Building Urban Resilience

Assessing Urban and Peri-urban Agriculture in Tamale, Ghana

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Building Urban Resilience

Assessing Urban and Peri-urban Agriculture in Tamale, Ghana

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Preface

Food production in and around cities is an integral part of the urban fabric in much of the developing world. In these regions, urban and peri-urban agriculture (UPA) plays an important role in diversifying urban diets and providing environmental services in urban and peri-urban areas. As such, there is growing interest in UPA as a strategic component of urban resilience and climate change adaptation planning. However, advocacy for UPA in this capacity is outpacing the body of evidence regarding important stressors and drivers that act on UPA. Such knowledge is especially critical in the developing world where urban areas are experiencing rapid growth and transformation. In these regions, UPA is facing intensifying pressures from urban encroachment, waste disposal, pollution, and climate change that may undermine the sector's long-term viability.

The need to better understand these critical sustainability dimensions provided the impetus for city-level knowledge assessments of UPA, whose main findings are contained in nine underlying assessment reports including this one. The assessed cities were Dakar (Senegal), Tamale (Ghana), Ibadan (Nigeria), Dar es Salaam (Tanzania), Kampala (Uganda), Addis Ababa (Ethiopia), Dhaka (Bangladesh), Kathmandu (Nepal) and Chennai (India). All of the reports and the synthesis report can be found at *http://start.org/programs/upa*. The assessments were conducted in 2012, with initial stakeholder engagement beginning in 2011. The assessments were led by city-based teams, the composition of which varied, with some of the teams being comprised predominately of researchers and other teams comprising of a mix of researchers, city officials and urban NGO representatives.

The assessments seek to better understand the changing nature of UPA systems, and the critical interactions at the land-water-climate nexus that influence resilience of UPA in rapidly growing developing-country cities. The audience for these assessments includes national and city-level policymakers, sectoral experts and city planners, the research community, and non-governmental organizations (NGOs) that interface with urban farmers and other actors within the broader UPA sector.

The UPA assessments are part of a larger project on strengthening understanding of critical links between climate change and development planning in West Africa, East Africa and South Asia. The premise for the project is that progress towards undertaking effective action to address climate change risks in these regions is hindered by low levels of awareness of global climate change, lack of understanding of the findings of the Intergovernmental Panel on Climate Change (IPCC) and other sources of scientific information, lack of location and sector specific knowledge, and the need for strengthening capacities to undertake integrated assessments that support decision making. This multi-year project has been a collaborative effort between the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), START, the University of Ghana, the University of Dar es Salaam, and the Bangladesh Centre for Advanced Studies (BCAS).

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In addition to the numerous authors listed in each of the separate reports, we are grateful to the following people for providing useful insights and feedback during the early conception of the knowledge assessment, and helpful review comments on the various manuscripts: Rafael Tuts, Anna Skibevaag, Stephen Twomlow, Elizabeth Migongo-Bake, Trang Nguyen, Volodymyr Demkine, Jane Battersby, Marielle Dubbeling, Anna Kontorov, Richard Munang, Jesica Andrews, Fatoumata Keita-Ouane, Jacqueline McGlade, Keith Alverson, Stuart Crane, Martina Otto, Robert Yennah, Beverly McIntyre, and Tom Downing. We would also like to express our sincere appreciation for the generous support of colleagues at the University of Cape Town's *Climate* Systems Analysis Group who with the climate projections for six African cities.

Acronyms and abbreviations

CALID	Center for Active Learning and Integrated Development, Ghana
CAPD	Community Action Programme for Development
CMIP3	Global Model Intercomparison Project Phase 3
CSAG	Climate Systems Analysis Group
DeCo	Decentralised Composting Company
ENSO	El Niño –Southern Oscillation
EPA	Environmental Protection Agency, Ghana
FASDEP	Food and Agricultural Sector Development Policy
GFDRR	Global Facility for Disaster Reduction and Recovery
GHS	Ghana Health Service
GMA	Ghana Meteorological Association
GSS	Ghana Statistical Service
ICRISAT	International Crop Research Institute in the Semi-Arid Tropics
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
IWMI	Integrated Water Management Institute
MADU	Metropolitan Agriculture Development Unit
METASIP	Medium Term Agriculture Sector Investment Plan
MoFA	Ministry of Food and Agriculture
MM5	Meteorological Model version 5
NADMO	National Disaster Management Organization
NCAP	Netherlands Climate Assistance Programme
NGO	Non-governmental organization
NPC	National population commission
PCMDI	Program For Climate Model Diagnosis and Intercomparison
RUAF	Resource Centres on Urban Agriculture and Food Security
SARI	Savanna Agricultural Research Institute
START	global change SysTem for Analysis, Research, and Training
TaMA	Tamale Metropolitan Assembly
TMA	Tamale Metropolitan Authority
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPA	Urban and Peri-Urban Agriculture
UDS	University for Development Studies
WMO	World Meteorological Organization
WRI	World Resources Institute

Contents

Executive summary

This report presents the findings of a knowledge assessment on urban and peri-urban agriculture (UPA) for the city of Tamale, Ghana, that was conducted in 2012. It examines the state of UPA in the city through the lens of intensifying urban pressures and increasing climate risks with the objective of identifying how these and other drivers potentially interact to affect the long-term sustainability of UPA, and what response options are needed to address existing and emerging challenges. The assessment is intended to:

1) describe the dominant characteristics of urban and peri-urban agriculture, and identify key knowledge gaps in these UPA systems;
2) explore the array of stressors that contribute to vulnerability of UPA systems to climatic and other environmental changes; and
3) identify critical areas for strengthening policies and institutional capacities that contribute to sustaining the UPA sector within the larger context of resilient cities and food systems.

The city of Tamale, an important urban hub in the semi-arid savanna region of northern Ghana, is experiencing rapid expansion resulting from internal population growth and in-migration from surrounding rural areas as well as from neighbouring regions. The resulting urban sprawl is encroaching on land used for agriculture, which is a dominant livelihoods source in peri-urban areas of Tamale.

Urban pressures on the peri-urban landscape are being further aggravated by increased land insecurity driven by changes in the traditional land distribution system of the indigenous people of Tamale (the Dagombas). Under this system, land is held in trust for the people by chiefs and distributed to family heads who in turn distribute it among individual family members. In recent times, the high demand for land for more lucrative ventures other than agriculture has enticed chiefs to allot and sell lands previously given to family heads and individuals for farming purposes, to developers; this is usually done without consulting with farmers. Urban expansion into the valleys bottoms around Tamale is of particular concern as this is productive land for agriculture and these lands also play an important role in helping manage stormwater runoff from the city.

Enforcement of relevant laws and regulations that are meant to protect lands for agriculture is weak. Thus, there is a strong need for clarification of rules and regulations governing agricultural land use in urban and peri-urban areas, and greater coordination of the disparate departments and agencies of the Tamale Metropolitan Authority. There are currently no provisions for setting aside land for agriculture in the city's zoning plans, and following from that, no by-laws to protect agricultural zones from encroachment. There are unused public lands within Tamale that could be allocated for agriculture if authority to release those lands could be granted.

As agricultural land is becoming increasingly scarce and tenancy weaker in the face of urbanization, cereal cultivation has begun to be deemphasized in favour of market gardening within the city and its periphery. Similarly, livestock keeping is beginning to show signs of shifting from extensive towards more intensive practices, such as in the case of confined poultry production.

Supportive policies and measures are needed to facilitate such shifts, and to understand potential co-benefits in terms of reducing exposure to increasing climate risks. Actions would include access to training on improved technologies and techniques for vegetable and livestock production, and the establishment of micro-credit services for farmers. Moreover, such efforts require strengthening of intersectoral relationships and coordination among the different institutions whose actions have an impact on UPA in Tamale. These include, in addition to farmer organizations, actors within the central government through the Ministry of Food and Agriculture, universities and research institutions (e.g., the University for Development Studies and the Savanna Agriculture Research Institute), the Tamale Metropolitan Assembly, the Town and Country Planning Department, the Lands Commission, the Metropolitan Agriculture Development Unit of MoFA, NGOs and local chiefs.

The urban agriculture sector in Tamale is also contending with challenges in accessing adequate or suitable water for crop production. In rainfed systems, the issue is untimely or inadequate rainfall while in irrigated vegetable production, contamination of surface waters (artificial ponds and small dams) from urban runoff is an important challenge. Planning and implementation strategies for the development of micro-catchment rainwater harvesting techniques, and the creation of more small reservoirs, shallow wells and water-conserving irrigation for crop production are also needed. This effort is underway and needs to be expanded.

Farmers engaged in urban and peri-urban agriculture face significant health risks associated with use of waste and wastewater for vegetable production. Urban wastewater management for re-use should be viewed as a link between sanitation, agriculture, and a proactive response to growing water scarcity challenges. However, such an approach requires the development of new designs for wastewater collection and treatment, as well as development of practices for safe wastewater handling. Related to this, the problem of urban solid waste holds significant potential to be addressed through conversion into high-quality organic fertilizer through mechanical composting and vermiculture. Incentives for private sector investment are needed in order to realize this potential. Regulations with provisions for strong enforcement need to be developed in the form of local by-laws that aim to reduce risks from various contaminants present in the wastewater and enhance environmental services of UPA associated with reduction of urban waste streams.

Climate change is likely to exacerbate vulnerabilities associated with increased marginalization of land and water resources for agriculture in and around Tamale. Strengthening adaptive capacities for UPA involves respect for accumulated local experience, enhanced access to new technologies and adequate financial resources, public health facilities, opportunities for education and training, existence of early warning systems, and strong and effective institutions. Support for research appropriate institutions into climate change and how it relates to urban and peri-urban agricultures, is in line with the Ghana Government's policy recognition of the importance of urban and peri-urban agriculture for the country's economy as embodied in the Medium Term Agriculture Sector Investment Plan (METASIP) 2011–2015.

1 Objectives and methods

As an assessment exercise, the work involved an interdisciplinary appraisal carried out with the primary intent of informing policy and raising awareness among the public, including farmer groups, on critical issues. Information for this assessment was derived from secondary sources that were supported by primary information gathering. The secondary sources consisted of scientific literature as well as unpublished unofficial documents (reports, policy statements, theses, etc.) which were compiled from libraries of the University for Development Studies (UDS) and the Savanna Agricultural Research Institute (SARI), the Northern Regional Library and Northern Regional Archives, the Tamale Metropolitan Authority, the Town and Country Planning Department, and from maps and remotely sensed images. Primary information was obtained through field work, which involved discussions with government and non-government officials for their views on critical issues related to the assessment objectives, rapid appraisal by questionnaire and group discussions with farmers located in urban, peri-urban and adjacent rural areas of Tamale.

The assessment's conceptual framework illustrates the key drivers and stressors, development factors and urban and peri-urban products and services. The assessment framework is presented in Figure 1.1.

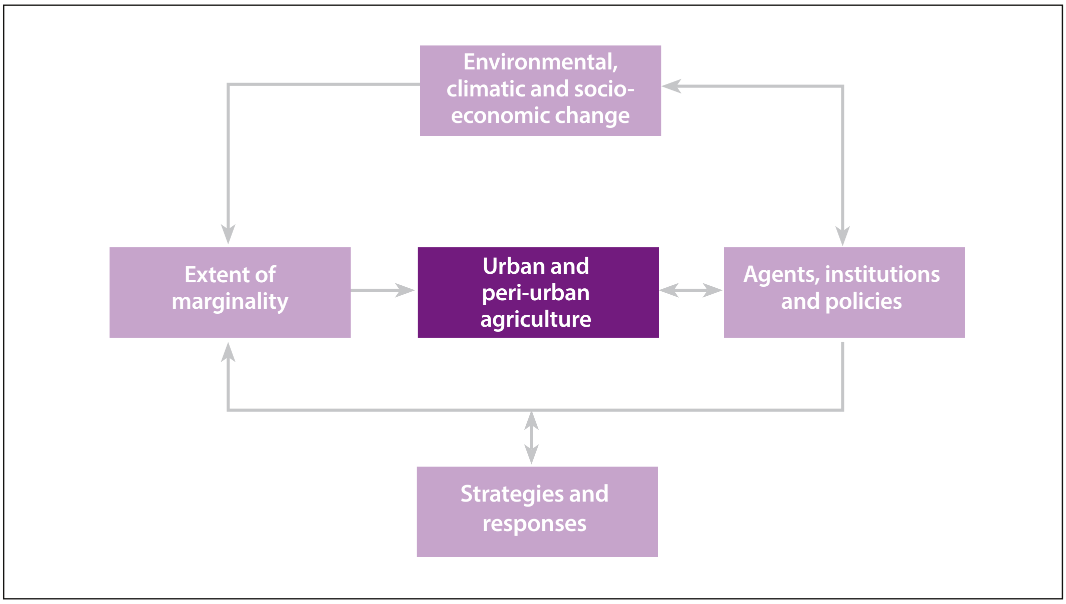


FIGURE 1.1
Conceptual framework

The objectives of this assessment are to:

- assemble and synthesize knowledge on agricultural activities in urban and peri-urban areas of Tamale, and provide scientifically credible information that supports policy planning and decision making at the city level;
- identify where insufficient knowledge exists and highlight where additional research and assessment efforts are needed; and
- strengthen capacity within the research community to undertake assessments, and foster networks of regional technical expertise, and to encourage stronger communities of practice engaged in the topic of urban food production and climate change.

2 Urban and peri-urban agriculture in Tamale

Overview of UPA in Tamale

Urban farming in Ghana gained in prominence during the 1972–1979 period when the then government, under the Operation Feed Yourself programme, encouraged farming in cities to supplement food production from rural areas. This edict was in response to food shortages occasioned by harsh economic conditions exacerbated by severe droughts in the country. Food production in cities was given increased recognition, and cities that had by-laws prohibiting the practice were ordered to relax those restrictions (Asomani-Boateng, 2002). The heightened interest in urban and peri-urban agriculture (UPA) declined when the long-term drought and ensuing economic difficulties subsided in the late 1980s.

In present times, UPA remains a significant contributor to the variety of foods found in urban markets. In Kumasi, 90 per cent of all lettuce and spring onions consumed are produced from open-space vegetable farming in the city and in Tamale and Accra, about 80 per cent and 10 per cent respectively of cabbage found on the markets are produced from the open-space farming in the cities (IWMI, 2002, as cited in MoFA, 2010). In Tamale, urban gardens have become important sources of food crops especially vegetables, and this activity provides supplementary sources of income for city dwellers (Abdul-Ghaniyu *et al*., 2002; Bediako *et al*., 2005). Urban farming provides employment and income for a chain of beneficiaries, such as farmers, market sellers, suppliers of agricultural input, etc., and, therefore, contributes to Tamale's urban economy (Obuobie *et al*., 2006).

UPA in Ghana involves the production of food crops (mainly vegetables) and raising of farm animals. Fruits and ornamental plants are also produced but in relatively small scale. In Ghana, UPA crop farming comprises of two forms: open-space production for the urban market, and backyard gardens cultivated mostly, but not only, for home consumption (Table 2.1).

TABLE 2.1
The two major categories of urban and peri-urban crop farming in Ghana

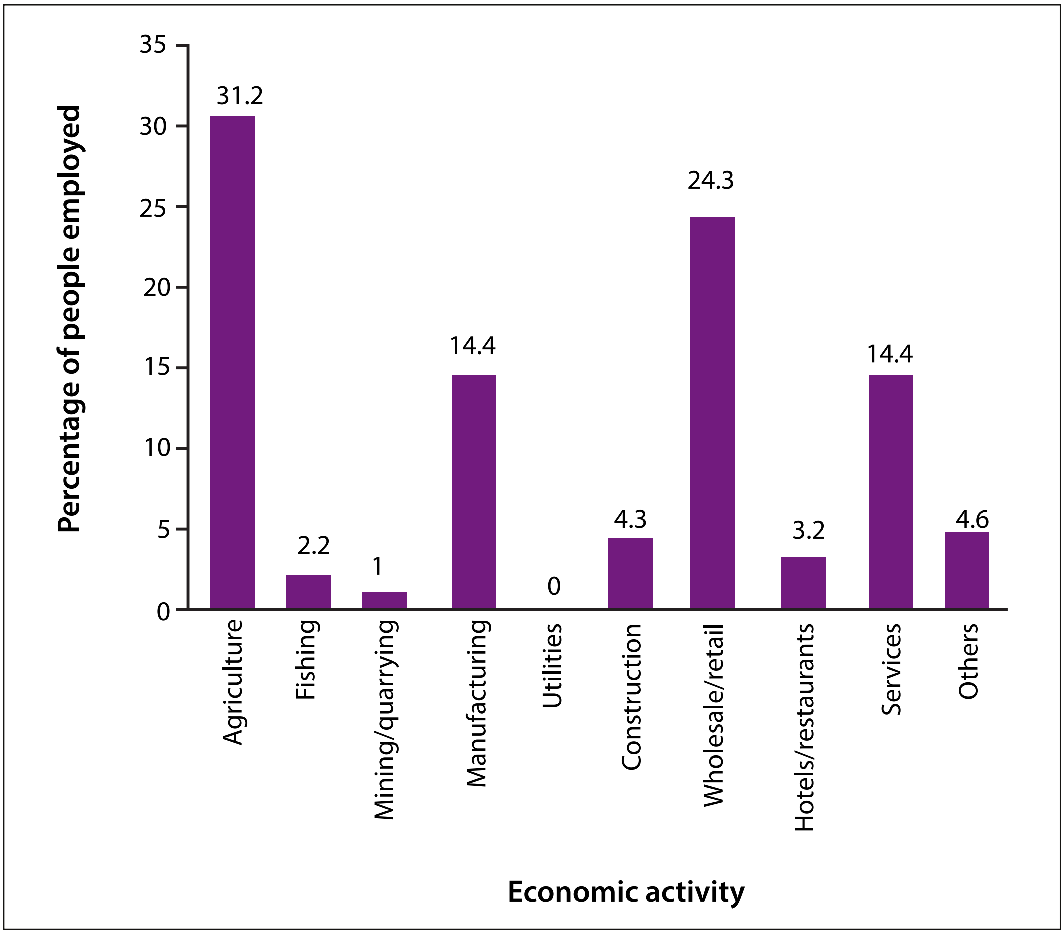
Farming systems	Urban areas	Peri-urban areas
Market production (cultivation on undeveloped urban land)	Irrigated vegetables (year-round or seasonal), flowers and ornamentals; rain-fed cereals	Irrigated vegetables (mostly seasonal), fruits; rain-fed cereals
Subsistence production (cultivation at the house)	Backyard or front yard farming	Home gardens; farming around homestead

Source: adapted from Obuabie *et al.*, 2006

Agriculture employs nearly one-third of the residents of metropolitan Tamale (Figure 2.1). Farming is the region's dominant occupation, although within Tamale, non-farming occupations such as through skilled employment in the informal and formal sectors predominate. The region's crop production is dominated by cereals (maize and sorghum), tubers (yam), groundnuts and pulses, while a vibrant vegetable production sector occurs in and around Tamale. Livestock are ubiquitous and poultry keeping is common in most households.

FIGURE 2.1
Distribution of metropolitan Tamale population by occupation

Source: Fuseini (forthcoming), based on Ghana Statistical Service data, 2005



The main UPA production systems in Tamale consist of vegetable production and marketing, livestock keeping (including poultry), cereal and legume production, and production of ornamental plants. A survey by Ayamga (2006) revealed that 64 per cent of urban and 70 per cent of peri-urban households in Tamale generate some portion of their income from agriculture. In urban Tamale households, yam is the largest contributor to household farm income (27 per cent of household income from the farm), with maize and groundnut contributing a total of 24 per cent. In peri-urban communities, income from maize and livestock (small ruminants) are the largest contributors to household farm earnings, with maize contributing 15 per cent of the household income. Livestock contributes up to 13 per cent of total household farm earnings in peri-urban communities.

The ability of UPA to sustainably contribute to livelihoods is becoming increasingly problematic, as the combined effects of urbanization, insecure tenancy, diminished land and water resources for UPA, and related stresses create significant challenges for the farming livelihoods in Tamale. Farming households visited in the course of this assessment indicated that agriculture now contributes less than half to their household income. In response, farmers are increasingly leaving agriculture for other occupations. According to the household survey, as many as half of respondents indicated that at least one member of their household had recently abandoned farming for other occupations, mostly for informal skilled employment and some for formal sector employment. A common sentiment expressed by farmers during focus group discussions was that parents now concentrate in giving their children formal education and informal skill training instead of traditional agriculture training, which they no longer view as rewarding. In-depth follow-up studies are needed to better understand how the diminution of agriculture affects household food and livelihood security.

Production of cereals and tubers/roots remains the priority of peri-urban and adjacent rural farmers for ensuring food security, since these crops constitute the staple crops for the local population. Most of the farmers (95 per cent) interviewed during the survey for all the three zones, i.e., core, peri-urban and rural areas, cultivate both staple crops (maize, cassava, rice) and vegetables. Cultivation of the staple crops requires large areas of land as compared to cultivation of vegetables; thus, cultivation of staple crops is greatest in adjacent rural areas and least in the urban core. The trend of increased cultivation of staple crops from the urban core to rural areas conforms to the distribution of farming households in the three zones, i.e., city core (20.8 per cent), the peri-urban (25 per cent) and the rural area (57.3 per cent). Access to wastewater and surface ponds for irrigation in the urban core, the scarcity of land and market opportunities are key reasons many farmers prefer to produce vegetables instead of cereals and tubers in the urban core. Results from the current field survey showed that vegetable production is the primary occupation for 72 per cent of farmers, and a secondary occupation for 28 per cent of the farmers in the urban core.

Despite the pressures of land resources on urban farming in Tamale, farmers who participated in focus group discussions described many opportunities that urbanization provided, including a ready market for agricultural produce, access to agricultural inputs, motivation for intensive agriculture (as a result of increased demand for food items), and the availability of garbage, sludge and other urban wastes as inputs for farming.

Characteristics of the urban and peri-urban producers

Gender

Both men and women participate in urban and peri-urban agriculture in Tamale; however, the sector is dominated by men. According to Shaibu (2002), out of 60 urban farmers surveyed in Tamale, 3.3 per cent were female and 96.7 per cent were male. One reason for this disparity may be that most of the undeveloped building plots are owned by men; however, cultural factors may also be at play. Obuobie *et al.*, (2006, citing Drechsel *et al.*, 2006) also indicated that men dominate open-space vegetable production in cities in Ghana, while marketing of produce is dominated by women. Adherence to traditional gender roles is an important factor in the male dominance of open-space vegetable production in urban and peri-urban areas.

Age distribution

Prior studies suggest that the majority of urban farmers in Tamale are within the age bracket of 20 to 40 years (Obuobie *et al.*, 2006) and 20 to 50 years (Shaibu, 2002; UrbANet, 2008; Al-Hassan, 2009). The survey carried out for this assessment found that the majority of farmers in the Tamale metropolis are below 30 years of age, which indicates that the youth and young adults are an important constituent.

Household size and marital status

Results from this assessment indicate that farming households in the Tamale metropolis have characteristics that are typical of northern households, being large with very high dependency ratios. The average household size among vegetable producers is 10, a figure higher than the average for the Northern Region, which is 6.1. Most of the urban farmers (85.2 per cent) are married.

Education level

From a survey conducted by Shaibu (2002), 45.9 per cent of the urban farmers were characterized as having low levels of formal education (i.e., primary school level), 44.3 per cent with no formal schooling, 8.2 per cent with formal education up to junior high school, and less than 2 per cent with secondary school education. A survey conducted by Abukari (2012) revealed that three-quarters of peri-urban farmers surveyed had no formal education.

Production characteristics

The majority of the farmers (70 per cent) use farmyard animal (including poultry) manure to enrich and condition soil on their farm. About 20 per cent use chemical fertilizer and only 10 per cent use their own prepared compost. Most farmers (58 per cent) use some form of pesticide for controlling pests on vegetables. Some (31 per cent) have no strategy for controlling pests on their farms, whilst a few (11 per cent) use organic means, including ash and extracts from neem seeds and leaves, as insecticides. Many farmers produce and use their own seeds. Most farmers (87 per cent) sell their produce at the farm gate and only a few (13 per cent) sell directly at the market. More commonly, buyers (mainly middle-women), go to the production sites to buy the produce for retail in the markets.

Crops, livestock and other production elements

Vegetables

The cultivation of vegetables in the Tamale metropolis is done individually and on a very small scale, because farmland in the city is scarce. In general, vegetable cultivation is restricted to open

spaces (especially on government lands), parcels around water bodies in backyards, and on private undeveloped building plots owned by individuals. This produce is harvested mainly for commercial purposes. A description of the land base for vegetable production is provided in Section 3.

The main vegetables cultivated in the core and peri-urban areas are tomato (*Lycopersicum esculentum*), pepper (*Capsicum*), cassava (*Manihot esculentum*), cabbage (*Brassica oleraceae*), "okra" (*Abelmoschus ssp*), "ayoyo" (*Corchorus spp*), kenaf and lettuce (*Latuca sativa*), "alefu" (*Amaranthus spp*), legumes and other local leafy vegetables, e.g., *Hibiscus sabdariffa* ('Bra'-Kenaf) (Shaibu, 2002). Pepper (*Capsicum annum*) and okra (*Abelmoschus esculentus*) are the vegetables mainly cultivated in the rural areas, mostly under rain-fed conditions. The percentage of farmers cultivating each crop is indicated in Table 2.2. Peri-urban farmers are reported to favour the cultivation of cereals either as a mono-crop or a mixture of cereals and tubers or legumes or vegetables. However, farmers who have access to sources of water for dry season farming grow only vegetables for sale as opposed to pursuing mixed farming.

TABLE 2.2
Types of crops grown by peri-urban farmers in Tamale

Crop	Frequency	Percentage (%)
Vegetables only	33	19.0
Cereals only	74	42.0
Tubers only	16	9.0
Legumes only	9	5.0
Mix 2 crops	41	23.0
Mix 3 crops	2	1.13
Mix 4 crops	1	0.6
Total	**176**	**100**

Source: Abukari, 2012

Whilst some of the vegetables are cultivated as both irrigated and rainfed crops, others are cultivated solely under rainfed conditions. The ones cultivated as both rainfed and irrigated crops are lettuce, kenaf, "ayoyo", "alefu" and cabbage. These are cultivated a number of times throughout the year. Other crops, including tomato, pepper and okro, are mainly cultivated under rainfed conditions and are, thus, grown once in a year. Pepper, for instance, is a succession crop planted after the harvesting of maize (Shaibu, 2002).

TABLE 2.3
Percentage of farmers cultivating various vegetable crops in Tamale

Crop	Farmers producing crop (%)
Ayoyo (*Corchorus Spp*)	48.0
Alefu (*Amaranthus spp*)	38.4
Bra (*Hibiscus sabdariffa*)	36.8
Pepper (Capsicum spp)	28.8
Cabbage (*Brassica oleraceae*)	27.2
Lettuce (*Latuca sativa*)	20.8
Okro (*Abelmochus spp*)	11.2
Tomato (*Lycopersicum esculentum*)	3.2

Source: Shaibu, 2002

The main vegetable production sites in the metropolis (Obuobie *et al.*, 2006) are:

- *Builpiela*, which is located to the south of Tamale, about 2 km from the centre of the city. Builpiela's prominence in vegetable production in Tamale is due to the year-round availability of water from a dam constructed in 1960 to supply water for domestic use, livestock and vegetable cultivation. Also the floodplains to the valley in which the dam is located provide ready land for the farmers since it cannot be used for building purposes.
- *Sangani*, which is located to the northeast of Tamale, about 2 km from the centre of the metropolis and like Builpiela, Sangani also contributes greatly to vegetable production in the metropolis. Farmers use water from surface ponds, which are available year-round. Though located in the urban core, vegetable farmers in Sangani whose lands are close to the water sources do not experience encroachment as elsewhere in the city. This is because the chief of the area supports the farmers by preventing encroachment on their land.
- *Water Works*, which is located in a suburb of Tamale called Gumbihini, is so named because of the existence of a dam that was built originally to provide pipe-borne water for Tamale. The dam is no longer used for domestic water provisioning, thus giving the residents of the area around the dam the opportunity to use the water for irrigated vegetable production.
- *Zagyuri*, which is located about 8 km north of Tamale on the Tamale-Savelugu road. It is opposite Kamina Barracks and farmers use untreated sewage water for vegetable production.

In addition to these main sites, other minor sites include Sakasaka, Kalpohini, Gumani and Ward K.

A major obstacle confronting agriculture in Tamale, as in the rest of Ghana, is the issue of guaranteeing a ready market for farm produce, especially for vegetables. The period between harvesting and the consumption of vegetables is very short, requiring a ready and efficient means of getting the produce to the consumer immediately after harvest. Limited storage infrastructure makes it difficult to store vegetables for long periods without incurring high post-harvest losses. Even though the quantity of vegetables produced and supplied at peak harvest periods is less than the quantity sold at the markets, farmers still receive very low prices due to the surplus that occurs as a result of overproduction and the restrictions that hinder direct engagement between farmer and consumers.

Cereals and legumes

The main cereals and legumes cultivated in peri-urban Tamale are maize, sorghum, rice and cowpea, which are cultivated under rain-fed conditions, and as either mixed or sole crops. The mixed relay cropping system of maize and rice occurs in valleys, with maize planted first to take advantage of the early rains, while the rice is planted later in the rainy season. In such a system maize is planted on ridges, whilst rice is planted in the furrows. The maize is harvested before the valley floods to enable the rice to take advantage of the excess water. Rice is cultivated as a sole crop in water-logged areas. Maize and sorghum are also sometimes grown in a mixed-relay arrangement. The maize is planted first, followed by sorghum so that after maize is harvested sorghum can take over. The peri-urban areas where cereals predominate include Fuo, Nyohini, Lamashegu, Kanvili, Shishegu and Kakpayili. As part of institutional visits organized in connection with this assessment, officials from the Metropolitan Agriculture Development Unit (MADU) noted that farmers in the peri-urban and adjacent rural areas are increasingly relocating their farms to valley bottoms to avoid crop losses due to reduced moisture and prolonged dry spells in the rainy season. These adverse weather conditions and others have compelled farmers to switch to the use of short duration crop varieties (e.g., jasmine rice) and hybrid crops. However, these areas are under urban development pressures, as described in Section 3.

Ornamentals

Ornamental horticulture has been practiced in the Tamale area for a long time. In fact, the indigenous people (the Dagombas) have a culture of planting at least one shady or edible fruit producing tree in front of their home. Places noted for the production of ornamental plants for commercial purposes are the Department of Parks and Gardens closer to Water Works, Forestry Services Division and Taimako Plants and Herbal Medicine Centre. Popular ornamental plants that are raised by these organizations include *Cassia siamea*, *Polyalthia longifolia, Duranta spp* and croton plant. In addition to the ornamental plants, these organizations produce fruit tree seedlings (e.g., grafted mango and guava) for sale to the public. There are a number of individually owned ornamental gardens dotted across the city. While some are kept for commercial purposes, others such as Ussif Gardens at Nyohini, Nba Alhassan Nursery at Gumbihini and Abass Nursery at Nalongfong are maintained for medicinal and aesthetic purposes.

Many sacred groves (forests preserved for local socio-cultural and religious purposes) are also found in the metropolis. These are usually small (0.2–1.0 acre) pockets of residual forest that are protected based on the religious beliefs of the indigenous people—the Dagombas (Dorm-Adzobu *et al.,* 1991). Before the advent of both the Christian and Islam religions, the Dagombas were mostly traditionalists. Their culture was deeply enshrined in their customs and beliefs. The sacred groves are therefore relics of shrines for clans and villages that have been engulfed by the sprawling city.

Livestock

Most of the population engaged in agriculture in the metropolis rear livestock, mostly on a small scale. Cattle, goats, sheep and poultry are the important elements of the livestock subsector of agriculture in the city. In terms of numbers, poultry account for the largest livestock sub-sector followed by goats, sheep, cattle and pigs respectively (Figure 2.2) (UNDP, 2010). Almost all the livestock, including

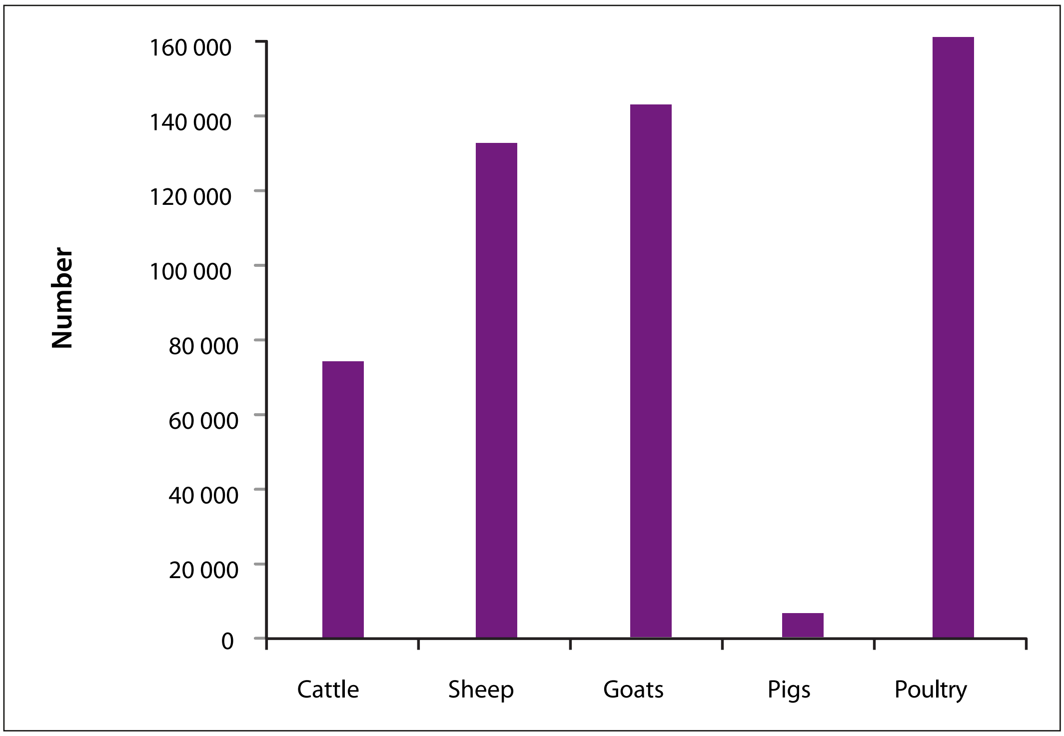


FIGURE 2.2
Comparative livestock for Tamale metropolis (2005)

Source: UNDP, 2010

poultry, are kept under extensive management systems where they are left to roam, especially after the cultivation season when there is little supplementary feeding. During the cultivation season, tethered animals are fed with groundnut vines and grass clippings as supplementary feed.

Recently, pigs have been integrated, often intensively, into the livestock industry for commercial purposes. The relatively low number of pigs reflects the religious composition of Tamale's population, where over 80 per cent are Muslims. In addition, Abukari (forthcoming) describes a new opportunity in livestock related to the purchase and fattening of young bulls before they are sent down to southern Ghana for sale. The young bulls (including calves) are fed with household (kitchen) waste and crop residue such as groundnut vines, soya beans, pigeon pea pods and cassava peelings.

Crop and animal integration is increasingly gaining prominence, especially in the peri-urban and urban areas of the metropolis in response to space and input constraints. In this case, kraals used for housing livestock provide an important source of manure for UPA crop production. For example, in the Aboabu area in the urban core, a few farmers keep some sheep under intensive management. The Metropolitan Agriculture Development Unit (MADU) view the crop-animal integration as a coping strategy for the effects of urbanization and other stresses. Other coping strategies that MADU help farmers to adopt are intensive livestock rearing, growing of fodder to feed livestock, adoption of hybrid/resistant animal species and regular vaccination of livestock to avoid outbreak of diseases that spread rapidly under adverse weather conditions. Poultry keeping is generally done on a small-scale basis, though there are a few commercial poultry operations. Aquaculture is a minor component of urban food production in Tamale. Fish ponds have begun to be established in the areas of Kamina Barracks, Kanvili and Dungu for the production of tilapia.

3 Institutions and policies influencing UPA

Institutions involved in UPA in Tamale

The Ministry of Food and Agriculture (MoFA) remains the primary source of improved farming technology in both urban and peri-urban communities. In the Tamale metropolis, many institutions—both governmental and non-governmental—have a stake in UPA. This includes farmer groups, research and academic institutions, and government and non-governmental agencies that play various roles in influencing the practice of UPA in Tamale (Table 3.1). Agriculture practiced within the urban boundaries has quite limited external support systems, especially extension services.

TABLE 3.1
Institutions involved in UPA in Tamale

Categories	Institutions	Role/function
Farmer Associations/ Groups	1. Northern Poultry Farmers Association 2. Livestock Farmers Association 3. Vegetable Farmers Association	Advocacy for subsidies on input, liaison between farmers and other agencies (Government and NGO), securing group credit for members and negotiating prices of produce.
Research/ Academic Institutions	1. University for Development Studies 2. Savanna Agricultural Research Institute 3. Animal Research Institute 4. Water Research Institute	Research in areas such as improved seeds, fertilizer trials, animal health and soil improvement.
Government Agencies	1. Ministry of Food and Agriculture 2. Town and Country Planning 3. Environmental Protection Agency 4. Department of Parks & Gardens	Administration and enforcement of legislations and by-laws, provision of extension services, city planning and beautification.
Non-Governmental Organizations	1. ActionAid Ghana 2. CARE International, Ghana 3. Center for Active Learning & Integrated Development 4. Community Action for Development 5. Community Action Programme for Development 6. Maata-N-Tudu 7. Sustainable Agricultural and Rural Development 8. World Vision Ghana	Advocacy for UPA, provision of credit and agricultural inputs, formation of farmer groups and provision of infrastructure like boreholes, dams and dugouts.

Source: Adapted from UrbANet, 2008

The policy landscape for UPA in Tamale

National, regional and municipal policy frameworks in Ghana provide several potential entry points for promoting greater sustainability of UPA. However, the policy landscape for UPA also suffers from a lack of coherency between different policy bodies and government units resulting in, among other adverse effects, diminished land-tenure security for farmers in peri-urban Tamale.

The Food and Agricultural Sector Development Policy (FASDEP II) constitutes the current policy framework governing the agricultural sector of the economy, including the sub-sectors of crop and livestock development, fisheries, service delivery, irrigation development, plant protection, agricultural mechanization, access to agricultural inputs, human resource development, youth in agriculture, gender mainstreaming and improved financial services (MoFA, 2009). Some elements of the FASDEP II framework relate specifically to UPA and enjoin urban and peri-urban farmers to take advantage of sub-sector policies, which include strategies for the development of food commodities.

The Medium Term Agriculture Sector Investment Plan (METASIP) 2011–2015 (MoFA, 2010) has the component 2.6: Increased Growth in Incomes devoted to urban and peri-urban agriculture. This explains that intensive market-oriented urban farming in open spaces is taking place year-round in Ghana's three main cities, Accra, Kumasi and Tamale. It recognizes the numerous benefits of urban and peri-urban agriculture to the Ghanaian economy and acknowledges that production is often associated with health risks, hence a need for regulatory restrictions on farming with regard to the use of pesticides and polluted water for irrigation.

Section 51–sub-section 3 of the Local Government Act 426 (1993) permits urban farming activities but with prior permit from the district/municipal/metropolitan assemblies. All farming activities (small-scale vegetable and flower gardening excluded) within the Tamale metropolis are illegal, unless permission has been granted by the metropolitan authorities, including the metropolitan officer of health. Part of this permission-granting process is to ensure the maintenance of good sanitation in the city. The Tamale Metropolitan Assembly has no by-laws regulating the cultivation of open spaces in the city, but extensive systems of rearing livestock (cattle, sheep and goats) in the urban and peri-urban areas is prohibited. Offenders whose animals are captured by the metropolitan authorities are required to pay a fee before the animals are released back to them.

City authorities would be better placed to grant permission for agriculture within the metropolis if a well-outlined spatial land-use framework was in place, one that integrated agriculture as a legitimate land use. In discussion with the Tamale Metropolitan Assembly during the assessment, the following positions on urban agriculture were taken:

- Agriculture is acceptable within the metropolis, but should be incorporated into the planning process.
- For regulatory matters (including legal restrictions), the assembly is totally dependent on the Local Government Act. The assembly by-laws do not currently address urban and peri-urban agriculture, even though location or community-specific regulations are needed for the metropolis.
- There are no provisions for agriculture in the zoning plans of Tamale. Should such provisions eventually be included, by-laws will be needed to protect agricultural zones from encroachment.
- There are derelict public lands within Tamale for which short- to medium-term licenses could be granted for agriculture. The assembly has indicated it could initiate negotiations with traditional authorities for release of such land—steps should be taken to do so.

4 Influence of urban growth on UPA in Tamale

Urban growth in Tamale

Tamale is among the fastest-growing cities in Ghana with an annual growth rate of 3.3 per cent. The city expanded from a village of about 1 500 inhabitants in 1907 to its present (2012) status of a metropolis of 444 000 people (Staniland, 1975; Braimoh and Vlek, 2004; Ghana Statistical Service, 2005; TaMA, 2012; Unpublished records of the Tamale Metropolitan Area). A major increase in the growth of Tamale occurred from the 1970s to the 1980s, ranking it the third-largest city in the country by 1984 and outstripping the position held by Sekondi-Takoradi in 1970 (Songsore, 2009). This expansion was spurred on by the large-scale rice cultivation in its catchment area, which made Tamale a centre for agro-processing with the provision of vital services to the rice industry. The development in rice cultivation ended abruptly in the early 1980s with the onset of a revolution of sorts that occurred in 1981, where the emerging capitalist rice producers was driven into exile and agricultural equipment were partially destroyed. Rice production in the catchment area experienced further decline after the removal of agricultural input subsidies in 1983 with the adoption of the Structural Adjustment Programme imposed by the IMF.

Around 1945, two years before Tamale was declared the administrative capital of the then Northern Territories of Ghana, the radius of Tamale reportedly measured less than 1 kilometre. Currently, the official spatial demarcation of Tamale shows that the metropolis has expanded to 922 km^2. Due to its relative flatness, the city is growing radially (Figure 4.1a). Under the assumption that the 3.3 per cent annual growth rate prevails for the next several decades, the metropolis's population would double by 2021 compared with 2000, and in 2050 would be about 1.5 million people. Assuming the rate of development is uniform throughout and all land parcels are suitable for development, projections done by the assessment team for 2024 estimate that nearly all the land between villages in the peri-urban zone will have been converted from agriculture to urban land uses (Figure 4.2).

Villages that were separate from the city in the late 1980s, i.e., Choggu to the north, Nyohini to the west, Lamashegu to south and Kukuo to the east, are now part of the core of Tamale. Based on an analysis of 1973 Landsat images, the land between these villages and the city was used mainly for farming. By 1989, 16 years later, housing developments had expanded to reach these villages and were integrated into the city. By 2005, developments had grown denser within the area of these villages and extended to distant villages. Expansion occurred to the north (Gbalo, Jisonayili and Kanvili), to the south (Dungu, Dabokpa and Vittin), to the west (Sheshegu, Kunyevila and Dumale) and to the east (Fuo and Taha-Kpawumo).

FIGURE 4.1a
The expansion of Tamale between 1989 and 2005

Source: Satellite image classification (Survey of Ghana)

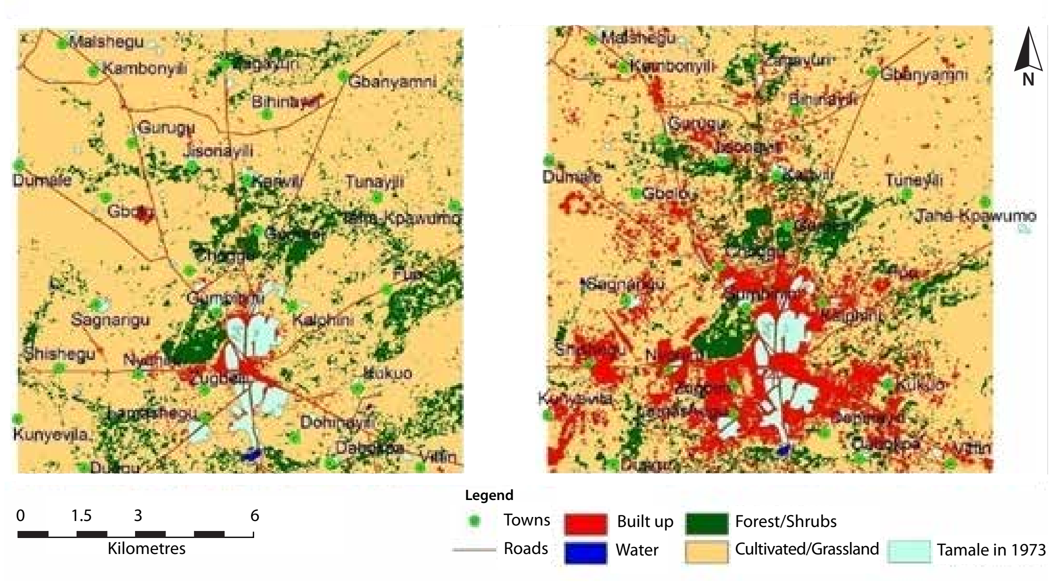
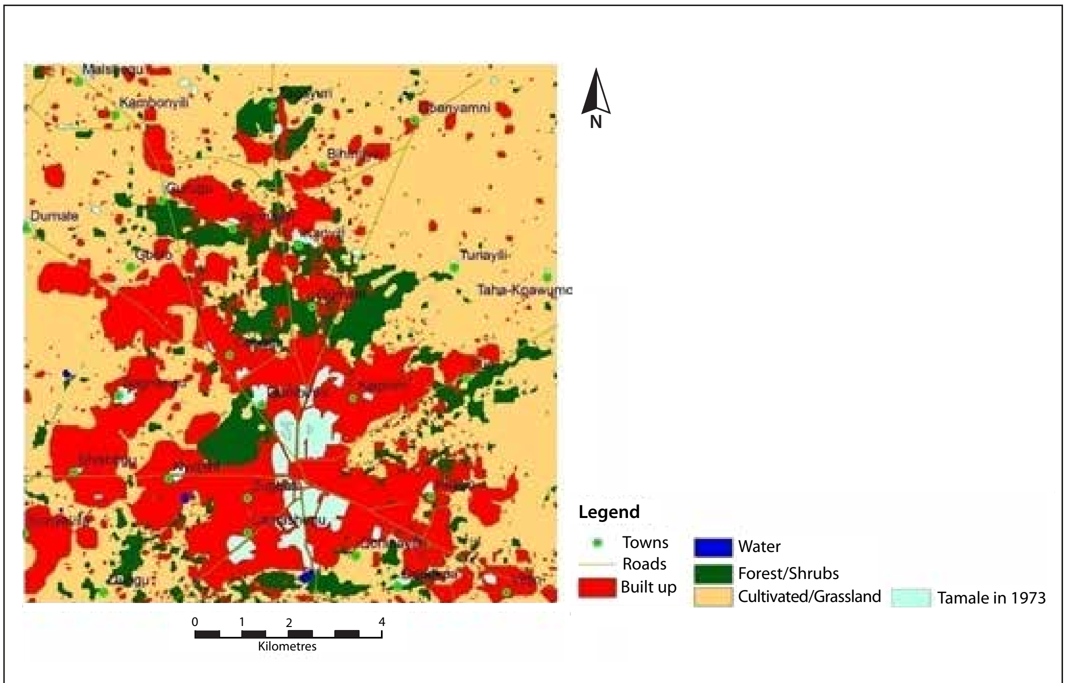


FIGURE 4.1b
Tamale: projection for 2024

Source: Satellite image classification (Survey of Ghana)



Zonation of Tamale

Using the official administrative map as the geographic baseline (Figure 4.2a), the assessment team modified the city's zonation using recent satellite imagery of the TaMA, traversing through the city along the trunk roads (Kumasi-Tamale; Yendi-Tamale-Bolgatanga; Tamale-Nyankpala) and their branches, and making ground observations along those routes and their branches based on the following parameters: housing density, traffic volume, frequency of farms and openness of the landscape. A total of more than 726 km² was delineated in the modified map and differs from the official zonation of about 922 km².

This exercise resulted in demarcation of the city into the following three sectors (Figure 4.2b):

- *City core*: Approximately 25 km² of built-up area extending up to about 3 km from the central market, which marks the most central point of the city.
- *Peri-urban area*: Approximately 168 km² area that extends up to 7 km beyond the boundary of the core area.
- *Rural area*: Over 535 km² area of the rural outlier located beyond the boundary of the urban periphery.

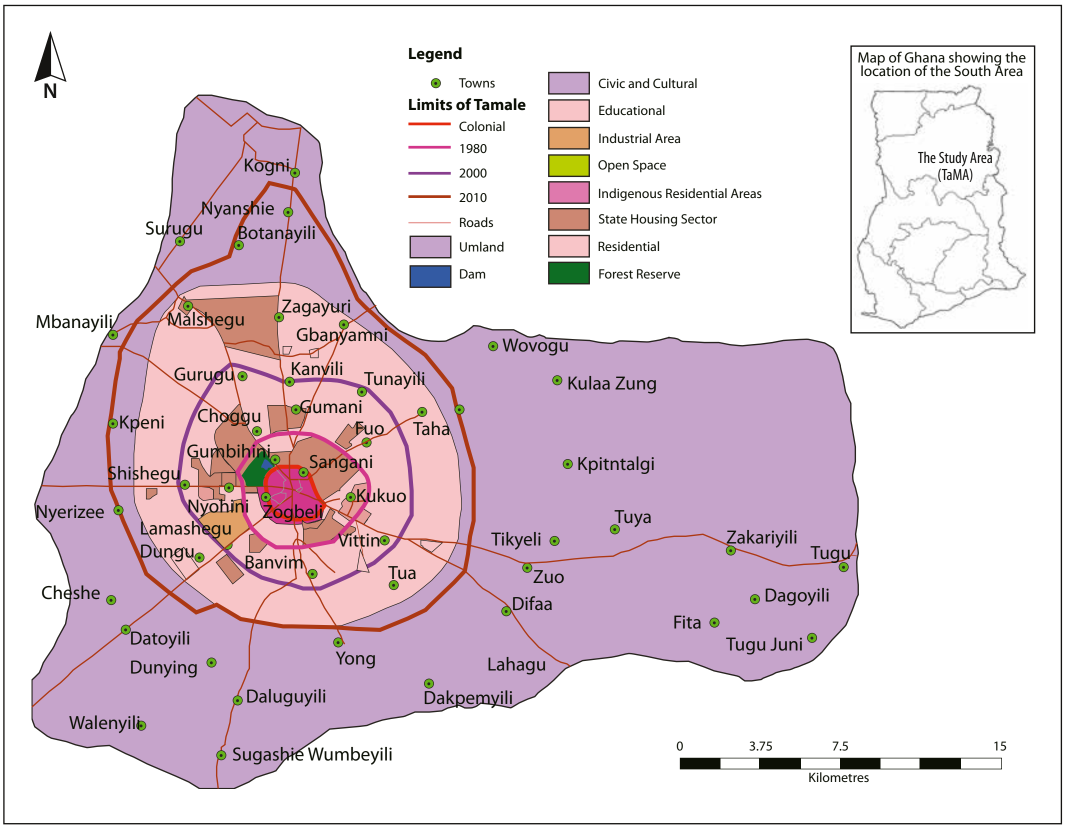
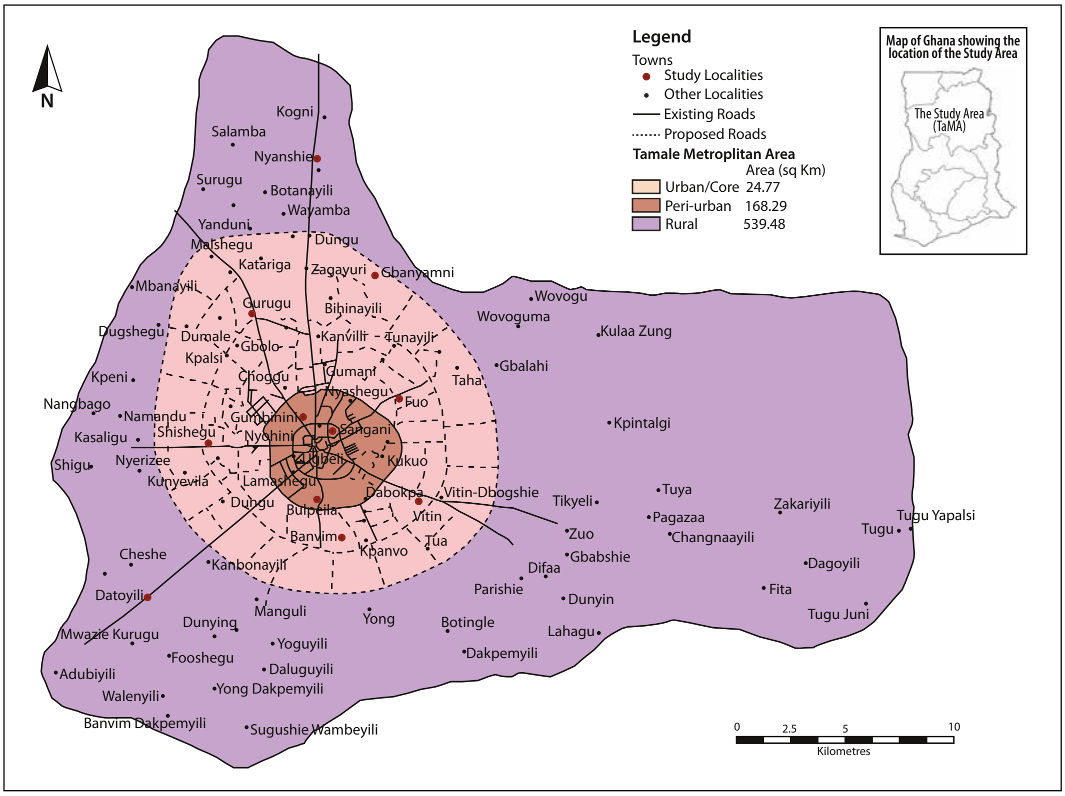


FIGURE 4.2a
The official map of Tamale metropolitan area

Source: Town and Country Planning Department, Tamale

FIGURE 4.2b
Modified map of Tamale metropolitan area
The dots represent the assessment field sites
Source: Field appraisal, 2012



Land resources for UPA in Tamale

The land-tenure system in Tamale is changing from customary to legal title ownership resulting in land tenancy becoming less secure. Farming can be stopped at any time if the traditional leader designates an alternative use for the land. In the past, land allocation was heavily tilted towards farming and indigenous residential development. The market involves speculative land sales in the wake of the rising land values, a situation which, as a rule, does not favour agriculture, especially by the poorer farmers who lack secure land tenure and whom urbanization often marginalizes (Ubink, 2006; Yaro, 2010).

Under this new dispensation, the sale of land in Tamale is done by the chiefs who keep a significant portion of the proceeds of land sales. The chiefs have the right to dispose of the land for any purpose without consulting existing land users. Although some parcels within the official land-use planning regulations are earmarked for agriculture, some chiefs sell the land to prospective developers without reference to the required legal provisions to apply for change of use. Almost all the land within a 15 km radius of the city centre, and in some cases beyond, has been acquired or allotted by chiefs for developmental projects other than agriculture. During one of the stakeholder workshops hosted in Tamale for this assessment, a representative of the Town and Country Planning Department expressed the concern that the schemes they design to provide for agriculture are not being enforced by the Metropolitan Assembly. Such lack of enforcement perpetuates agriculture's disadvantage in the face of rapid urban development pressures. In this assessment, farming households indicated that nearly two-thirds of them acquire land for farming through traditional family/kinship arrangements while almost one-third acquire land through sharecropping. The high reliance by farming households on these arrangements increases their susceptibility to being displaced by other more economically lucrative uses of the land.

With increasing loss of farmland due to expanding industrial development, infrastructure and housing, farmers are compelled to move away from their own cleared lands and family farmlands to other tenancy forms. During the survey, farmers in the core and peri-urban areas whose lands have already been taken away from them indicated that they are relocating to more distant communities to farm. Farmers of large tracts of land who bush fallow have to migrate seasonally to distant farming communities. Others do not migrate, but commute daily between the city and their distant farms. This is, however, very expensive given the large investments required for land preparation, transportation and labour acquisition.

Due to the acquisition of land for non-agricultural purposes, those who farm within the city core do so increasingly on government lands and in open spaces. Some of these farmers practice backyard farming for subsistence, while others are commercial vegetable producers. Urbanization, however, provides opportunities to move from traditional occupations, such as farming, to new ones, such as trading. For others, intensive livestock rearing is considered most viable, especially poultry farming and rearing of pigs and small ruminants. Few respondents considered relocation into distant rural areas as a viable option for continuing traditional practices.

The undulating landscape in peri-urban Tamale includes many valley bottoms that contain good soil for rice, maize and vegetable production, and the ephemeral streams in the valley bottoms are important for peri-urban livestock keepers. In addition, these valleys play a critical role in stormwater management for Tamale because they carry stormwater runoff away from the city. The destruction of these streams, either through building structures on them or poor farming practices in the stream channel is diminishing the potential of the valleys both for food production and for regulating stormwater management. Urban encroachment pressures in these valleys have increased in recent years, especially in the northeast part of the city (Gurigubaani off the Tamale-Kumbungu road, Vittin-Barrier off the Tamale-Salaga road, Kasalgubaani off the Tamale-Nyankpala road and Kobilmahagu).

Small farm size is also a concern. Based on the Shaibu (2002) field survey, the mean size of farm plots is about half an acre with more than half (53 per cent) of respondents farming on half an acre or less. In some instances, farmers own more than an acre of land, but rarely cultivate all of it. The average land sizes for the cultivation of the crops, based on Shaibu (2002), are presented in Table 4.1. In farmer surveys associated with this assessment, it was revealed that about half of the farmers cultivated less than 1 acre of land and only 1 per cent had sizable allocations of land, those greater than 5 acres.

TABLE 4.1
Average land sizes for vegetable crops

Crop	Average land size (acres)
Tomato	0.25
Pepper	0.15
Cabbage	0.10
Okra	0.27
Ayoyo	0.05
Kehaf	0.01
Lettuce	0.07
Maize	0.25

Source: Shaibu, 2002

Urbanization and impacts on the community

The native Dagbon people of Tamale are still dominant, although the population is becoming more diverse as people migrate into the city from within and outside of Ghana (Ghana Statistical Service, 2005). Moreover, due to the relative peace in Tamale, people from nearby conflict-prone towns of Bawku, Yendi and Gushiegu are increasingly settling there. Development patterns for housing are changing in Tamale from the traditional compound housing system that can hold a large number of households to self-contained dwellings (UN-Habitat, 2009). This more individualistic type of housing development has negative implications for the availability of agricultural land, as more land in the periphery is likely to be converted for housing. The assessment team observed during its field visits that lands about 15 km away from the town centre along the major routes have been acquired for development and signposts of property owners have been erected on those properties.

Tamale's physical growth was also confirmed by residents during the field survey carried out for this assessment. Indicators that respondents used to confirm the expansion included increased road networks, the presence of people of diverse ethnic background in their communities, improved social amenities, provision of services which were previously non-existent in their communities such as transportation, the felling of trees for construction and limited availability of land for farming, especially in the core zone. They also added that, in the past, one was afraid to walk alone to town, but now bushes have been cleared and houses constructed along the routes. A respondent from Vittin, a community in peri-urban Tamale, explained that in the past "*anybody from where I come from will say I am from Vittin, a village near Tamale, but now I will confidently say I come from Tamale, because it is difficult to separate Vittin from Tamale.*" Due to urbanization, these distant villages are now considered to be within peri-urban Tamale.

The expansive growth of Tamale also brings benefits. Those benefits, as identified during the focus group discussions and corroborated by the household surveys, included the availability of modern means of communication, more schools, readily available markets, increased health facilities, access to transport, more stores, available electricity, credits, women empowerment, availability of building materials, availability of fuel, access to fertilizer, more houses and increase in commercial activities (Figure 4.3).

Residents, however, also considered the negative effects of the expansion and urbanization of Tamale to include land scarcity and deterioration of soil fertility, lack of firewood, shortage of water, lack of grazing land for animals, food shortages, loss of the economically important *shea* and *dawadawa* trees and livelihoods associated with their processing, waste management problems, out-migration, rampant road accidents, extinction of medicinal plants, high cost of education, high prices of goods and services, loss of traditional values and negative influence of Western cultures among youth (Figure 4.4).

Water resources and UPA

The Tamale metropolis is poorly endowed with groundwater resources. The aquifers are mainly sandstone, shale and mudstone. The drilling success rate is quite low and the yields of wells and boreholes are generally poor (Abdul-Ghaniyu *et al*., 2002). As a result, the population relies mainly on surface water for domestic, industrial and agricultural use.

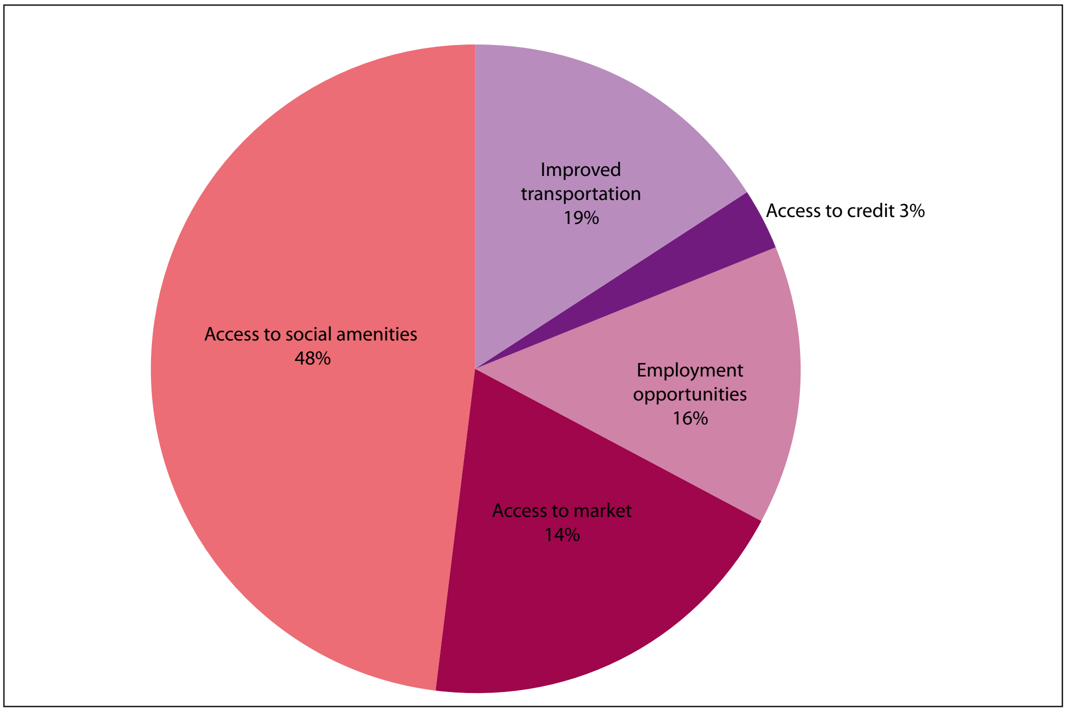


FIGURE 4.3
Benefits of Tamale's growth/urbanization (multiple choice responses), by frequency of response

Source: Field appraisal by the assessment team in 2012

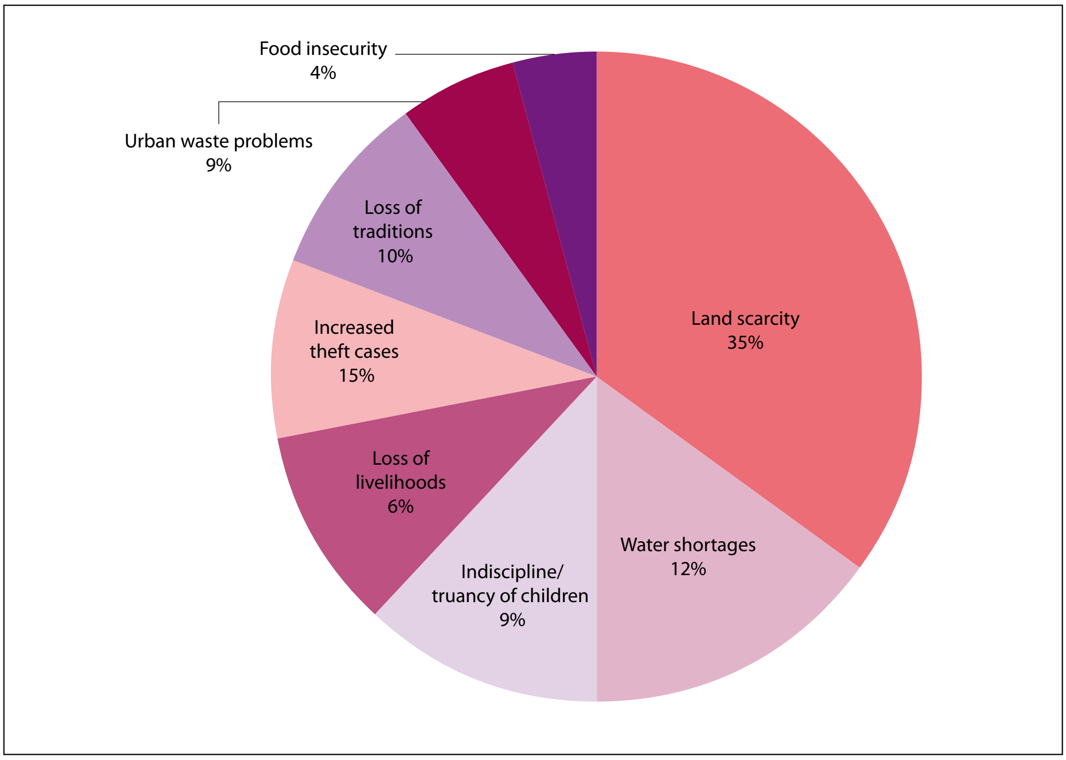


FIGURE 4.4
Adverse effects of Tamale growth/urbanization (multiple choice responses), by frequency of response

Source: Field appraisal by the assessment team in 2012

The Nawuni River, also known as the White Volta, a tributary of Ghana's major freshwater body Lake Volta, is the primary source of drinking water in the Tamale metropolis. However, this source of water is threatened by siltation as a result of sand harvesting along the riverbanks. The shallow riverbed in turn heightens the risk of increased flooding during the rainy season. Water-borne guinea worm disease, which was common in the region in the late 1980s and 1990s due to a general lack of clean drinking water, has now been almost eradicated owing to educational campaigns and the extension of pipe-borne water to many parts of the city. Even though as many as 79 per cent of the residents have access to pipe-borne water, 46 per cent of that group do not have pipes going directly into their homes. The ever-increasing population in the city has made it difficult for the Ghana Water Company Limited to supply water to the entire city at all times. Water is therefore rationed to different sections, mostly on a weekly basis.

Alternative water bodies are few and ephemeral, usually lasting only for the duration of the rainy season. Notable among these streams are the Pasam, Dirm-Nyogni and Kwaha. Water sources for crop production consist of wastewater, micro-dams, shallow wells and small reservoirs (Obuobie *et al.*, 2006). Artificial dams (e.g., the Builpela and Lamashegu) and small ponds have been constructed by some communities to store water for both humans and livestock, but these dry up after the rainy season (Abdul-Ghaniyu, 2002). There are about 91 micro-dams dotted around communities within the Tamale metropolis. However, with increasing urbanization, these sources of water are polluted with runoff water that carries indiscriminately disposed waste and human excreta. The high incidence of open defecation due to lack of toilet facilities in many homes (35 per cent) (NPC, 2006) contributes significantly to the contamination of these surface water bodies. This increases the cost of treatment of water for domestic and industrial uses.

The higher water demand for domestic and industrial purposes with increasing urbanization limits access to water for agricultural purposes. According to respondents in the field survey, the situation for farmers has worsened in recent years as they experience extreme and erratic weather conditions such as floods, droughts, reduced rainfall, shortened rainy season, windstorms and changing pattern of the *harmattan*. These conditions have led to shortage of water, crop failure and disease intensity and rapid spread.

According to Zibrilla and Salifu (2004), approximately 52 per cent of irrigation schemes use wastewater; however, this is in sharp contrast to the findings in this assessment, which is 1 per cent. Shallow wells offer better quality water for irrigation, but as they dry up in the long dry season, it limits the ability of farmers to grow crops year-round. With increasingly scarce water due to increased non-agricultural demand, farmers may increasingly rely on wastewater sources for intensive vegetable production. At present, significant amounts of water are wasted due to improper handling and lack of planning. The main drainage system passing though Tamale is not complete, thus causing floods in some residential areas, as well as flooded cultivated fields during peak flows. Completion of drainage works, as well as expansion of the wastewater treatment plants, would provide additional water sources for agriculture and reduce pressure on dams, dugouts and wells that are presently used for drinking, livestock and irrigation purposes.

Health risks associated with waste and wastewater use

Farmers engaged in urban and peri-urban agriculture face significant health risks associated with use of waste and wastewater for crop production. The main crops cultivated using wastewater in Tamale are leafy vegetables, mainly cabbage, and some local vegetables (e.g., *Corchorus spp*), while fecal material is used to fertilize cereal fields. Surveys carried out in 2007 and 2008 show that over 80 per cent of the UPA farmers do not use any form of protective clothing when engaging in farming activities, even when these include handling of wastewater and waste (Asenso, 2007; Norvinyeku, 2007; Ansu, 2007; Kennedy, 2008). In addition, 50 per cent of urban farmers interviewed during 2008 surveys admitted that they use children to help with wastewater irrigation of vegetables (Kennedy, 2008), which poses heightened levels of risk. Farmers also face health risks associated with the application of agrochemicals for crop protection predominantly without protective clothing, and with very poor knowledge of appropriate use of the pesticides (Northern Presbyterian Agricultural Services, 2012). A recent study (Abdul-Ghanyu *et al*., 2011) indicates a high incidence of skin and gastro-intestinal diseases associated with wastewater use for agriculture in Tamale (Table 4.2).

TABLE 4.2
Disease incidences associated with wastewater application

Observed problems/disease incidence	Respondents (%)
Foot rot	47
Diarrhoea	17
Skin sores	13
Nausea	10
No problems observed	13

Source: Abdul-Ghanyu *et al.*, 2011

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One tangible benefit of UPA for Tamale could be its potential to reduce the urban waste stream through the conversion of urban waste into high-quality organic fertilizer with mechanical composting and vermiculture. Recent research efforts have been oriented towards processing fecal sludge into compost, reducing risks in handling wastewater (Kranjac-Berisavljevic *et al*., 2009; Abaidoo *et al*., 2009), and improving general hygiene and knowledge of farmers and other groups involved in production and selling of food crops in the metropolis, especially for leafy vegetables where contamination risks to the consumer are high (Amoah *et al*., 2009). The establishment of the Decentralised Composting Company (DeCo) in 2008 to produce compost for Tamale holds promise for elevating the role of UPA as a user of compost that can reduce the urban organic waste (Box 1). The company produces about 3 000 metric tonnes of compost annually that is being used by small-scale farmers in and around Tamale.

Box 1. The Case of Decentralised Compost Company (DeCo) in Tamale

The Tamale Decentralised Composting Company (DeCo) was established in 2008 as a registered social business NGO with the overall objective of improving the organic matter content of soils of the savanna region of Ghana. It buys farm and household waste biomass from local people and composts the biomass into organic fertilizer for farmers in northern Ghana. It also works with a waste management company called Zoomlion to get biowaste from towns for the same purpose. DeCo operates decentralized composting plants and follows a low-tech approach, windrow composting, in order to minimize technical barriers and risks, and employs local people. The plants are located close to villages to lower the cost of production and transportation and are run by local managers with higher education degrees and employ people from the surrounding villages part time. On the basis of diverse inputs (like fruit and vegetable waste, neem tree leaves, and waste from processing shea butter and other local agro-processing activities), DeCo produces high quality organic fertilizer targeting small-scale farmers close to the production sites. By working together with local NGOs, MoFA (Ministry of Food and Agriculture) and research institutions, DeCo aims not only to sell a product but inform and educate farmers about the benefits of applying organic matter to their soils.

5
Climate factors and UPA in Tamale

Climate trends

The climate in northern Ghana is driven by the El Niño–Southern Oscillation (ENSO) and the West African monsoon. The seasonal rainfall fluctuates considerably on inter-annual and inter-decadal timescales, due in part to variations in the movements and intensity of the Inter Tropical Convergence Zone (ITCZ), and in the timing and intensity of the West African monsoon (GFDRR, 2011).

Tamale has a relatively dry climate, with a single rainy season that begins in May and ends in October. Annual rainfall for Tamale varies between 900 mm and 1 100 mm, with a long-term average annual rainfall of 1 078 mm (Table 5.1). Inter-annual variability of rainfall is up to 17 per cent (GMA field data, 1960–2010). Total annual rainfall has slightly decreased in the period between 1960 and 2010, though the trend is not significant (Figure 5.1a). The mean daytime temperature for Tamale is 28° C, with a range from 34° C for the March–April period to 21° C for the December–January period. Mean annual temperatures have risen by approximately 1° C between 1960 and 2010 (Figure 5.1b).

TABLE 5.1
Average monthly rainfall distributions in Tamale, 1939–2009

Rainfall (mm)												Annual Rainfall
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
3.0	8.3	41.5	82.2	118.0	142.0	153.7	195.8	222.1	90.3	16.9	4.4	1077.6

Source: Meteorological Services Department, Tamale, 2011

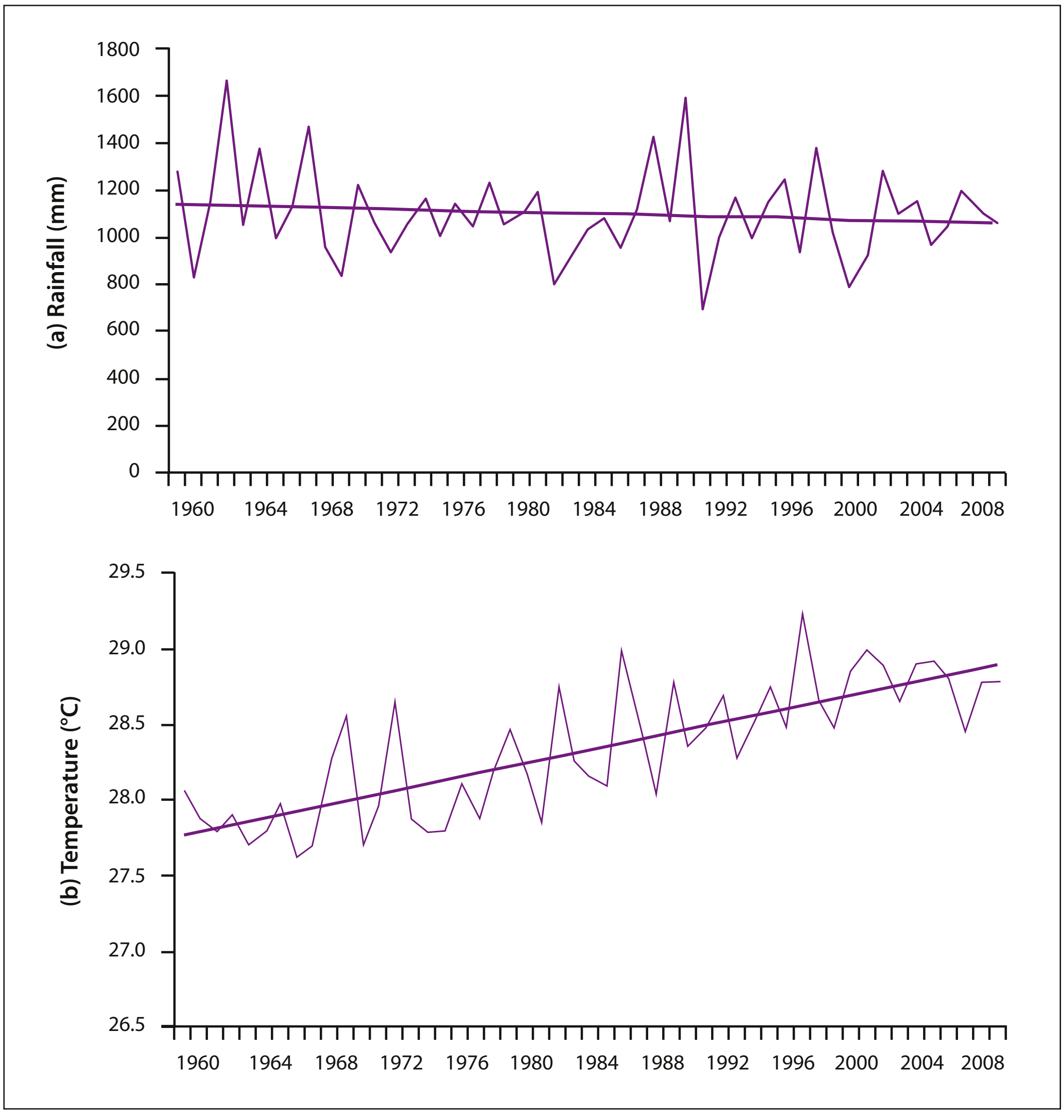
Climate projections

Rainfall

A few studies have been undertaken in Ghana to ascertain overall future climate projections in the Guinea savanna zone. The World Bank study of the Economics of Adaptation to Climate Change for 2010–2050, and the UNDP Climate Profile of Ghana for 2060–2090 (Lizcano and McSweeney, 2008) project a decrease in rainfall (UNFCCC, 2007), while the Meteorological Model version 5 (MM5) projects an increase. Figures 5.2a and b depict an envelope of projected precipitation change derived from a suite of regionally downscaled climate model projections from CMIP3, under a future scenario of high greenhouse gas emissions (A2) and a future scenario of low greenhouse gas emissions (B1). In Figure 5.2a, the light purple bars represent historic precipitation trends (1961–2000) by month and the dark purple bars represent projected precipitation in the 2046–2065 period.

FIGURE 5.1a, b
(a) Rainfall trends for Tamale, 1960–2010; (b) Temperature trends for Tamale, 1960–2010

Source: Authors' construct based on data from Ghana Meteorological Agency



The analysis (under both A2 and B1 scenarios) indicates that by mid-century, the months of July, September, October and November could become wetter, rainfall in August could become drier than historical means, while the rest of the months show none or very little change in the amount of rainfall (Figure 5.2 b). As indicated by the purple bars, the model projection trends for the months with increased rainfall are predominately above the zero line, indicating general agreement between the models as to the direction of future rainfall.

In interpreting these results, it is important to note that, in Figure 5.2b, the bars indicate the spread of the climate model results and thus the relative degree of uncertainty with respect to the envelope analysis. The shorter the bar the greater the degree of agreement of rainfall projections between the models, and thus higher the degree of relative certainty with respect to future rainfall projections. The distribution of the bars is also important. Bars that are distributed predominately in one direction relative to the zero line indicate agreement between the models regarding either increasing rainfall (bar is mostly above the zero line) or decreasing rainfall (bar is mostly below the zero line). Bars that evenly straddle above and below the line show poor agreement and thus a relatively greater degree of uncertainty.

Heavy rainfall events

Near-term (2040–2060) projected changes indicate a potentially increasing incidence of extreme rainfall during June and July (Figure 5.3). Projected changes for September are also positive, but in the context of existing high incidence these changes are relatively less significant. April, however, shows nearly doubling of the incidence of extreme rainfall, but historically is a month of low incidence so the impacts of these changes may be smaller.

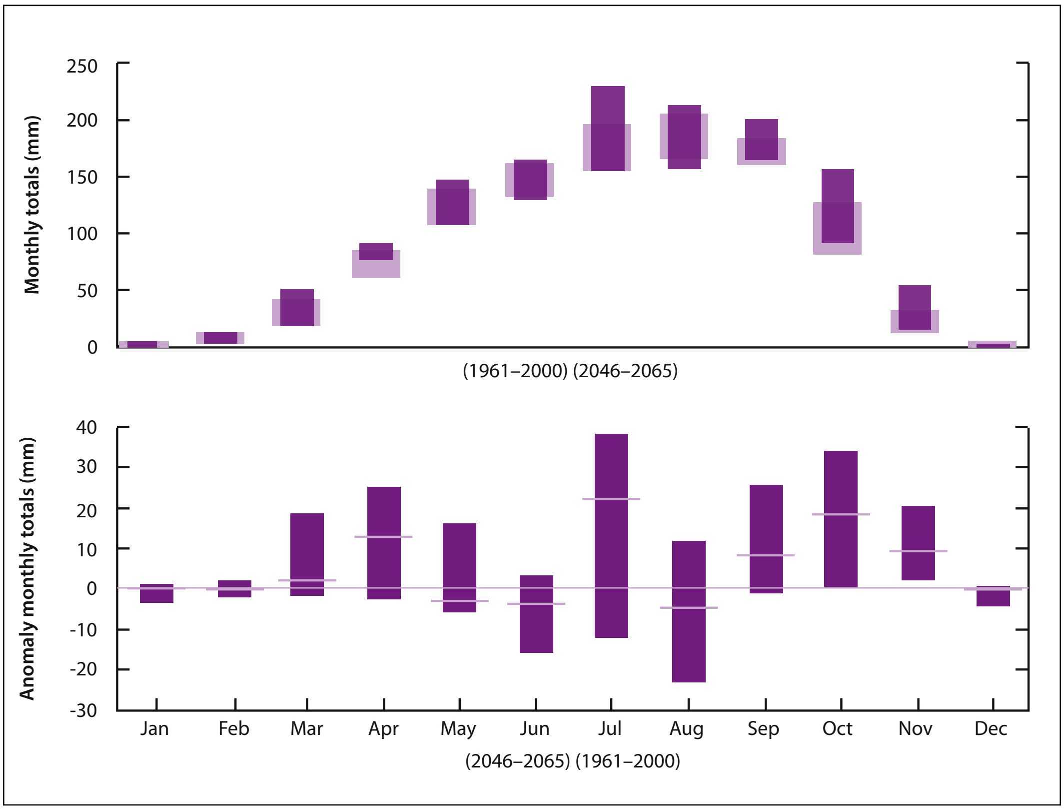


FIGURE 5.2a, b
Change in monthly total rainfall (mm) for Tamale station (a) SRES A2 Scenario and (b) SRES B1 Scenario

Source: GSAG, 2013

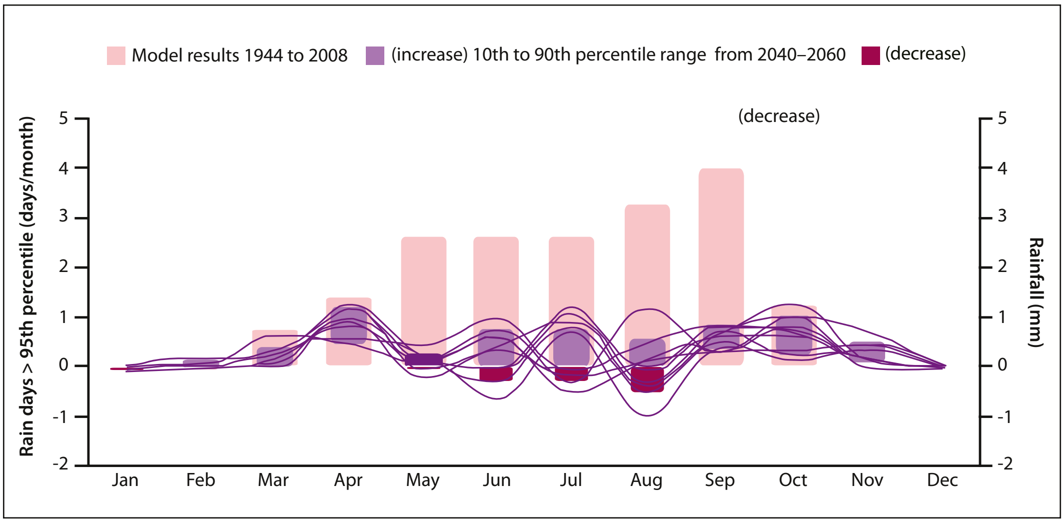


FIGURE 5.3
Change in rain days >95th percentile (days/month)

Source: GSAG, 2013

Temperature projections

Climate model projections of temperature analysed by the University of Cape Town's Climate Systems Analysis Group indicate a mid-century temperature rise of between 2.0° and 2.5° C (A2 scenario) and 1.6° to 1.9° C (B1 scenario), with the largest difference between current and future temperatures occurring in the June to September period (Figure 5.4a, b). Minimum temperatures are projected to increase by about 2.2° to 2.7° C (A2 scenario) and 1.7° to 2.0° C (B1 scenario) (Figure 5.5a, b).

These figures show an envelope of projected temperature change derived from a suite of regionally downscaled climate model projections from CMIP3[1], under a future scenario of high greenhouse gas emissions (A2) and a future scenario of low greenhouse gas emissions (B1). In Figure 5.4b, the light purple line represents historical trends (1961–2000) and the dark purple line represents projected temperatures for the 2046–2065 period. In Figure 5.4b, the dashed blue line indicates the mean projected temperature anomaly and the pink area that encompasses the dashed line represents the spread of model projections for temperature; a narrower line indicating closer agreement between models, a broader the line indicating less model agreement.

Observations of climate change

According to a World Bank analysis of Ghana (GFDRR 2011), extreme rainfall events increased during the 1980s and 1990s with greater frequency and recurrence of storms, floods and droughts. Respondents in the field survey acknowledged increasing risks to their livelihoods brought about by climate change. Various descriptions of how the climate has changed and affected agriculture included erratic rainfall, reduced rainfall, warmer temperatures, changing pattern of the *harmattan*, increased windstorms, drier conditions, shortened raining season, stunted growth of crops and disappearance of certain crops.

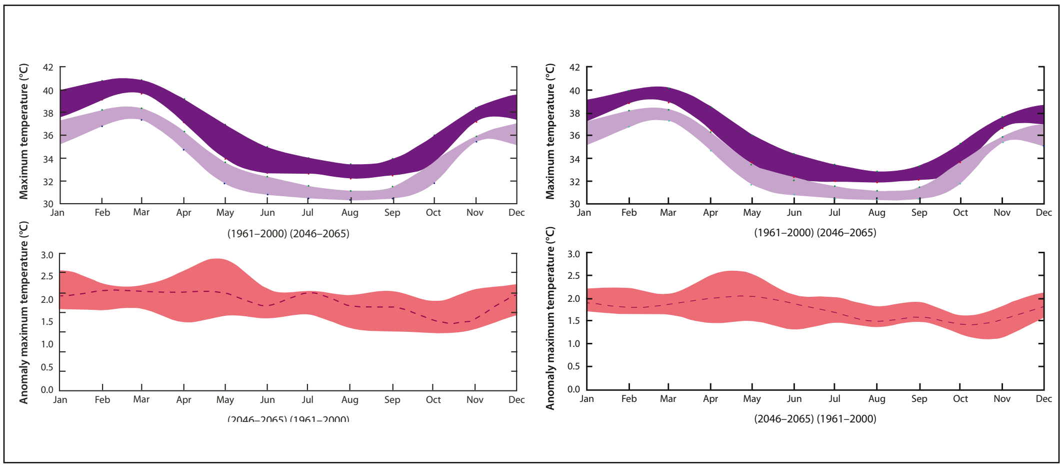


FIGURE 5.4a, b
Change in monthly mean maximum daily temperature (degrees C) for TAMALE station (a) SRES A2 Scenario and (b) SRES B1 Scenario
Source: *CSAG 2013*

1 CMIP3 or Coupled Model Intercomparison Project Phase 3, is a climate model output from simulations of the past, present and future climate (20th–22nd century) for the physical climate systems (atmosphere, land surface, ocean and sea ice) collected by the Program for Climate Model Diagnosis and Intercomparison (PCMDI).

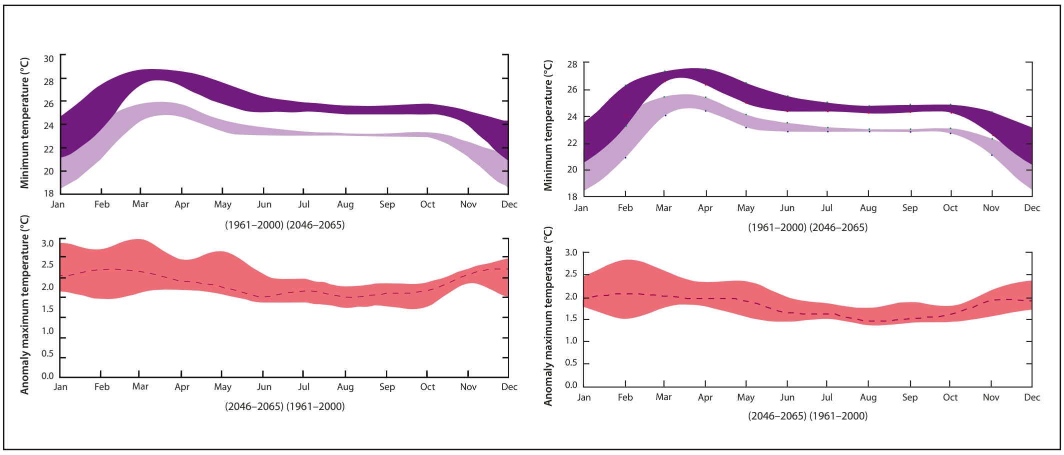


FIGURE 5.5a, b
Change in monthly mean minimum daily temperature (degrees C) for TAMALE station (a) SRES A2 Scenario and (b) SRES B1 Scenario

Source: *GSAG, 2013*

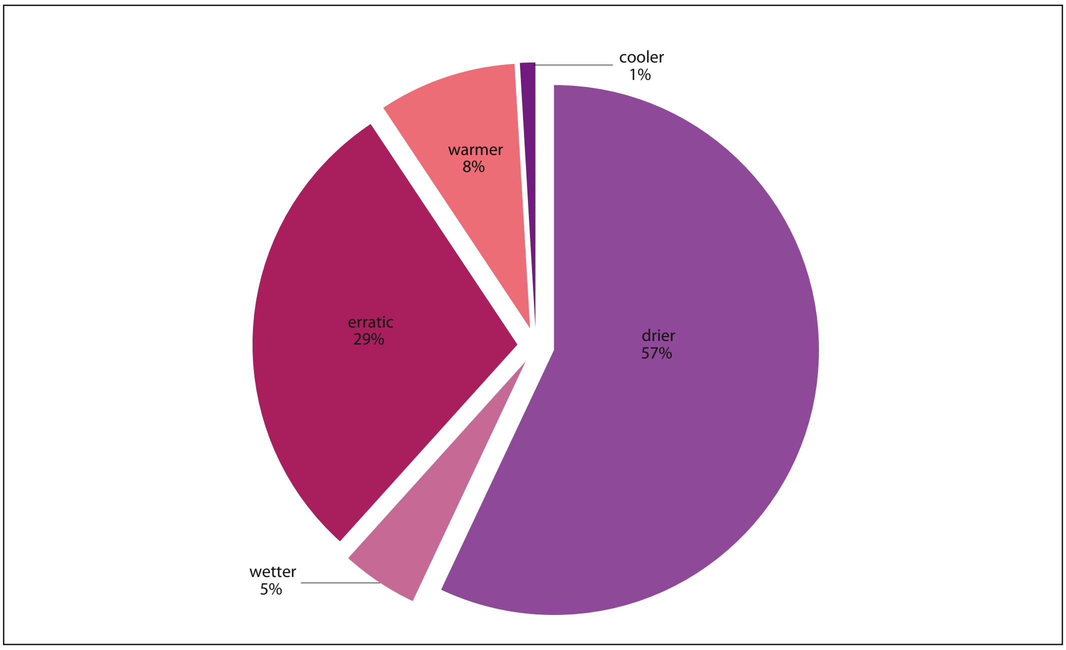


FIGURE 5.6
Farmer perception of changing climate

Source: Field survey, 2012

Populations at risk of food insecurity are concentrated in the northern, upper east and upper west regions of Ghana. Periods of acute food insecurity result from the convergence of climatic and non-climatic factors, as was the case in 2007 when severe floods and drought combined with chieftaincy conflicts and a spike in global food and fuel prices to amplify the already existing vulnerabilities among people and communities in these regions (Cudjoe *et al*., 2010).

The high degree of climate risks in the north contributes to low and volatile productivity levels, and the prospect of increasing climate risks to agriculture from climate change is of serious concern. Rainfed cereal cultivation, the mainstay of food production in Ghana, faces a number of potential threats from climate change related to rainfall deficits, high temperature stress, extreme events, pest and disease pressure, and enhanced land degradation (UNEP/UNDP, 2010). For example, a temperature increase of 1°C in the Tamale area has been estimated to decrease yield of maize by 6 per cent (Atakora, 2011). The most significant factor limiting agricultural production is the erratic nature of the rainfall with annually occurring intra-seasonal dry spells lasting between two to three weeks. The dry spells have become more frequent and longer (Bediako *et al.*, 2005).

Respondents in the assessment confirmed that the rainy season has become drier and warmer than it was 20 years ago (Figure 5.6). These seasonal dry spells often resulted in significant crop losses and occasionally total crop failure. Most farmers in the Tamale area now plant in July instead of May/June, which was formerly considered the period of onset of the rains. There are also potential impacts on livestock productivity including the loss of livestock herds to drought, heat-related reductions in livestock productivity, reduced productivity of rangeland, and high cost/unavailability of feed and water for livestock (UNEP/UNDP, 2010).

Farmers consistently reported stunted growth of crops, for example some local varieties of late-maturing millet and sorghum are no longer being grown by farmers in the metropolis, since they cannot reach maturity before the rains stop (Field survey, 2012). Farmers also observed that due to insufficient moisture during pod formation, groundnut seeds no longer fill the pods. During a discussion with a group of poultry farmers, one poultry farmer remarked "*we now experience very high temperatures in the months of January and February and during those times many layers become spent leading to a reduction on the number of eggs collected daily.*"

Variability and changes in rainfall patterns and increasing temperatures could have serious repercussions on UPA in the Tamale area. While the knowledge base regarding potential impacts on cereal and tuber crops is growing, there remains a lack of clear understanding of how irrigated and rainfed vegetable production in northern Ghana may be affected by climate change, or how indirect effects linked to urban stresses, such as greater marginality of land resources for agriculture or increased demand for non-agricultural use of water, may interact with climate change to affect UPA. Such compound stresses are likely to impel farmers to further shift to the use of marginal water sources, such as municipal wastewater for irrigating crops, which have attendant health risks. Important climate change factors to consider for horticultural crops produced under UPA include the extent of direct impacts from heat and water stress, and how water resource availability and quality for UPA production may change as both urbanization and climate change play out over the next several decades.

6 Response options and recommendations

Protect land in valley bottoms for agriculture

Land located in valley bottoms is less drought-prone thus provides good soils for agriculture. This land provides an important environmental service by carrying stormwater runoff away from the city. The lack of legal provision backing UPA has led to the conversion of valley bottoms and swampy areas into built-up areas. Areas such as Gurigubaani and Gumani were good rice fields before they were converted to residential facilities. Strong policy frameworks are needed to protect valley-bottom lands for agriculture. These efforts need to be informed by greater understanding of the urban flood mitigation function of these lands and how the potential for increased heavy rainfall with climate change will affect the need for such environmental service provisioning.

The importance of valley bottoms for UPA also requires greater farmer support, such as through extension services, in the peri-urban zones to manage risks of crop loss to flooding. For example, access to short duration varieties and to other inputs that make it easier to undertake early planting and harvesting before the peak of the rains can reduce flood loss risks. Policy support for resolving conflicts between livestock keeping and crop production as the land base constricts is also needed.

In terms of land-tenure security and land-use planning more broadly, credible security of access to land either through formal mechanisms such as legal title and enforcement or through informal mechanisms such as community recognition and enforcement of rights, is needed to enhance the viability of agriculture. Facilitating urban households' access to land may require the acquisition of temporary rights for use of idle public lands. The Metropolitan Assembly has expressed support for such an exercise. The major task now is to conduct a detailed profile of possible locations for action. In the case of peri-urban areas, the possibility of zoning and demarcating agricultural land still exists. However, such a process should start at the community level. Policy makers in ministries and state departments, especially the Department of Town and Country Planning, the Tamale Metropolitan Assembly and the Ministry of Food and Agriculture could then be introduced into the process at later stages. City authorities could be better placed to grant permission for agriculture within the metropolis if there were a comprehensive spatial land-use framework, integrating agriculture as legitimate land-use form.

At the community level, the demarcation process could begin with community mapping and should be done by communities and should highlight priorities of communities in terms of land use. In such maps community members, through a participatory process, would outline the sites they intend for various uses or infrastructure, including agriculture or farming zones. This is a process that requires significant time and resources. Green belts in the form of agriculture and woodlot enclaves should be used to separate adjoining residential areas. This will help increase the amount of land surface with vegetative cover in the city.

Actors: Tamale Metropolitan Assembly, Town and Country Planning Department, the Lands Commission, Ministry of Food and Agriculture, Department of Parks and Gardens and local chiefs.

Enhance water resource management

Competition between agricultural and non-agricultural uses of water will intensify with increased urban growth, and this competition is likely to be exacerbated by higher temperatures and more erratic rainfall with climate change though the extent to which this will occur has not been estimated. The future outlook on water resources for Tamale requires a careful examination of the potential for using wastewater to meet increasing irrigation needs for UPA, including potential health risks for producers and consumers of UPA products, particularly leafy greens. The International Water Management Institute should collaborate with Tamale-based research institutes and universities to provide training to vegetable farmers in Tamale on safe use of wastewater for vegetable production.

Planning and implementation strategies for the development of micro-catchment rainwater harvesting techniques, and the creation of more small reservoirs, shallow wells and water conserving irrigation for crop production are also needed. This effort is underway and needs to be expanded. For example, the Savanna Agricultural Research Institute and the International Crop Research Institute in the Semi-Arid Tropics introduced drip irrigation to the communities around Tamale under the African Market Garden project (SARI, 2007) with promising results. Rainwater harvesting has the potential to curb flooding during heavy rainfall events, but requires resources and inputs for efficient and safe capture and storage, including aptly covered containers to prevent mosquito breeding. Possibilities for rainwater harvesting include rooftop gutters, creating of reservoirs and building micro-dams and ponds on ephemeral streams to collect water during the rainy season. Important actors for leading investment in water resource efforts are the District Assembly, the Tamale Municipal Assembly, NGOs, and the Irrigation Development Authority of the Ministry of Food and Agriculture (MoFA).

Diversify production systems to lessen reliance on rainfed agriculture

Farmers in the region have demonstrated a strong predilection to adopt new varieties of rainfed staple crops (e.g., cowpea, maize and sorghum) that are shorter duration and thus escape drought or that are more tolerant of drought than older varieties (Bediako *et al*., 2005). This need is likely to increase in response to climate change. Furthermore, diversification of urban and peri-urban agriculture to give more emphasis to vegetable production under small-scale irrigation and subsequent reduction in rain-fed cereal production could become increasingly important both as a response to a growing market for horticultural crops from an expanding urban population and as a risk-management measure to counter rainfall vagaries in cereal and other rainfed crop production.

Many vegetable producers are cultivating local leafy vegetables that are of high nutritional but low market value. New entrants into vegetable production need specialized training, with the Savanna Agricultural Research Institute (SARI), MoFA and University for Development Studies appropriate to provide this training. For example, vegetable production requires intensive use of pesticides with which come health and environmental impacts; training and monitoring are required to minimize these risks. Access to seeds of improved varieties of high-value vegetables is also needed. Prices of seed for such improved varieties are high for farmers and only seeds of exotic varieties such as carrot (*Daucus carota*), cucumber (*Cucumis sativus*) and cabbage (*brassica olereceacapitata*) are sold since farmers cannot easily produce them. An extension of the current subsidy on inorganic fertilizer to cover planting materials of improved varieties will motivate private agro input dealers to put them on stock for sale.

Commercial poultry production is increasingly gaining grounds in Tamale, as agriculture practitioners are given technical assistance by the Metropolitan Agriculture Development Unit (MADU) in livestock production to enable them to diversify from solely producing crops. According to MADU officials, this training of farmers becomes necessary in the wake of diminishing agricultural land in the city and unfavourable weather conditions resulting from changing climate. A survey conducted by Mensah-Bonsu and Rich (2010) identified breeders/hatcheries, farmers, traders and consumers as major actors in the poultry industry in the Tamale metropolis. Inputs identified as used by commercial farmers are concentrates (i.e. formulated feeds), vitamins and labour. The main products of the commercial poultry farms include eggs (and spent layers), broilers for the holiday seasons and manure. Whilst formulated feeds are purchased from an Agricare sales outlet in Tamale, day-old chicks are mostly purchased in Kumasi and transported to Tamale usually in the evenings. Due to the young nature of the poultry industry in Tamale, about 85 per cent of the supply of eggs comes from Sunyani in the Brong Ahafo region (Mensah-Bonsu and Rich, 2010).

Beekeeping is gaining importance, especially among women in the peri-urban settlements of Tamale. This can become an import vocation, which together with poultry production, could reduce reliance on rainfed crop production. Both poultry and beekeeping require some capacity building related to management practices, which could be provided by research and development partners. These capacity building efforts should increasingly target women, as they are more vulnerable to climate change effects, due to their lack of access to land, capital and other resources. One group to target are women involved in shea butter nut gathering and processing, an enterprise that has diminished in Tamale due to urban sprawl and environmental changes that have reduced the number and productivity of shea trees.

Farmers who participated in focus group discussions held in the core, peri-urban and adjacent rural areas of Tamale expressed a strong need for diversification as a way of better coping with more variable climatic conditions. Strategies for doing so included 1) increasing the share of market-oriented gardening as an alternative to traditional cereal-based subsistence agriculture; 2) concentrating on intensive livestock rearing to deal with greater constriction of the land base and to provide a more reliable source of animal manure for crop production; 3) promoting alternative livelihoods that include trading or other professions such as construction work, mechanics, tailoring, etc.; and 4) increased support for education, especially for children; the traditional occupation of farming is no longer as rewarding and thus parents find it prudent to channel their resources into giving their children good formal educations, which provide greater future job opportunities than farming.

Actors: Central government, Ministry of Food and Agriculture, research institutions (e.g., the Savanna Agricultural Research Institute), universities (e.g., the University for Development Studies), Tamale Metropolitan Assembly and local chiefs.

Increase farmer access to seasonal weather forecasts

Climate risk management at the farm level, such as shifts in planting dates and time of fertilizer application, are already being adopted. For example, most farmers in the Tamale area now plant cereals in July instead of June due to delay in the onset of the rains. Shifting planting dates is a very difficult response to manage, as changes in the onset of the rains are quite variable. In the absence of good seasonal weather forecasts, farmers will be unable to adjust effectively to the annual variability in the onset of the rains.

The efficiency with which farmers can adapt to climate change and variability by changing their planting dates will depend on availability of timely, relevant and actionable seasonal weather forecast information, especially prediction of the onset of the rains. There is need to develop seasonal weather forecasting that farmers understand, in addition to early warning systems of impending drought or excess rainfall. The National Disaster Management Organization (NADMO), which has its regional office in Tamale, has limited resources to deal with the effects of flood and drought, and they have no early warning systems for impending drought and floods. Weather forecast information from Ghana Meteorological Association (GMA) hardly gets to farmers and even when it does, the forecasts are often ignored because of lack of confidence in weather forecasts made by GMA.

Actors: Tamale Metropolitan Assembly, the Metropolitan Agriculture Development Unit of MoFA, the National Disaster Management Organization (NADMO), and the Ghana Meteorological Association (GMA).

Promote more sustainable technologies and extension support for UPA farmers

As land holdings around Tamale diminish as a result of urbanization and land degradation undermines the resource base, land-use intensification will become more prominent as a means of sustaining and increasing productivity. The use of fertilizers and pesticides will increase, which will pose health and environmental hazards if not properly managed. To maintain the productivity of the land under intensive cultivation, the use of integrated management regimes (e.g., integrated pest management and integrated nutrient management) is important. Such efforts can be implemented in a manner that also reduces the urban waste stream. As described in this report, the NGO DeCo is producing organic fertilizers near Tamale using poultry manure and compost made from urban waste. DeCo is also developing a partnership with Zoomlion to compost all waste generated in Tamale for use as fertilizer. If this partnership succeeds, organic fertilizers will be available for farmers at affordable prices, which would have positive implications for reducing pollution and health risks from UPA.

Expanding the availability of credit and crop insurance could help farmers acquire inputs, and thus encourage diversification. In particular, there is widespread interest in the development of crop insurance schemes that would reimburse farmers in the event of a climate-related production problem. The availability of insurance could also promote the adoption of new, better-adapted varieties. Interventions to protect human and livestock health are also needed, such as through conducting tuberculosis and brucellosis screening in the milk collection areas, and organizing vaccination campaigns for livestock.

Non-governmental organizations such as ActionAid Ghana and CARE International Ghana together with the University for Development Studies, Tamale, should collaborate with MoFA to facilitate the delivery of new technology and extension services to urban agricultural producers and other actors. Through research and development, enormous amounts of technology have been developed that when made available to households could significantly improve output levels. Again it lies within the ambit of the of Ministry of Food and Agriculture (MoFA) to embark on door-to-door education and sensitization of farming households on new technology that will enable the farmers to maximise output even in the face of changing climate and shrinking land size. The MoFA can do this through the Metropolitan Agriculture Development Unit (MADU), a unit of the Metropolitan Agriculture Department.

Actors: Tamale Metropolitan Assembly, the Metropolitan Agriculture Development Unit of MoFA, universities, research institutions and non-governmental organizations (NGOs).

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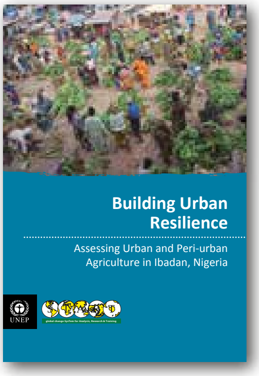
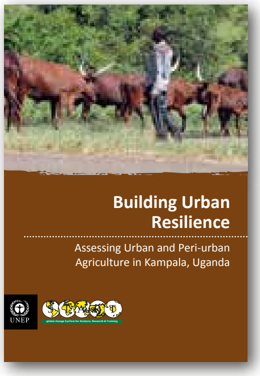
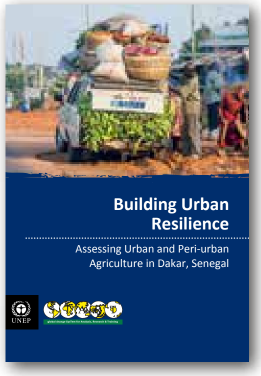
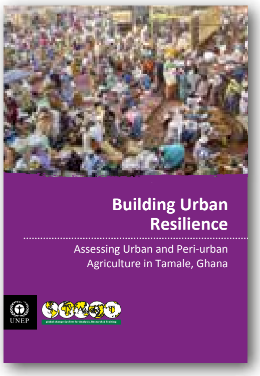
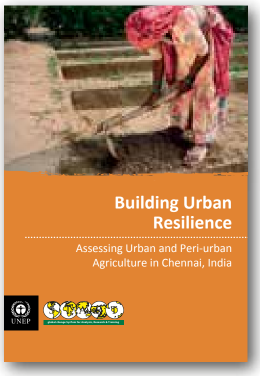
This report represents one from a series of nine city-level reports on urban and peri-urban agriculture (UPA), which together form a larger knowledge assessment. The knowledge assessment was carried out in Dakar (Senegal), Tamale (Ghana), Ibadan (Nigeria), Dar es Salaam (Tanzania), Kampala (Uganda), Addis Ababa (Ethiopia), Dhaka (Bangladesh), Kathmandu (Nepal) and Chennai (India). The nine reports and a synthesis report can be downloaded at: http://start.org/programs/upa

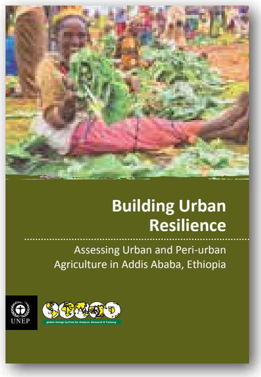


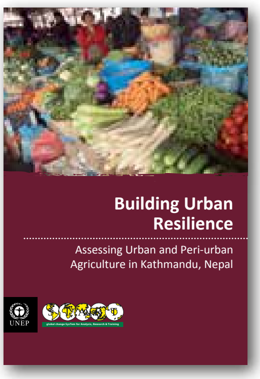


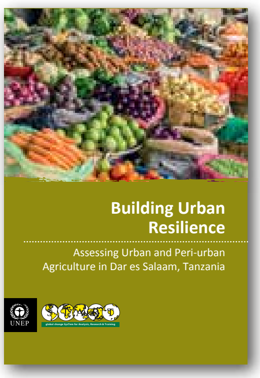


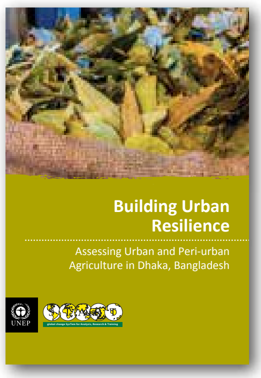












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This assessment report presents the findings of a knowledge assessment on urban and peri-urban agriculture (UPA) for the city of Tamale, Ghana, that was conducted in 2012. The assessment examines the state of UPA in the city through the lens of intensifying urban pressures and increasing climate risks with the objective of identifying how these and other drivers potentially interact to affect the long-term sustainability of UPA, and what response options are needed to address existing and emerging challenges.

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