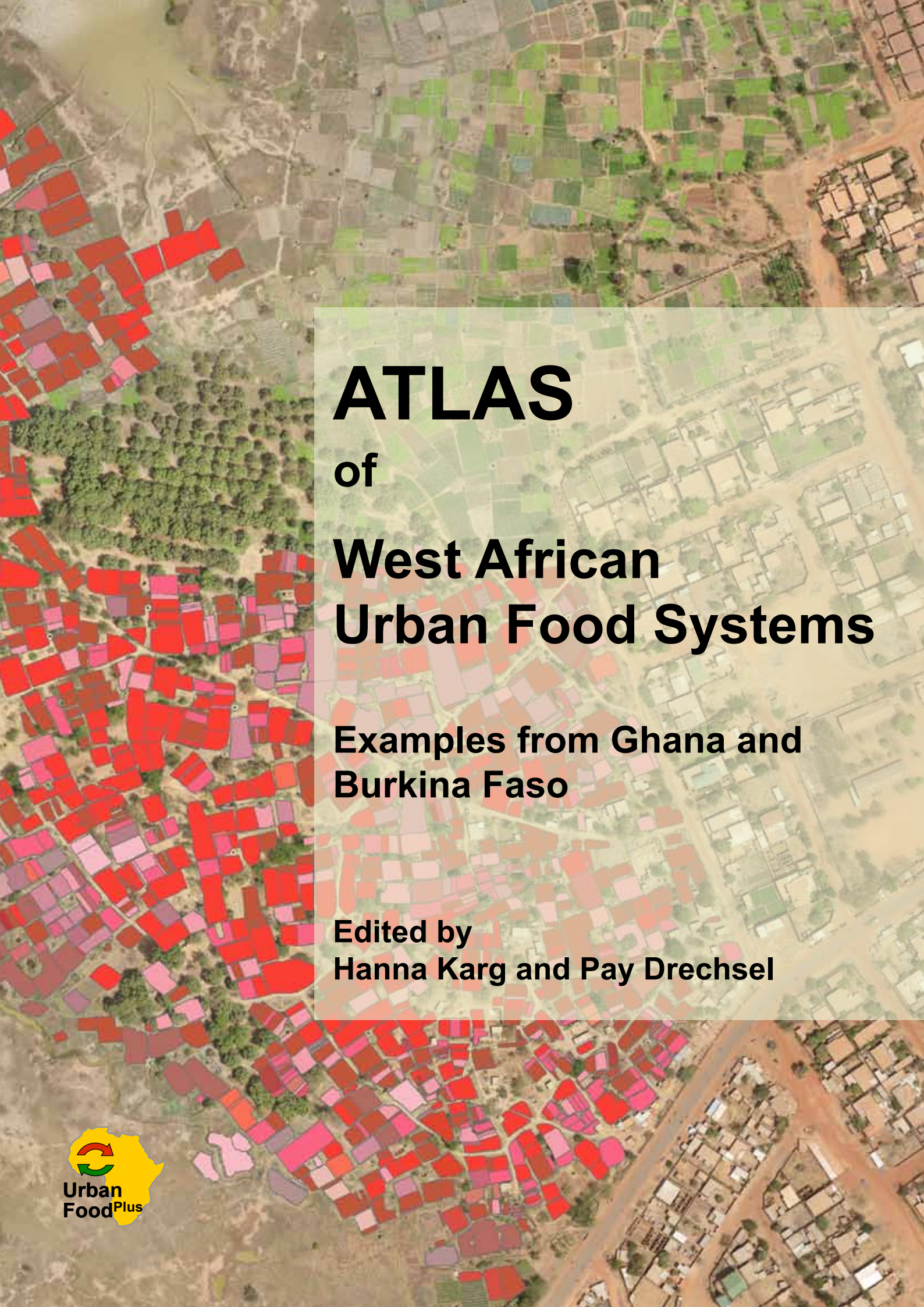

ATLAS
of
West African Urban Food Systems

Examples from Ghana and Burkina Faso

Edited by
Hanna Karg and Pay Drechsel

Urban Food Plus

The attached CD contains a movie describing UrbanFood^{Plus} project activities in English and French. If there is no CD attached to the inside front cover, please access the featured movies online:

Project movie 'Feeding the city: Urban agriculture in West Africa' (English version)
https://www.youtube.com/watch?v=gEx23jGX47g&feature=youtu.be

Project movie 'Nourrir la ville: L'agriculture urbaine en Afrique de l'Ouest' (French version)
https://www.youtube.com/watch?v=o7B2FV18h1A&feature=youtu.be

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The editors

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Project

The GlobE UrbanFood[Plus] project is an African-German partnership to enhance resource use efficiency in urban and peri-urban agriculture for improved food security in West African cities.

Project partners

Contents

Foreword

Andreas Buerkert, Eva Schlecht and Bernd Marschner

Understanding the scope, efficiency and limitations of West African urban food systems becomes increasingly important as African agriculture continues to be exposed to demographic, political and ecological pressure. Rising demands on the provisioning, supporting, regulating and cultural ecosystem services[0.1] of Africa's vast and largely agriculturally used landscapes are driven by population growth and changes in consumer preferences. They reflect, among others, shifts from largely cereal-, root- and tuber-based meals to diets richer in animal-based protein. These are increasingly complemented by vegetables and fruits. United Nations projections indicate that over the next 25 years the urban population in sub-Saharan Africa will double from currently 475 million people, while the share of African urban residents is projected to grow from 11% in 2010 to 20% in 2050.[0.2, 0.3] Political unrest leading to major migration from rural hinterlands to cities, continuing disparity between rural and urban infrastructure, and opportunities for jobs, education and communication are major drivers of accumulations of predominantly young citizens. This entails not only growing conflicts about land, water and labor resources in urban areas, but also the need to further enhance local and regional resource use efficiency. Urgently needed are therefore recycling schemes for (organic) waste, stringent urban planning and effective regulations for the provision of safe food. In order to strengthen efforts for informed decision making and empower stakeholders along rural-urban food value chains, we need to better understand how African urban food systems operate under different agro-ecological conditions. This will require an interdisciplinary analysis of the spatial structure, intra- and inter-annual patterns of functioning, and of telecoupling components of these systems, which are often closely related to regional and global markets. New concepts such as urban sprawl, quality control in urban vegetable and livestock production, targeted urban forestry and wastewater recycling, together with an analysis of food and feed flows, food mileage, virtual water, willingness-to-pay for food safety and the reliance on stakeholder dialogues need to be employed to understand system dynamics and resilience.

This atlas summarizes recent advances in interdisciplinary approaches to address the different components of West African urban food systems. It thereby draws on the results of several major collaborative research projects conducted in West Africa over the past two decades. Most results come from the UrbanFood^{Plus} (www.urbanfoodplus.org) consortium set up in Burkina Faso, Cameroon, Ghana and Mali. Besides providing data, the authors want to stimulate discussions about the role of the different stakeholders and provide a framework for site-specific analysis and action rather than a one-fits-all blueprint. Bringing urban food systems out of the shadow of illegality is necessary as they provide nutritious food, jobs, biodiversity refugia and open green spaces in often overly busy cities throughout sub-Saharan Africa. The multiple roles of urban and peri-urban plant production and animal husbandry systems supplying staples, fruits, vegetables, milk, meat, eggs and manure has too long been overlooked, but their importance will likely increase in the coming years. Only an understanding of these roles will allow better use of open space and resources, and development of more effective policies that control potential negative externalities of urban food systems, such as nutrient contamination of aquifers and microbe-loaded food items.

Key Messages

Urban development

Expanding urban farming in support of urban food supply requires formalizing land use planning. But in Tamale and other Ghanaian cities, rapid growth is disrupting the land market. Conflicts occur when traditional and modern land rights clash, such as when traditional *chiefs* take advantage of their custodian status and sell land originally meant for local farmers. The first step to improved land use planning in growing cities is to address such conflicts in a timely and transparent manner.

Backyard farming can support household food supply as well as urban markets, but varies in extent and appearance with urban development and planning. As new urban centers expand, traditional villages are absorbed into the city rather than demolished. This means that the traditional housing layouts can remain, including spaces for farming. In more established and higher density housing areas, the size of backyards, their appearance and the crops grown in them will change.

Urban farming links and supports many urban development objectives. The complexity of the urban institutional environment calls for multi-stakeholder dialogues to address farming-related challenges and opportunities through a participatory planning process. Local nongovernmental organizations (NGOs) can be instrumental in facilitating related dialogues, ideally supported by action research for informed decision making, as exemplified by the GlobE UrbanFood^{Plus} project.

Urban agriculture

The extent of irrigated and rain-fed farming in cities can vary widely depending on the availability of land and water. Access to water for irrigation allows farmers to grow high-value perishable crops in the dry season, which helps to maintain urban food diversity and supports the livelihood of urban farmers.

Access to water allows year-round crop production, which increases the risks of pests, especially for non-traditional vegetables, such as cabbage. To maintain their profits, farmers are increasing pesticide use and in turn the related health risk for themselves and consumers. This development calls for more education on alternative integrated pest management options and pesticide residue monitoring.

Manure is a highly valued, traditional organic fertilizer. The marketing or exchange of manure reduces nutrient losses within a livestock–crop system for mutual economic and environmental benefits. Opportunities to market manure could be improved, given the high demand and ongoing waste of manure.

Trees, woodlots and forests in cities serve a number of purposes, including food supply. Every third tree in Tamale is a fruit-bearing tree, of which mango trees represent the majority, delivering a free supply of high amounts of vitamin C, vitamin A, and fiber to children and adults. The contributions of urban fruit trees to a balanced, pro-poor diet should not be overlooked in urban planning.

Key Messages

Urban food supply

Up to half of urban food needs, covering the main food groups, is met from smallholder farms within an average radius of about 100 km from the cities. The analysis of these urban 'foodsheds' allows to determine the nature of 'rural–urban linkages' and the relative contribution e.g., of urban farming, which has a particular role in the supply of fresh crop and livestock products that easily spoil if transported over longer distances.

The longer the food supply chain cities have, the higher the risk of disruptions, for example through flooding or droughts, which can significantly affect food prices. A larger geographical diversity of food sourcing areas helps to enhance the resilience of urban food systems. In addition, infrastructure investments, such as storage facilities for key commodities, can help buffer shocks.

Markets and consumption

Given the use of wastewater and pesticides in urban agriculture, the large majority of consumers in Tamale is willing to pay a 30% higher price for certified, non-contaminated vegetables. However, clean and contaminated crops are marketed together, and so far buyers seem to care more about crop appearance and price than invisible risks.

A transformation of the livestock sector is taking place in both Ouagadougou (especially dairy and pig) and Tamale (sheep), moving from subsistence to commercial production. Especially milk holds a huge potential to improve nutrition, but requires a well-balanced feeding program, especially in the dry season. As demand increases, urban livestock rearing will remain an essential component of urban farming, unless cool transport and storage begin to allow for alternative sourcing. The same applies to easily perishable fruits and vegetables.

Urban diets are shifting to more rice and meat, away from the traditional tubers and plantain. With city growth and greater distances between people and their own kitchens, restaurant and street food meals are becoming more popular. This also reflects a shift to smaller family units and a preference for convenience, as rice-based meals are faster to prepare than the traditional cassava, yam and plantain meals.

Introduction

Aboabo market in Tamale.

Hanna Karg and Pay Drechsel

The world is urbanizing, and cities are becoming consumption hubs that drain their surroundings of food, water, energy and labor. Urban food systems are changing worldwide, driven not only by growing urban demand for food, but also by globalizing food markets and changing diets. Urban food system activities, ranging from production through distribution and processing to consumption, span across - and thereby link - urban, peri-urban, regional and international spaces.

For instance, urban food demand has an effect on food production areas within and beyond provincial and national boundaries through trade and vice versa; where crops cannot be stored, urban and peri-urban agriculture producing perishable crops benefit from the proximity to permanent and reliable markets; urban diets are influenced by international fast food.

In many low-income countries, food insecurity affects both urban and rural populations, as the majority of urban dwellers relies on food markets and is therefore vulnerable to rising food prices.

There has been an increasing interest in urban food systems research given the pace and intensity of change these systems are undergoing and related emerging issues of urban food system resilience and sustainability. Aside from the academic interest, cities are considered key in solving many of today's challenges, for instance, urban agriculture is considered a means to minimize negative environmental effects from long-distance food transportation and a way to recycle urban organic waste as well as to generate income and contribute to food security in urban areas. At the same time, urban agriculture is affected by uncontrolled expansion of cities and air and water pollution. Beyond urban agriculture, improving city–hinterland interactions and relations has received increasing attention to enhance urban food system resilience and sustainability in urbanizing environments.

Given growing urban populations and the tremendous changes food systems are undergoing, there is a need to better understand urban food systems, the related production areas, opportunities and challenges, and how this is or should be linked to urban planning.

About the publication

This publication tries to shed light on these issues in the context of cities in Ghana and Burkina Faso, West Africa. It was developed as part of the interdisciplinary UrbanFood[Plus] project (UFP), studying urban agriculture in four West African cities (www.urbanfoodplus.org). This publication mainly presents findings of project activities in Ouagadougou, Burkina Faso, and Tamale, Ghana (Figure 0.1), carried out between 2013 and 2017. It provides a selection of the comprehensive results generated by the project on food system activities, including urban production, distribution, marketing and consumption, in these cities in the context of rapid urban growth and planning challenges. The publication comprises a background chapter on urban development and four main chapters describing urban food system activities that start with **urban farming** activities in Tamale and Ouagadougou. **Urban food supply** includes food flows and supply challenges. The chapters on **markets and consumption** give insights into retail markets and changing consumption patterns. The last chapter provides insights into **stakeholder dialogues**, a process which has accompanied the project from the very beginning.

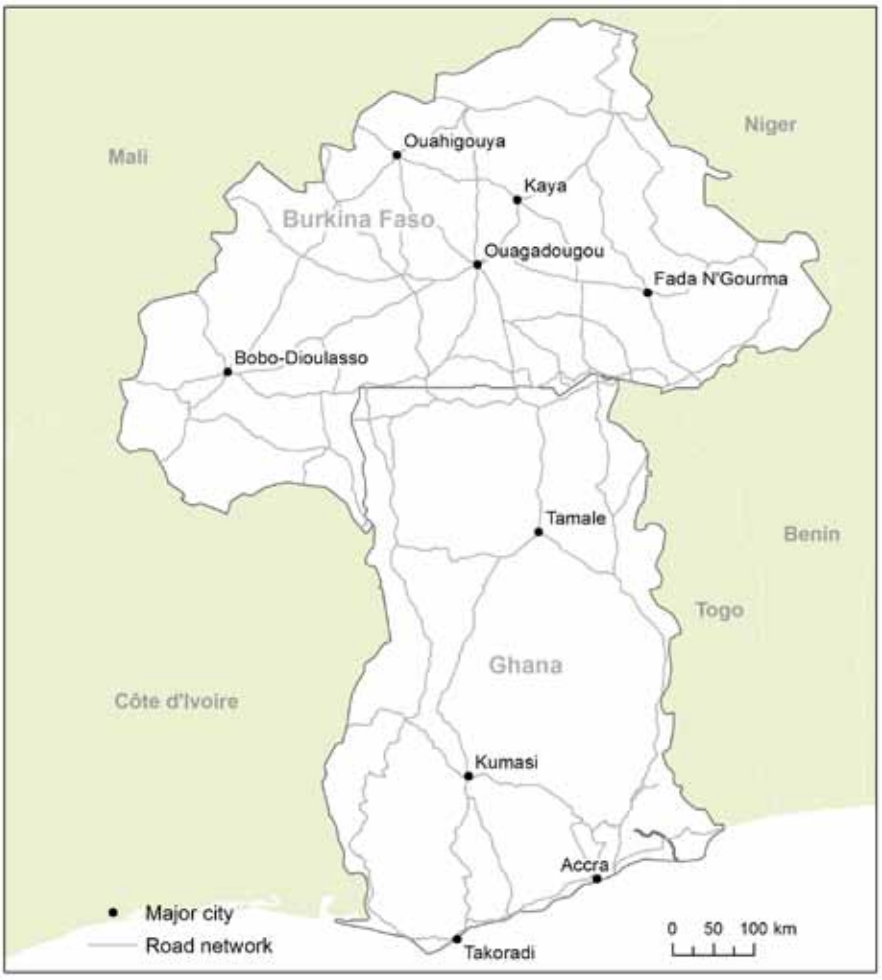
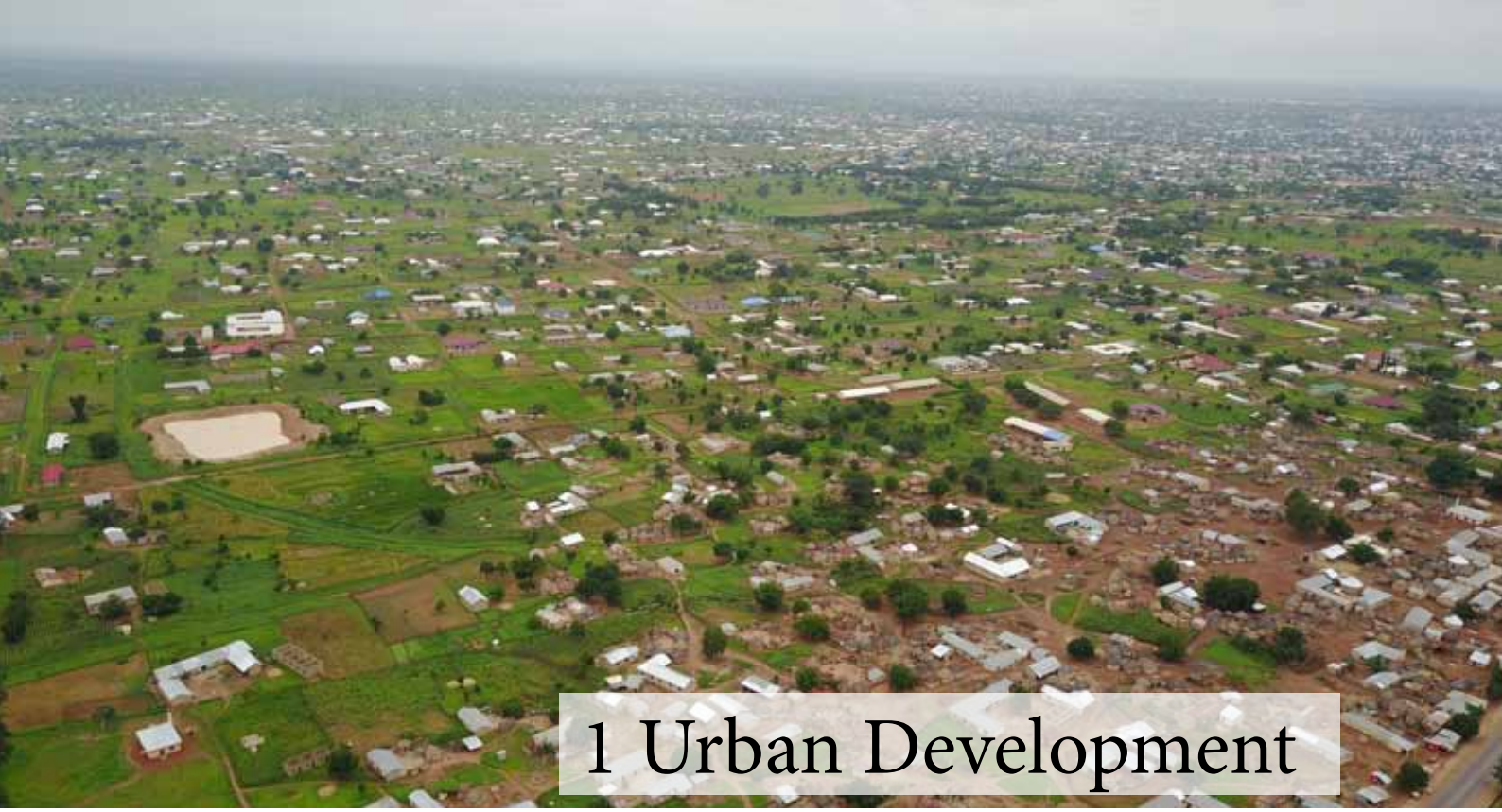


Figure 0.1. Map of Ghana and Burkina Faso.



1 Urban Development

Peri-urban village being absorbed by the city (Tamale).

Hanna Karg

Rural–urban transformation represents one of the most profound demographic challenges at a global scale. In sub-Saharan Africa, the urban transformation is a relatively recent phenomenon, which is why urbanization levels are still relatively low as compared to the world average (Figure 1.1). It is expected that in sub-Saharan Africa, 50% of the population will live in urban centres by 2040, while globally half of the population already live in cities today. Despite declining urban growth rates, the number of people being added to urban areas is unprecedented in sub-Saharan Africa.[1.1] Africa's fast urbanization is caused by the growth of small and intermediate cities. Urban centers with fewer than 300,000 people accounted for almost 60% of urban growth in Africa between 2000 and 2010, while those over 1 million inhabitants only accounted for 29%.[1.2]

Eastern Africa is the most rapidly urbanizing subregion in Africa, followed by West Africa, whose urban population is expected to increase from 44.9% in 2011 to 65.7% by 2050, largely driven by natural increases in urban population rather than rural–urban migration.[1.3] As on the rest of the continent, increasing urbanization in West Africa is owing to the growth of secondary cities. Not only have smaller and intermediate cities exhibited higher growth rates, but the number of smaller centers (10,000-49,999 inhabitants) has more than doubled between 1980 and 2010. In West Africa, 80% of the population lives in settlements with populations smaller than 500,000.[1.2]

The main reason for Africa's fast urbanization is the growth of **small and intermediate cities**.

Across the continent, rural areas continue to play a role in the future with growth rates

of more than 1% annually.[1.2] While urban centers grow and new settlements emerge, the average distance between these agglomerations constantly decreases, and the connections between rural and urban areas increase. Ghana and Burkina Faso are urbanizing more rapidly than the sub-Saharan average, even though the urbanization level in Burkina Faso is still below the one of sub-Saharan Africa (Figure 1.1), and both Tamale and Ouagadougou are facing rapid urban growth.

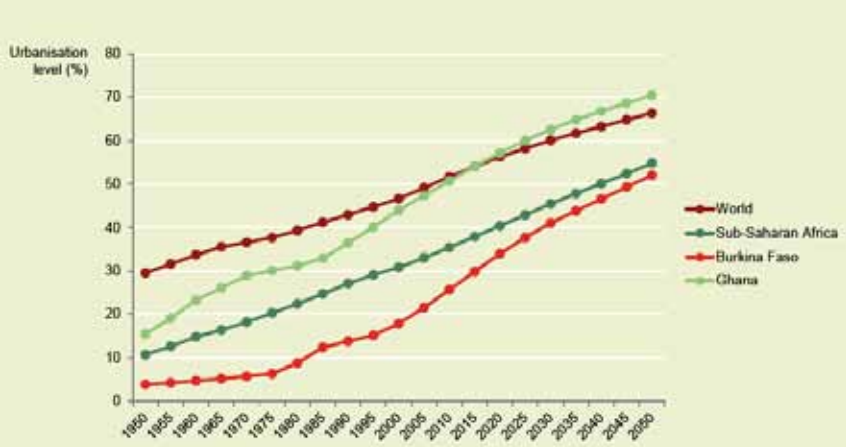


Figure 1.1. Urbanization levels.[1.4]

Urban sprawl

2001

2017

In Tamale (Ghana) traditional building structures are part of the urban form. Unplanned sprawl results in the conversion of mostly agricultural land into built-up area.

Effects of land markets on urban farmers in Buipela, Tamale

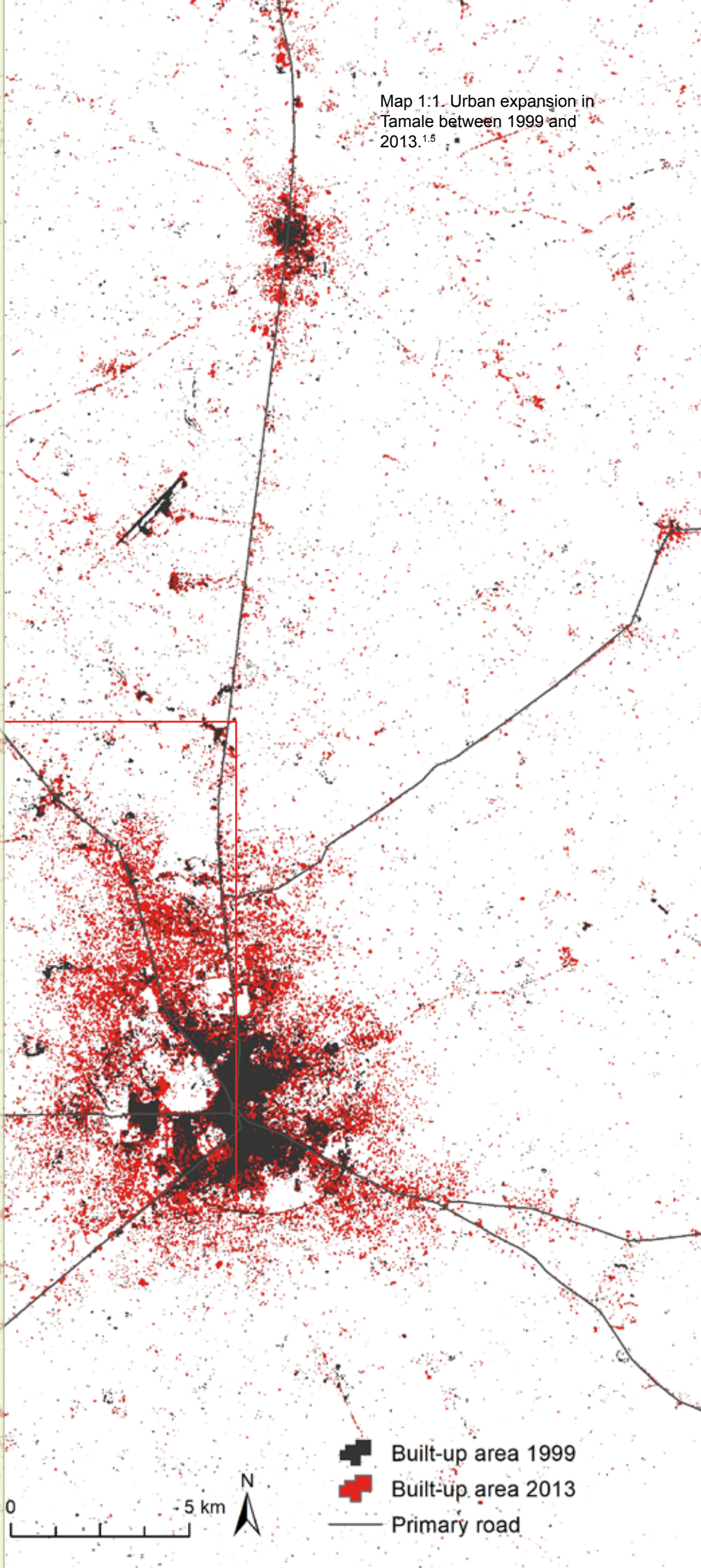
Eileen Bogweh Nchanji

Tamale is experiencing rapid population growth. This is a result of its centralized position and its offer of jobs and education to communities within and outside of the region. In Tamale, traditional *chiefs* own 90% of the land, which they hold in trust for the community, and the state owns 10% of the land through eminent domain. Attached to this ownership is a social obligation to lease these lands and use the money for the development of the community. Rapid urbanization has resulted in a valuable land market. Chiefs are taking advantage of this situation to act as 'private land owners' and lease lands to estate developers for personal gain. This move often occurs to the detriment of urban farmers who have user rights over these lands. In Buipela (Tamale), more than 90% of land has been sold to estate developers, displacing farmers to peri-urban areas. Discussions with urban farmers and the Ministry of Agriculture revealed that money from sales of these lands is unfortunately not used for community development, but to maintain chieftaincy status and ostentatious lifestyles for most of the *chiefs*.

For more information:

Nchanji, E.B.; Bellwood-Howard, I.; Schareika, N.; Chagomoka, T.; Schlesinger, J.; Axel, D.; Rüdiger, G. 2017. Assessing the sustainability of vegetable production practices in northern Ghana. *International Journal of Agricultural Sustainability* 15(3): 321–337.

Map 1:1. Urban expansion in Tamale between 1999 and 2013.[1.5]



In the past decade, urban population growth has been speeding up, accounting for an annual growth of 4.5% in Tamale and 3.8% in Ouagadougou (Figure 1.2 & 1.5). Urban population growth is reflected in the physical expansion of the cities. Within the past 15 years, Tamale's urban land has increased 2.5 times (Map 1.1).[1.5] In Ouagadougou, urban built-up area has more than doubled as compared to the year 2000 (Map 1.2).[1.6] Due to rapid urban growth, urban planning and infrastructural development are challenged. Therefore, and due to different planning traditions, administrative boundaries do not necessarily reflect the actual urban built-up area. For the purpose of comparing food systems in Tamale and Ouagadougou, a simplified boundary was created including grid cells with more than 25% built-up area (Figure 1.3 & 1.6).[I]

On average, the urban population in Tamale doubled every decade, increasing from about 83,000 in 1970 to about 371,000 in 2010.[1.7] In Tamale, traditional authorities (*chiefs*) are responsible for managing most land in and around the city. Due to increasing demand for land, land prices have risen, resulting in *chiefs* selling land to property developers (see page 8). Besides the tremendous urban growth, urban planning is thus further challenged by conflicts over the allocation and use of land between the traditional authorities on the one hand and governmental planning institutions on the other. As a result, the urban area is expanding, creating vast peri-urban landscapes without adequate services and facilities. Chapter 4 illustrates the discrepancy between governmental plans and urban development on the ground.

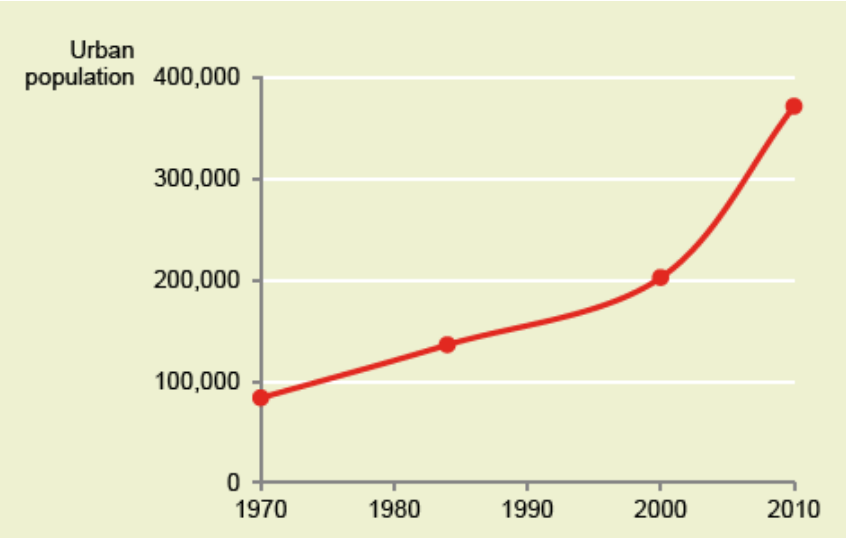


Figure 1.2. Tamale's population growth between 1970 and 2010.[1.7]

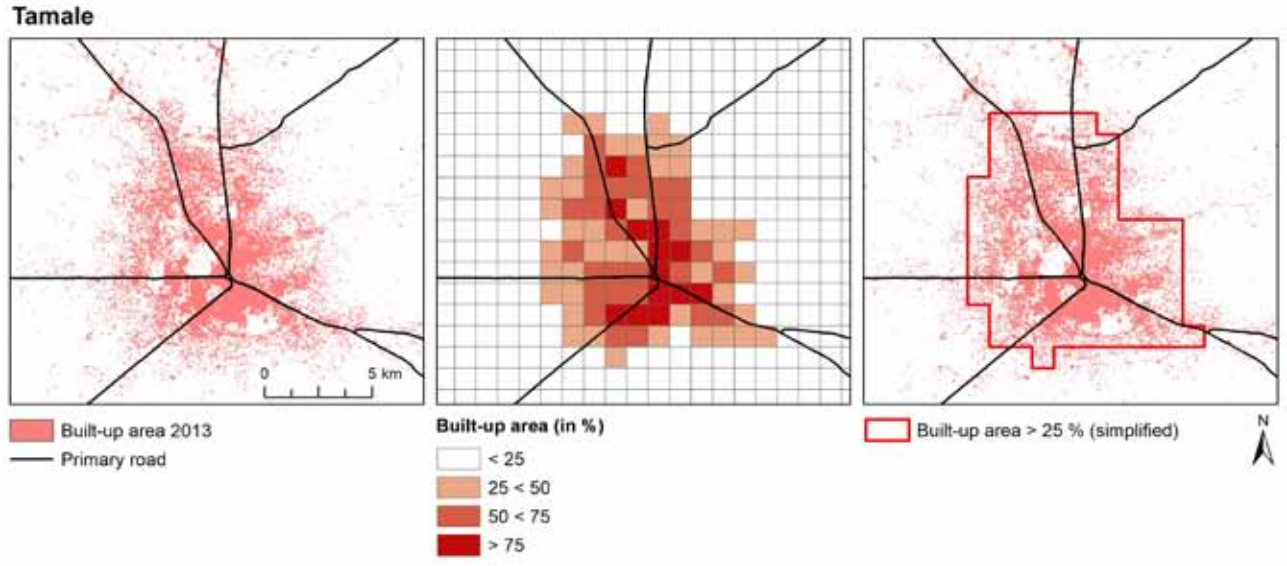


Figure 1.3. Creation of simplified urban boundary for Tamale, Ghana.

Figure 1.4. Division of land into plots (white areas) (*lotissement*) in an informal settlement of Ouagadougou, Burkina Faso.[1.10]

Map 1.2. Urban expansion in Ouagadougou between 2000 and 2013.[1.6]

Primary road
Built-up area 2000
Built-up area 2013
0 2,5 5 km
N

Ouagadougou experienced a population increase of 400% between 1985 and 2012, rising from 500,000 to almost 2 million people.[1.8] In Ouagadougou, until the 1980s, no formal urban policy had accompanied the demographic and spatial expansion of largely unorganized settlements that were allocated by traditional authorities (*chefs de terres*).[1.9] It was only after 1984, when a land reform was established and the land nationalized, that urban land was demarcated on a large scale, resulting in the division of land into regular plots (*lotissement*) that were allocated to households, facilitating legal ownership and infrastructural development (Figure 1.4).[1.9]

Today, this inner urban area constitutes a rather homogenous area that is well equipped with infrastructure. As the city becomes increasingly formal, informal settlements are almost exclusively found at the periphery of the city, where the rapid expansion of the city has outpaced municipal strategies. Here, traditional allocation of land persists, resulting in parallel structures that facilitate land speculation.[1.11]

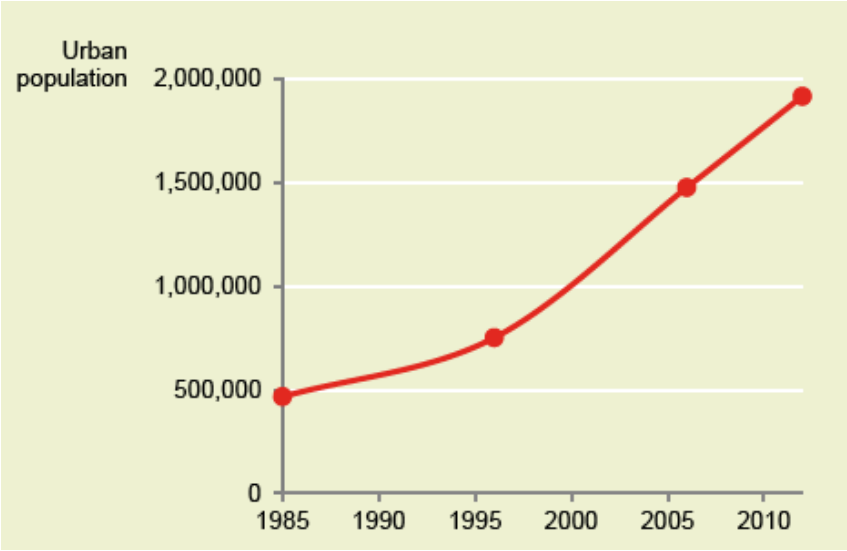


Figure 1.5. Ouagadougou's population growth between 1985 and 2012.[1.8]

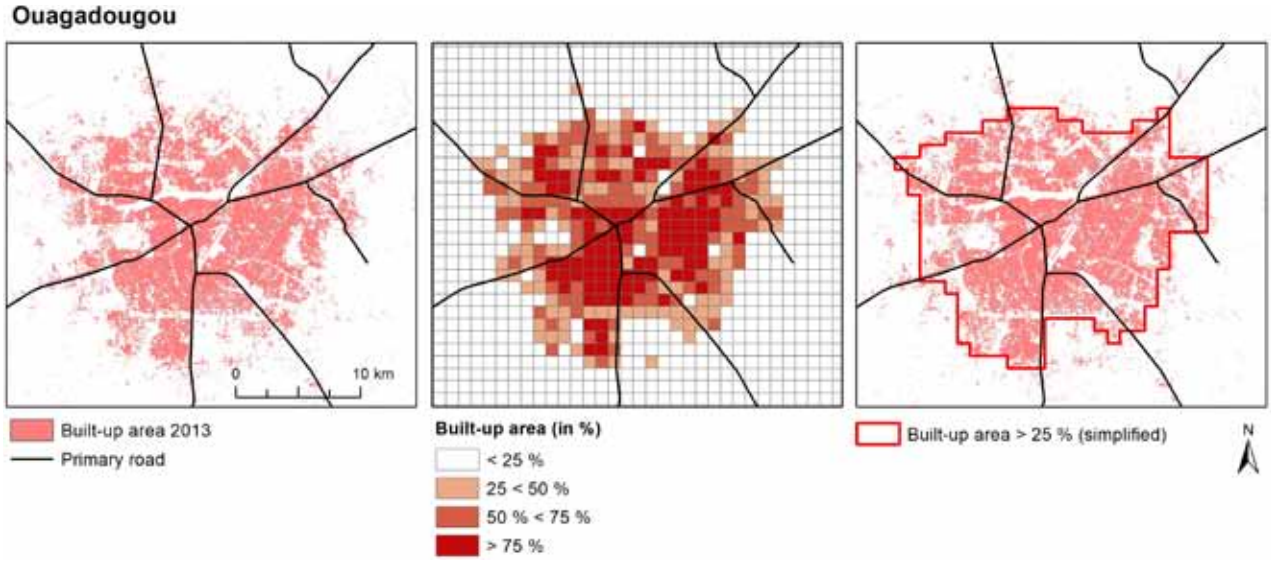


Figure 1.6. Creation of simplified urban boundary for Ouagadougou, Burkina Faso.

2 Urban Agriculture

Gumbehene New Dam farming site in the city center of Tamale, Ghana.

Hanna Karg

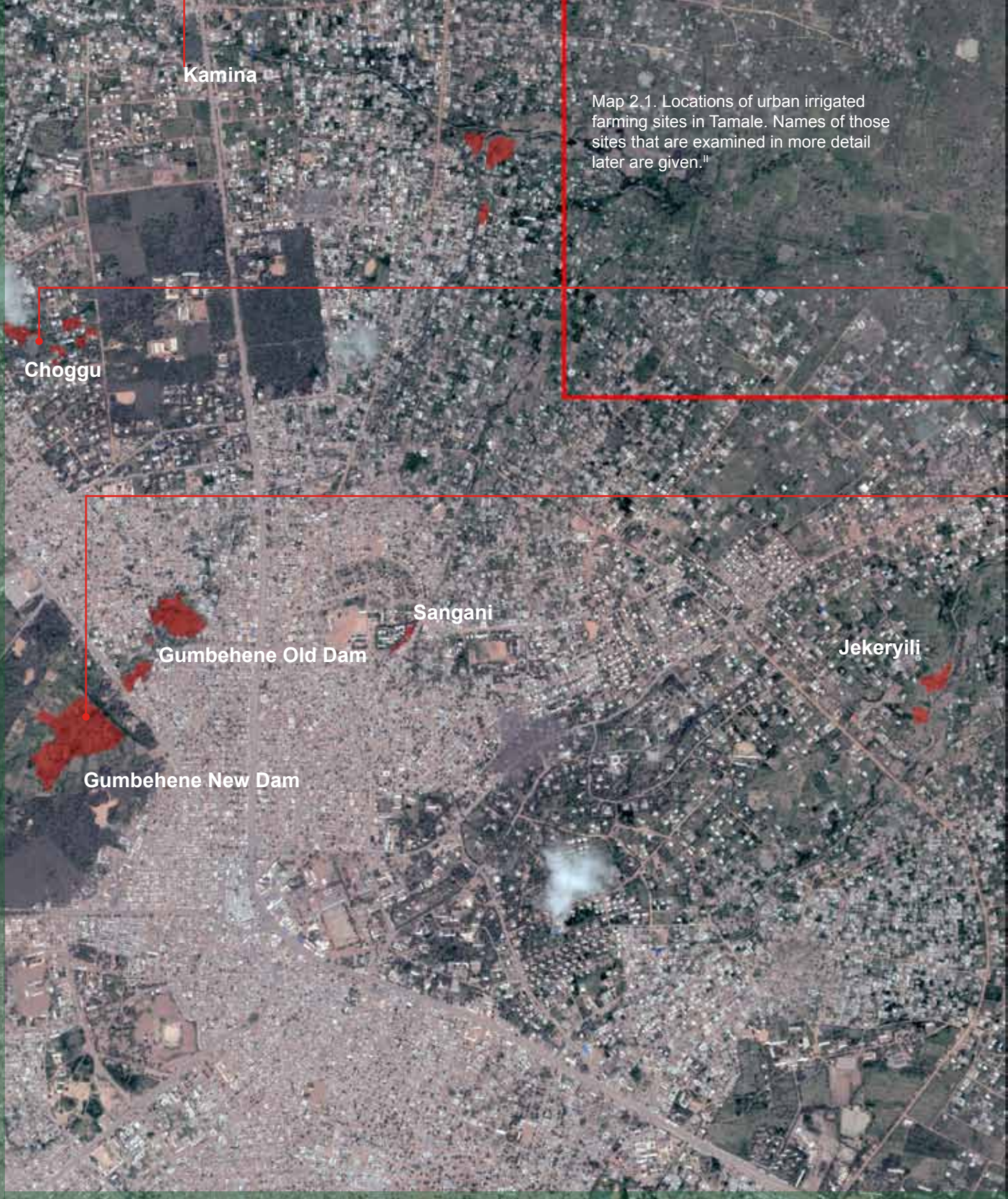
Urban and peri-urban farming are vibrant activities in Tamale and Ouagadougou. In this publication, we focus on food production within the urban boundaries, including crop, livestock and fruit production. Urban crop production has been classified as 1) open-space production of high-value products on undeveloped urban land and 2) mostly subsistence gardening in backyards.[2.1] Both forms of urban farming can be found in Tamale and Ouagadougou, albeit with major differences between the cities. In Ouagadougou, open space sites play a greater role in production and marketing than in Tamale, where isolated urban fields, including backyards, are more relevant for food production than in Ouagadougou (Chapter 2.2).[2.2] These differences are related to the historical urban development in both cities, but also to climate and water availability.

Because it only rains during a short rainy season, farming during the dry season is restricted to locations where irrigation is available, such as along streams, wells or dams. In Tamale and Ouagadougou, farming often takes place on seasonally flooded or waterlogged areas not suitable for housing, which therefore may, despite the generally poor land tenure security, be sustained as farming sites.

In many cities, including Tamale and Ouagadougou, the use of wastewater for irrigation is also common, allowing a year-round supply of vegetables in particular (see pages 25 and 28, showing a simple waste-water treatment plant in Tamale and the use of industrial wastewater in Ouagadougou). Organic wastewater increases soil fertility in a region where soils are generally poor and low in nutrient and organic matter. As part of the UrbanFood^{Plus} project, different treatments, including the amendment of biochar, and their effect on soil fertility and yields was tested (see pages 22 and 23). Livestock keeping is a traditionally widespread activity in both cities (Chapter 2.3), and a better integration of crop–livestock systems may considerably improve soil fertility.

Urban farming in Ouagadougou (Burkina Faso) is characterized by large irrigated open space vegetable production and livestock rearing.

In Tamale (Ghana) crop production is part of the urban landscape, in particular during the rainy season when small, unused spaces are used for crop production. Livestock keeping is also common.



Map 2.1. Locations of urban irrigated farming sites in Tamale. Names of those sites that are examined in more detail later are given.[II]

Because of the two distinct seasons, one wet and one dry, seasonal variation in terms of crop composition as well as area under cultivation is substantial. In the dry season, crop production is limited to areas with access to irrigation water. In Tamale, the main irrigated farming sites are located in the city center (Gumbehene New Dam and Old Dam). Irrigation water sources vary and include groundwater, piped and gutter water, with varying degrees of contamination. During the dry season, around 25 ha are under cultivation within the urban boundary (see Map 2.1).[II] During the rainy season, when people make use of small, unused spaces, the area under cultivation increases considerably. A land use classification revealed that 3,700 ha within the urban boundary are covered by crop land and savannah.[III] This corresponds to 41% of land within the urban boundary, as compared to only 18% in Ouagadougou.

2.1 Open Space Farming

Hanna Karg and Johannes Schlesinger

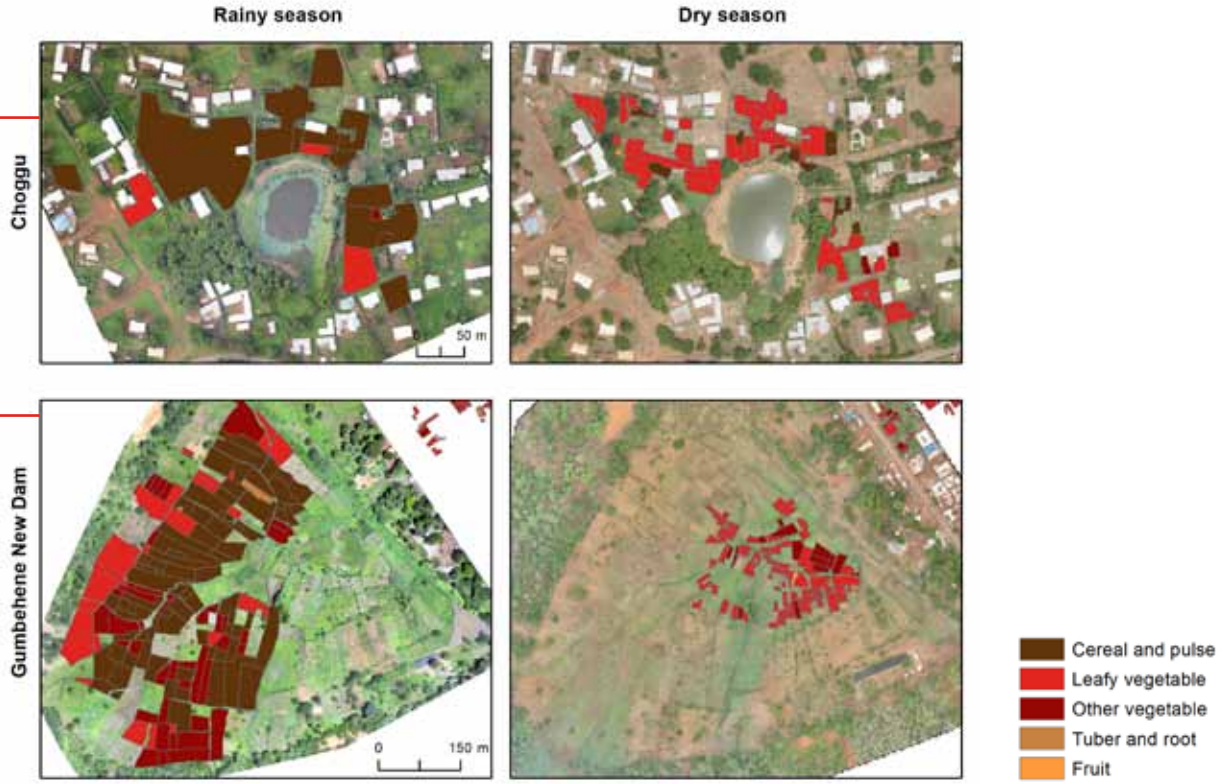


Figure 2.1. In-situ mapping of two selected open space farming sites in Tamale, Ghana (rainy season 2014, dry season 2015).

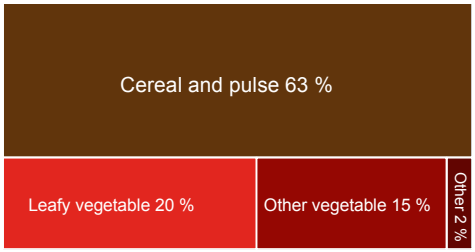


Figure 2.2. Crop mix in Tamale (Ghana) during the rainy season.

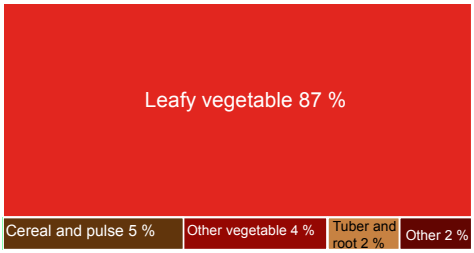
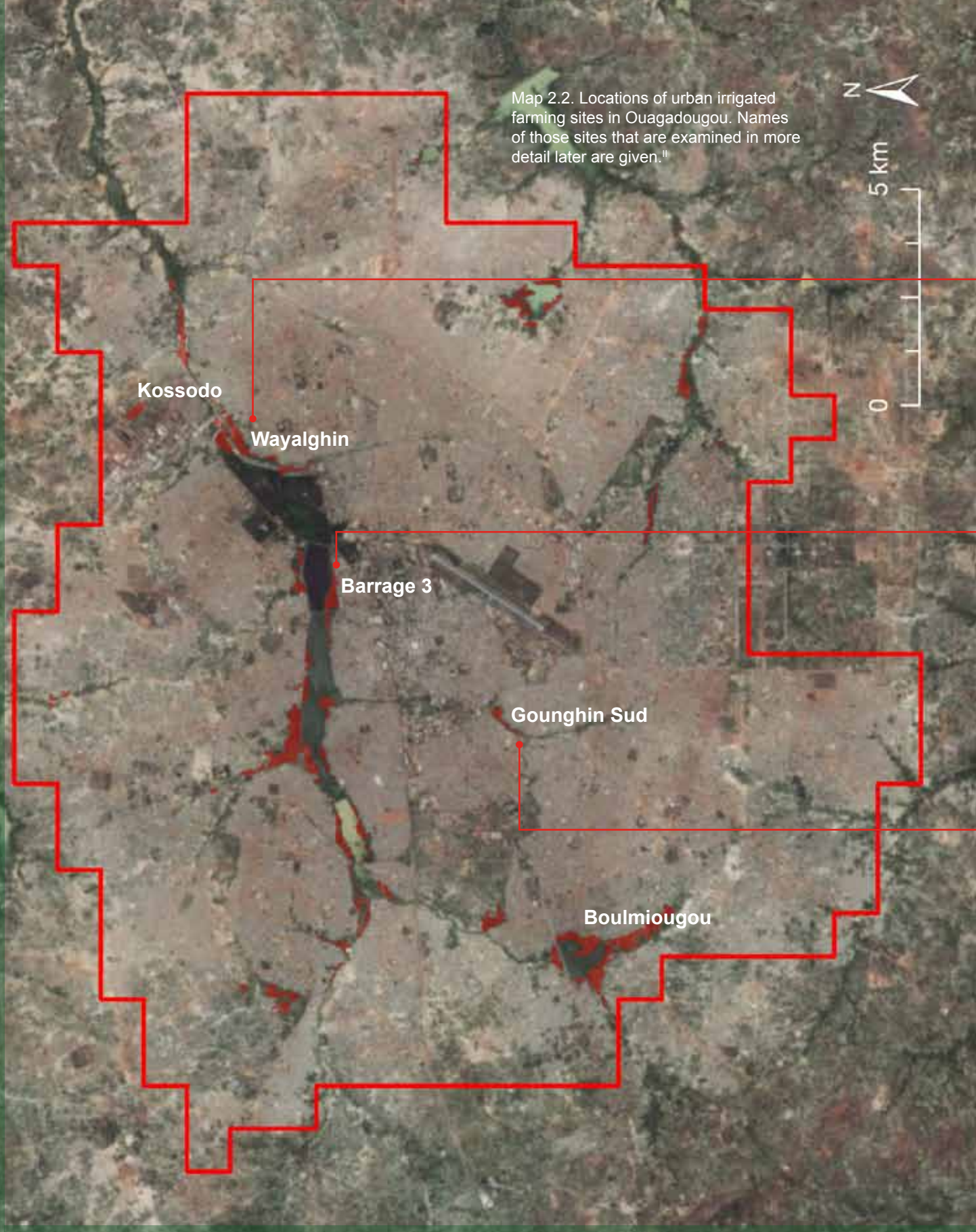


Figure 2.3. Crop mix in Tamale (Ghana) during the dry season.

Mapping open space sites revealed which types of crops were cultivated, the areal extent of cultivated sites, as well as seasonal variations (Figure 2.1). In total, four sites were mapped in each city, during both rainy and dry season. Results revealed that, in Tamale, the area under cultivation more than doubled in the rainy season as compared to the dry season. Crop mix also changed considerably across the two seasons on the mapped sites (see pages 20 and 21). Cereals such as maize and rice covered more than 60% of the cultivated area during the rainy season (Figure 2.2), while during the dry season, leafy vegetables, in particular traditional leafy vegetables, dominated, covering almost 90% of the area (Figure 2.3). The cultivation of perishable produce in urban agriculture is common and has been reported for other cities in Africa and Asia where the lack of cool storage does not allow for long distance–transportation of fresh produce.[2.3, 2.4]

Urban crop production shows **strong seasonal variations**, in terms of crop mix as well as area under cultivation.



Map 2.2. Locations of urban irrigated farming sites in Ouagadougou. Names of those sites that are examined in more detail later are given.[II]

In Ouagadougou, most irrigated open space farming sites are located close to the centrally located dams (*barrages*) with a high groundwater level and wells for irrigation. Other irrigation water sources include streams (partly with diluted wastewater) and industrial wastewater. In total, 527 ha are under cultivation during the dry season within the urban boundary (see Map 2.2),[II] more than 20 times the irrigated area in Tamale. Rain-fed cultivation is, unlike in Tamale, a minor activity within the urban boundary of Ouagadougou, one reason being the formal nature of urban planning in Ouagadougou (Chapter 2.2).

Figure 2.6. In-situ mapping of three selected open space farming sites in Ouagadougou, Burkina Faso (rainy season 2014, dry season 2015).

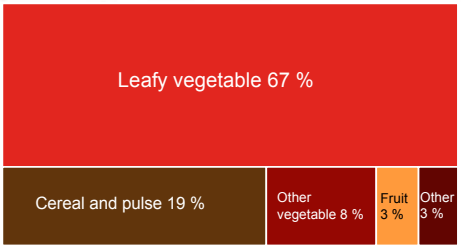


Figure 2.4. Crop mix in Ouagadougou (Burkina Faso) in the rainy season.

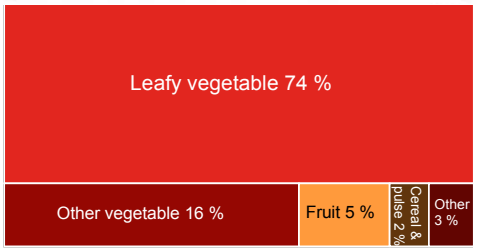


Figure 2.5. Crop mix in Ouagadougou (Burkina Faso) in the dry season.

In Ouagadougou, the sites that were mapped *in situ* produced a large number of different vegetables covering 75% (rainy season) to 90% (dry season) of the area under cultivation (Figures 2.4 & 2.5). Cereal production played a role in the rainy season, with maize and rice covering 19% of the area, far less than the scale of cereal production in Tamale.

Unlike in Tamale, the area under cultivation therefore decreased by more than 50% in the rainy season in Ouagadougou (Figure 2.6). The most common crop, lettuce, an exotic leafy vegetable, reflects the status of Ouagadougou as a Francophone capital city. Diversity of vegetables was also significantly higher in Ouagadougou compared with Tamale.

Figure 2.7. Cultivated areas in Boulmiougou, Ouagadougou, during the rainy season.

Figure 2.8. Cultivated areas in Boulmiougou, Ouagadougou, during the dry season.

Shifting Cultivation I

In Ouagadougou, the Boulmiougou farming site illustrates how lack or abundance of water influences spatial production patterns. While in the rainy season crop production is limited to vegetables in the elevated areas and the production of rice in the lower-lying land (Figure 2.7), the area under cultivation expands as previously waterlogged areas dry out. At the same time, cultivation in the center of the more elevated area decreases (Figure 2.8). Like in Tamale, the cultivation of particularly leafy vegetables is more common during the dry season.

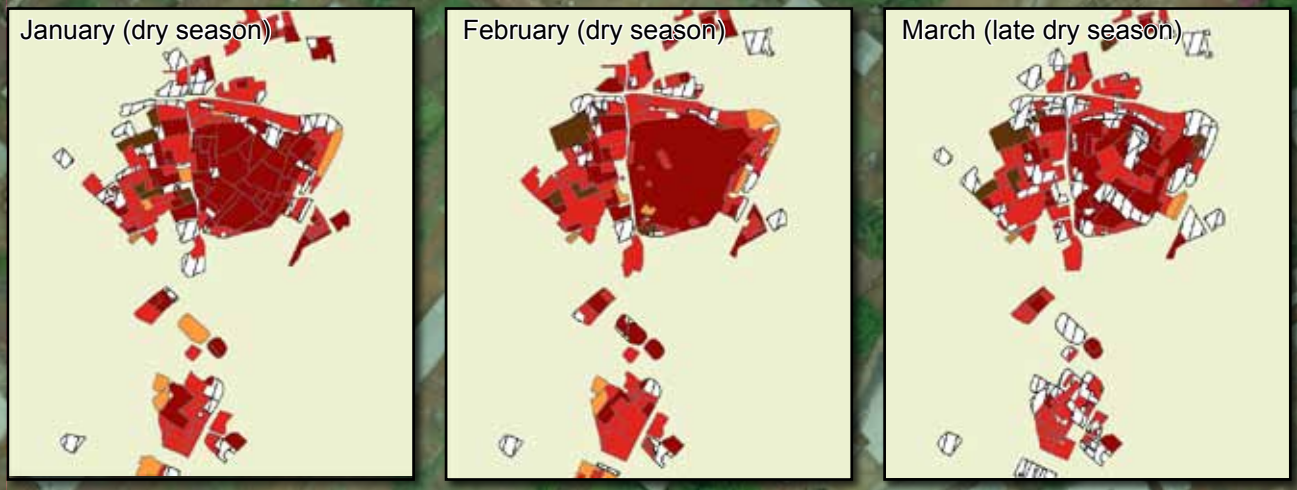
Thus, water availability, or lack thereof, affects location and areal extent of production as well as the type of crops produced. Water availability is a function of season and location, with lowlands being waterlogged during the rainy season, and elevated areas too dry during the dry season. While water availability is an important factor for the choice of crop, it is not the only one. In the dry season, the demand for vegetables exceeds the supply, when (leafy) vegetables can only be cultivated in places with acces to irrigation water, and therefore it is highly profitable for farmers to grow vegetables in the dry season.[2.5]

Figure 2.9. Cultivated areas in Gumbehene Old Dam, Tamale, during the rainy season.

Shifting Cultivation II

The Gumbehene Old and New Dam farming sites have been cultivated for more than 50 years. Since 2007, the area of land under cultivation in these sites has remained constant due to institutional support from non-governmental organizations and research institutes that have lobbied for the permanent stay of farmers in these areas.These sites are designated green belt land by the local authorities, following flooding in the 1980s.[2.6]
We mapped the Gumbehene Old Dam site on a monthly basis (October 2014–March 2015) to detect finer temporal changes. The shift from rainfed cereal to irrigated vegetable production comes with uncultivated fallow land (during which plots are prepared for the next cropping cycle) (Figures 2.9 & 2.10). This shows that urban crop production is highly dynamic in terms of which crops are cultivated where (Figure 2.11). Therefore, the results of efforts to determine the size of urban farm land will depend on the timing of data collection.

Figure 2.10. Cultivated areas in Gumbehene Old Dam, Tamale, during the dry season.



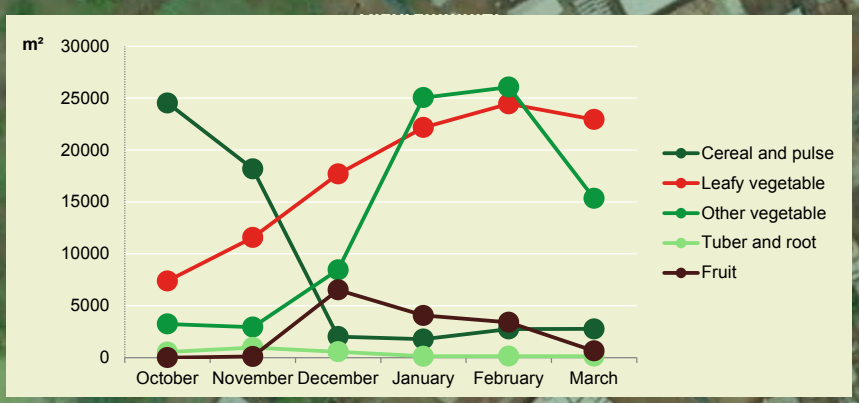


Figure 2.11. Area under cultivation on the Gumbehene Old Dam site in Tamale (Ghana) by different food groups mapped on a monthly basis.

Soil managment in urban agriculture

Steffen Werner

Soil fertility and health is crucial for agricultural productivity and the reduction of negative environmental impacts. The management of soil in urban agriculture in West Africa is dominated by the use of mineral fertilizer, manure and irrigation with mostly untreated wastewater. In the case of Tamale, less than 30% of farmers use manure or compost, while in Ouagadougou about 70% of the farmers use manure, and 45% use compost besides mineral fertilizer.[2.7] The Central Field Experiment of the UrbanFood^{Plus} project showed a significant reduction in soil carbon and pH under local farmers' soil management in Tamale (only mineral fertilization) and an increase in Ouagadougou (manure and mineral fertilization) (Figures 2.12a and 2.12b). These parameters are generally very important for soil fertility, and the findings underline the importance of organic soil amendments, such as manure or compost. The irrigation with pathogen polluted wastewater is a health risk for farmers and consumers and needs special treatment (see page 25). However, the nutrient loads in wastewater have beneficial effects on crop growth and can reduce the need for mineral fertilization (Figure 2.12c).

For more information:

Häring, V.; Manka'abusi, D.; Akoto-Danso, E.K.; Werner, S.; Atiah, K.; Steiner, C.; Lompo, D.J.P.; Adiku, S.; Buerkert, A.; Marschner, B. 2017. Effects of biochar, wastewater irrigation and fertilization on soil properties in West African urban agriculture. Scientific *Reports* 7(1): 10738.

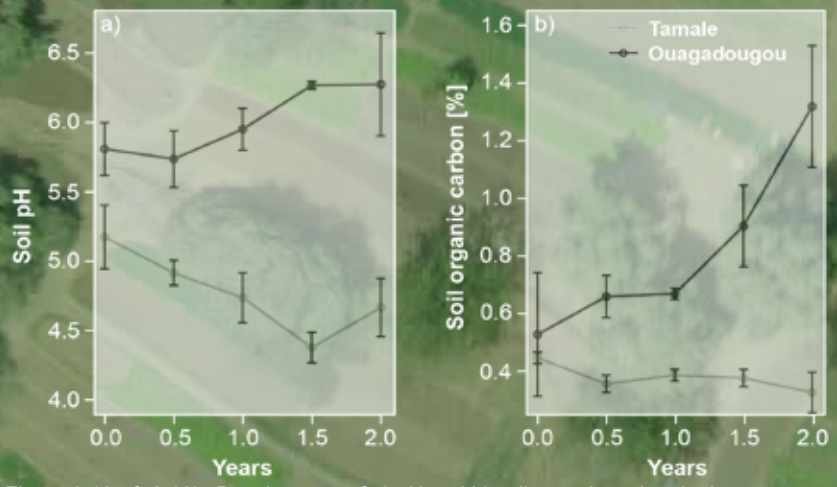


Figure 2.12a & 2.12b. Development of a) pH and b) soil organic carbon in the UrbanFood^{Plus} field trials of Tamale (only mineral fertilization) and Ouagadougou (manure and mineral fertilization).

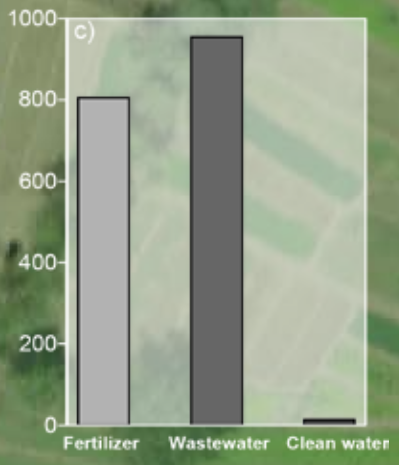


Figure 2.12c. Nitrogen input in field trials from fertilization and irrigation water source (wastewaster or clean water) in Tamale.

Agronomic effects of biochar and wastewater on crop production in urban agricultural systems of Tamale and Ouagadougou

Edmund K. Akoto-Danso and Delphine Manka'Abusi

We studied the effects of a single biochar application, fertilization, and irrigation water quality and quantity on soil properties and yields in Ouagadougou and Tamale. The incorporation of biochar at 20 tons ha^{-1} from corn cobs and rice husks had no effect on soil pH, but rice husks retained nitrogen. Wastewater irrigation increased soil pH over time. Biochar addition significantly increased yields in both cities, by 9% after two years. This reveals the potentials of biochar in an agricultural system characterized by consumer-driven high input levels. The positive effects of biochar were observed on fertilized plots, which further highlights that biochar can be a valuable resource to improve fertilizer use efficiency in intensive urban agricultural systems of West Africa. This is probably due to improved soil physical conditions rendering it more conducive for root growth and nutrient uptake. Wastewater was more effective in Tamale due to its high nutrient input from raw untreated sewage. It increased yields ten to twentyfold on unfertilized plots during the dry seasons, and fourfold in the rainy season, compared to clean water. Biochar from agricultural waste, such as corn cobs and rice husks, can thus be a low-cost resource that may improve input use efficiency in urban horticulture and that would have otherwise been a nuisance to the environment.

Incorporation of biochar into the soil.

For more information:

Manka'abusi, D.; Steiner, C.; Akoto-Danso, E.K.; Lompo, D.J.P.; Haering, V.; Werner, S.; Marschner, B.; Buerkert, A. Submitted. Agronomic effects of biochar application and wastewater irrigation in urban vegetable production in Ouagadougou, Burkina Faso.

Akoto-Danso, E.K.; Manka'abusi, D.; Steiner, C.; Werner, S.; Häring, V.; Nyarko, G.; Marschner, B.; Drechsel, P.; Buerkert, A. 2018. Agronomic effects of biochar and wastewater irrigation in urban crop production of Tamale, northern Ghana. *Nutrient Cycling in Agroecosystems* 543(295): 1–17.

Anticipated impact of biochar amendment on farmers' income and amaranths production in Ouagadougou and Tamale

Lesley Hope and Wilhelm Löwenstein

Biochar amendment can improve soil quality and hence farming yields. So, what are the effects of this intervention on farm income for urban farmer households? What is the effect on the supply of vegetables and salad in the urban area? The evidence for Ouagadougou and Tamale provides a mixed picture on these questions, given the differences between these two sites. The anticipated impact of biochar application on urban farmers in Ouagadougou is higher than in Tamale. While on average, each farmer in Ouagadougou is expected to increase his farm revenue by USD 517 per annum, in Tamale this increment is expected to amount to USD 57 only.

This difference also prevails in the supply increment of agricultural produces, e.g., with respect to amaranth. This produce forms a critical part of the diet in both cities. In Ouagadougou, the amendment of biochar would yield an increase in annual production by more than half a ton per urban farmer. In Tamale, amaranths production would increase by 44 kg per farmer per year.

An amaranth farm in Gumbehene Old Dam, Tamale, Ghana.

For more information:

Hope, L. 2018. *Biochar amendments to agricultural soils and changes in urban food supply in Tamale and Ouagadougou*. PhD thesis. Ruhr University Bochum, Germany.

Anaerobic biochar filtration of domestic wastewater in West Africa for safer food production and enhanced crop yield

Korbinian Kaetzl, Manfred Lübken and Marc Wichern

Untreated wastewater is frequently the only available water source for urban and peri-urban irrigation in West Africa. Hence, a simple and efficient low-cost wastewater filtration plant in Tamale for the production of safer irrigation water with locally produced corn con and rice husk biochar was developed. This water treatment system allowed a reduction of hazardous bacteria by 99.9% and organic substances by 90.0% and improved irrigation water quality to a normal surface water level in Tamale. Thereby, essential plant nutrients such as nitrogen and phosphorous remained in the water and treated wastewater retained its fertilizer effect. Crops irrigated with treated wastewater were to no greater extent contaminated with harmful bacteria than crops irrigated with tap water, and clearly less contaminated than crops irrigated with untreated wastewater (Figure 2.13). Beside safer vegetable production, irrigation with purified wastewater increased crop production by 30% compared to raw sewage and more than double in comparison with tap water and commercial fertilizer (Figure 2.14).

This effect may have been caused by the removal of iron as a chelator of phosphorus in the wastewater. Hence, wastewater treatment with locally available materials allows higher and safer vegetable production and may contribute to food security in West African cities.

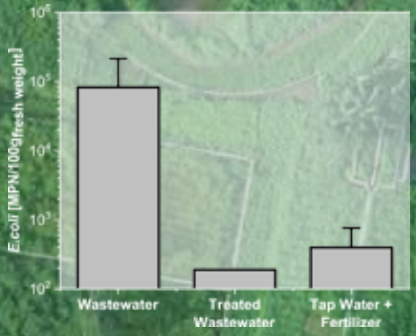


Figure 2.13. *E. coli* contamination of jute mallow (*Corchorus spp.*), irrigated with wastewater, treated wastewater and tap water with commercial fertilizer (NPK).

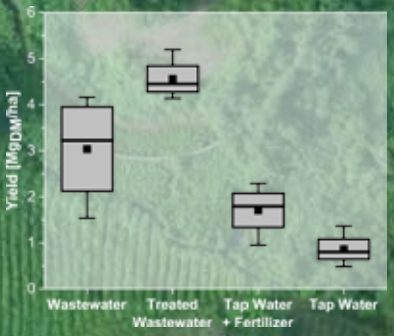


Figure 2.14. Yield of jute mallow (*Corchorus spp.*) in kg dry matter per hectare irrigated with wastewater, treated wastewater and tap water with commercial fertilizer (NPK) and without fertilizer.

Risk and profits associated with pesticide use in dry season vegetable farming

Eileen Bogweh Nchanji

Pesticide use and management in Tamale differ depending on the community's land ownership and needs of farmers. In Sangani, the area of the land used for dry season vegetable cultivation has not decreased even with increased value of land. This is because this land is sacred, making it impossible for *chiefs* to lease it for economic gain. Religion and tradition interact nicely on this site where a mosque has been built. This is the only site in our study area where farmers use only organic fertilizers (chicken droppings) with hardly any pesticides.

They mainly grow lettuce, amaranth and green pepper. Only people from within this community can farm here. This is different at the Gumbehene Old Dam site, which is a melting pot of farmers from different clans interacting with the application of research innovation in cabbage. It is a site where researchers have also introduced improved amaranth seeds and compost. The main crop grown here is cabbage, which is profitable (Table 2.1) but requires regular application of pesticides. Farmers are aware of the risk of pesticides on their health and that of consumers. However, as a result of decreasing urban farmlands, farmers are concentrating more on the profit accrued with increased cabbage yield than the health risk involved. Changes in climate is another factor influencing increased use of pesticides as pests become more rampant and difficult to manage.

Table 2.1. Cabbage production profitability in the wet and dry season per ha of land in Tamale (Ghana).
Values are given in USD based on an exchange rate of $USD 1:3.8 Ghanaian Cedi.

Season	Production cost	Revenue	Gross margin
Dry	1085.7	4318.3	3232.6
Wet	615.1	2265.5	1650.3

For more information:

Nchanji, E.B.; Hope, L.; Nchanji, Y.K.; Abia, W.A.; Donkoh, S.A.; Schareika, N. 2018. Pest management among smallholder cabbage growers. *International Journal of Vegetable Science*: 1–16.

TAMALE - Sangani

Agrobiodiversity of okra gardens under different intensities of management and urbanization

Kathrin Stenchly and Andreas Buerkert

Along the rural–urban gradient around Ouagadougou and Tamale, we studied 72 fields with okra (*Abelmoschus esculentus*) cultivation. Weed that grow in and next to these fields were affected by urbanization in different ways (habitat degradation, anthropogenic impact) and by agricultural intensification (increasing input of mineral fertilizers and pesticides). The results show that okra production can benefit significantly from insect visits during flowering. These beneficial insects are strongly related to certain weed species within and around crop fields that provide alternative food resources and refuge.

In our study, we found a strong relationship between gender- and market-orientedcultivation of okra which may be explained by gender roles whereby, particularly in Ghana, cash crop farming is predominantly considered men's work. Hence, most women cultivated okra primarily for self-consumption and with low agricultural inputs on either small fields within rural areas or in backyard gardening systems within peri-urban and urban areas. The management of okra and associated soil properties was highly variable and influenced by farmers' socioeconomic background. This affected the functional diversity of beneficial weeds, particularly on urban okra fields, where we found fewer insect-pollinated plants and more species with seeds distributed by birds (Figure 2.15).

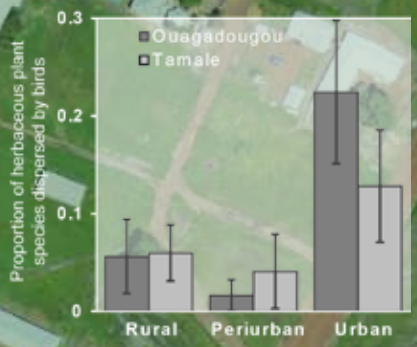


Figure 2.15. Community weighted mean (± standard deviation) of plant species dispersed by birds and their distribution on and around okra fields located in rural, peri-urban and urban areas of Ouagadougou and Tamale.

For more information:

Stenchly, K.; Lippmann, S.; Waongo, A.; Nyarko, G.; Buerkert, A. 2017. Weed species structural and functional composition of okra fields and field periphery under different management intensities along the rural-urban gradient of two West African cities. *Agriculture, Ecosystems & Environment* 237: 213–223.

Use of treated industrial wastewater for irrigation in Kossodo, Ouagadougou

Juliane Dao

Food production in Ouagadougou is limited to the rainy season or to areas with access to irrigation water. Where water for irrigation is available, urban gardens can be highly productive and supply the city with fresh vegetables, as production can take place year round. In an attempt to reduce the number of unofficial gardens in the city, land in Kossodo, an industrial and previously rain-fed farming area in the northeast of Ouagadougou, was given to urban farmers in 2010 by the municipality. An irrigation system was created at the outlet of a wastewater treatment plant, which was fed with wastewater from a slaughterhouse, a tannery and a brewery. However, pollutants in the water were more challenging than expected, negatively affecting soil quality. One underestimated factor was the sodium content of the brewery wastewater that was not taken care of in the treatment plant. The discharge of sodic and alkaline water led to an accumulation of sodium in the soil, followed by an irreversible damage of soil structure that impedes plant growth. Not only the irrigated fields were affected, but the whole area around the wastewater channel as soil water movement distributed the pollutants. Finally, cultivation declined over years.

For more information:

Dao, J. 2017. *Effects of irrigation water quality on soil properties and crops in urban gardens of Ouagadougou, Burkina Faso*. PhD thesis. Universität Kassel, Germany.

Canal diverting water from the treatment plant to the fields

Spinach field in Kossodo

0 100 m

2.2 Backyard Farming

Backyard farm in Tamale.

Imogen Bellwood-Howard

Backyard farming in context

Urban planning approaches influence urban form and layout, which in turn affect the spaces available for different forms of urban agriculture, and how they function. In Tamale and Ouagadougou, clear differences in how backyard farms are laid out and the role they play reflect different trajectories of urban development and planning.

Urban planning in Tamale

Land use planning has historically been weakly enforced in Tamale. As the city expands rapidly, traditional villages are absorbed into the urban structure rather than being demolished. Thus, traditional housing layouts remain, including spaces for farming between dwellings.

Furthermore, traditional *chiefs*, who own most land in Ghana, frequently unofficially demarcate areas for residential allocation, which yields them revenue. When these are inexpertly demarcated, interstitial spaces are available for backyard farming.

Backyard farming in Tamale

Backyard faming is ubiquitous in Tamale. Average field size is just 0.11 ha. Yet these small gardens are integrated into the market economy: 49% and 64% of those farming in the wet and dry season produce commercially (Figure 2.16). The open urban structure facilitates this: Over 60% of backyard farmers invest in wooden fencing. Marketers walking around residential areas can then see the produce in the gardens. Okra and irrigated leaf vegetables such as amaranthus are produced all year by commercial backyard farmers. In the wet season, a large number of people take advantage of the rains to produce maize and tomatoes.

Fenced backyard chili pepper farm in Tamale, Ghana.

This means that more people practice backyard farming during the rainy season, reflecting this opportunistic element.

Urban planning in Ouagadougou

As the capital of French Upper Volta since 1919, Ouagadougou was formally planned, with wide streets separating gridded neighborhoods. All land is state owned, and the process of *lotissements* allocated geometrical housing plots to residents, a style that is less common in Tamale. Rooms are therefore usually constructed inside a rectangular walled compound, rather than in the traditional arrangements found in villages, where unallocated space remains between circular compound structures.

Backyards in Ouagadougou

Backyard farming in Ouagadougou is uncommon in residential areas: *lotissement* and geometrical allocation lead to interstitial space being rare. People also take very seriously the interdiction of urban cultivation of tall crops: an oft-cited reason for the occurence of mosquitoes. Many interpret this to prohibit cultivation within compounds. When backyard farming does occur, it is generally limited to maize and okra for household consumption, on small plots inside the ubiquitous compound walls. Just 8% of those farming in the wet season produce commercially; none do so in dry season. Residents perceive that plots should always be walled, both for security and due to a sense of propriety. This means that fencing is unnecessary, and cultivation remains 'hidden', which carries the disadvantage that crops are out of view for potential marketers. Less than 50% of people spend money on inputs at all, and less than 5% expend on fencing.

Figure 2.16. Commercial cultivation in backyard farms by city and season.[2.8]

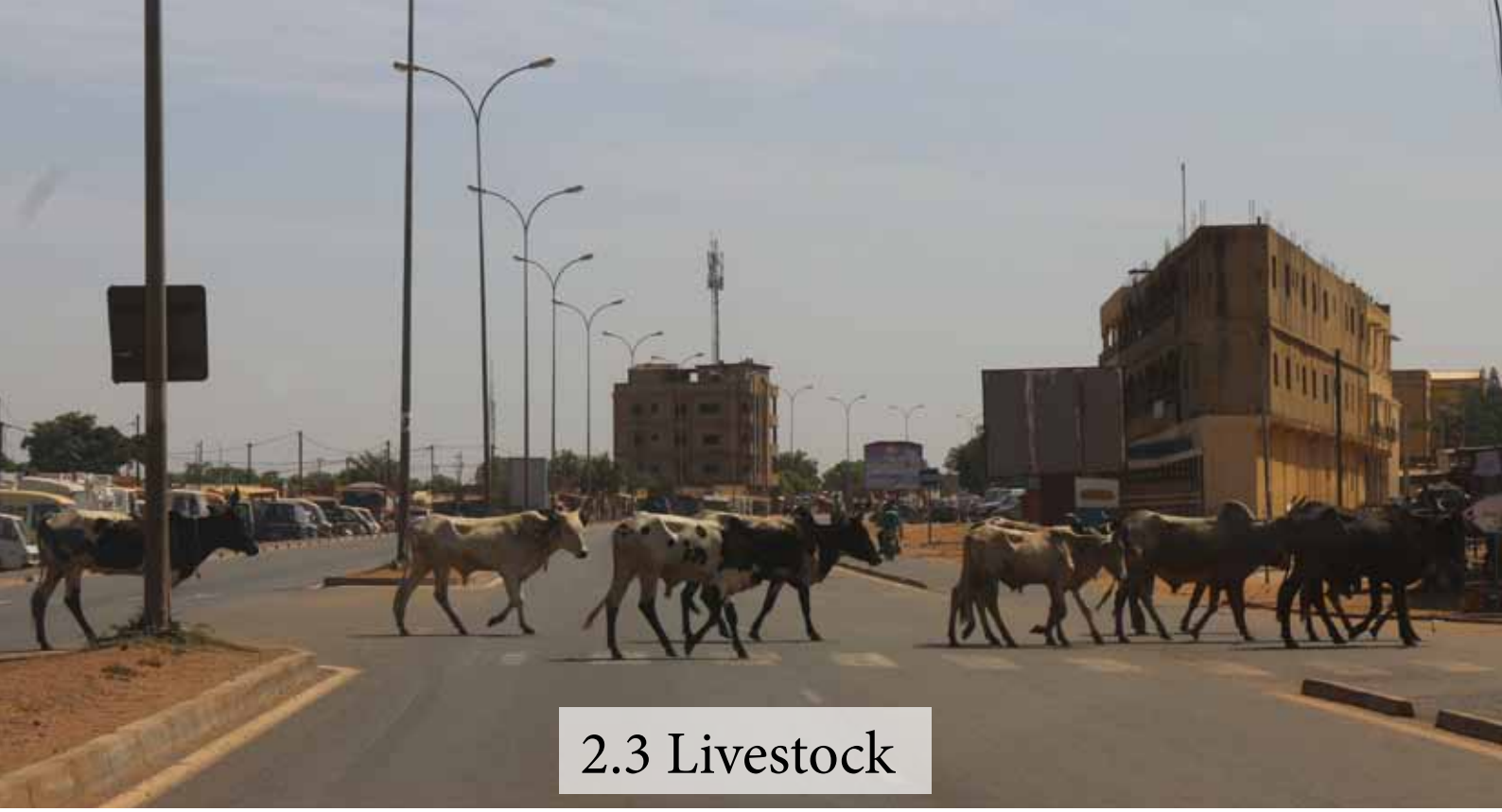
For more information:

Bellwood-Howard, I.; Shakya, M.; Korbeogo, G.; Schlesinger, J. 2018. The role of backyard farms in two West African urban landscapes. *Landscape and Urban Planning* 170: 34–47.

Gridded layout (left) and backyard farm in Ouagadougou, Burkina Faso (right).

Comparison

Some aspects of backyard farming in Tamale and Ouagadougou are similar, such as the cultivation of okra and maize for household consumption and concentration of backyard farming in the rainy season. Yet different urban planning trajectories have led to major differences. Looser planning implementation in Tamale means unconfined backyard farms are more common. These remain open and visible to market traders, and are more easily integrated into the urban food marketing system (see page 56). One implication of this is that backyard farmers in Ouagadougou will have to actively seek traders or market access. Thus, if backyard farming is recognized and possibly facilitated in urban planning, it can enhance not only household food and income security, but also marketing livelihood opportunities, especially for women. The wider implications are that urban planning could usefully consider how backyard farming fits into the urban landscape.



2.3 Livestock

Cattle in Ouagadougou.

Regina Roessler and Eva Schlecht

Livestock keeping is a common phenomenon in West African cities. In Ouagadougou metropolitan area, about half of the total households rear livestock. In Tamale Metropolis it is 13%, equally distributed between the urban and peri-urban area.[2.9, 2.10] In both cities, a traditional form of small-scale livestock keeping prevails that is frequently integrated with crop farming or other professional activities.

Manure management

The combination of livestock rearing and crop production allows the recycling of nutrients by using manure as a crop fertilizer. Furthermore, the marketing (Ouagadougou) and exchange (Tamale) of manure reduce manure loss and hence provide both economic and environmental benefits. Still, opportunities to market manure should be developed in Tamale to further reduce wastages.
In Ouagadougou, homestead feeding of animals entails an important influx of nutrients to the city. Straws and hays are harvested in the periphery of the city or in the rural hinterlands, and industrial by-products (cottonseed cake, molasses and brewer's spent grains) come from national industries or are imported from West African coastal countries. Due to the accumulation of nutrients through livestock manure in the city, nutrient depletion of the feed-supplying rural hinterland of Ouagadougou is expected.

Characteristics of livestock keeping

Usually, livestock keepers rear a diversity of livestock species, among which small ruminants and chickens are by far the most predominant. Without doubt, the Muslim tradition of backyard fattening of sheep and goats as well as the limited requirements for space and production inputs for poultry production contribute to the large number of livestock species in both cities. Yet, a transformation of the livestock sector is taking place. In the dairy sub-sector of Ouagadougou, richer urban dwellers, who live and work in the city, have been

establishing intensive farms in the periphery of Ouagadougou. They employ waged laborers to manage the farm, and strongly invest in breeding technologies (e.g., artificial insemination using imported semen of international breeds, crossbreeding to upgrade local zebu cows, hormonal synchronization) and commercial feedstuffs to increase the milk production output.

In parallel, a commercial pig production system has been developing close to Ouagadougou. Similar to the commercial dairy sub-sector, it is based on crossbreeds of local and imported pig breeds, and on homestead feeding of pigs with purchased feedstuffs. Pigs are usually confined and do not move freely around the house to scavenge and find food for themselves. Pork is marketed through traditional marketing channels, or processed by butchers and in grocery stores (e.g., Marina market), which form a niche market for this type of product.[2.11]

In Tamale, the transformation of the livestock sector is limited to sheep production in the inner-urban quarters of the city. Here, sheep production is less frequently integrated with crop production, flock sizes tend to be larger and animal sales are increased as compared to the traditional production type, indicating a trend from subsistence toward commercial orientation of sheep production in Tamale.

Sheep in Tamale, Ghana.

Cattle grazing on fallow land in Tamale (Gumbehene New Dam).

Farmer fencing his field to protect it from grazing livestock.

Grazing livestock in Tamale and Ouagadougou

Regina Roessler

Peri-urban and urban spaces of Tamale and Ouagadougou are frequently used for foraging of livestock (Figure 2.17). Our case studies among cattle kept in the periphery of both cities reveal that cattle are usually *kraaled* overnight, and are accompanied by a herder to the pasture area during daytime. During the rainy season, fallow lands and savannas close to the livestock *kraals* constitute the main grazing areas due to the occupation of land for crop cultivation. After crop harvest, grazing of crop residues is an important practice of cattle keepers. In the late dry season, animals have to walk further to reach more distant open grasslands and savannas in Ouagadougou, while in Tamale, predominantly fallow lands and harvested rice fields are used for foraging during the dry season. Hence, animals spend more time on walking and browsing and less time on grazing in Ouagadougou. In Tamale, animals spend more time foraging outside their *kraals* in the late dry season. This is partly explained by the fact that in the less densely populated city of Tamale, cattle are *kraaled* either close to the livestock keeper's house, or away from the livestock keeper's residence at the outskirts of the city, or even in the rural hinterlands where they are managed by *Fulani* herdsmen.

For more information:

Akapali, M. 2018. *Seasonal variation in forage availability and grazing behavior of cattle in selected peri-urban areas in the northern region of Ghana*. MSc thesis. University for Development Studies, Ghana.

Sarambé, C. 2016. *Analyse du système d'alimentation des vaches laitières dans les fermes périurbaines de la ville de Ouagadougou*. Diploma thesis. University Polytechnique de Bobo-Dioulasso, Burkina Faso.

Figure 2.17. GPS track showing grazing routes of cattle kept in the city centre of Tamale, Ghana.

2.4 Forestry

Savannah vegetation in the peri-urban areas of Tamale, Ghana.

Hanna Karg

Traditionally, planting of trees has been integral and important part of human settlements in West Africa.[2.12] Trees were planted around houses, providing fruits, nuts, seeds, leaves, fuelwood, fodder and raw materials and served for shade and windbreaks. In West African cities, trees are also part of the urban green spaces, including street trees, public parks, green space in residential and industrial areas, plantations, green belts, etc.

Urban forestry is considered a vital element in the urban green landscape, providing wood for construction and non-timber forest products such as fruits and medicine. The environmental services provided by urban forests and trees can also address problems associated with urbanization such as by reducing air pollution and creating microclimates.[2.12]

Despite the multiple functions of urban trees and forests, sustainable management is constrained by urban population growth and a related increasing demand for land and fuelwood.

In Tamale, trees and woodland significantly contribute to the urban green spaces, notably the two major forest reserves in the city center (Nyohini and Agric Forest Reserves; Figure 2.18). Besides, trees are also found across the urban space along streets, in house yards, grouped on vacant plots, and as single trees.

Urban trees provide an often overlooked contribution to **food security and air quality**.

A land use classification based on SPOT satellite images at 1.5 m resolution (Figure 2.18) revealed that within the urban boundary of Tamale, trees and woodlands cover 855 ha, that is 9.4% of the entire area. To assess the importance of urban fruit trees for food supply in Tamale, the number of fruit trees in the city was estimated based on an *in situ* survey and the land use classification.

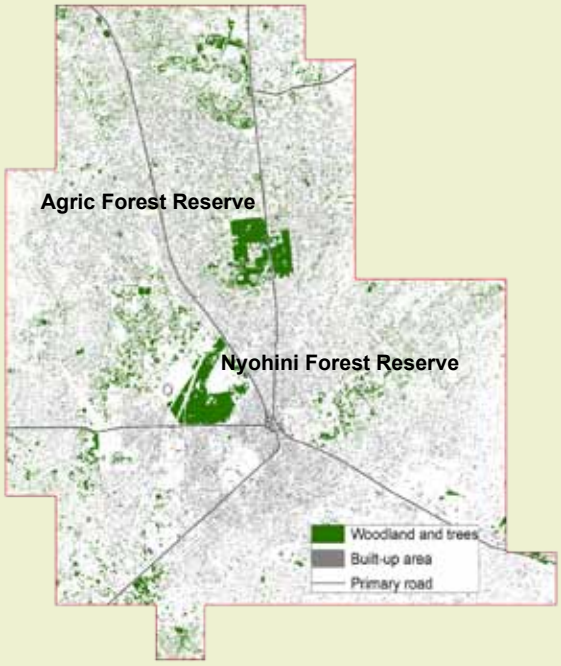


Figure 2.18. Woodland and trees within the urban boundary of Tamale, Ghana.

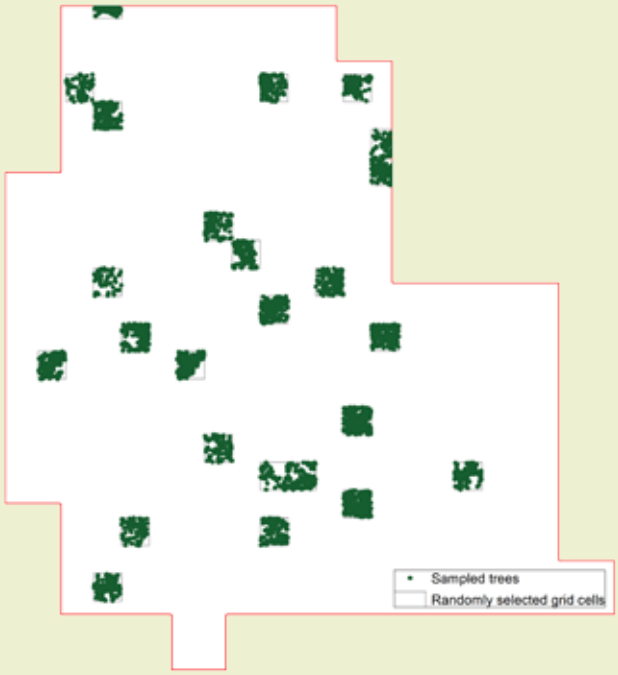
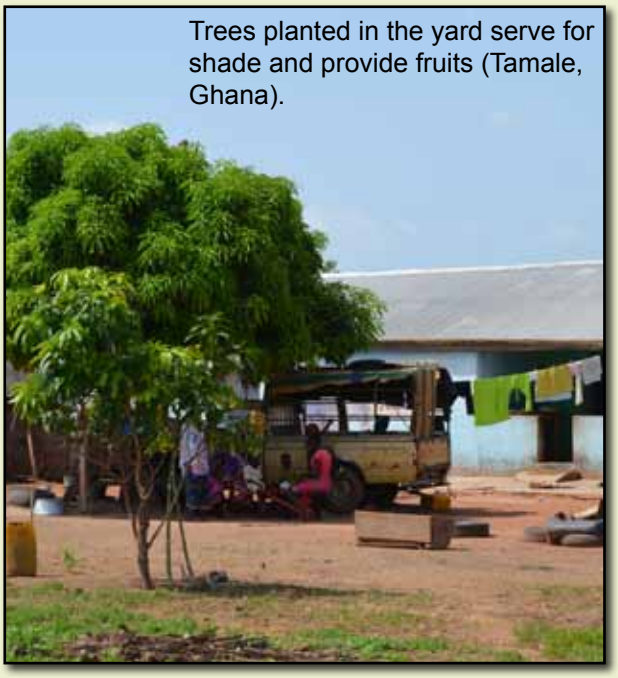


Figure 2.19. Trees sampled within 25 randomly selected grid cells in Tamale, Ghana.

Urban trees in Tamale

For the *in situ* study, 3,457 trees were sampled in 25 randomly selected grid cells of 25 ha each (Figure 2.19).[IV] Relating the number of trees to the area covered by trees and woodland, we estimated the total number of trees within the urban area, excluding the two forest reserves, to be about 16,250. Out of the total 16,250 trees, 35%, or 5,690, are fruit trees, of which mango trees (*Mangifera indica* L.) represent the majority (77%), followed by Dawadawa (African Locust Beans, *Parkia biglobosa*) (13%) and Jackal berry (*Diospyros mespiliformis*) (7%) (Figure 2.20). Assuming a conservative number of 100 mangos per tree of 0.5 kg each,[2.13] there is a yearly mango harvest of 220 tonnes, amounting to one fifth of the yearly incoming mango flows (see Chapter 3). Among the non-food trees, the neem tree (*Azadirachta indica*), known for its medicinal properties, is the most common (78%).



Trees planted in the yard serve for shade and provide fruits (Tamale, Ghana).

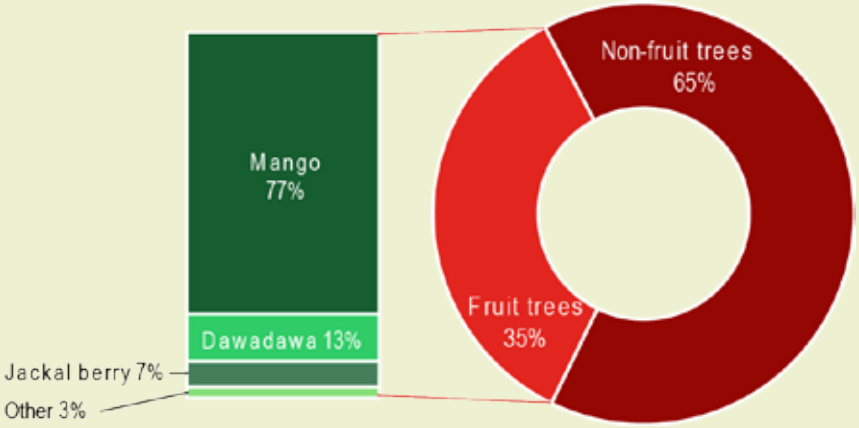


Figure 2.20. Proportion and type of fruit trees within the urban boundary of Tamale, Ghana.

3 Urban Food Supply

Truck carrying tomato from Burkina Faso to Tamale, Ghana.

Hanna Karg

The majority of the food consumed in developing regions comes from domestic sources, and only a small share from imports.[3.1] Industrialized countries, on the other hand, rely more on globalized food chains.[3.2] However, recently in developing countries, the situation has been changing as urban food systems are increasingly affected by growing urban demand for food, the globalization of food markets and changing diets toward more animal products and processed foods.[3.1] In urban areas, most people do not grow their own food, and are therefore dependent on cash income to purchase food, which makes them highly vulnerable to price changes.[3.3]

Short food supply chains, strong rural–urban linkages and local production have the potential to minimize food-related problems such as inadequate nutrition, volatile food prices and food waste.

Given increasing urban populations and their strong reliance on marketed food, we wanted to investigate the ways food reaches urban markets in Tamale and Ouagadougou, the quantities entering the cities on a daily basis, and, in general, which geographical areas supply the cities. What is their reliance on imported food and how does this relate to the resilience of food systems?

In urban areas, most people do not grow their own food, and are **dependent on cash income** to purchase food, which makes them highly vulnerable to price changes.

In the following chapter, we will introduce a study examining flows of unprocessed food in Tamale and Ouagadougou, including 1) the quantities entering the cities per season, 2) the food miles certain commodities travel to get to the urban consumer, 3) transport characteristics, 4) nutritional indicators and 5) supply challenges.

Truck entering the main market in Tamale (Ghana) directly from Burkina Faso. Produce coming from the rural and peri-urban areas is assembled at village markets, before going to the urban market of Tamale.

Tomato travelling to the urban market in Ouagadougou (Burkina Faso), directly from farm gates by public transport and via an assembly market in the nearby village.

3.1 Food Flows

Truck passing a tollbooth in Ouagadougou, Burkina Faso.

Hanna Karg and Edmund K. Akoto-Danso

Recording food flows

1. Road survey

In- and outgoing food flows were recorded on major access roads day and night during one week during the end of rainy (peak) season and end of dry (lean) season. In Tamale, flows were recorded at police check points. In Ouagadougou, data were recorded at the tollbooths.

2. Market survey

In all urban markets, traders were interviewed about the origin and the collection point of the traded commodity. The survey was carried out during the road survey period as well as on a monthly basis.

3. Secondary data

Secondary data were acquired from customs, airport and railway agents to account for alternative transport channels, as well as for flows that did not occur during the main survey period.

For the transportation of food, roads were the only entry point to Tamale. In Ouagadougou, selected crops, rice in particular, was also imported via railway from Côte d'Ivoire (Figure 3.1). While, generally, some types of fresh food, such as mango and green beans, are exported from Ouagadougou by air (mainly to Europe), almost all high-value processed food is imported by plane. Tamale, *via* the ports in Tema and Takoradi, has direct access to overseas imports, whereas Ouagadogou mainly relies on its francophone neighboring countries for imports from overseas.

Train station in Ouagadougou, Burkina Faso.

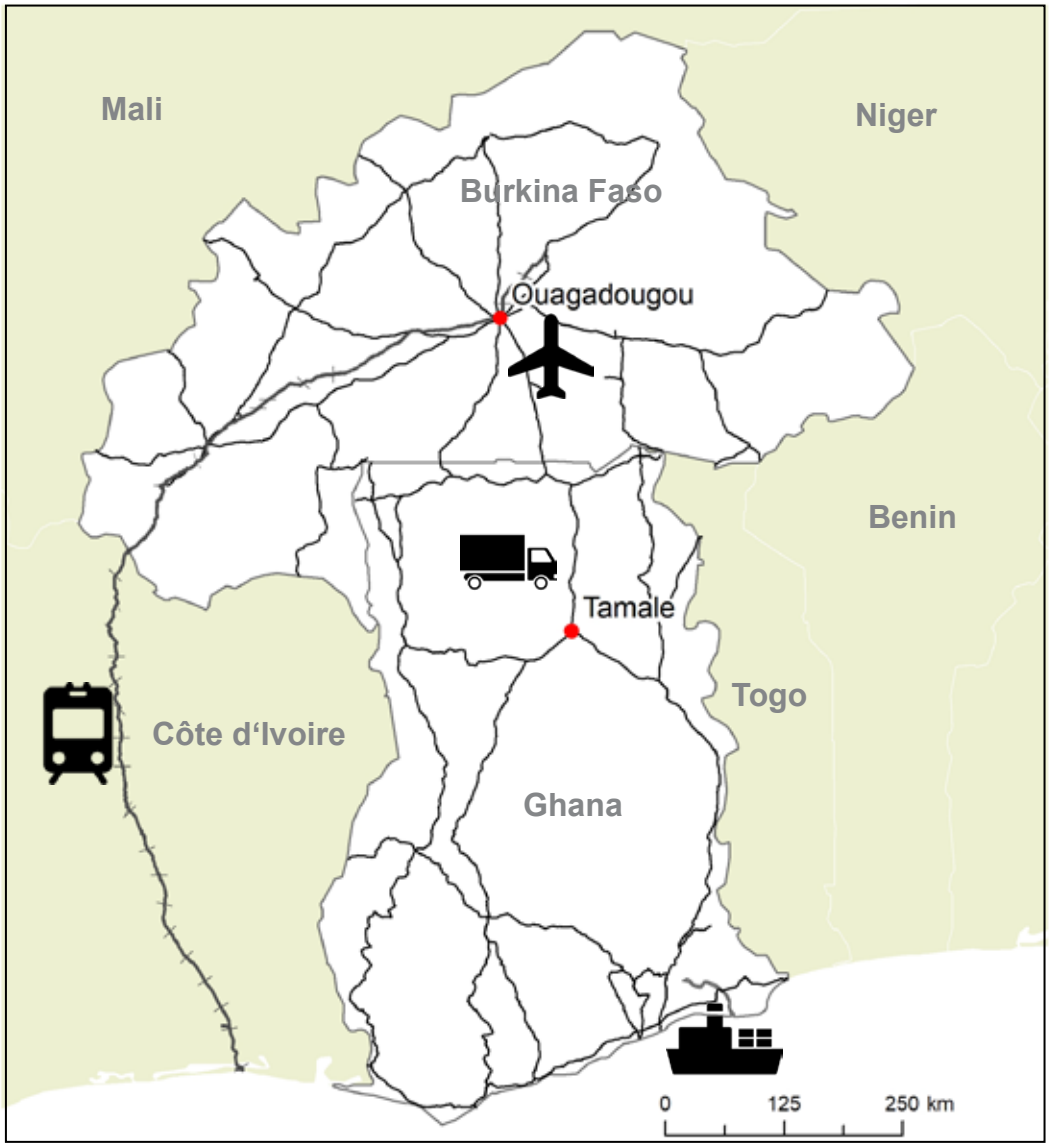


Figure 3.1. Transport channels leading to Tamale (Ghana) and Ouagadougou (Burkina Faso).

Food composition

Incoming per capita quantities of food commodities reflect consumption patterns in both cities, despite outgoing flows not having been considered (Figure 3.2). Both countries heavily rely on cereals as the main source of calories. In terms of weight, maize and rice are the most important cereals entering the cities, followed by millet and sorghum. In Tamale, cereals, apart from wheat and imported rice, are produced in close proximity to the city (see page 47) where warehouses ensure stable supply across seasons. From Tamale, cereals are also exported to the central and southern parts of the country in both seasons. Apart from imported rice and wheat, cereals supplying Ouagadougou are largely produced within Burkina Faso (Figure 3.3). Root crops such as yam are more prominent in Tamale than in Ouagadougou, with more than five times the incoming product per capita (Figure 3.2). Due to higher rainfall, Ghana is better suited to the production of roots and tubers. Yam mostly originates from areas around Yendi, east of Tamale, close to the Togolese border.

While the supply of staple crops such as cereals, roots and tubers is rather stable across seasons, seasonal differences primarily concern perishable goods such as vegetables and fruits (e.g., avocado, orange, mango and watermelon; Figure 3.4). For Tamale, the central part of Ghana is a main supplier of fruits such as orange, papaya and banana, and vegetables such as cabbage and avocado. In Ouagadougou, apart from onion, urban vegetable supply is largely met by domestic production, albeit with large seasonal differences concerning the source locations. In the peak season, vegetables entering the city come from surrounding areas, taking advantage of the proximity to urban markets, whereas in the lean season, vegetables are produced in various locations throughout the country with available irrigation water. Leafy vegetables, both traditional and exotic, are supplied exclusively by urban and peri-urban farming with no other sources outside the urban and peri-urban zones.

While the supply of staple crops is rather stable across seasons, seasonal differences primarily concern perishable goods such as vegetables and fruits

The livestock sector is a major pillar of Burkina Faso's economy. Accordingly, more than half of the cattle is exported. Northern Ghana is also suitable for livestock keeping, and animals are exported to the central and southern parts of the country. In Burkina Faso, domestic production of chickens accounted for almost 100% of total consumption, reflected by the large inflow of live chickens into Ouagadougou.

Transportation of chicken in Ouagadougou, Burkina Faso.

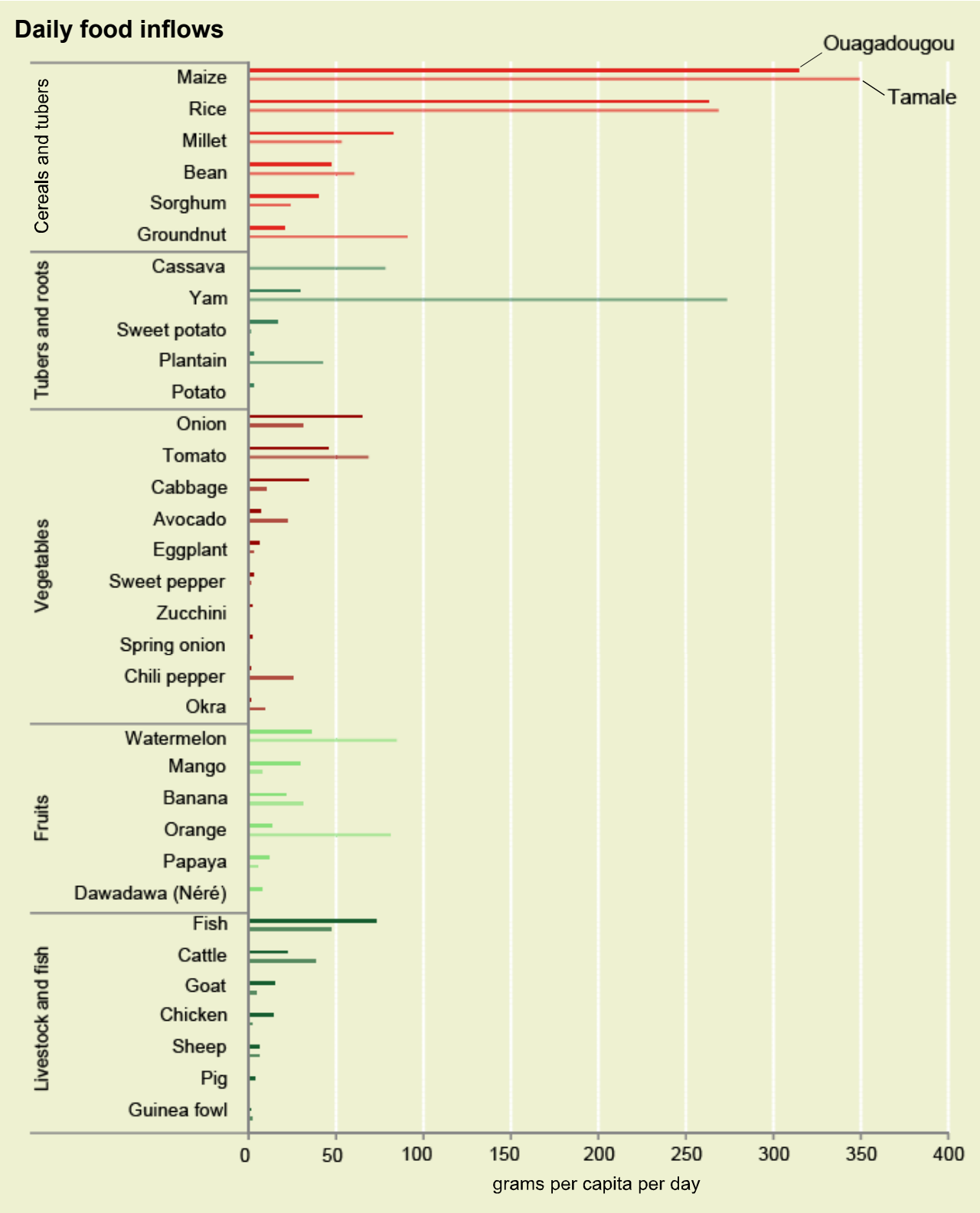


Figure 3.2. Daily food inflows in grams per capita per day to Ouagadougou (Burkina Faso) and Tamale (Ghana), whereby outflows are not considered.

Foodsheds

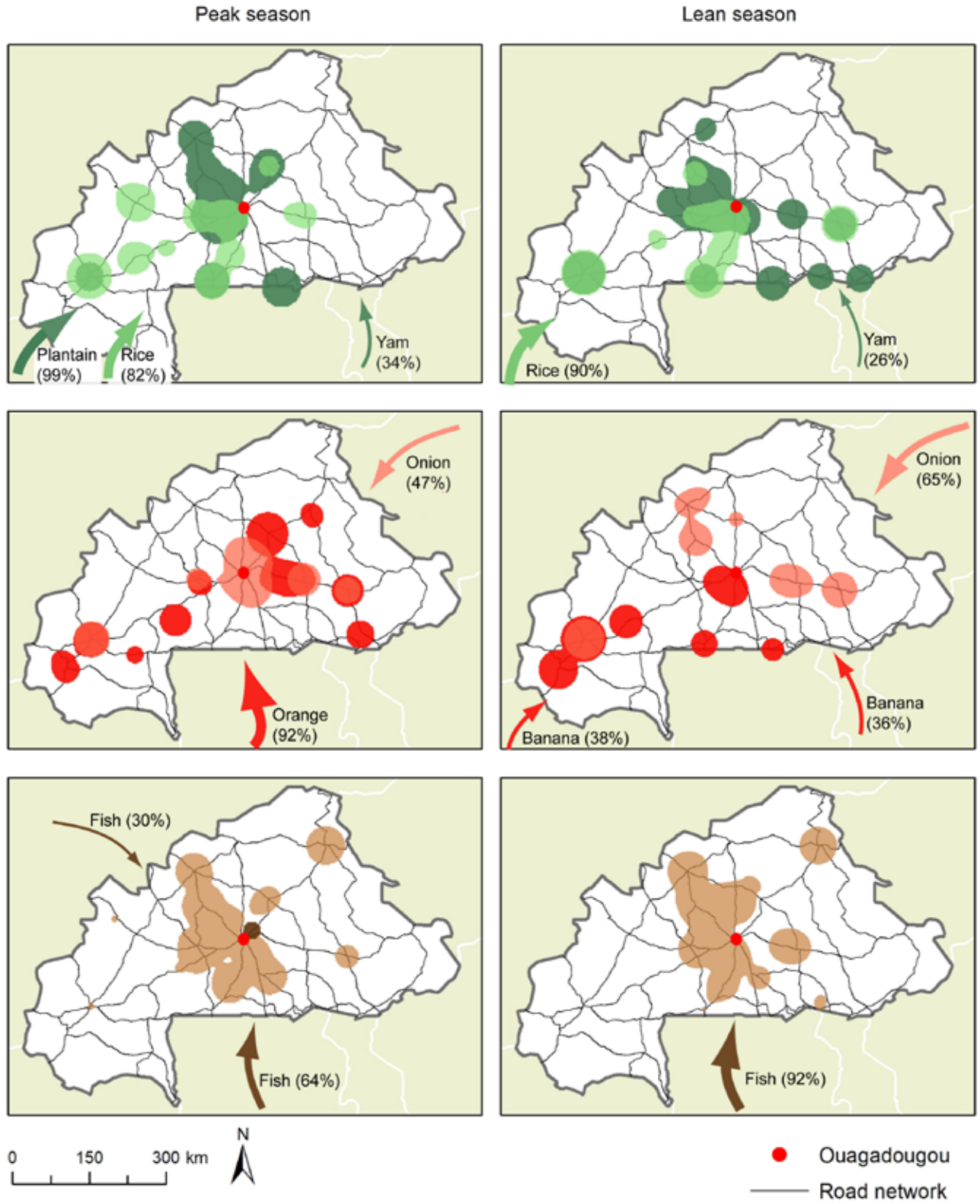


Figure 3.3. Season-specific sources of various food groups for Ouagadougou, Burkina Faso ('foodsheds').[v]

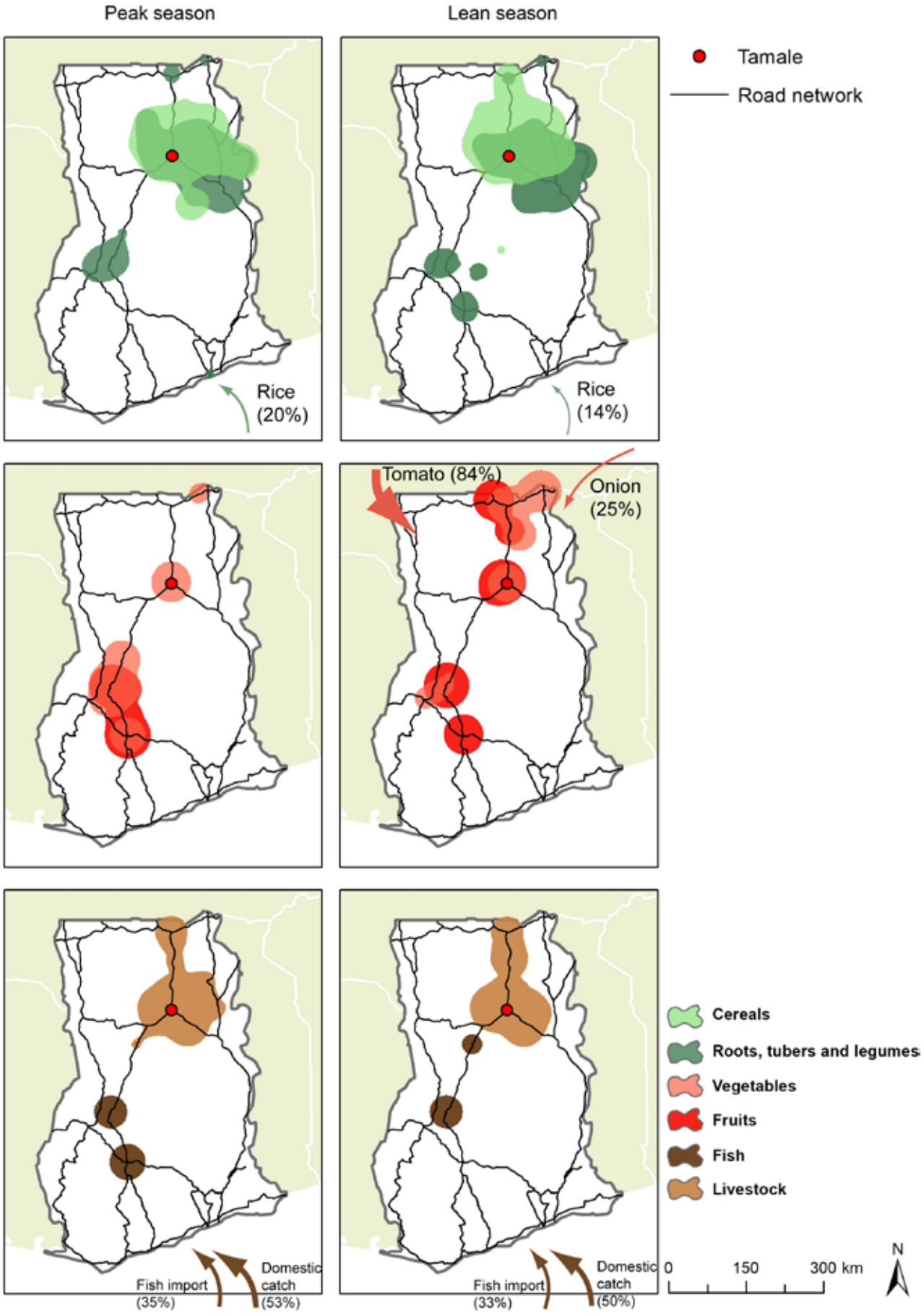


Figure 3.4. Season-specific sources of various food groups for Tamale, Ghana ('foodsheds').[v]

Food miles

The status of Ouagadougou as capital city is reflected in the larger diversity of food products, vegetables in particular, as well as the higher share of imported food as compared to Tamale. Besides, agro-ecological conditions in Burkina Faso are less favorable than in Ghana, a country with a wider range of agro-ecological zones. Accordingly, Burkina Faso is importing selected products, such as oranges, avocado, yams and plantains, from its coastal neighboring countries. Tamale, on the other hand, relies more on local and regional sources, apart from certain vegetables and fruits, and imported cereals (wheat and rice). Therefore, the majority of food products originate from within a distance of 100 km from the city (Figure 3.5). Rice and fish cover the largest distances before they reach their destination. The average distance rice travels to Ouagadougou is 9,176 km, with the majority of rice originating from South and Southeast Asia.

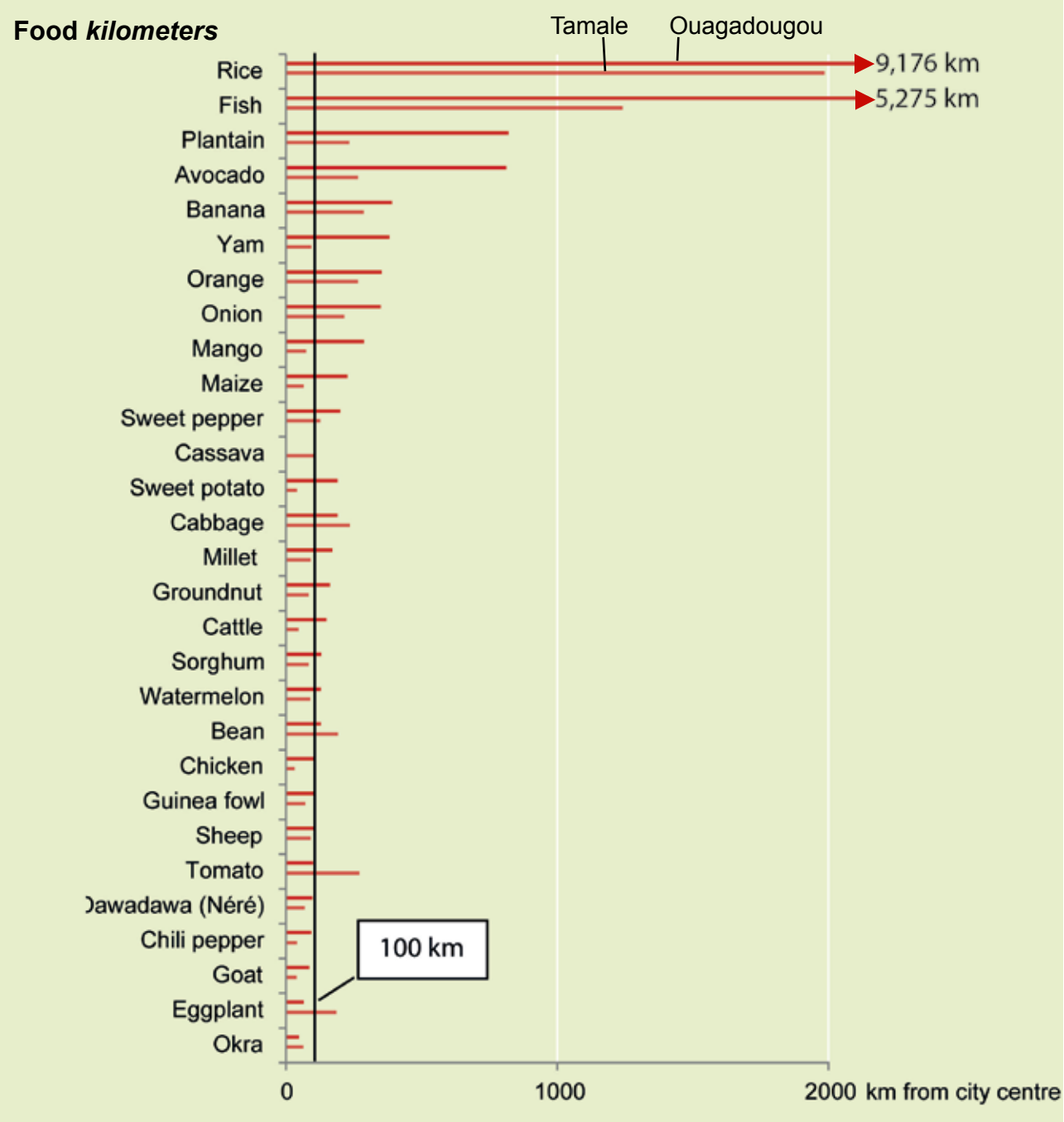


Figure 3.5. Average distance in km that food travels to Ouagadougou (Burkina Faso) and Tamale (Ghana), respectively.[VI]

The average distance rice travels to Tamale is only 1,987 km since the share of imported rice within the total incoming rice is significantly lower than in Ouagadougou, namely 14-20% as compared with 75-90% in Ouagadougou.[3.4]

Fish is the major animal product in both cities in terms of incoming weight per capita (re-export not considered). The reason why higher quantities of fish enter Ouagadougou than Tamale is likely that fish is redistributed within the country after arriving in the city's main fish market. National data show that Ghana produces and imports far more fish than Burkina Faso (Figure 3.6). Ghana is one of the few countries in the world where fish accounts for more than 50% of the population's animal protein intake, compared with the world average of 17%.[3.5] In Ouagadougou, the majority of fish is imported from Senegal and Mali (dry fish) as well as coastal neighboring countries (fresh fish). According to UN Comtrade data, the Republic of Korea was the main supplier of fish in Ghana in 2013.[3.6]

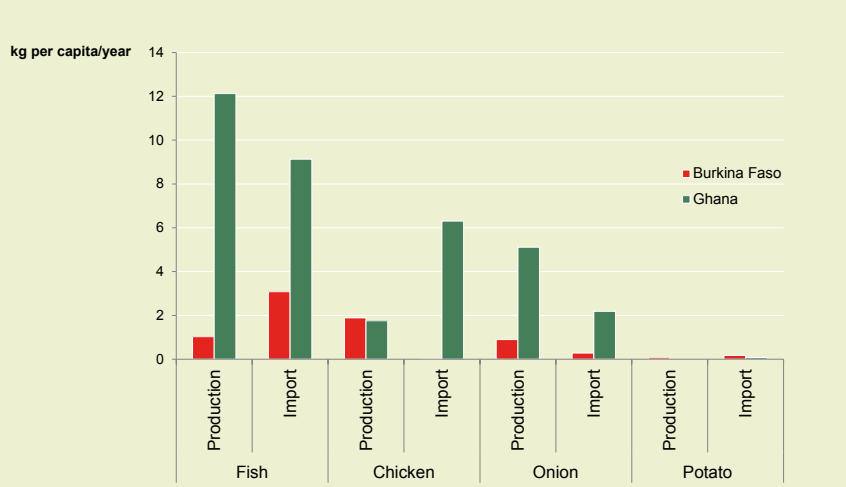


Figure 3.6. Levels of imports *vs*. domestic production for selected commodities in 2013.[3.6, 3.8, 3.9]

Apart from these two major commodities, Ghana and Burkina Faso each have an individual import portfolio. While in Burkina Faso, chicken supply is met by domestic production, Ghana imports more than three times more than it produces despite its poultry industry flourishing already in the late 1980s and despite having import regulations and tariffs similar to those in Burkina Faso.[3.7] More than 80% of the chicken imports come from the United States, Brazil and Belgium.[3.6] Despite domestic production of onion, both countries import onion. The main suppliers for imported onion in Burkina Faso are Niger (32%), the Netherlands (24%) and Morocco (21%), while 90% of Ghana's onion imports originate from Niger and Burkina Faso. Even though the demand for potato is still relatively low in Burkina Faso, compared to the demand for onions (in Ghana, potato play an even smaller role), Burkina Faso imported 1,560 tonnes of potato from the Netherlands in 2013. This corresponds to 39 trucks (40 tonnes each) per year and to 45% of the total potato import.

Imported onions from the Netherlands in a market of Ouagadougou, Burkina Faso (above). Articulated truck transporting onions from Niger in Tamale, Ghana (below).

Transport

Diversity of food products decreases with the distance food travels.

Apart from selected commodities, both cities rely heavily on their hinterland for the provision of food (see page 47). This is reflected in the number and type of vehicles from the area. In Tamale, 350 vehicles coming from within a radius of 100 km, an area referred to as the 'city region' hereafter, were recorded every day. This translates into 87% of all vehicles entering the city. In Ouagadougou, which relies less on its city region than Tamale, about 400 vehicles from the city region enter the city on a daily basis, corresponding to 75% of all vehicles. The city region and other domestic sources provide the full diversity of the recorded commodities, whereas neighboring countries provided only 57% (Ouagadougou) and 30% (Tamale) of the commodities entering the cities. The range of products imported from global sources is the least diverse where unprocessed products are concerned. Modes of transport differ greatly according to the origin and nature of the product as well as between the cities (Figure 3.7). Small vehicles, such as motorbikes and bicycles in Ouagadougou and motorized tricycles in Tamale, are particularly relevant for the transportation of food originating from the city region.

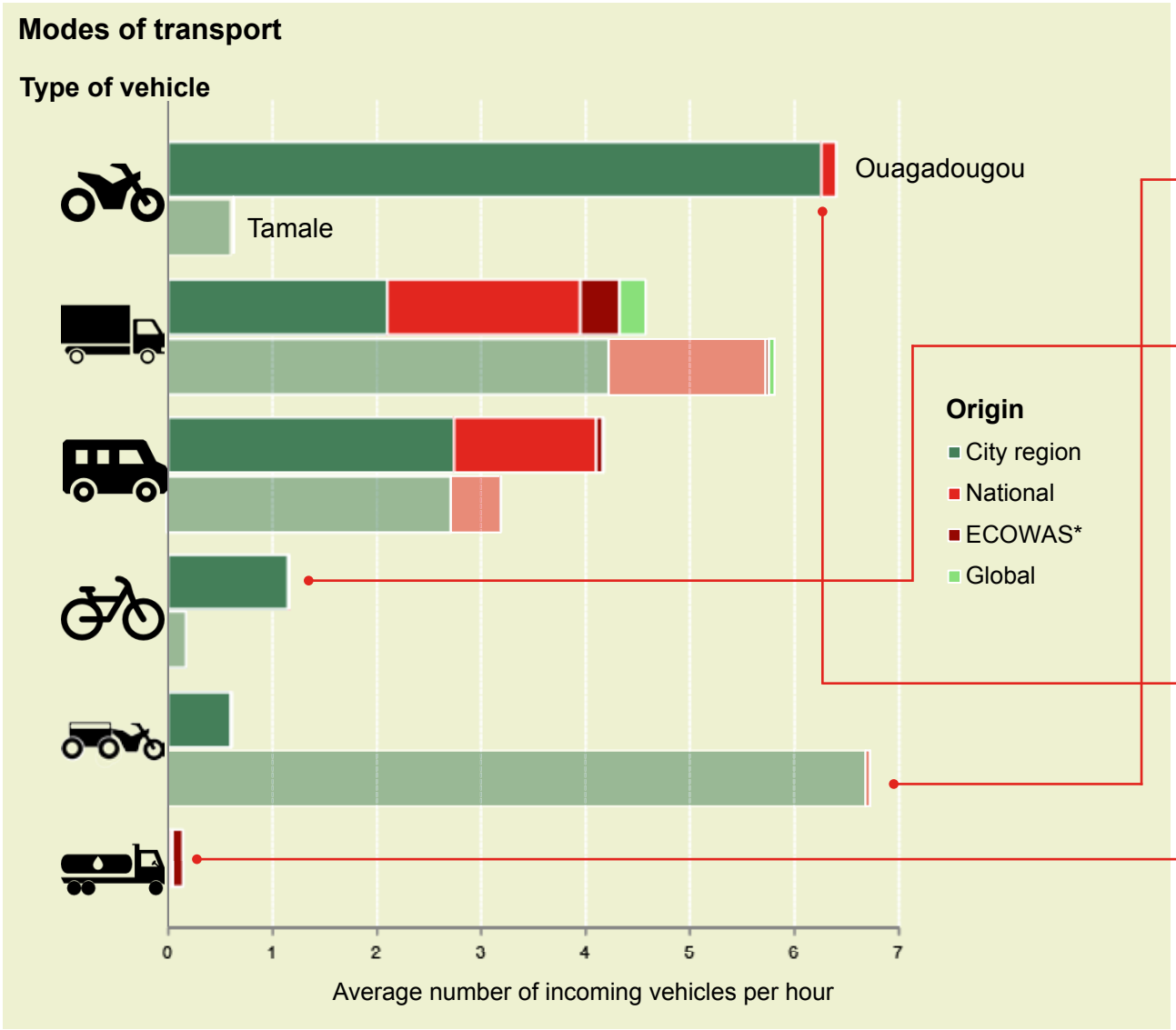


Figure 3.7. Type, number and origin of food-transporting vehicles entering Ouagadougou (Burkina Faso) and Tamale (Ghana) per hour.

* Economic Community of West African States, a regional economic union of fifteen countries in West Africa (Figure 3.9).

Rural-urban linkages and the periodic market system in Tamale

Hanna Karg

Tamale's cereal supply is largely met by its rural hinterland (Figure 3.8). Cereals are sold either directly to the Tamale market, or channelled to the city through a traditional hierarchical system of periodic small-town and village markets. There, markets take place every three or six days and rotate in such a way that market days in villages located close to each other will be separated by a relatively long period. This system also links farmers to the large urban centers in central and southern Ghana as well as to international markets.

The existence of food markets strengthens the development of related infrastructure, such as roads and public transport, and *vice versa*. Thus, village and small-town markets are critical in linking urban and rural people through flows of goods and capital, and simultaneously they experience infrastructural and economic change. Tamale's rapid growth suggests that the market towns examined in this study may experience further development in the near future.

For more information:

Karg, H.; Bellwood-Howard, I.; Akoto-Danso, E.K.; Schlesinger, J.; Chagomoka, T.; Drescher, A. 2018. Small town agricultural markets in northern Ghana and their connection to rural and urban transformation. *European Journal of Development Research*.

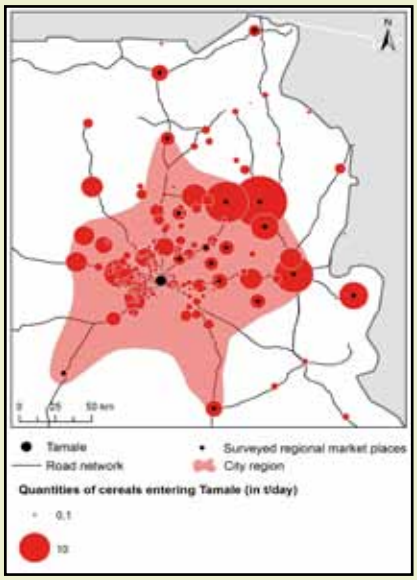


Figure 3.8. Surveyed markets in the regional hinterland and sources of cereals entering Tamale.

In Tamale (Ghana), motorized tricycles are very common and oftentimes used for transporting food items. They are getting increasingly popular in Ouagadougou (Burkina Faso), too.

In contrast with Tamale (Ghana), people in Ouagadougou (Burkina Faso) sometimes cover large distances by bicycle to transport food from villages to the city. Motorbikes are most commonly used for the transportation of food.

Pineapples from neighboring Togo and Benin are transported on top of fuel trucks to Ouagadougou, Burkina Faso.

Nutritional and monetary indicators

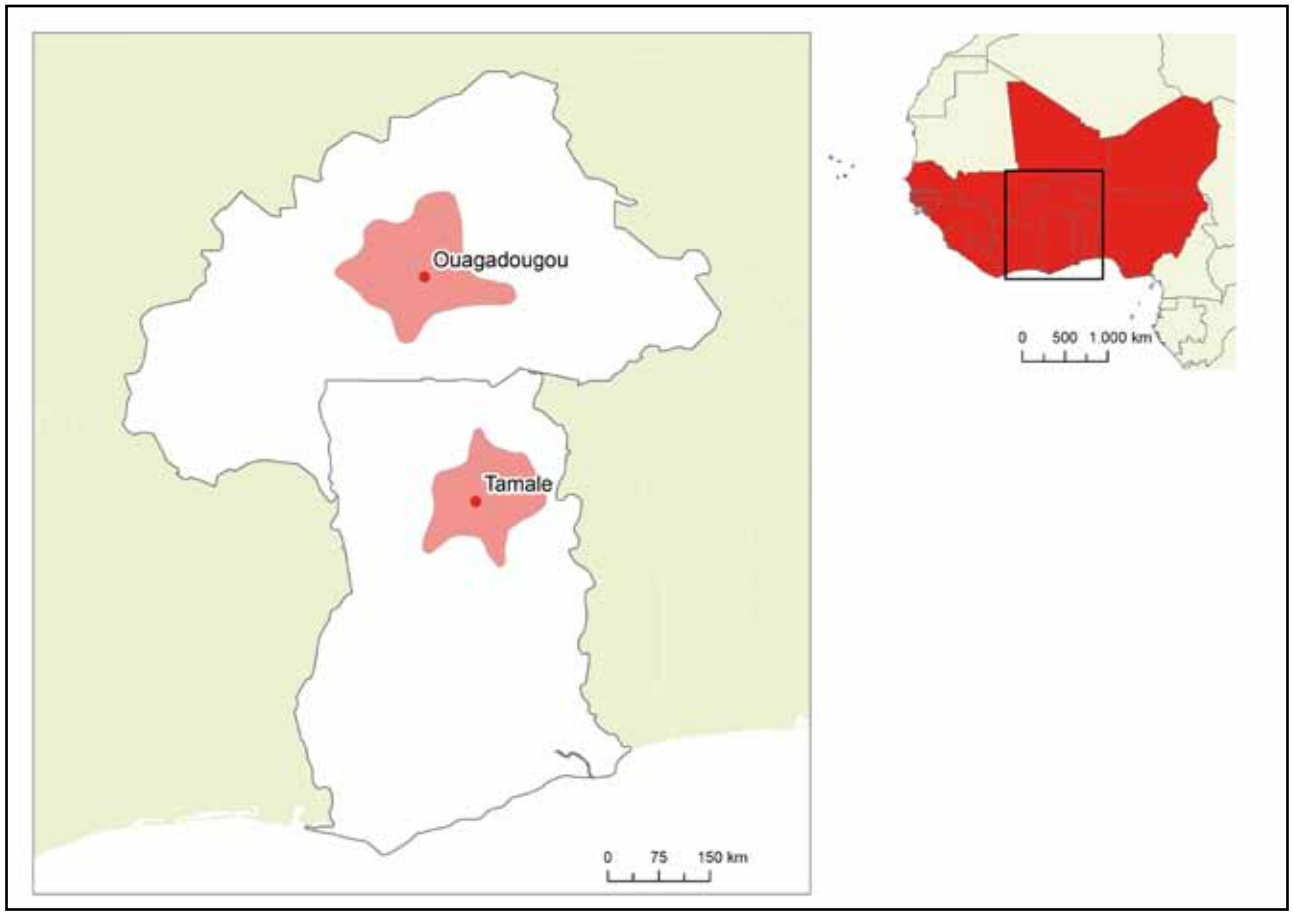


Figure 3.9. City regions of Tamale (Ghana) and Ouagadougou (Burkina Faso), and the location of the two countries within the ECOWAS zone.[3.4]

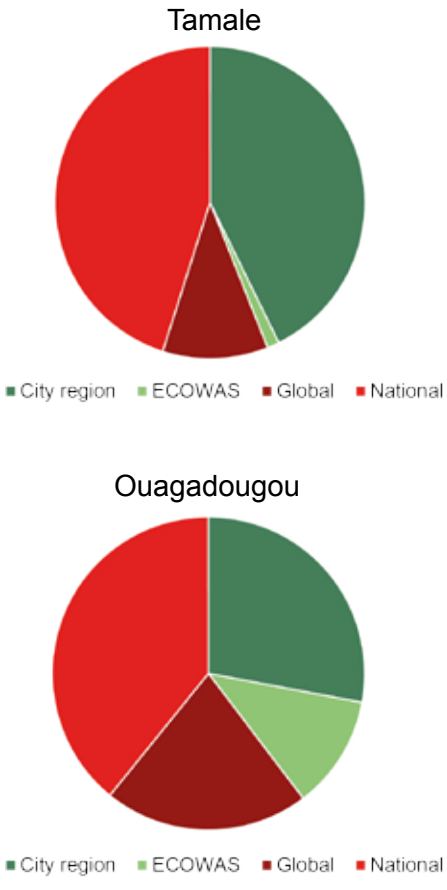


Figure 3.10. Return flow of money spent on non-processed food items.[VII]

Households in Ghana and Burkina Faso spend about half their income on food.[3.10, 3.11] Based on expenditure data[3.12] and food inflows, we calculated which countries and regions benefit from the expenditure of thousands of households on food. In Tamale, 88% of the money spent on non-processed food stays in the country, while 11% are spent on global products and only 1% on products from other ECOWAS countries. This is different in Ouagadougou, where one-third is spent on food coming from ECOWAS or other foreign countries (Figure 3.10). The share returning to global sources, however, is relatively high when comparing food expenditure with the nutritional values from globally sourced food, reflecting the relatively high monetary value of imported commodities such as rice and fish.

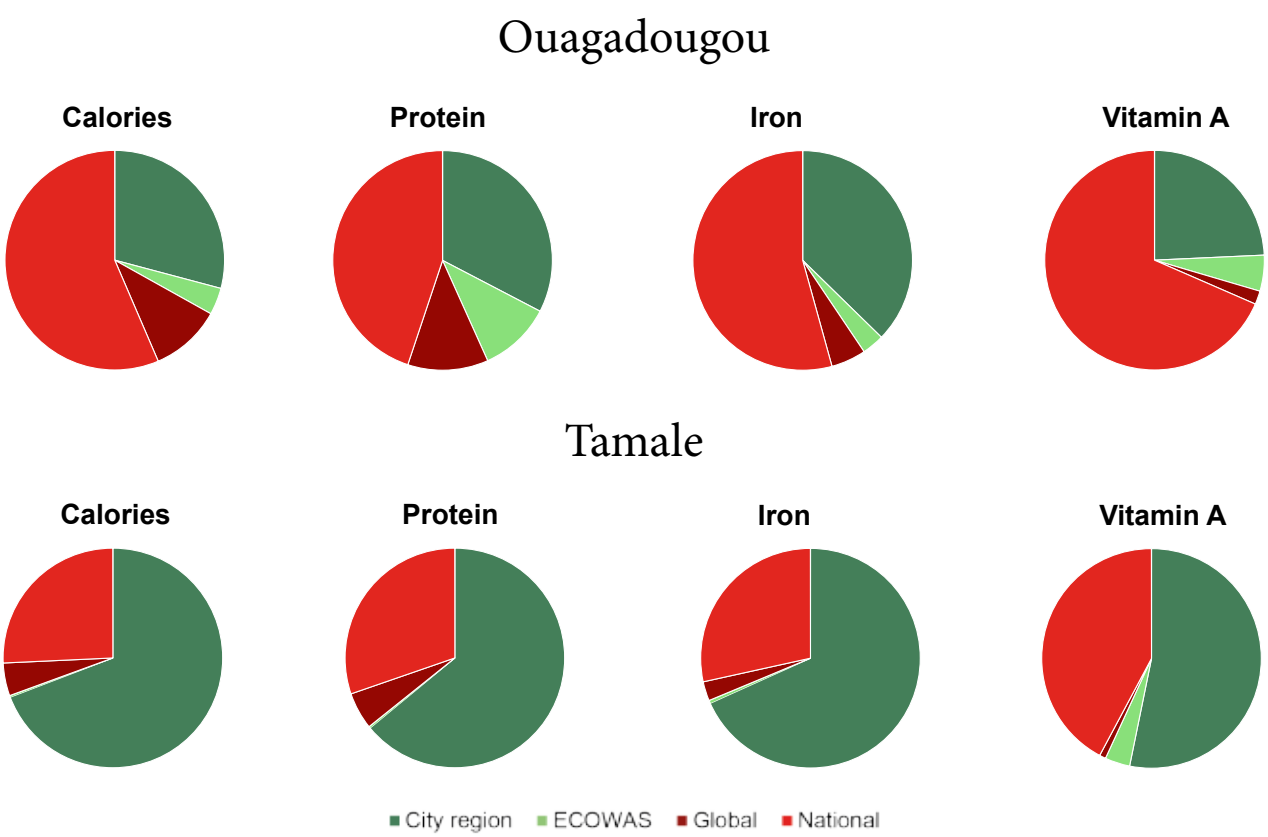


Figure 3.11. Contribution of city region, other national sources, ECOWAS countries and global food sources to the supply of nutrients.[3.13]

The origins of the cities' nutrient supply reflect the relationship between domestic supply *vs.* imports (Figure 3.11). Ouagadougou sources a higher share of its key commodities such as rice, fish and selected fruits and vegetables from foreign countries, including ECOWAS countries and other global sources, as compared to Tamale. Not only is the quantitative proportion relevant, but also the type of product. For instance, in Ouagadouogu, the relatively higher share of imported protein, as compared to other nutritional indicators, can be attributed to the high proportion of imported protein-rich fish (making up 17% of protein inflows). In Tamale, on the other hand, domestically produced groundnut contributes 18% to the protein inflows. Green leafy vegetables produced in urban agriculture are an important source of vitamins and minerals such as iron, but are not included in the analysis, like offals, eggs and dairy products.

Nutritional indicators

Calories: Expresses dietary energy supply of food intake (also kilocalorie = kcal).

Protein: Provides dietary energy besides carbohydrates and fats. Animal source protein is considered of particularly high value given its composition of amino acids; however, in low income countries, protein is mainly derived from cereal-based staple foods.

Iron: Low dietary intakes of iron are a major cause of anaemia among children and women. In addition, African diets are usually poor in vitamin C, which further hampers iron absorption.

Vitamin A: Inadequate or excessive intake of vitamins A or E can lead to various disorders. For example, vitamin A deficiencies are considered to be the main cause of childhood blindness in low-income countries.

3.2 Urban Food Supply Under Stress

Flooding in northern Ghana.

Pay Drechsel and Richard Appoh

How do cities react to supply shortfalls? To answer this, 90 traders were interviewed on 25 retail and wholesale markets in Accra, Kumasi, Tamale, all in Ghana, and Ouagadougou, Burkina Faso, about their commodity-specific experiences and coping mechanisms, considering the supply of yam, cassava, plantain, millet, maize, local rice, okra, onions and eggplant. The most common supply challenges were extreme climatic events such as large-scale flooding as well as lack of rain and drought. Traders recorded supply problems for one crop or another every year, mostly related to particular weather conditions in their production areas, but also across commodities, in particular due to fuel price increases. In particular, 2011 posed severe challenges due to low rain, as mentioned by every third trader who could recall the exact year across the cities. Supply losses due to changes in rainfall ranged between 40% and 100%. However, in two out of every three cases alternative sourcing allowed the wholesalers to buffer losses. Related extra costs (like additional transport costs for a longer distance) were eventually passed on to the customer. Several traders reported extra profits when they were able to benefit from elevated prices based on the demand–supply gap. Supply shortfalls, which some traders could not buffer, concerned products such as local rice, millet, maize and onions.

A tendency to increased city vulnerability to shortfalls of food from south to north was observed. Compared with Accra and Kumasi, many more cases of unsuccessful coping were reported in Tamale, and even more in Ouagadougou. Larger geographical diversity of food sourcing areas (foodsheds) appeared to enhance the resilience of urban food systems. However, while urban traders generally appeared prepared to cope with extreme climate events, price increases up to 35% or more are not easy to absorb for low-income consumers.[3.14] It has to be explored to which extent such

trade-offs could be addressed by the government through storage facilities for key commodities. For perishable commodities that cannot be stored, the risk of supply shortfalls is even higher, in particular if cities depend on one supply area. This applies to the supply of tomato from Burkina Faso to Tamale during the dry season, where tariff regulations, road damages or the closure of borders may have a serious impact on the supply (see below).

The existing regional early-warning systems on threats to food security are based on a geographical disaggregation of food and nutrition insecurity zones but do not make an explicit distinction between urban and rural areas. Even though the numbers of urban and rural residents in West Africa are now roughly equivalent, analyses are lacking and the available tools are insufficient for providing an accurate picture of the food and nutrition situation in urban settings and designing effective response mechanisms. The development of tools and indicators for monitoring food and nutrition (in)security in urban areas has been initiated by the Sahel and West Africa Club Secretariat (OECD) in collaboration with the Comité Permanent Inter Etats de lutte contre la Sécheresse dans le Sahel (CILSS).

Cross-border trade challenges
Edmund K. Akoto-Danso and Hanna Karg

To better understand social and organizational factors influencing food trade across borders, we travelled with a truck carrying Indian rice from the port in Tema, Ghana, to Ouagadougou, Burkina Faso. The exploratory study revealed that long-distance and cross-border trade entails various challenges, including delays caused by equipment malfunction and numerous checkpoints on the route, most of which are managed by the Police Service and Customs (Figure 3.12). At these checkpoints, drivers usually buy their way out in order to avoid further delays by officials who easily find faults with the state of the vehicle or request documents. For a journey of 920 km from Tema to Ouagadougou, we counted about 108 checkpoints, the large majority in Ghana, run by these institutions as well as various tollbooths (12) and weighing bridges (10). Informal interviews revealed that drivers employed by transporting companies or organized in drivers' unions experience far less harassment than drivers transporting local goods who are not backed by a powerful institution. For example, in the dry season, Ghanaian traders rely on Burkina Faso for fresh tomatoes. Police and customs officers tend to harass these drivers, who have no other option but to quickly settle the matter to avoid that their highly perishable goods start to rot. As a result, tomato traders reported payments of more than $USD 500 on the route from Techiman to Ouagadougou, 10 times more than a vehicle transporting rice imported from overseas. Thus, the extent to which drivers experience harassment on the road depends on the organization of drivers and truck owners, drivers' literacy rates and other factors. The lack thereof among local food transporters seriously affects cross-border food trade in the ECOWAS region, despite it being a sector with a high potential of offering employment along the entire supply chain.

More information: www.urbanfoodplus.org

Figure 3.12. Checkpoints recorded on the route from Tema, Ghana, to Ouagadougou, Burkina Faso.

4 Markets

Aboabo market in Tamale, Ghana.

Hanna Karg

Most urban dwellers in West Africa heavily rely on food markets as their main source of food. Physical access to these markets is determined by their place of residence as the occurrence of markets is closely related to past urban growth and infrastructural development. As these differ in Tamale and Ouagadougou, access to markets also differs. In Ouagadougou, markets have developed simultaneously with the early expansion of the city. The number of markets in Ouagadougou increased from 12 in 1974 to 50 in 1994 along with the implementation of formal urban planning policies and the parcelling of land (Chapter 1).[4.1]

The existence of food markets strongly relates to urban planning.

The consolidated part of the city is well equipped with infrastructure, including markets (Figure 4.1). Rapid urban expansion has outpaced formal planning mechanisms in the urban fringe, which is why the density of food markets in the city decreases toward the urban periphery, where the more precarious informal settlements are located. Thus, due to the long history as a capital city, and formal land zoning in the past decades, Ouagadougou's retail system is decentralized and food markets can be found in the established suburbs (*quartiers*), supplying the neighborhood, while in the periphery the number of markets is limited. Liu (2016)[4.2] showed that altogether there were 118 markets in Ouagadougou (including small roadside markets), out of which 60 were general markets, offering a wide range of food and other products. Fifty-three markets sold mainly vegetables and fruits, and five markets were specialized in animal products. Supermarkets, mostly Lebanese owned, offer imported high-value products for the national and international high-income groups, but for the majority of people, traditional market places remain the main source of food.

One of the formal neighborhood markets in Ouagadougou, Burkina Faso.

Market in Kumbungu, a village close to Tamale, Ghana.

Food shopping preferences

Pay Drechsel

Open-air markets remain an integral part of the food supply chain for the majority of urban households by offering convenience and availability of inexpensive basic foods. About 17% of responding households in Tamale, Takoradi and Accra reported shopping for food at supermarkets “at least once a week”, and about half of all households responded “almost never.” Open-air markets, on the other hand, were visited by about 70% of all households at least once a week, and only about 3% of the households never shopped in open markets. In addition, street hawkers remain popular, for various items including snacks, and fill a niche to meet consumers’ specific demands for ready-to-eat foods. They particularly attract commuters at street junctions and bus stops. About 16.5% of households reported buying their food from hawkers more than once a week. To maintain their dominant market share, open-air market traders will need to employ stricter guidelines and adopt necessary storage/protection technology to maintain and enhance food quality and a clean shopping environment.[4.3]

Supermarket in Accra, Ghana.

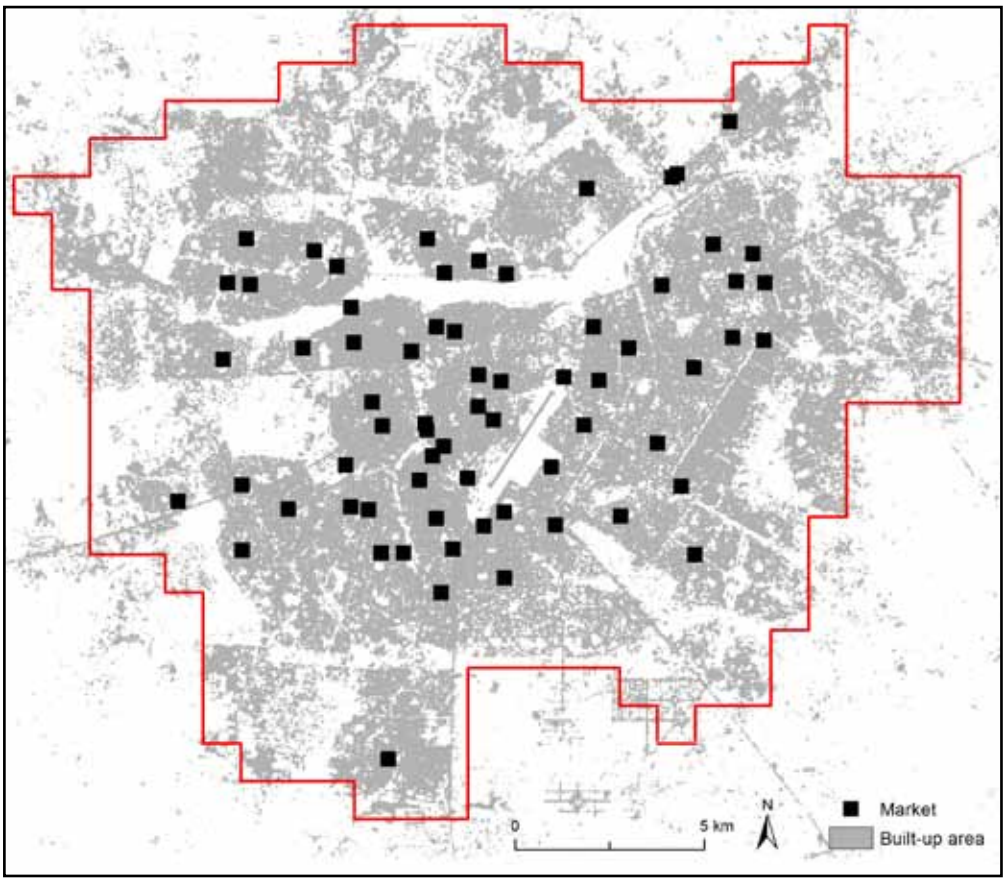


Figure 4.1.
Food markets in Ouagadougou, Burkina Faso.

In Tamale, a medium-sized city in the less-developed north of the country, the variety of food products is more limited as compared to in Ouagadougou. The few supermarkets usually do not offer fresh produce, but largely processed food. Traditional meals consist of largely unprocessed, unpacked food from food markets, and are cooked in homes. They are also served by eateries and street food vendors. Modern dishes include rice, chicken and salad (Chapter 5). In Tamale, two central markets, one with wholesale functions, are the main sources of marketed crops. Additionally, there is one small neighborhood market in Lamashegu, southwest of the city center (Figure 4.2). One factor contributing to the centralized market system is the lack of planning of newly emerging urban areas. While plans by the Town and Country Planning Department that include public facilities such as markets exist, the implementation of these plans is challenging

Planned food market

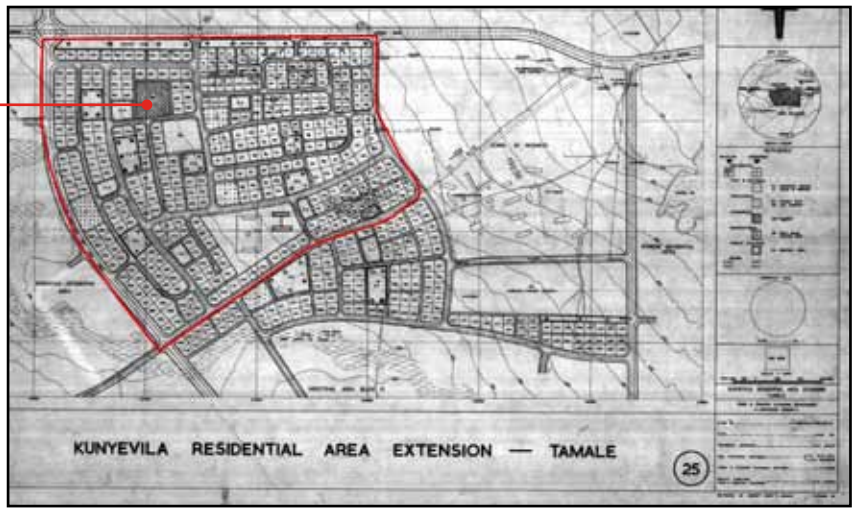


Figure 4.3. Land development plan for a neighborhood in Tamale, Ghana.

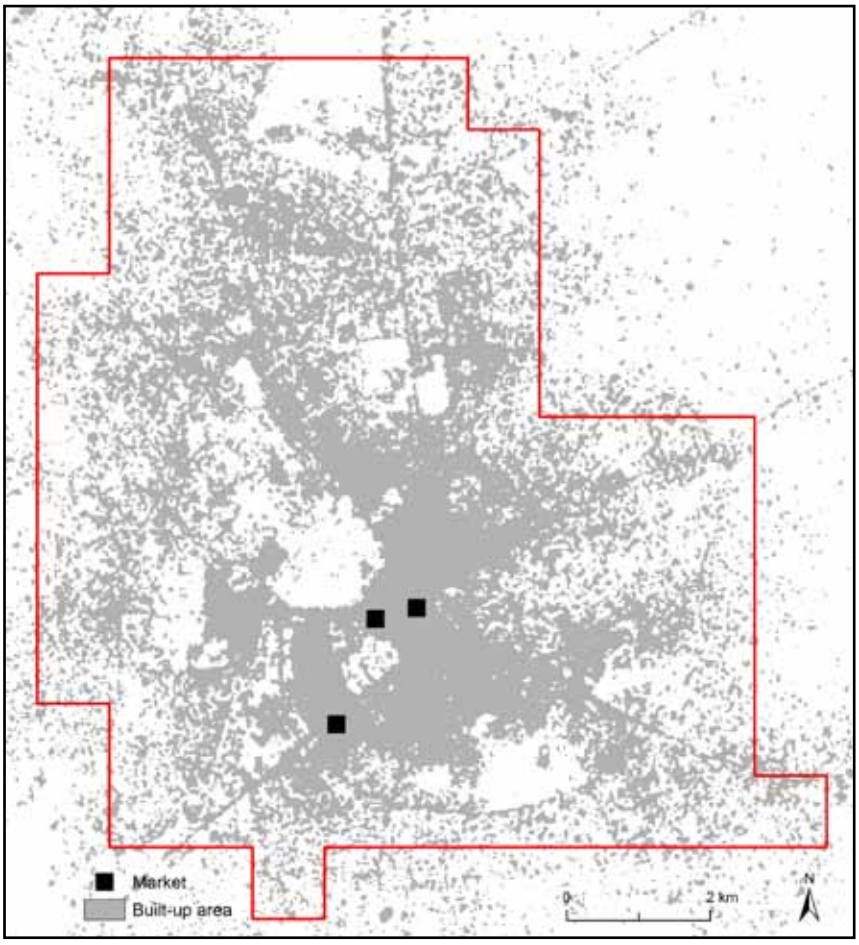


Figure 4.2. Food markets in Tamale, Ghana.

(Figures 4.3 and 4.4). This is partly due to the prevailing customary land tenure system. As a result, market infrastructure is poor outside the city center and physical access to markets is limited for people living there. A study on food access in five neighborhoods in Tamale, located in urban, peri-urban and rural areas, showed that food, such as uncooked ingredients and cooked street food, was available in all neighborhoods. However, in all but the urban neighborhood the availability of fresh food, such as fruit, vegetables, meat and fresh milk, was highly limited and subject to seasonal variation.[4.4] Thus, households are dependent on the central markets, which involves higher costs regarding transportation expenses and travel time for people living outside the center.

Figure 4.4. Neighborhood in Tamale, Ghana that has developed to a residential area without public facilities.

Marketing of leafy vegetables in Tamale

Imogen Bellwood-Howard

Marketing of traditional leafy vegetables is an important livelihood option for women in Tamale, with vendors dealing in amaranthus, roselle, jute mallow and bean leaves.

The traditional leafy vegetable market is loosely structured and unregulated. Within Tamale, there are non-statutory marketers' associations for some goods, such as tomatoes, which regulate the entry of goods, mediating prices. Yet, access to the leafy vegetable market is not regulated in such a fashion. It is relatively easy for farmers to grow local leafy vegetables in the tropical environment, and for local women to trade them. The trade of leafy vegetables is closely connected to traditional community structures of mutual support and reciprocity, and facilitated by Tamale's low-rise, open urban form.

Traders can opportunistically purchase vegetables from farmers cultivating within their local neighborhoods, in particular in backyard farms (Chapter 2.2). There are also patterns of long-term obligation and reciprocity between farmers and wholesalers, and between wholesalers and retailers. These function to guard against seasonal gluts, spoilage and shortages, in a fashion typical of West African agricultural markets in general. When gluts occur, the selling party in the transaction may be able to oblige the purchaser to collect the goods at a price higher than that on the market. This is possible because the purchaser is assured that by doing so, the seller will provide them preferential access to goods in seasons of scarcity. Another mechanism is the horizontal exchange of goods between traders at no profit, allowing a peer to maintain their customers in an event where they have run out of goods. The motivation is not immediate profit, but the possibility of reciprocal assistance, because the long-term maintenance of customers is as important an imperative as daily profit.

These interactions are often between relatives, friends or neighbors. Access to credit is provided through informal no-interest loans, and goods are more often purchased on credit than not.

The entwinement of market imperatives with social structures makes vegetable marketing a resilient livelihood option. It therefore also provides the mainly male vegetable farmers with a commercial livelihood activity and give urban consumers access to nutritional vegetables at minimal transaction costs. Nevertheless, the informal nature of the market means that infrastructure, in particular for storage, is limited.

Marketers about to purchase amaranth from a backyard farm in Tamale, Ghana.

Storage of ayoyo in a bag.

Lettuce marketing chains and bacteria in Ouagadougou

Juliane Dao

Lettuce, which is sold on markets in Ouagadougou, is produced in the urban gardens of the capital city. These gardens are located along rivers, channels or dams, as the fresh vegetables have a high water demand and need to be irrigated daily. Irrigation water is often polluted with pathogenic bacteria, which leads to a contamination of the produce. The harvested lettuces are usually washed on farm with well water and afterwards transported on motorbikes by trading women to the market (Figure 4.5). On the official markets lettuce is often washed with clean tap water to reduce microbiological contamination and to keep it fresh. Still, contamination of lettuce is often above health–based targets, which might result from the pathogen transfer by contaminated irrigation and wash water or by other cross contaminations on the way from farm to the market. Consumers have to wash the lettuce very carefully before consumption to prevent foodborne diseases.

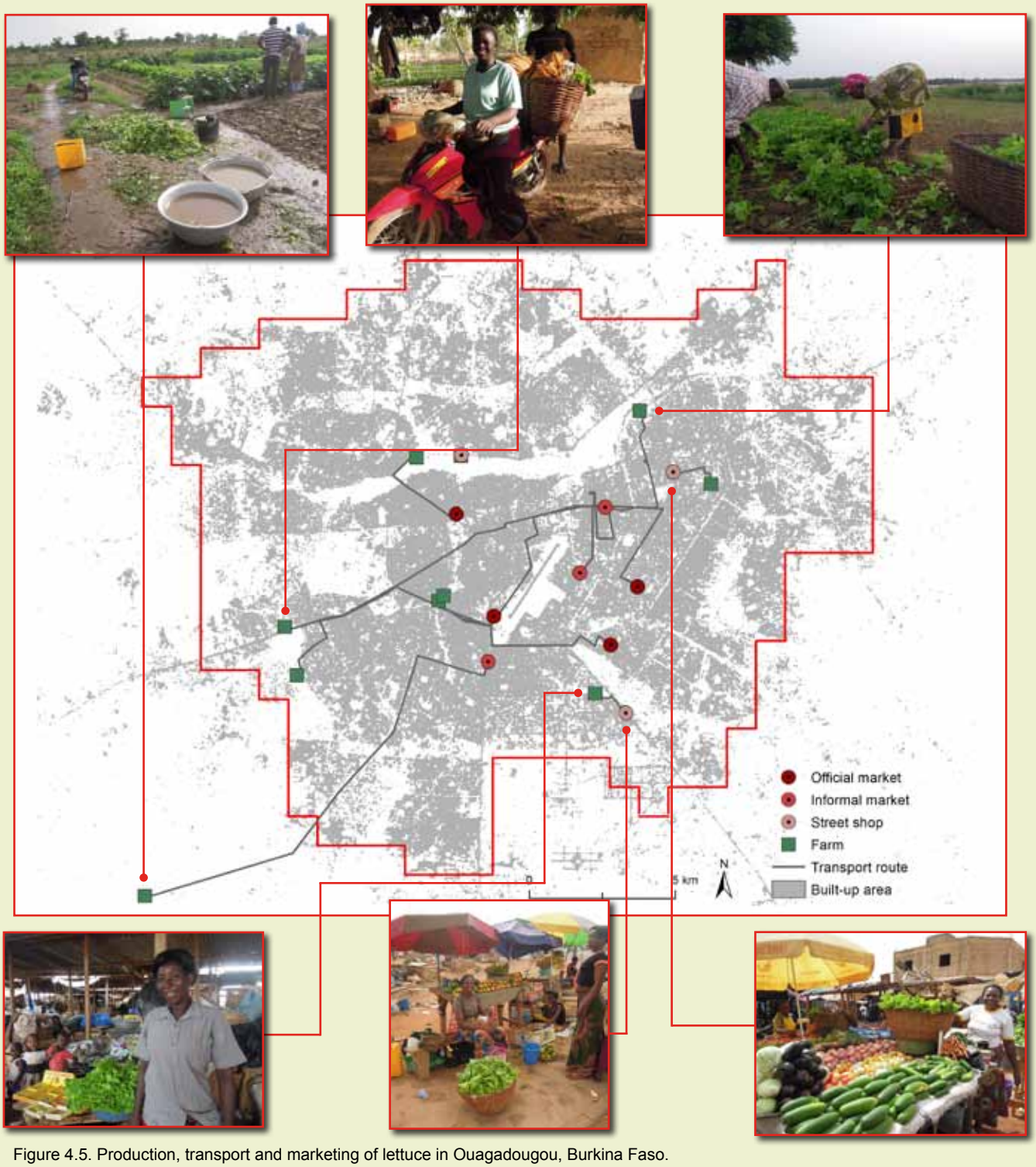


Figure 4.5. Production, transport and marketing of lettuce in Ouagadougou, Burkina Faso.

Cattle market in Ouagadougou.

Milk offtake and milk quality of cows in Ouagadougou

Regina Roessler

Milk holds a huge potential to improve nutrition and livelihoods of urban dwellers in Burkina Faso. From a nutritional point of view, milk protein is particularly valuable, and the milk fat serves as an important energy and vitamin source for humans. Burkina Faso is seeking to improve its self-sufficiency in dairy produce by developing dairy value chains in major cities like Ouagadougou. Improved breeds, technologies and management have been promoted by national and international initiatives and are widely adopted by commercial producers. Accordingly, we observed a substantially higher daily milk offtake from upgraded zebu cows than from purebred local zebu cows managed in the traditional production system (Figure 4.6). The fat and protein content of the milk is similar between cows with different genetic background, and average 4.9 ± 1.45 % and 3.2 ± 0.18 %, respectively. Metabolic disorders, in particular ketosis, are a key problem in commercial as well as traditional dairy cattle herds in Ouagadougou. Without appropriate information and support in feeding management to avoid metabolic disorders due to imbalanced feeding, especially in the dry season, the production potential of dairy cows is not fully exploited and nutrients are lost to the environment.

For more information:

Roessler, R.; Mpouam, S.E.; Schlecht, E. 2018. Identification of appropriate livestock genotypes to improve production performances in small household farms in Ouagadougou (Burkina Faso). *Proceedings of the World Congress of Genetics Applied to Livestock Production, Volume Genetic gain - Strategies for Local Breeds 1, p. 588, 2018, 2018, Auckland, New Zealand*.

Schlecht, E.; Plagemann, J.; Mpouam, S.E.; Sanon, H.O.; Sangaré, M.; Roessler, R. Submitted. Nutrient and energy flows in urban and peri-urban livestock systems of Ouagadougou, Burkina Faso. *Nutrient Cycling in Agroecosystems*.

Milking of cows in a commercial dairy herd in Ouagadougou, Burkina Faso.

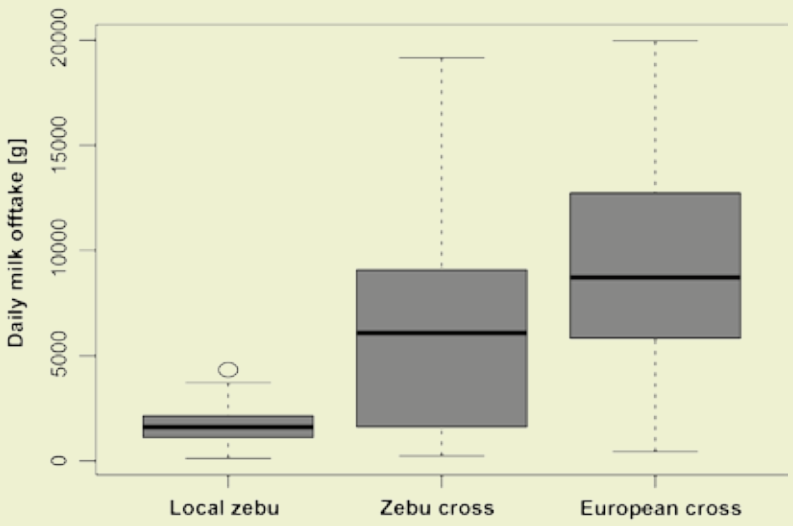
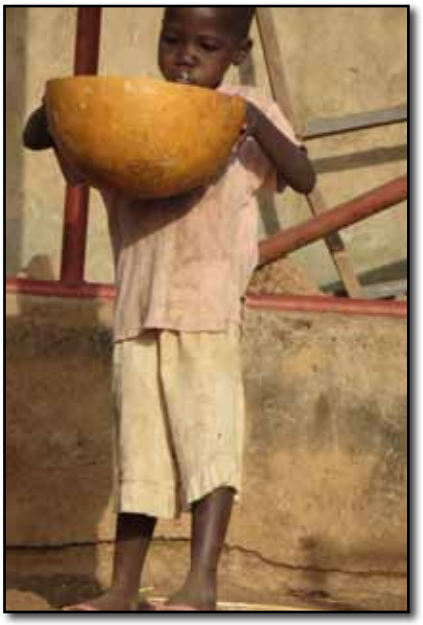


Figure 4.6. Comparative daily milk offtake (milk used for human consumption) across cattle genotypes in Ouagadougou, Burkina Faso.



Raw milk for home consumption (Ouagadouogu, Burkina Faso).

Hand milking of cows
(Ouagadouogu, Burkina Faso).

Raw milk for direct marketing
(Ouagadouogu, Burkina Faso).

Milk processing – filling of milk bags
(Ouagadouogu, Burkina Faso).

Milk processing – yoghurt bags
(Ouagadouogu, Burkina Faso).

5 Consumption

Women preparing food in the yard (Tamale, Ghana).

Pay Drechsel

Moving across different agro-ecological zones in West Africa, by starting in Accra at the Atlantic Ocean, towards Kumasi, Tamale and finally Ouagadougou (Figure 5.1), traditional diets are changing with culture and food that can be produced. These differences remain important despite global and regional trade, multi-cultural diets and a trend toward urban fast food.

In the example of the mentioned four cities,[5.1] the overall food consumption in kilogram peaks in Kumasi (Figure 5.2), which lies in the heart of the tuber belt and is famous for its (heavy) tuber- and plantain-based *fufu* dishes. In Ouagadougou, on the other hand, cereals like sorghum and millet as well as livestock meat play a major role in household food consumption, while the share of fruits and vegetables increases towards the south, with Accra also having the easiest access to fish and a significantly higher fish consumption than any other city. Vegetable consumption is particularly high in Kumasi, where tomatoes and garden eggs are common. Accra has the highest household consumption of fruits, especially oranges. In comparison, fruits and vegetables are less prominent in Tamale and Ouagadougou, which might also be linked to the increasingly drier climate (Figure 5.2).[5.2] The variations in amounts and types of food influence the calorie and protein intake across the urban populations. Overall, the protein supply appears sufficient in all cities and relatively high in Accra and Ouagadougou, based on the higher shares of fish and meat in the respective local consumptions. While cassava, yam and plantain have much lower protein levels than for example sorghum and millet, beans are a common protein source in Kumasi (e.g., *red-red* dish, which refers to red plantain and red beans) and Tamale (e.g., *Waakye*, which refers

> Urban diets are undergoing change, but traditional meals still play an important role.

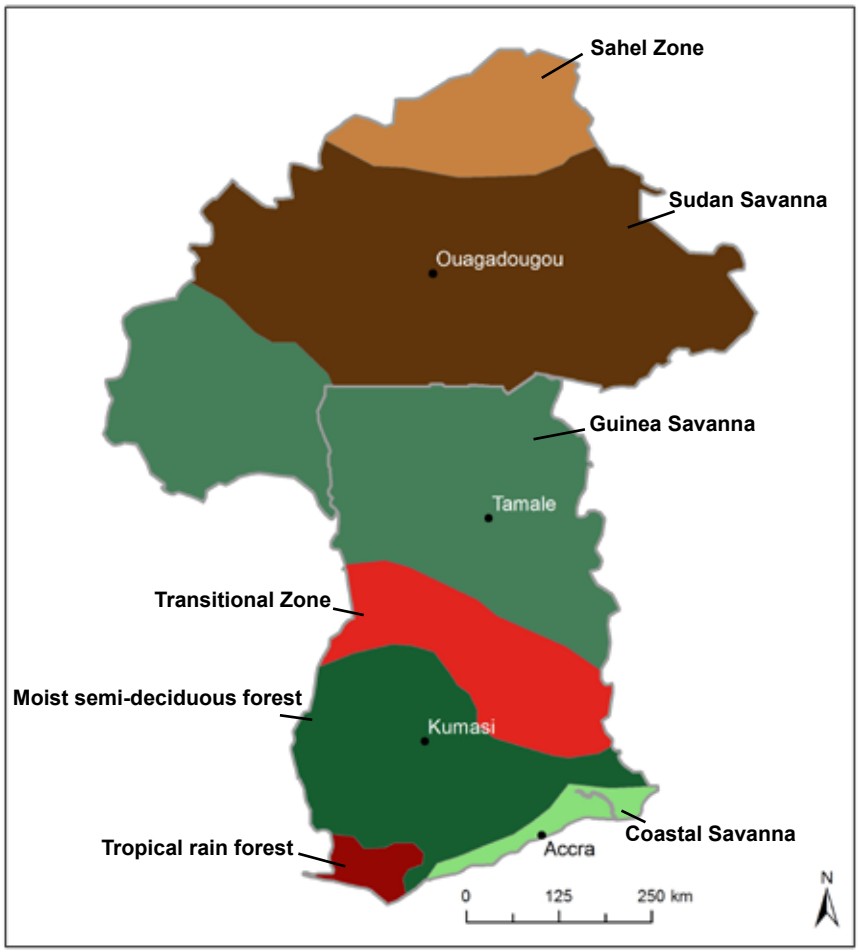


Figure 5.1. Agro-ecological zones in Ghana and Burkina Faso.[5.1]

Cereals and legumes sold in Tamale, Ghana.

Waakye: a popular dish in Ghana based on rice and beans.

Fresh vegetables offered at markets in Ouagadougou, Burkina Faso.

Check-check: modern urban fast food consisting of rice, chicken, and raw salad (lettuce or cabbage).

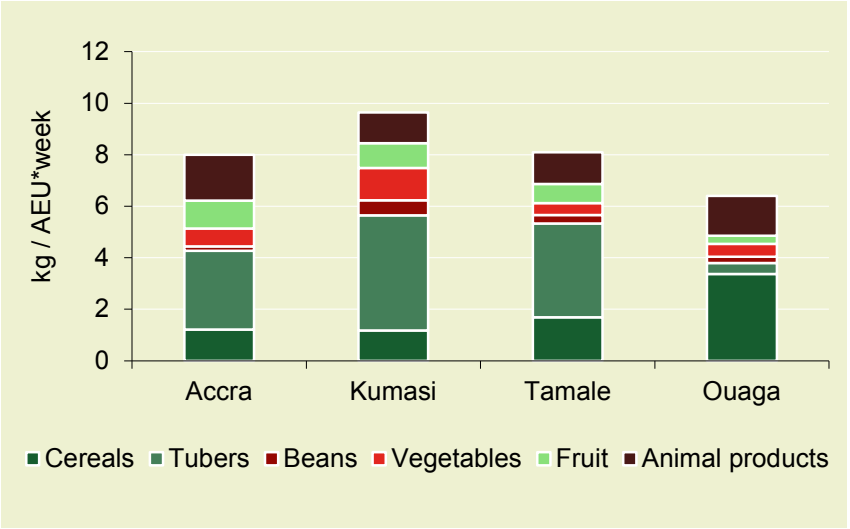


Figure 5.2. Combined household and street food consumption of major food groups in kg per adult-equivalent unit (AEU) per week (fresh weight).

to beans and rice). The average urban household in all four cities keeps four to six chickens, which contribute to a regular supply of eggs; in Kumasi the number is twice as high, and the surplus is sold.

The amount of calories consumed per day can, however, be below what active adults require, which is between 2000 and 3000 Kcal. The calorie intake appears lowest in parts of Accra's population where food prices and living costs peak, which motivates many households to buy yam and plantain when returning from the northern countryside. The contribution of subsistence home production (urban agriculture) to urban consumption varies strongly with the size of available land, but also ethnic preferences for example in view of the types of local vegetables produced, and the distance from the city.[5.3, 5.4] Compared with national consumption data in Ghana, the main difference reflected in the urban diets is a shift in the cities to more rice and meat-based meals and fewer tuber- and plantain-based meals. The difference also reflects a shift to smaller family units and greater convenience in food preparation, as rice-based meals are faster to prepare than the traditional cassava/yam and plantain meals that require hours of pounding, usually by unemployed home-based family members. The urban diet also shows a growing contribution of food bought in street restaurants and canteens, which serve the working population as well as the poor (see page 65). In Accra, especially, poorer urban households can spend about 40% of their food budget on street food. This is especially the case where homes do not have sufficient water or space for cooking. The fast food served in streets, like the popular *check-check* (rice

In case of fresh vegetable purchases, households in Tamale showed about 40% lower expenditures than households for example in Accra or Takoradi, despite lower market prices. Well-educated and high-income households have higher fresh vegetable and fresh fruit expenditures and daily consumption rates, a relationship also observed for other food and non-food items, implying that nutritional programs might be most successful if linked to initiatives supporting an increased household income.[5.6, 5.7]

Fresh vegetables sold at a market in Ouagadougou.

Consumers' stated willingness to pay for food safety in Tamale

Christina Seeger and Wilhelm Löwenstein

Smallholder farmers cultivating in Tamale often rely on the use of wastewater for irrigation and lack knowledge regarding the safe use of agrochemicals in agricultural production. Thus, consumers are likely exposed to health risks, especially when eating raw vegetables like cabbage. Of the 318 consumers surveyed in Tamale, 65% were concerned with agrochemical and wastewater use in agriculture, and they were aware of the health risks associated with it. However, at the local markets, safe vegetables and unsafe vegetables are supplied together and they are traded at the same market price. This makes it impossible for consumers to differentiate safe vegetables from contaminated ones prior purchase. One option to guarantee consumers that vegetables are safe is certification. We assessed how consumers in Tamale value food safety by asking them to state their willingness to pay a price premium for certified safe cabbage. Roughly 97% of the respondents are willing to pay a higher price for certified vegetables. The estimated price premium on the average market price for one averaged sized certified cabbage was 120%. This shows that consumers are highly sensitive about the health risks of agrochemicals and wastewater in agricultural production and consumers' preference for product differentiation.

Market stall in the central market in Tamale.

For more information:

Seeger, C., Löwenstein, W. (forthcoming). Trust, certification, and consumers' willingness to pay for safe vegetables in Tamale, Ghana, IEE Working Paper. Bochum.

and chicken), supports in all cities the production of exotic vegetables, which form a side dish. As these leafy vegetables, like lettuce, are highly perishable, production takes place in close market proximity on otherwise unused urban open spaces where polluted water may be used for irrigation. The majority of all traded lettuce (60% in Accra and 83% in Kumasi) ends in the street food sector. The remaining share goes to restaurants, canteens and hotels. Private households in Ghana take only about two percent of the production, which reflects the 'exotic' character of raw salads in the national diet. The share of salad consumption is likely to be higher in parts of Ouagadougou's population, given its exposure to the French cuisine, than in the Ghanaian cities. When asked about possible health risks, consumers are concerned (see above) although in real life they hardly ask about the origin of their vegetables and care more about fresh appearance and neatness.[5.5]

Irrigated lettuce field in Ouagadougou's city center.

Shifts in dietary patterns, with more processed foods being consumed, are significantly influencing not only food production, but also the post-harvest sector. Demand for convenience is an overarching trend across income groups and is reflected in the strong demand for processed and prepared foods and in the expansion of street food. The combined effects of rapid urbanization, population growth and resulting transformations in food demands have had major impacts on the size of the West African food economy. Such effects have also contributed to the rapid development of non-agricultural postharvest activities, such as processing, packaging, distribution and retail. According to the OECD, across West Africa, 66% of total employment is in the food economy, from the farm level to processing, packaging, transportation, distribution and retailing, providing jobs for 82 million people. About 35% of jobs in urban areas are in the food economy. About 60% of these urban jobs are in marketing and food away from home, in contrast to 15% in rural areas.[5.8]

Women dominate the post-harvest food sector in West Africa.

These transformations open new opportunities for value addition and gender-specific employment creation, especially in the off-farm segments of the value chain (Figure 5.3). In urban areas, one out of three jobs for women (one out of seven for men) are in off-farm food activities. Food processing and food-away-from-home services are growing and lucrative activities. Given the size of the food economy, its functioning, competitiveness and development will have major impacts on employment structures and gender-specific job opportunities.[5.8]

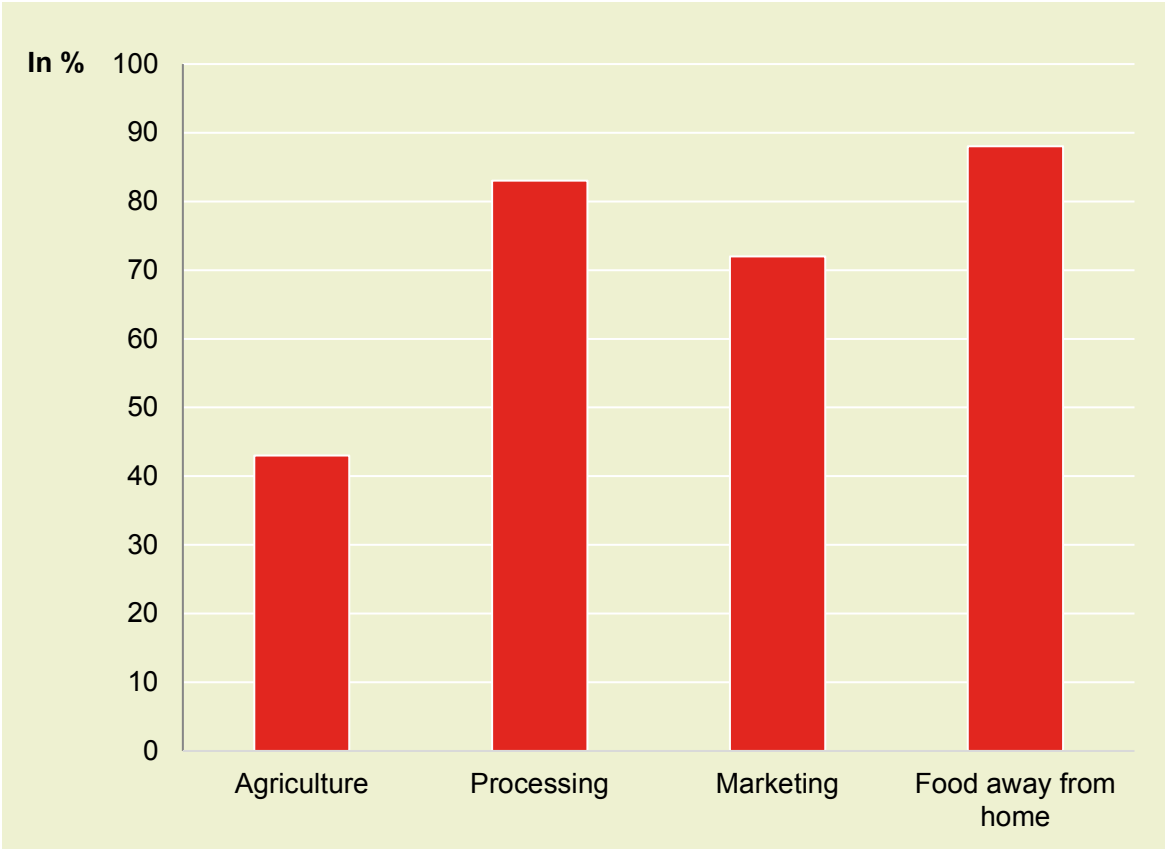


Figure 5.3. Share of women's employment by food system activity in West Africa.[5.8]

Food consumption and malnutrition in Ouagadougou

Pay Drechsel

Despite a large variety of food consumed in Ouagadougou, many food items are seldom served, particularly foods from animal sources such as dairy products and eggs. Still, the variety of the city diet remains higher than that of people living in rural Burkina Faso. The typical daily diet in Ouagadougou consists largely of cereals, vegetables and fats from vegetable sources. Sweetened products, fried foods, dairy products, non-fatty meats, nuts, seeds, fruits and other vegetables are also frequently consumed during the week, while eggs are consumed less than once a week. Among the nutritious 'vegetables', the leaves of Amaranth are consumed by over 90% of the urban dwellers interviewed, either boiled with or without cereal-based meals like couscous, or in groundnut sauce. However, despite the reasonable frequency of such vegetable intake, the quantities consumed remain low and cooking is causing a loss of nutrients, while on the other hand the consumption of 'snacks' is on the increase. A statistical analysis of the most prominent groups of food consumed revealed two dietary patterns: 'snacking' (frequent food consumption outside the main meals) and 'modern foods' (scrambled eggs, chicken, tomato sauce, pastas, cheese, meat, sodas, soup, French dressing, hamburger), which are both typically urban. Both patterns were positively and independently associated with the economic status of households and with food expenditures. The 'snacking' behavior was strong among younger, unmarried people having a formal job, whereas the 'modern foods' pattern was less pronounced in districts with a high proportion of Muslims or particular ethnic groups, like Mossi.[5.9]

A typical urban challenge, not only in Ouagadougou, is the co-existence of obesity and undernutrition within the urban area. The two most recent demographic and health surveys showed an unchanged picture with about 30% of women living in Ouagadougou being overweight or obese, as compared to only about 6% of their rural counterparts. In the same city, however, between 17 to 18% of children below the age of five show wasting or stunting.[5.9, 5.10, 5.11]

Streetfood sold in Accra, Ghana.

6 Stakeholder Dialogue

Stakeholder workshop in Tamale, Ghana.

Charles Adams, Hector A. Codjoe, Zakaria Abdul-Rashid, Abdul Halim Abubakari, Imogen Bellwood-Howard and Rene van Veenhuizen

Although urban agriculture is rarely the main topic of discussion, it interlinks and supports a large array of development objectives given its interface between agriculture, food safety, sanitation, health, urban planning and the environment, as the example of irrigated vegetable farming in open spaces shows (Figure 6.1).

Given this complexity, different institutions, local assemblies, statutory and regulatory bodies, traditional leaders, NGOs, CBOs, and the (formal and informal) private sector can have a stake in urban farming, not to mention urban farmers, traders, consumers and researchers. Similarly, a range of bylaws, policies, regulations, medium-term plans and strategies address urban farming directly or indirectly. This applies in particular to those ministries that underwent the decentralization process in Ghana and shifted responsibilities to district departments and units, reporting to local assemblies. In particular, the decentralization of the Ministry of Food and Agriculture should be mentioned, as it created at city district level *de facto* Metropolitan Directors of Urban Agriculture, which gives urban farming an institutional home. Yet, the complexity of the urban institutional environment calls for multi-stakeholder dialogues to address farming-related challenges or opportunities, as the impacts might be felt across the institutional nexus and require a participatory planning process. This situation becomes even more challenging when peri-urban agriculture is concerned, which requires a dialogue across administrative rural–urban boundaries.

As a response, various research and development organizations concerned with urban food security and urban food systems have over the

years convened a series of often interlinked stakeholder processes. In Tamale, these consultations were commonly facilitated by the University for Development Studies (UDS) and the Urban Agriculture Network (URBANET). External support came, for example, from the Ghana Water Sanitation and Hygiene (WASH) Alliance, and international projects and organizations like the International Water Management Institute (IWMI), the RUAF partnership and the UrbanFood^{Plus} research project.

Especially where urban food supply and agriculture are subject of research, stakeholder platforms can (a) steer the research to locally relevant questions and knowledge gaps, and (b) discuss the implications of research findings for informed decision making and urban planning. Key issues around urban farming relate to land availability, ownership and land use planning, which are in general one of the most common issues of conflict in Ghana, in particular in urban and peri-urban areas, making the reconciliation of interests one of the major challenges for participatory stakeholder processes. Other contentious issues, in particular in Tamale, are water access for agriculture, given that Tamale can face long periods of insufficient domestic water supply, and the impact of poor sanitation on water quality and food safety.

The UrbanFood^{Plus} project-facilitated stakeholder dialogue in Tamale started in 2011 and moved from a situation analysis to identify priority areas for interventions and/or policy attention to a phase of agreement on a joint **strategic city agenda** with institutional commitments for urban agriculture development in Tamale. Latest with the acceptance of the city agenda, the ownership of the multi-stakeholder process should pass on to the local stakeholders.

This transition is, however, not without challenges. There can remain 'lip services' or different readings of traditional and current land rights, or a mismatch between formal planning approaches (like

Figure 6.1. Development objectives linked to open-space urban farming.

zoning) and informal realities. A common example in Ghana is that traditional *chiefs* transfer agricultural community land for non-agricultural purposes, also to third parties. This might even affect agricultural land zoned for flood retention, which is protected by the Riparian Buffer Zone Policy. In all these cases, especially farmers need a platform to explain their stakes, also as urban agriculture continues to struggle with its recognition as a valid urban land use category.

Another issue of public concern and for stakeholder discussion is the pollution of water used for crop irrigation. Participants in the stakeholder process conceded that treatment of wastewater before use for irrigation would be an appropriate solution, but municipal scale options were still far off. UrbanFood^{Plus} engaged in the search for alternative safety options, like on-farm wastewater filtration. The stakeholder dialogue indicated that this requires a solution between the slow water flow preferred by scientists for good filtration and the high water flow needed by farmers to save time during manual irrigation. With storm water gutters in the metropolis being reconstructed to divert wastewater out of the city center towards peri-urban areas, stakeholders pointed at alternative irrigation water sources, such as rain or floodwater.

Finally, as also experienced in other African cities, an important step in the dialogue is to explicitly recognize the role of informal activity in urban food systems, rather than attempt to enforce formal approaches with limited resources.

These examples show the value, but also challenges of a multi-stakeholder platform, and the need for a mutually respected facilitator, especially considering that the dialogue process involves the interactions of diverse groups with differential levels of power. A powerful stakeholder not mentioned so far is the media. To reduce the risk of 'lip services' in the jointly agreed city agenda, media attention can be effective to support commitments and accountability (Figure 6.2).

Saturday 10th March, 2018

Print

Policy makers urged to help improve agriculture

By Comfort Sena Fetrie, GNA

Tamale, March 10, GNA - Mr Iddrisu Musah, the Metropolitan Chief Executive (MCE) of Tamale has advised all policy makers to support the government by committing themselves towards helping to improve urban and Peri-urban agriculture.

He said the country needed to address critical challenges bothering on urban food security saying, "All policy makers must be concerned and devise ways of improving agriculture production".

He said it was important for stakeholders to collaborate with government to improve on urban environment to enhance the capacity of a sustainable food security.

Mr Musah gave the advice during a three-day technical and multi-stakeholder workshop organised by the Urban Food Plus in

For more information:

Bellwood-Howard, I.; Kranjac-Berisavljevic, G.; Bogweh Nchanji, E.; Shakya, M.; Veenhuizen, R.V. 2018. Participatory planning for food production at the city scale: Experiences from a stakeholder dialogue process in Tamale, Northern Ghana. In: *Integrating food into urban planning*, eds., Cabannes, Y.; Marocchino, C. London, England: UCL Press; Rome, Italy: Food and Agriculture Organization (FAO).

Bellwood-Howard, I.; Amoah, P.; Zakaria, R.; Veenhuizen, R.V. 2016. Experiences from stakeholder dialogues in Tamale, Northern Ghana. *Urban Agriculture Magazine* 31: 33–34.

Drechsel, P.; Obuobie, E.; Adam-Bradford, A.; Cofie, O.O. 2014. Governmental and regulatory aspects of irrigated urban vegetable farming in Ghana and options for its institutionalization. In*: Irrigated urban vegetable production in Ghana: characteristics, benefits and risk mitigation*, eds., Drechsel, P.; Keraita, B. Colombo, Sri Lanka: International Water Management Institute (IWMI). Pp. 199–218.

Figure 6.2. Media response to the stakeholder workhop held in Tamale, Ghana, in 2018.

Visit of project members and stakeholders to the central field experiment in Tamale, Ghana.

Conclusions

UrbanFood^{Plus} team.

Hanna Karg and Pay Drechsel

The diversity of studies under the UrbanFood^{Plus} project showed a dynamic picture of urban food systems in rapidly growing West African cities. Of the four cities studied (Bamako, Barmenda, Ouagadougou and Tamale) this publication draws in most parts on the results of the last two, where the research started the earliest and the data are already available. In Tamale and Ouagadougou, urban food systems are shaped by the co-existence of contemporary developments and historical patterns. For instance, the livestock sector in Ouagadougou has been modernized through private investments to meet the growing urban demand for dairy products. On the other hand, traditional structures prevail, such as the traditional periodic market system in Tamale's hinterland, a system that is integrated into a diverse food distribution system influenced by local and global food sources. In other cases, traditional systems collide with new developments, creating new conflicts and challenges. For instance, the traditional customary land tenure system has been increasingly undermined by valuable land markets and related financial incentives when selling the land to private developers.

The urban agricultural system as part of the urban landscape is also influenced by urban planning, land tenure and past urban development, demonstrated, for instance, by visible backyard farms and consequent marketing opportunities for women in Tamale, which are less developed in Ouagadougou. Growing urban demand, also for 'modern' urban food, can boost the production of particular commodities, like exotic vegetables, rice and milk products, provide employment and increase incomes. Intensifying crop production, by improved management practices and the use of new technologies with locally available materials, is therefore key to urban farmers making best use of small plots. Health risks caused by polluted water or the

excessive use of pesticides can be minimized by on- and off-farm water treatment and safe post-harvest food handling. An increasing challenge for urban food systems are climate change–related events, such as flooding or droughts which can affect common urban food supply chains. Adaptation measures by traders (alternative (short) supply channels) as well as authorities (storage) are needed.

As city development interacts with urban food systems, the path for more sustainable and resilient future food systems can be laid at the city level today, for instance by improving access to markets, supporting inner-urban production and creating enabling environments for food safety measures.

Twelve key messages from the UrbanFood^{Plus} project which summarize major conclusions of the research studies are presented on page 2 and 3 of this publication.

Food market in Ouagadougou, Burkina Faso.

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Notes

[I] The urban extent is based on a land use classification using LandSat images.[1.5, 1.6] A grid with cells of 1,000m was overlaid and the share of urban built-up area determined for each grid cell. Those grid cells with more than 25% (25 ha) were considered urban. The final polygon comprises urban grid cells, as well as enclosed grid cells, and those with at least three shared borders.

[II] The total irrigated area under cultivation was determined through visual interpretation of recent GoogleEarth images during the dry season. Due to the large variability regarding location and area under cultivation, these figures have to be considered estimates.

[III] The land use classification is based on LandSat data at a resolution of 15 meters.[1.5, 1.6] In Ouagadougou, uncultivated institutional land (such as the airport and public parks) that was classified as savannah or agricultural land was not considered. In Tamale, however, institutional land was largely cultivated and therefore included.

[IV] Wood land and trees were extracted from a land use classification, which was based on a SPOT satellite image. A grid with cells of 1,000m each was overlaid and grid cells classified according to the predominant structure of trees and woodland. In total, four categories of trees and woodland were identified: 1) individual trees, 2) individual trees next to houses, 3) grouped trees and 4) trees arranged in lines. 25 grid cell cells were randomly selected and stratified according to the respective categories of trees and woodland (each category was represented by five to seven grid cells). Based on high-resolution GoogleEarth images, all trees in each of the selected grid cell were marked. These georeferenced data were transferred to a GPS device and the type of tree identified *in situ*. In total, 3,457 trees were sampled within the urban boundary of Tamale. The extraplation was done by relating the number of trees in a given grid cell to the tree and woodland area (determined by the land use classification) and by calculating the average area per tree.

[V] Geographical destination and source of food flows were recorded, allowing for geolocation of flows. To map urban foodsheds of different commodities and seasons, all flow records with an urban destination were extracted from the dataset. The urban boundary was based on the densely built-up area. Then, heat maps were created to visualize the sources of these flows on the basis of relative quantities. Unless stated otherwise, fresh weight was converted to percentages to allow for comparisons between commodities, regardless of their weight.

[VI] Food ‘kilometers’ were calculated for all flows originating from beyond the check points and for records with source information. The distance is proportional to transported quantities.

[VII] Food groups falling under the category ‘unprocessed’ and included in this analysis comprised vegetables, legumes, cereals, rice, roots and tubers, fruits, beef and veal, poultry, fish, lamb, mutton, and goat and pork.

Picture credits

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7	Satellite image	GoogleEarth (13 October 2017), Digital Globe, 2018
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8	Aerial photograph	University of Freiburg
12	Aerial photograph	Andreas Buerkert
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13	Farmer irrigating	Hanna Karg
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Key publications

Akoto-Danso, E.K.; Manka'abusi, D.; Steiner, C.; Werner, S.; Häring, V.; Nyarko, G.; Marschner, B.; Drechsel, P.; Buerkert, A. 2018. Agronomic effects of biochar and wastewater irrigation in urban crop production of Tamale, northern Ghana. *Nutrient Cycling in Agroecosystems* 543(295): 1–17.

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Web links

UrbanFood^{Plus} project website

http://www.urbanfoodplus.org/

Project movie ‘Feeding the city: Urban agriculture in West Africa’ (English version)

https://www.youtube.com/watch?v=gEx23jGX47g&feature=youtu.be

Project movie ‘Nourrir la ville: L’agriculture urbaine en Afrique de l’Ouest’ (French version)

https://www.youtube.com/watch?v=o7B2FV18h1A&feature=youtu.be

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This Atlas summarizes recent advances in interdisciplinary approaches and research to address the different components of West African urban food systems, including urban and peri-urban agriculture. It thereby draws on the results of several major collaborative research projects and stakeholder consultations conducted in West Africa over the past two decades, and in particular on the UrbanFood^{Plus} project in Ghana and Burkina Faso (www.urbanfoodplus.org). The publication targets with its innovative design a broad range of stakeholders.

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