

URBAN AGRICULTURE IN THE AMHARA REGION

Production Constraints and Strategic Solution



**ARARI
2025**

Amhara Agricultural Research Institute

Urban Agriculture in the Amhara Region: Production Constraints and Strategic Solutions

2025

Amhara Agricultural Research Institute

Urban Agriculture in the Amhara Region: Production Constraints and Strategic Solutions

Bahir Dar, Ethiopia

Authors: Yalfal T.¹, Ayenew M.¹, Mulugojjam G.¹, Kiber T.¹, Asmare W.², Sisay G.², Getachew K.², Melkamu B.², Melese W.², Minwyelet J.², Molla H.², Misganaw W.³, Lissanwork M.³, Yeshiwas T.³, Demelash K.³, Lijalem A.³, Getachew G.³, Adebabay A.³, Arega G.⁴, Mesfin B.⁴, Yimam A.⁴, Tamirat T.⁴, Gebeyehu A.⁴, Solomon T.⁴, Degu T.⁵, Altaye T.⁵, Demisew G.⁵, Tefera M.⁵, Amsalu A.⁵, Yehuala K.⁵, Yohannes A.⁶, Yohannes K.⁶, Simachew Y.⁶, Zerfu B.⁶, Azeze W.⁶, Erkie A.⁷, and Getinet T.⁷

¹ Amhara Agricultural Research Institute, P.O. Box 527, Bahir Dar, Ethiopia

² Adet Agricultural Research Center, P.O. Box 08, Bahir Dar, Ethiopia

³ Andassa Livestock Research Center, P.O. Box 27, Bahir Dar, Ethiopia

⁴ Sirinka Agricultural Research Center, P.O. Box 74, Woldia, Ethiopia

⁵ Debre Birhan Agricultural Research Center, P.O. Box 112, Debre Birhan, Ethiopia

⁶ Gondar Agricultural Research Center, P.O. Box 1337, Gondar, Ethiopia

⁷ Bahir Dar Fisheries and Other Aquatic Life Research Center, P.O. Box 794, Bahir Dar, Ethiopia

"All authors have contributed equally".

Editors: Mesfin Lakew, Tadelle Amare (PhD), Asresu Yitayew (PhD), Yeshitila Merene (PhD), Adebabay Kebede (PhD), and Asmare Dejen (PhD)

© 2025 Amhara Agricultural Research Institute (ARARI)

This publication is copyrighted by the Amhara Agricultural Research Institute.

The Views and interpretations expressed in this report are entirely those of the authors and should not be attributed in any manner to Amhara Agricultural Research Institute and the World Bank.

ARARI encourages fair use of this material. Proper citation is requested.

Design and layout – Mesfin Lakew

Cover photos – Tadesse Misganaw

ISBN: 978-99944-930-1-2

Citation: Yalfal, T., Ayenew, M., Mulugojjam, G., Kiber, T., Asmare, W., Sisay, G., Getachew, K., Melkamu, B., Melese, W., Minwyelet, J., Molla, H., Misganaw, W., Lissanwork, M., Yeshiwas, T., Demelash, K., Lijalem, A., Getachew, G., Adebabay, A., Arega, G., Mesfin, B., Yimam, A., Tamirat, T., Gebeyehu, A., Solomon, T., Degu, T., Altaye, T., Demisew, G., Tefera, M., Amsalu, A., Yehuala, K., Yohannes, A., Yohannes, K., Simachew, Y., Zerfu, B., Azeze, W., Erkie, A., & Getinet, T. (2025). Urban agriculture in the Amhara region: Production constraints and strategic solutions. In Mesfin, L., Tadelle, A., Asresu, Y., Yeshitila, M., Adebabay, K., & Asmare, D. (Eds.), *Research report*. Amhara Agricultural Research Institute (ARARI), Bahir Dar, Ethiopia

Box 527, Bahir Dar, Ethiopia

Phone +251 58 220 6400

Fax +251 58 226 6077

Email arari@ethionet.et

www.arari.gov.et

Contents

Message	iii
Preamble	iv
Acknowledgments	v
1. Executive Summary	1
2. Introduction	4
2.1. Study Objectives	5
3. Methodology	6
3.1. Study Area Description	6
3.2. Data Collection	7
3.3. Sampling and Respondent Selection	8
3.4. Data Analysis	9
4. Key Findings	10
4.1. Farming System of the Study Areas	10
4.2. Urban Crop Farming Systems	10
4.2.1. Production and Productivity	10
4.2.2. Management Practices in Urban Crop Farming	12
4.2.3. Major Constraints in Urban Crop Farming Systems	19
4.2.4. Strategic Interventions for Urban Crop Farming Systems	23
4.3. Urban Livestock Farming Systems	24
4.3.1. Urban Poultry Farming	25
4.3.2. Urban Dairy Farming	36
4.3.3. Cattle and Sheep Fattening	45
4.3.4. Aquaculture Production	50
4.3.5. Major Constraints in Urban Livestock Farming Systems	54
4.3.6. Opportunities in Urban Livestock Farming	55
4.3.7. Strategic Interventions for Urban Livestock Farming Systems	56
4.4. Crop Product Safety Practices, Constraints and Interventions	60

4.4.1.	Crop Product Safety Practices	60
4.4.2.	Constraints in Crop Product Safety	62
4.4.3.	Strategic Interventions for Crop Product Safety	62
4.5.	Livestock Product Safety Practices, Constraints and Interventions	63
4.5.1.	Livestock Product Safety Practices	63
4.5.2.	Constraints in Livestock Product Safety	65
4.5.3.	Strategic Interventions for Livestock Product Safety	66
4.6.	Partnership and Institutional Support	66
4.6.1.	Legal Status of the Urban Farming	66
4.6.2.	Agricultural Extension Services and Access to Technologies	69
4.6.3.	Capital Availability for Urban Farming	74
4.6.4.	Gender Roles and Participation in Urban Farming	77
4.6.5.	Environmental Impact of Urban Farming	78
4.7.	Marketing, Consumption and Processing in Urban Farming	80
4.7.1.	Horticultural Crop Marketing	80
4.7.2.	Livestock Product Marketing	84
5.	Conclusions	94
6.	Proposed Strategic Solutions	96
6.1.	Impact of Strategic Solutions	98
7.	References	100

Message

I am pleased to endorse the publication *Agricultural Production and Interventions in Urban Agriculture*, a timely and insightful resource that addresses the critical challenges and opportunities in urban agriculture. As urbanization accelerates, sustainable food production within cities becomes imperative for food security, environmental resilience, and community well-being.



This research result book will provide a comprehensive analysis of the barriers faced by urban dwellers and farmers from limited space resource constraints—while offering practical, evidence-based interventions. It aligns with ARARI's mission to promote innovative agricultural research and extension services, ensuring that urban farming contributes meaningfully to the Amhara region's agricultural transformation.

I commend this rigorous research and actionable recommendations, which will benefit policymakers, practitioners, researchers, and urban dwellers alike. ARARI is proud to support this valuable contribution to the discourse on sustainable urban agriculture.

Let us embrace these insights to foster greener, more food-secure cities.

Asmare Dejen Demeke (PhD)

Director General,

Amhara Agricultural Research Institute (ARARI)

Preamble

Urban and peri-urban agriculture (UPA) has emerged as a critical component of sustainable food systems, particularly in the context of rapid urbanization and growing demand for fresh, nutritious, and locally produced food. In Ethiopia, and specifically in the Amhara Region, urban and peri-urban areas possess significant untapped potential for agricultural production. These areas offer unique opportunities for enhancing food security, creating employment-especially for youth and women-and improving environmental management through innovative, resource-efficient technologies. However, while substantial agricultural technologies have been developed and promoted for rural farming systems, there has been limited availability and adaptation of technologies tailored to urban and peri-urban contexts. As a result, the agricultural potential of these areas remains underutilized, and the role of UPA in regional development has not been fully recognized or supported.



In light of this, the Food Systems Resilience Program (FSRP-Ethiopia) has initiated efforts to assess urban and peri-urban production systems with the aim of identifying existing practices, challenges, and technological gaps. This initiative seeks to promote context-specific innovations that respond to the unique constraints of space, water, labor, and waste management in urbanizing environments.

This research report serves as a working document for FSRP and other stakeholders, offering foundational insights to guide future agricultural research, technology promotion, and development interventions in urban and peri-urban areas of the Amhara Region. It reflects a growing recognition of the importance of inclusive, location-responsive approaches to agricultural transformation in Ethiopia's evolving urban landscape.

Adebabay Kebede Belew (PhD)

Program Manager, Food System Resilience Program (FSRP)

Amhara Agricultural Research Institute (ARARI)

Acknowledgments

This research report on “**Urban Agriculture in the Amhara Region: Production Constraints and Strategic Solutions**” has been made possible through the collaborative efforts of the Food System Resilience Program and a multidisciplinary research team. The Amhara Agricultural Research Institute (ARARI) played a pivotal role in leading data collection and report preparation, ensuring alignment with the study scopes and key focus areas.

We extend our heartfelt gratitude to all the producers and experts who engaged in the focus group discussions and key informant interviews. Their invaluable contributions, firsthand experiences, and perspectives have played a vital role in shaping the findings and recommendations of this study.

We also acknowledge the dedicated researchers from various research centers within the Amhara Agricultural Research Institute, whose expertise and commitment have been instrumental in shaping this report with scientific rigor and analytical depth. Their contributions have enriched the assessment and provided valuable insights into the production systems examined.

Special thanks go to the editorial team of this research report for their meticulous efforts in refining and structuring the document. Their dedication to clarity, precision, and scientific rigor ensures the report’s accessibility and impact.

ARARI is grateful to the Food System Resilience Program for its generous financial support, which made this research possible. Their investment in advancing agricultural sustainability and resilience is truly commendable.

To all contributors, direct and indirect, we express our deepest gratitude. Your collective efforts have made this study a meaningful endeavor toward enhancing agricultural systems in the Amhara region.

1. Executive Summary

Significance of Urban Agriculture Urban agriculture is emerging as a vital solution to food security, economic resilience, and environmental sustainability in rapidly expanding cities. As urban populations grow, the demand for fresh, locally produced food increases, necessitating optimized urban farming systems. In Ethiopia, particularly in Bahir Dar, Gondar, Debre Birhan, and Dessie, urban agriculture is crucial in ensuring food availability, income generation, and ecological conservation. Urban farming enhances food security by reducing dependency on distant food sources and providing nutritious vegetables, fruits, eggs, dairy, meat, and fish within city limits. It also fosters economic empowerment by creating jobs for producers, traders, and processors, while supporting urban livelihoods through micro-enterprises.

Furthermore, urban agriculture contributes to environmental sustainability by integrating green spaces, recycling organic waste, and improving urban microclimates. Despite these advantages, urban agriculture faces systemic challenges, including land scarcity, water shortages, limited access to improved inputs, weak market linkages, and underdeveloped regulatory frameworks. Addressing these constraints is essential to unlocking its full potential and ensuring long-term sustainability in urban centers.

Methodology This study employed a mixed-methods approach, combining primary and secondary data collection to assess urban agriculture practices, constraints, opportunities, and policy interventions across four major cities in the Amhara Region. Surveys and interviews targeted urban farmers, traders, processors, consumers, and agricultural experts to capture diverse perspectives on urban food production. Focus group discussions provided deeper insights into systemic challenges and practical solutions, while field observations documented firsthand agricultural practices, irrigation methods, market behaviors, and environmental conditions. Secondary data from government reports, research institutions, and policy documents complemented the primary findings, ensuring a well-rounded analysis. Using thematic and content analysis, the study synthesized qualitative insights, while statistical evaluations quantified production trends and market dynamics.

Key Findings The study identified several challenges that hinder urban agriculture, ranging from production bottlenecks to market inefficiencies. Land scarcity remains a significant issue due to urban expansion, limiting cultivation space for horticultural crops. Water shortages further restrict irrigation potential, particularly in dry seasons, while degraded soil fertility necessitates interventions in organic and inorganic fertilizers. Additionally, limited access to quality seeds, pesticides, and agricultural inputs reduces crop yields.

Livestock production faces hurdles such as high feed costs, limited availability of improved dairy breeds, weak veterinary services, and unstable poultry and dairy market demand. Despite strong economic potential, aquaculture remains underdeveloped due to poor site selection, insufficient feed supply, and weak market integration. Market challenges are also prevalent, with price volatility, broker dominance, and limited access to direct retail spaces affecting profitability for urban farmers. Moreover, environmental and public health concerns arise from waste disposal issues, contaminated irrigation sources, and weak regulatory enforcement.

Despite these obstacles, urban agriculture presents substantial opportunities for growth and sustainability. Cities like Bahir Dar benefit from favorable agro-ecological conditions, including access to water bodies and fertile soil. Consumer demand for fresh, locally produced food is increasing, particularly for vegetables, dairy, and poultry products. Emerging innovations such as hydroponics, aquaponics, rooftop gardening, and vertical farming offer promising solutions for space optimization and sustainable production.

Strong potential exists for stakeholder collaboration to enhance input distribution, market access, and technical training. Additionally, expanding financial services through microfinance programs and cooperative-led funding can support urban farming enterprises.

**Strategic
Solutions**

To enhance the efficiency, sustainability, and economic viability of urban agriculture, several strategic interventions are necessary. Policy and institutional support should focus on formally recognizing urban agriculture in city planning, allocating designated agricultural zones, and integrating stakeholder collaboration into urban food policies. Resource optimization efforts must improve irrigation systems, promote water conservation strategies, and establish efficient input supply chains for seeds, fertilizers, and livestock feed.

Strengthening livestock and aquaculture production requires developing feed supply networks, improving breeding programs, and providing targeted health services. Expanding market access through cooperative-driven retail spaces, investing in value-added processing facilities, and stabilizing price fluctuations can further enhance profitability. Food safety and environmental management must prioritize strict hygiene regulations, waste recycling initiatives, and climate-smart agriculture. Additionally, capacity-building initiatives, such as farmer training programs, technology integration, and knowledge-sharing platforms, will be instrumental in sustaining urban agriculture's long-term growth.

**Final
Thought**

Urban agriculture has the potential to transform food systems, enhance urban livelihoods, and promote sustainable development in the Amhara Region. However, achieving these objectives requires coordinated efforts among policymakers, research institutions, private-sector stakeholders, and local communities.

Strategic investments in land accessibility, irrigation infrastructure, input distribution, market development, and technological innovation will be essential in ensuring urban agriculture fulfills its role as a resilient, productive, and sustainable sector. A multi-sectoral approach that integrates financial services, policy reforms, technological advancements, and grassroots engagement will be crucial in creating thriving urban food systems that support both economic sustainability and environmental resilience.

2. Introduction

Urbanization is an increasingly prevailing global trend, with over half of the world's population residing in cities (Boonyabancha and Kerr, 2018). By 2050, two-thirds of the world population is expected to live in urban areas, with Africa and Asia accounting for 90% of this growth. Urban households largely depend on market-based food systems, yet rising food prices exacerbate economic disparities, making nutritious food less accessible—especially for low-income populations (Birhane et al., 2014). In Sub-Saharan Africa (SSA), rapid urbanization exacerbates these challenges, contributing to high levels of urban food insecurity (Dinku et al., 2023). Ethiopia is no exception, with major cities in the Amhara region facing heightened food insecurity due to population pressures, rising unemployment, environmental degradation, and climate variability.

In response to these challenges, the Ethiopian government has launched urban agriculture initiatives in major cities to strengthen food security (Derso et al., 2021). Urban agriculture encompasses the production, processing, and distribution of food and non-food agricultural products within urban and peri-urban areas, serving both local markets and individual households. This approach offers a viable solution for improving food security, enhancing nutritional outcomes, and fostering economic opportunities for urban populations. However, several production constraints—ranging from limited land availability to resource inefficiencies—impede its effectiveness, limiting its overall impact. To counteract these barriers, Ethiopia has launched programs such as the Food Systems Resilience Program (FSRP), designed to build resilient food production systems, promote sustainable resource utilization, enhance market accessibility, and strengthen policy frameworks (PID, 2022).

Given the significance of urban agriculture in improving food security, a comprehensive assessment of existing production constraints is essential. This study aims to systematically examine these challenges and propose strategic interventions to foster a more sustainable and productive urban agriculture system. By identifying key constraints and potential solutions, the study aims to unlock urban agriculture's capacity to enhance food security, boost economic development, and promote sustainable urban livelihoods.

2.1. Study Objectives

The assessment of production constraints in emerging urban agriculture within the region aims to achieve the following objectives:

1. **Identify Existing Practices and Potential** – Examine prevailing urban agricultural systems, including production methods, resource utilization, and growth potential.
2. **Evaluate Contributions to Livelihoods and Employment** – Analyze the role of urban agriculture in enhancing food security, income generation, and employment opportunities for urban dwellers.
3. **Diagnose Challenges and Bottlenecks** – Systematically identify and prioritize the key constraints affecting urban agricultural productivity, including infrastructural, economic, environmental, and policy-related barriers.
4. **Assess Safety and Public Perception** – Investigate consumer attitudes, quality standards, and safety concerns related to urban agricultural products.
5. **Propose Feasible Interventions** – Recommend practical solutions in the domains of development, research, extension, and policy to enhance the sustainability and effectiveness of urban agriculture.

3. Methodology

3.1. Study Area Description

To address the region's expanding urban population and evolving food consumption shifts, the study areas were purposively selected. The target cities—Bahir Dar, Gondar, Debre Birhan, and Dessie—are among the largest urban centers in the Amhara Region in terms of population density and land area. A detailed overview of each city is presented below:

Bahir Dar, the capital of the Amhara National Regional State, is located in the western part of the region at an altitude of about 1,840 meters above sea level, providing a moderate and favorable climate conducive to agricultural activities. Average temperatures remain relatively stable throughout the year, with highs ranging from 25°C to 30°C and lows between 10°C and 15°C. Bahir Dar is a major hub for fruit production, particularly mangoes, bananas, citrus fruits, and avocados. Livestock farming, specifically dairy and poultry production constitutes a significant portion of agricultural activity. Furthermore, Bahir Dar's closeness to Lake Tana promotes a strong fishing sector, with Nile tilapia and catfish being the most commonly harvested species, ensuring food security and economic opportunities for urban and peri-urban populations.

Gondar is situated at an altitude of approximately 2,133 meters above sea level, with latitude of around 12.6°N. Gondar is characterized by mild temperatures throughout the year, averaging between 18°C and 22°C. The city experiences two distinct seasons: a dry season from October to May and a wet season from June to September, with peak rainfall recorded between July and August. Gondar is widely recognized as one of Ethiopia's premier tourist destinations, owing to its historical and cultural heritage. With its impressive medieval castles and churches, the city stands as a testament to Ethiopia's ancient glory and continues to captivate tourists with its unique charm and architectural wonders.

Dessie is located in the eastern part of the Amhara Region and lies approximately 400 kilometers northeast of Addis Ababa at an altitude of about 2,470 meters above sea level (latitude 11.15°N). The city exhibits a moderate climate, with temperatures ranging from 16°C to 21°C throughout the year. Dessie's seasonal cycle consists of a dry period from October to May, followed by a rainy season from June to September, with peak rainfall recorded between July and August.

Debre Birhan is positioned in the North Shewa Zone of the Amhara Region, approximately 130 kilometers northeast of Addis Ababa. With an elevation of 2,840 meters (latitude 9° 41'N, longitude 39° 32'E), the city exhibits a highland climate characterized by temperature variations between 6.6°C and 24°C, alongside an average annual rainfall of 964 mm. Debre Birhan has five sub-cities and 39 kebeles, including 21 urban and 18 peri-urban kebeles.

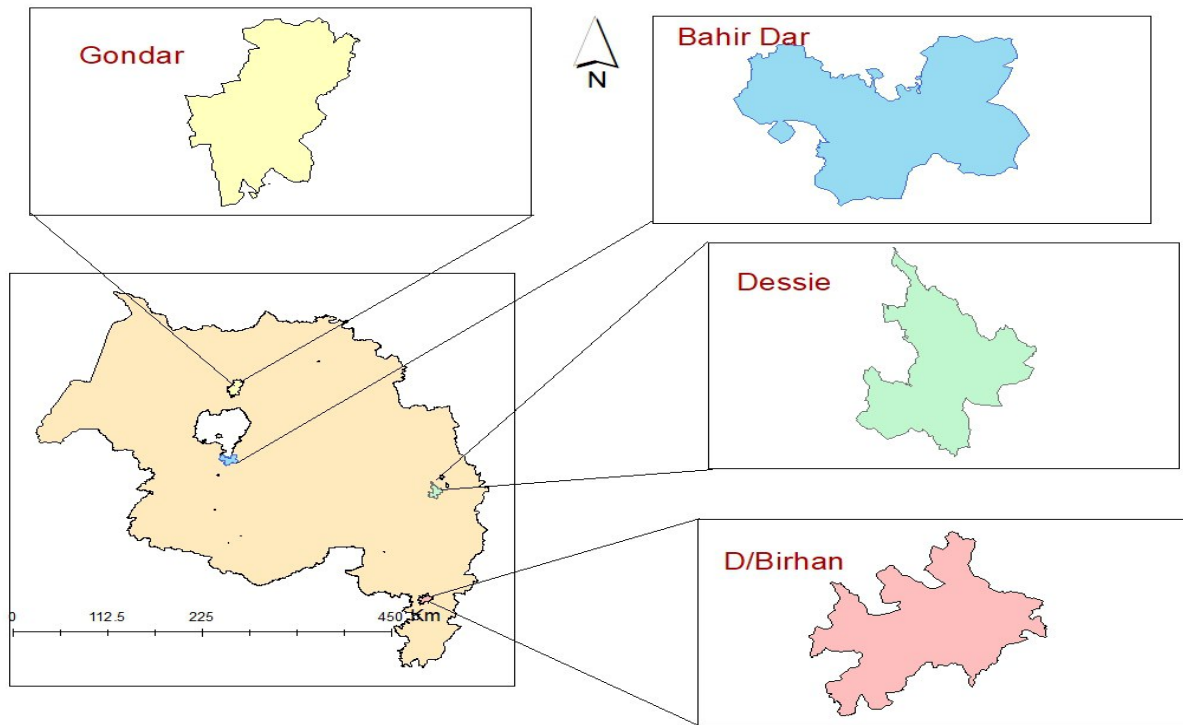


Figure 1: Map of the Study Cities

3.2. Data Collection

This study employed both primary and secondary data. Primary data were collected using semi-structured questionnaires targeting urban producers, processors, traders, and consumers. Qualitative survey methods, including key informant interviews and focus group discussions, were used to gather in-depth insights.

To ensure that participants in the key informant interviews possessed adequate knowledge of urban agricultural systems, a snowball sampling technique was employed. Key informants were selected based on their expertise and involvement in urban agriculture. The selection criteria included agricultural specialists in fields such as agronomy, horticulture, irrigation, and extension services for the crop and horticulture sectors, as well as experts specializing in fattening, dairy, poultry, forage management, and beekeeping for livestock sectors.

Producers were chosen from three sub-cities to capture diverse experiences and perspectives on urban agriculture practices. Furthermore, key informants representing consumers and processors were included to provide insights into the market dynamics and consumption patterns of urban agricultural products.

To facilitate the focus group discussions, a manageable number of 7 to 10 producers, farm owners, and practitioners were selected for each focus group discussion (FGD). A total of 24 FGDs were conducted, with six sessions held in each of the four selected cities. Structured checklists guided the discussions, which were moderated by the researchers. Field observations supplemented the qualitative data collection process by providing direct insights into existing urban agriculture practices and challenges in the study area.

3.3. Sampling and Respondent Selection

Key informant data were collected using checklists tailored to each respondent category, including agricultural experts, producers, consumers, and processors, to ensure comprehensive coverage of urban agricultural production, challenges, opportunities, market dynamics, and stakeholder perspectives.

In-person interviews were conducted with key informants at their convenience. A total of 244 urban households participated in key informant interviews. Table 1 presents the sample size of the key informant participants categorized as agricultural experts, producers, traders, processors, and consumers. Agricultural experts and consumers were not included in the key informant interviews conducted in Debre Birhan.

Table 1: Sample Size of the Study

KKI	Bahir Dar	Gondar	Dessie	Debre Birhan
Agriculture experts	12	9	8	
Producers	41	30	17	31
Traders	5	14	6	11
Processors	6	4	3	4
Consumers	20	13	10	
Total	84	70	44	46

3.4. Data Analysis

A mixed-method approach was employed to analyze the qualitative data collected in this study. Information obtained from key informant interviews was transcribed, coded, and analyzed using triangulation techniques to ensure reliability and depth. This analytical process was critical for identifying common themes and patterns, categorizing textual data, and interpreting participants' experiences and perspectives.

To achieve a comprehensive understanding of the potential, practices, challenges, and opportunities within the urban agriculture sector, the following data analysis methods were utilized:

- **Thematic Analysis** – Used to identify recurring themes related to urban agricultural systems, constraints, and stakeholder perspectives.
- **Content Analysis** – Employed to systematically classify qualitative data, allowing for objective interpretation of responses.
- **Narrative Analysis** – Applied to assess personal accounts and lived experiences shared by stakeholders, capturing insights into urban agriculture practices.

The data analysis aimed to uncover valuable insights and perspectives, contributing to an in-depth understanding of urban agricultural production and market dynamics. The use of structured checklists in key informant interviews facilitated a detailed exploration of stakeholder views, enhancing the depth and richness of the findings.

4. Key Findings

4.1. Farming System of the Study Areas

Urban agricultural practices in the study cities predominantly involve small-scale farming, which remains non-mechanized and serves both household consumption and commercial purposes. The agriculture bureau primarily emphasizes crop production at small and medium scales, encouraging micro and small enterprises to engage in horticulture production, including vegetables, fruits, and coffee farming. These activities are conducted in backyards (home gardens) and field areas designated for urban farming.

The major fruit and vegetable crops cultivated in the selected cities include tomatoes, lettuce, Swiss chard, papaya, avocado, coffee, bananas, onions, kale, cabbage, mangoes, and apples. Dessie City is notable for its green maize production, which serves as a dominant cereal crop. In addition to horticultural production, livestock farming, including dairy, poultry, fattening, and aquaculture, constitutes a significant urban agricultural practice. These activities are highly encouraged and offer promising opportunities for job creation, particularly among youth and individuals seeking economic stability.

4.2. Urban Crop Farming Systems

4.2.1. Production and Productivity

Urban farmers cultivate a diverse range of horticultural crops, including lettuce, kale, tomatoes, cabbage, onions, Swiss chard, and potatoes, alongside fruit crops such as mangoes and avocados. In Bahir Dar City, spice crops like turmeric and cardamom, as well as coffee, are also grown. In Debre Birhan City, the most commonly cultivated crops are kale (8.4%), apples (16.6%), and carrots (75%). Other crops, such as Swiss chard, lettuce, potatoes, and garlic, are grown on a smaller scale, with carrots emerging as the dominant root vegetable, covering land areas ranging from 0.06 to 3 hectares. Among urban crops, vegetables such as lettuce, kale, tomatoes, cabbage, and Swiss chard hold the highest share in terms of production and productivity.

Urban farming in these cities is predominantly small-scale, with landholdings ranging from 0.01 to 0.25 hectares. Most farmers rely on traditional agricultural methods, which are deeply rooted in local knowledge and passed down through generations. However, urban agriculture faces severe challenges, including:

- **Limited land availability**, restricting expansion opportunities.
- **Insufficient capital investment** hinders large-scale farming operations.
- **Urbanization pressures**, where agricultural lands are repurposed for residential development, exacerbate food security concerns.

Due to these constraints, urban agricultural productivity remains low in the Amhara Region. The major contributing factors include:

- **Limited access to quality agricultural inputs**, such as improved seeds, compost, and fertilizers.
- **Suboptimal farm management practices** result in inefficient resource utilization.
- **High prevalence of pests and diseases**, significantly reducing crop yields.

A noticeable difference exists in productivity levels among producers due to variations in expertise in crop management, integrated pest control, and access to agricultural technologies. Notably, horticultural crops are particularly vulnerable to plant diseases and pests that substantially affect their growth and productivity. Addressing these challenges requires targeted interventions, including:

- **Farmer training programs** to enhance agronomic and pest management skills.
- **Improved access to quality inputs**, ensuring sustainable production.
- **Strengthened pest and disease control strategies**, mitigating crop losses and improving overall yield.

Table 2 presents an overview of productivity of some crops in the studied cities, highlighting the variations in horticultural output.

Table 2: Productivity of Some Crops (Secondary data from office)

Crop type	Productivity (Qt/ha)	
	2014	2015
Carrot	157	-
Swis chard	140	145
Beetroot	178	165
Potato	280	180
Tomato	300	280
Lettuce	130	125
Cabbage	303	303
Corn	50	
wheat	13	
Tef	13	

Vegetable and Coffee Production

Urban farmers in major cities of the Amhara region primarily cultivate vegetable crops such as lettuce, kale, tomatoes, cabbage, and Swiss chard. The preference for these crops is largely driven by their short life cycles, which allow for multiple harvests per year, providing farmers with a consistent and reliable income stream. The ability to produce and market these vegetables year-round helps stabilize farmers' cash flow, making their operations more resilient to market fluctuations and seasonal variations.

Beyond vegetable cultivation, coffee production is also a significant urban agricultural activity. However, coffee productivity per hectare varies considerably among farmers, primarily due to differences in management practices. Variability in input application, soil fertility management, and cultivation techniques contribute to disparities in coffee yield.



Figure 2: Vegetable, Fruit, and Spice Crops Produced in the Studied Cities

4.2.2. Management Practices in Urban Crop Farming

Urban agriculture in and around Bahir Dar, Debre Birhan, Gondar, and Dessie cities predominantly focuses on horticultural crops and livestock production, with limited instances of cereal and pulse production conducted using traditional methods.

Most agricultural activities in these areas rely on irrigation, although some farmers integrate rain-fed practices. The irrigation techniques employed are primarily conventional, characterized by flood irrigation. Land preparation is commonly carried out using oxen or manual digging, while planting is performed manually through direct seeding and hand transplanting of seedlings. Most vegetable crops undergo seedbed preparation, except carrots.

Pest and disease management relies predominantly on chemical applications, which are selected based on individual farmers' experiences rather than expert recommendations. This absence of structured advisory support highlights the need for evidence-based guidance in chemical selection and application.

Input Sourcing and Challenges in Urban Farming

Key informant interviews indicate that urban farmers predominantly source their agricultural inputs through informal channels. The primary inputs utilized include seeds, fertilizers (both inorganic and organic), agrochemicals for pest and disease management, as well as essential resources such as water and land. This heavy reliance on unregulated supply chains and personal experience underscores the necessity of structured advisory services and institutional support to enhance urban agricultural productivity.

Beyond horticultural crops, farmers in Debre Birhan cultivate wheat and barley in peri-urban areas. However, these farmers are classified as rural producers rather than urban agricultural practitioners, as their farming methods align more closely with conventional rural agriculture. Consequently, the present survey focuses exclusively on individuals actively involved in urban agriculture within the main city limits. Within urban agricultural settings, nearly all respondents practice farming for both commercial and subsistence purposes, with over 95% of their produce being sold in local markets.

In Gondar and Dessie, urban agriculture incorporates both improved and traditional seed varieties, with farmers cultivating horticultural crops such as onion, potato, carrot, head cabbage, and beetroot. Despite the availability of improved vegetable seeds, germination rates remain suboptimal, and expired seeds are occasionally distributed by traders, leading to inefficiencies in production. Due to limited access to improved seed varieties, local seeds continue to be widely used. Seedlings are procured from various sources, including individual farmers, government-operated nurseries, cooperatives, and self-saved seed stocks.

However, vegetable seed varieties, predominantly acquired through traders sourcing from Addis Ababa, often fail to meet farmers' preferences. Persistent concerns regarding seed quality, including low germination rates, purity inconsistencies, and rising costs, represent significant challenges in urban farming.

In both Gondar and Dessie, horticultural crop seeds are primarily supplied by merchants who source them from Addis Ababa. However, the varieties available often fail to align with farmers' preferences, exhibiting inconsistencies in quality and significant price fluctuations over time. Limited availability further exacerbates procurement challenges. The Amhara Regional Agricultural Office and seed enterprises provide cereal crop seeds, while farmers commonly retain seeds for the next cropping cycle, particularly for cereal crops and potato tubers.

Several factors influence seedling quality, including the production season, household management practices, and land suitability for seedling cultivation. Many seedlings exhibit poor quality due to the absence of improved varieties, inadequate management practices, and shortages of essential inputs such as water and fertilizers. Seedling prices, determined by producers, vary and often increase over time due to market dynamics. Additional input-related challenges include the considerable distance of seed enterprises from Dessie, rising seed costs, limited availability of improved seeds, and insufficient access to high-quality pesticides.

In Debre Birhan, agricultural inputs, including seeds, fertilizers, pesticides, and herbicides, play a fundamental role in urban farming. An assessment revealed that farmers primarily source seeds from local markets, often unaware of whether the varieties are improved or traditional, as purchasing decisions are based on availability rather than informed selection. Commonly mentioned carrot varieties include "Top" and "Baker," though many respondents were unable to recall other seed names. The key concerns cited by farmers include high seed costs and limited availability during planting seasons. Only a few home gardeners receive free seeds from the city agriculture office. Besides, certain carrot varieties were identified as suboptimal, particularly those producing fibrous roots that affect their desirability for consumption.

Fertilizers Accessibility

Urban farmers in Bahir Dar utilize both inorganic and organic fertilizers, though inorganic options such as Urea and NPS are primarily obtained from informal markets due to the absence of legal suppliers or cooperatives. This unregulated access results in elevated costs and supply inconsistencies.

Organic fertilizers are typically sourced from local livestock farms, with poultry waste being regarded as high-quality, whereas liquid organic fertilizers are often considered ineffective. Despite the availability of inorganic fertilizers, transportation and packaging expenses remain prohibitively high.

In Gondar, organic fertilizers are the predominant choice among farmers due to the high cost and limited accessibility of inorganic fertilizers. Farmers produce their own compost and manure using locally available materials, though quality variations arise from differences in individual expertise. While organic fertilizers are generally cost-effective, challenges include sourcing adequate raw materials and managing their bulkiness during application.

In Debre Birhan and Dessie, chemical fertilizers are supplied primarily by traders and government agencies. Approximately 33% of farmers prefer locally available organic fertilizers and refrain from using chemical alternatives. While individual farmers experience high input costs from private dealers, enterprises benefit from lower government-regulated rates, leading to significant price disparities. This price imbalance highlights the necessity of policy adjustments to establish fair pricing mechanisms for all farmers.

Agrochemicals Accessibility

In Bahir Dar, urban farmers obtain agrochemicals from licensed suppliers and local markets; however, concerns persist regarding product quality, efficacy, and improper application without expert guidance.

In Debre Birhan, approximately one-third of farmers avoid agrochemicals due to health concerns, while others rely on agrochemicals for pest and weed control, typically purchasing products from costly traders. Many agrochemicals, particularly herbicides, exhibit quality inconsistencies and reduced effectiveness.

In Gondar and Dessie, pesticides serve as primary pest and disease management tools, predominantly sourced from local traders. However, high costs render them unaffordable for many farmers. Issues related to product expiration, improper storage, and quality degradation frequently compromise effectiveness. Farmers often pay premium prices for more effective pesticides, but low-cost options frequently fail to meet expected standards. Additional concerns include chemical residue accumulation on crops and the sale of expired agrochemicals by traders, which may negatively impact seedling viability. In Dessie, Ambasel serves as an additional source of agrochemicals.

Land Accessibility

Land availability remains a fundamental determinant of urban agricultural productivity. In Bahir Dar, land for urban farming is acquired through private ownership, rentals, familial transfers, and temporary government allocations, particularly for organized youth initiatives. Access to irrigation significantly enhances land productivity; however, many farmers express frustration with the city administration due to the lack of formal recognition and certification for their agricultural activities.

In Gondar, urban farmers encounter substantial challenges related to land scarcity, exacerbated by rapid urbanization and population expansion. Meanwhile, in Dessie, urban agriculture relies on various land acquisition mechanisms, including ownership, rental, sharecropping, and leasing agreements. Farms demonstrate strong production potential when improved seedlings are utilized. Pre-urban areas, as noted in official records, have an average of 0.25 hectares of irrigated land, whereas agricultural activities within core urban regions typically occur on smaller plots obtained through rental or lease arrangements. Sharecropping remains a common practice in peri-urban areas. High leasing costs and the absence of designated urban farming areas further constrain agricultural development. City administrators often prioritize land allocation for public infrastructure, including sports complexes, governmental institutions, schools, and office buildings, over urban agricultural areas.

Irrigation and Water Sources

Urban agriculture in the major cities of the Amhara region occurs year-round, supported by irrigation water and seasonal rainfall. This continuous cultivation strengthens food security and fosters economic growth by ensuring a steady supply of fresh produce to urban populations. The findings highlight the critical role of sustainable water management practices, as reliable irrigation access is vital for sustaining urban agriculture in rapidly expanding cities.

In Bahir Dar, farmers benefit from Lake Tana and the Abay River, which provide essential irrigation sources for uninterrupted crop production. Even farmers without direct access to the Abay River utilize irrigation pits, which store and regulate water availability during dry periods, ensuring consistent horticultural output. Despite the abundant water resources from the Nile and Lake Tana, the city lacks modern irrigation infrastructure. Consequently, farmers rely on fuel and motor pumps, incurring unnecessary costs and suboptimal water management.

Similarly, in Gondar and Dessie, small and medium-sized rivers supplement natural rainfall, supporting irrigation needs. Farmers also employ rainwater harvesting techniques, enabling year-round agriculture despite seasonal variations in water availability.

In Gondar, urban agriculture depends on rivers, springs, and rainfall, with most farmers using river water for fruit and vegetable cultivation through flooding or furrow irrigation. The city benefits from four perennial rivers, 25-30 springs, and groundwater reserves that support year-round farming. However, a lack of irrigation canals and coordinated production schedules limit farmers' access to river water, reducing agricultural productivity and employment opportunities. Furthermore, water quality remains a concern, as irrigation sources are often untested for safety. Farmers face challenges such as pollution, seasonal water shortages, and inefficient water use, further constraining sustainable agricultural practices.

In Dessie, urban farmers primarily depend on tap water, though rainfed systems remain prevalent. Some temporarily utilize river and spring water until these sources dry up. Flooding and furrow irrigation methods are widely practiced, with broad-based furrows commonly used to channel water from the Berreyesa River or municipal taps for home gardens. However, high water pump costs, fuel expenses, accessibility limitations, and general water shortages pose significant challenges.

Like Gondar, Dessie has three perennial rivers, 32 springs, and underground water reserves that could support year-round cultivation. However, underdeveloped irrigation systems hinder efficient water use, with few farmers able to directly access river water due to the lack of canals and structured production schedules. Limited investment in irrigation infrastructure restricts urban agricultural productivity and reduces employment opportunities. While the widespread use of tap water minimizes water quality concerns, sedimentation and pollution from waste disposal remain persistent challenges.

Labor Availability

Labor in urban farming is primarily provided by family members, with occasional reliance on hired labor. However, many laborers lack formal agricultural training, depending instead on traditional practices. Secondary data indicates approximately 100 casual laborers engaged in urban agriculture, comprising 60 skilled and 40 unskilled workers. Labor availability fluctuates seasonally, with daily wages ranging from 150 to 300 birr. Seasonal labor shortages and the varying skill levels of workers pose challenges to the efficiency and sustainability of urban farming.

Table 3: Major Input Sources in the Studied Cities

Input Type	Major Source	Availability	Price Trend	Quality	Related Problems
Seed	Market, traders, farmers, local seed collectors, own sources	Available	Increasing	Good	Low germination, high price, seed mixing
Inorganic Fertilizer	Legal market, black market	Not available	Increasing	No significant quality difference	High price, insufficient supply
Organic Fertilizer	Farmyards	Available	Increasing	Good, except for liquid fertilizer	Rising cost, liquid fertilizer is ineffective
Chemical Inputs	Market, traders	Available	Increasing	Not uniform	High price, inconsistent quality and supply
Water	Rainfall, tap water, rivers (Nile, others), lakes (Tana, others), groundwater, springs	Available	Only fuel cost for pumping	Good	High fuel costs, lack of modern irrigation infrastructure
Labor	Hired labor, family labor	Available	Increasing	Mostly unskilled	Seasonal availability, rising labor costs
Land	Rented, sharecropping, leased, owned, family holdings, government allocations	Not available	High rent price	Fertile	No legal certification for urban agriculture land

4.2.3. Major Constraints in Urban Crop Farming Systems

The production and productivity of horticultural crops in urban areas face numerous constraints, including biotic factors (disease and insect pests), abiotic factors (frost and shade), and input supply limitations. Key challenges include shortages of improved seed varieties, chemical fertilizers, water pumps, modern irrigation facilities, and adequate land for cultivation. Additionally, skill gaps in pesticide application, inconsistent agricultural input availability, inadequate extension services, limited access to capital, weak market linkages, and restricted irrigation access further hinder urban agricultural productivity. Other contributing factors include insufficient modern agricultural tools and facilities, a lack of training programs and experience-sharing initiatives focused on technological applications, unavailability of credit services, and inadequate technical support from agricultural offices and related organizations.

These constraints contribute to substantial yield gaps in the production of horticultural crops such as lettuce, kale, tomato, cabbage, onion, Swiss chard, and potato. Fruit crops—including mango, avocado, guava, and coffee—also experience productivity challenges due to these factors. While most farmers perceive themselves as productive because they generate income through farming, others recognize lower yields compared to their peers due to skill deficiencies and high input costs. Addressing the challenges of urban agriculture in the major cities of the Amhara region requires a multi-faceted approach involving collaboration among government authorities, urban farmers, non-governmental organizations, and other stakeholders. This effort must focus on developing supportive policies, providing technical assistance and training, and improving resource access to strengthen urban agricultural systems. The primary challenges include:

Land Availability and Tenure Security: Urban agriculture is constrained by limited land availability, as competition from housing and commercial development restricts farmers' access to suitable agricultural plots. Additionally, insecure land tenure—where urban farmers lack formal ownership or tenancy rights—discourages investment in farming and restricts access to credit and essential resources.

Water Access and Irrigation Constraints: Water scarcity remains a significant barrier, particularly in Bahir Dar. Urban farmers often struggle to secure adequate water for irrigation, leading to reduced crop yields and limited agricultural productivity. In many cases, irrigation infrastructure is underdeveloped, preventing farmers from efficiently utilizing available water resources.

Limited Access to Agricultural Inputs and Financial Support: Urban farmers face difficulties in acquiring essential agricultural supplies such as seeds, fertilizers, and equipment. Urban agriculture often receives less policy attention and resource allocation compared to rural farming, further limiting input availability. Access to credit is also constrained, preventing farmers from investing in their operations or scaling their businesses. Additionally, technical assistance—including training and best-practice guidance—is often insufficient, leaving farmers without the necessary knowledge to optimize production methods.

Lack of Supportive Policies and Institutional Frameworks: Urban agriculture is frequently overlooked by local governments, resulting in a lack of formal recognition, regulatory frameworks, and supportive policies. Without institutional backing, urban farming initiatives struggle to establish sustainable production systems.

Climate Change and Environmental Challenges: Increasingly frequent and severe weather events—such as droughts and floods—pose significant risks to urban agriculture. Farmers often lack the necessary adaptation strategies to cope with these unpredictable climatic conditions, making it difficult to maintain stable production levels.

Pest and Disease Management Issues: Managing pests and diseases is a recurring challenge for urban farmers due to limited access to pesticides and veterinary medicines. A lack of knowledge regarding integrated pest management practices exacerbates these difficulties, leading to crop and livestock losses.

Urban farmers in Bahir Dar City contend with significant pest infestations affecting both vegetable and fruit crops. Key vegetable pests include fruit borers, leaf miners, aphids, whiteflies, and thrips. Karate is the most commonly used chemical for managing these insect pests. However, the repeated and inappropriate use of a single pesticide can lead to resistance development and pest resurgence, exacerbating long-term control challenges.

Beyond vegetable pests, urban farmers also struggle with fruit crop infestations. Mango white scale and Persia mite are the primary insect pests affecting mango and avocado production, respectively. At present, farmers lack management strategies for these pests, leading to uncontrolled population growth. The incidence and severity of Mango white scale and Persea mite infestations are nearing 100%, forcing many farmers to uproot mango and avocado plantations due to extensive damage.

Coffee production also faces significant challenges from damping-off disease, coffee leaf rust, and coffee berry disease (CBD). In response, farmers are transitioning from local coffee varieties to improved, disease-resistant cultivars to mitigate disease incidence and severity. Alongside varietal improvements, agronomic practices are being adopted to further suppress coffee disease outbreaks and enhance crop resilience.

Infrastructure Deficiencies: Basic infrastructure, including storage facilities, markets, and transportation networks, is insufficient in major cities, hindering the efficiency and profitability of urban farming operations.

Socio-Economic Barriers: Urban farmers often face economic and social challenges such as poverty, limited educational opportunities, and restricted access to profitable markets. These factors reduce their ability to invest in their farms, adopt improved agricultural practices, and increase their earnings.

Land Use Conflicts and Competing Interests: Urban areas frequently experience conflicts between agricultural land use and competing interests such as housing, industry, and commercial development. In Bahir Dar, urban farmers struggle against pressures from other sectors that threaten their ability to continue farming in urban settings.

Table 4: Summary of Urban Agriculture Challenges in the Studied Cities

Rank	Challenges	Causes	Effects	Suggested Solutions	Available Opportunities	Responsible Organizations
1	Perception of Agriculture	Agriculture is not widely seen as a business	Increased food insecurity	Awareness campaigns and education	Training, field visits, and experience-sharing programs	BoA, Research System, Universities
2	Unclear Extension System	Existing extension approach is poorly understood	Inefficient technology adoption	Establishing a clear extension framework	Identifying the most suitable extension model for the country	Agricultural offices (Federal to City Administration)
3	Knowledge & Skill Gaps Among Development Agents (DAs)	Limited focus on capacity building for urban agriculture	Poor promotion and adoption of agricultural technologies	Capacity-building initiatives for experts	Structured training programs	BoA, Research System, Universities
4	Limited Access to Improved Seeds	Lack of seed dealers, weak support from government and NGOs	Reliance on lower-quality varieties	Multiplying enough amount of improved seeds through research stations, seed multiplier agencies, and cooperatives	Government and NGO support for seed production cooperatives	Research System, Universities, NGOs
5	Market Linkage Issues	Brokers, price fluctuations, occasional lack of buyers	Disruptions in agricultural trade	Government intervention to regulate market intermediaries	Focus on quality products to attract stable buyers	Government
6	Climate Change Challenges	Poor sustainable land management practices	Reduced crop productivity	Crop rotation and climate-adaptive strategies	Integrated climate-smart agriculture practices	Research System
7	Irrigation Water	Lack of sufficient irrigation infrastructure, arid conditions	Limited water access for cultivation	Construction of irrigation infrastructure	Constructing canals to improve water distribution	Agricultural offices

4.2.4. Strategic Interventions for Urban Crop Farming Systems

Urban agriculture serves as the backbone of food production for urban populations, providing fresh produce despite limited space and high population densities. Urban horticulture plays a pivotal role in addressing food security, nutrition, and environmental sustainability in rapidly growing cities. A strategic approach to urban horticultural crop production and consumption requires several key interventions, outlined below.

4.2.4.1. Innovative Growing Techniques for Space Optimization

Advancing cultivation methods is essential for maximizing space efficiency and ensuring a continuous food supply in urban environments:

- **Vertical Gardening:** Utilizing walls, trellises, or stacked containers to optimize land use.
- **Hydroponics:** A soilless method delivering nutrients through water, promoting faster plant growth while conserving water.
- **Aeroponics:** Suspending plants in the air and providing nutrients via misting, significantly reducing water consumption.
- **Aquaponics** – A system that combines fish farming with plant cultivation, where fish waste provides nutrients for plants, creating a self-sustaining ecosystem.
- **Rooftop Gardening:** Converting rooftops into productive green spaces to mitigate urban heat and improve air quality.

4.2.4.2. Sustainable Soil and Water Management

Maintaining soil health and efficient water use is crucial for urban horticulture sustainability:

- **Soil Fertility Enhancement:** Applying organic compost, bio fertilizers, vermicompost, and crop rotation to sustain productivity and reduce dependence on synthetic fertilizers.
- **Water Conservation Strategies:** Implementing drip irrigation, rainwater harvesting, and greywater recycling to optimize resource use.

4.2.4.3. Waste Management and Environmental Integration

Urban horticulture contributes to environmental resilience through waste management and ecosystem integration:

- **Composting and Organic Waste Recycling:** Transforming food waste into bio-fertilizers supports soil health and minimizes environmental impact.
- **Urban Green Spaces:** Integrating horticultural plots into city planning reduces carbon footprints, enhances biodiversity, and improves air quality.

4.2.4.4. Community Engagement and Social Inclusivity

Strengthening local engagement is vital for ensuring equitable access to urban horticultural benefits:

- **Home and Community Gardens:** Encouraging urban residents to participate in horticultural projects fosters food security and community resilience.
- **Equitable Access to Resources:** Policies promoting land allocation for urban farms enhance inclusivity and social cohesion.
- **Educational Initiatives:** Providing training programs on sustainable practices empowers communities and strengthens urban agricultural knowledge.
- **Market Integration and Economic Viability:** Supporting local farmers with subsidies, financial incentives, and direct producer-consumer networks fosters economic sustainability.

4.2.4.5. Food Safety and Policy Implementation

Ensuring food safety and effective governance is critical for sustainable urban horticulture:

- **Contaminant Mitigation:** Conducting soil and water quality assessments reduces exposure to pollutants.
- **Integrated Pest Management:** Promoting organic alternatives minimizes synthetic pesticide overuse.
- **Post-Harvest Optimization:** Improving storage, handling, and preservation techniques enhances food quality and safety.
- **Regulatory Frameworks:** Establishing clear urban agricultural policies supports infrastructure development, financial incentives, and land allocation.

4.3. Urban Livestock Farming Systems

Population growth, urbanization, and rising incomes are driving a significant increase in demand for livestock products. This trend is especially pronounced in developing countries, where demand for animal products is growing faster than in developed countries. As Africa's urban population grows at an annual rate of 6.9%, contributing more than 3.1% to the overall population increase in Sub-Saharan Africa (World Bank, 2017), the demand for animal products is expected to continue rising.

Urban agriculture is becoming a crucial component of the local food systems of Ethiopian cities, aligning with global trends. According to the FAO (2020), meat and milk consumption are projected to increase by 1.3 million and 5.0 million tons, respectively, between 2015 and 2050. By 2050, urban consumers are projected to account for approximately 51% and 54% of total meat and milk consumption, respectively, up from the current levels of 27% and 32%. A significant portion of this demand is met through urban livestock production, emphasizing the need for greater attention in this sector.

Dairy farming, poultry production, sheep rearing, and cattle fattening are the predominant livestock practices in the major cities of the Amhara Region. Consequently, this assessment focuses on major livestock species, providing a comprehensive analysis of their production dynamics. While fisheries and aquaculture are not widely practiced across all cities, some water bodies in Debre Birhan support fish farming and aquaculture techniques have been employed in Bahir Dar, particularly during the fasting season.

Dairy production has been the dominant form of animal farming in the region's major towns for over five decades. Crossbred dairy cattle (Holstein × Local) are prevalent across farms and primarily raised for commercial purposes. While a few dairy farms operate as sideline activities, the majority serve as primary businesses, providing substantial household income.

In contrast, poultry production has historically thrived in the warmer towns of western Amhara, relying on exotic breeds. Recently, this trend has expanded to colder areas such as Debre Birhan and Dessie. Due to its short generation cycles and low investment costs, poultry farming presents an attractive business opportunity, particularly for unemployed youth and women.

Although livestock fattening is more suited to warmer climates like Bahir Dar and Gondar, sheep and cattle fattening remain popular supplementary income sources in Debre Birhan and Dessie.

4.3.1. Urban Poultry Farming

4.3.1.1. Input supply

Feed and Water Supply: All chicken producers rely on formulated commercial compound feeds, purchased from private feed manufacturers and their distributors. The main sources of these feeds include Mulie Feed, Ethio-Chicken Feed, Alema Koudijs, and Merkeb Union. Despite high prices, feed quality and availability are not significant concerns within the city.

Tap water serves as the primary water source for chicken production, though some producers occasionally purchase water from local suppliers. While water quality remains acceptable, seasonal shortages during the dry season pose a challenge.

Various types of feed are used depending on the production system. For layers, feed types include starter, rearing, pullet, and layer feed, whereas broilers are typically fed starter and finisher feed. These feeds come in two forms—mash and pelleted—both of which are readily available from feed companies, retailers, and traders. Producers provide feed twice a day, dividing the daily ration into two portions to ensure proper nutrition. Additionally, all producers utilize feeders and water equipment to maintain efficient flock management.

Breed and Breeding Stock: In Ethiopia, all layer, broiler, and dual-purpose parent stocks are imported and handled by private entities, public-private partnerships—such as the Ethio Chicken Breeding Company—and government breeding institutions, including the Andassa Livestock Research Center and the Debre Zeit Agricultural Research Center. The primary broiler breeds in the study area include Cobb-500, Hubbard, and Ross 308, with Cobb-500 being the dominant breed utilized in broiler production. Similarly, Bovans Brown is the region's most popular layer breed for egg production. In addition, dual-purpose breeds—primarily Sasso and, to a lesser extent, Koekoek—are utilized for meat and egg production.

There are no companies in the study area engaged in the production or maintenance of grandparent stock. However, the Andassa Livestock Research Center (ALRC) maintains a pure line of Potchefstroom Koekoek, with a population of approximately 1,200 birds, which avoids the requirement for frequent imports of Koekoek parent stock.

Sasso and Bovans Brown are the preferred breeds among out-growers and play a dominant role in city-administered egg production across all production systems. The Ethio Chicken Breeding Company is the primary supplier of both breeds. Male Sasso chickens are favored by some producers for meat production, particularly for sale during Christian holiday markets. Meanwhile, Koekoek remains a secondary choice, with limited adoption among out-growers, who rear them primarily for sale at 45 days of age to farmers and other backyard producers in rural areas.

Breeding stock plays a crucial role in poultry production. In Ethiopia, parent stocks of layer, broiler, and dual-purpose chicken breeds are found in Ethio Chicken and Alema Koudijs Private Limited Companies, as well as government breeding centers such as the Andassa Livestock Research Centre (ALRC) and the Debre Zeit Agricultural Research Centre (DARC). However, these government breeding centers did not have the grandparent stocks, which are crucial for the breed's multiplication and distribution.

Ethio Chicken and Alema Koudijs supply Sasso, Lohmann Brown, and Bovans Brown day-old chicks (DOC), whereas ALRC and DARC provide Potchefstroom Koekoek DOC. Private companies deliver DOC within three to six months upon payment in Ethiopian Birr through commercial banks, while ALRC and DARC distribute Potchefstroom Koekoek DOC within one month. Ethio Chicken and ALRC are 20 kilometers from Bahir Dar, on the road to Chis Abay, while Alema Koudijs and DARC are located in Debre Zeit, almost 600 kilometers from Bahir Dar.

In Debre Birhan town, Bovans Brown and Sasso breeds dominate commercial poultry production. Bovans Brown is highly productive, making it ideal for intensive farming, whereas Sasso is less productive and more appropriate for extensive production systems.

Day-old chicks are sourced from Wolkite, Adama, and Bishoftu, where they are raised by private and enterprise-owned urban farms. At 45 days old, Sasso pullets and cockerels are sold to smallholder farmers for extensive rural poultry production, whereas Bovans Brown is supplied to intensive private and enterprise farms for urban livestock production.

Access to Farmland and Legal Status: Access to land is a fundamental requirement for urban chicken production. However, obtaining land from the government for investment is highly bureaucratic, with requests often taking three to seven years to process. Producers secure land through three primary ways: small enterprise sheds, investment via lease holding, and direct purchasing. The majority of urban chicken farms operate within rental houses or residential compounds, as no dedicated land has been allocated for poultry farming. The existing farms are often unsuitable for efficient production.

Small enterprises provide sheds to chicken producers, granting them ownership for 15 years. However, the temporary nature of land possession discourages producers from expanding or modifying chicken housing infrastructure. Urban chicken farms function either within residential compounds or as separate farms located away from housing areas.

In Debre Birhan town, both small-scale and large-scale chicken farms operate.

- Small-scale (village) poultry production consists of fewer than 10 chickens, primarily for household consumption, with occasional sales to generate income.
- Large-scale poultry farms maintain between 300 and 1,500 chickens, producing broilers and eggs for commercial purposes.

Large-scale production is classified into two categories:

1. **Non-legally recognized farms:** These operations lack formal legal status and access to designated land, relying instead on family-owned properties.
2. **Enterprise-based farms:** These are legally registered entities with temporary access to government-owned sheds for a period of five years. The sheds, constructed and owned by the government, are recycled among new enterprises until they accumulate sufficient capital to invest in permanent infrastructure.

These government-constructed sheds are clustered within a single compound, maintaining only 10-meter spacing between units. This arrangement restricts enterprises from implementing proper biosecurity measures, posing risks to poultry health and production efficiency.

Access to Capital and Credit Services: Chicken farms rely on start-up financial capital primarily sourced from personal savings, donations from relatives and friends, and borrowing. Access to credit services is essential for commercial poultry production, particularly for youths and financially disadvantaged groups seeking to enter the industry. However, commercial banks require collateral—typically urban houses or other fixed assets—to issue loans, making access to credit challenging. Additionally, high interest rates further limit financial accessibility for producers.

The Development Bank of Ethiopia is a public financial institution responsible for advancing national development priorities through financing prioritized agricultural development projects. According to interviewees, however, the bank provides credit services for sesame and haricot bean commercial farms in Ethiopia's lowlands, while poultry farms remain excluded from its financing schemes. As a result, securing financial resources for both starting and expanding chicken production remains a significant constraint.

Due to the seasonal nature of poultry product markets, producers often retain their products for over a month to secure better prices. During this period, they generate no income to cover feed expenses, creating additional financial strain. Consequently, poultry farmers require sufficient capital to sustain operations and remain profitable. Many producers purchase feed on credit, repaying suppliers only after selling their products. Given these financial challenges, expanded access to capital and credit services is critical for ensuring business viability and long-term success.

Access to Extension Services: Extension services provide technical and practical guidance to poultry producers. However, many farmers lack formal training in livestock production and have expressed dissatisfaction with the support available.

Some producers have no access to extension services at all, while the limited number of experts in the city administration's livestock production office cannot adequately address the growing demand for technical assistance. Additionally, the absence of structured extension experts at the sub-city or kebele level weakens the support provided by the city livestock office.

Effective livestock extension is essential for enhancing chicken farm productivity. Experts offer guidance on housing construction, management, biosecurity, feeding, and health practices. However, interviewees and focus group discussants revealed that Bahir Dar city livestock experts visit chicken farms only once every three to six months, limiting their ability to provide consistent and timely support.

The Bahir Dar Livestock Department faces significant constraints, including a lack of vehicles and financial resources, which hinders its ability to deliver extension advisory services. Despite these challenges, most interviewees have received training on poultry production and management, primarily through non-governmental projects such as Feed the Future. Farm owners also gain knowledge through experience sharing with fellow producers and by reading poultry management manuals.

The livestock experts visit chicken farms and advise about house construction and management, biosecurity, feed, and health management issues. The interviewee and focus group discussants mentioned that Bahir Dar city livestock experts visit chicken farms once in three to six months. The Bahir Dar Livestock Department extension service is constrained by a lack of car and finance use to provide extension advisory service.

Most of the interviewees have received training about the production and management of chicken, at least once by non-government projects such as Feed the Future. The farm owners learn through experience sharing with their fellow farm owners and reading chicken production and management manuals. Group discussants and interviewees emphasized the need for additional training and experience-sharing opportunities, particularly in egg production, management, and processing—especially during fasting seasons, when market dynamics shift.

Access to Labor: Urban chicken production relies on two primary sources of labor: hired labor and family labor. Family labor consists of farm activities carried out by the owner’s family members, whereas hired labor includes both skilled and unskilled workers employed on a daily or monthly wage basis. Unskilled laborers are commonly engaged in general farm duties and serve as attendants, receiving either daily or monthly wages. Skilled labor, however, is rarely employed and is primarily utilized by large-scale farms for farm management and production monitoring.

Large-scale farms typically employ at least two unskilled laborers, with monthly wages ranging from 2,500 to 3,000 Birr. While labor shortages occur seasonally during harvest periods (October and November), there are no significant concerns regarding labor availability or wage costs in other seasons. Most large-scale farmers possess expertise in poultry production, providing orientation to their workers and supervising farm activities closely. Specific critical tasks, such as vaccination, are performed in the presence of the farm owner to ensure proper execution.

4.3.1.2. Production and Productivity in Poultry Farming

Bahir Dar City hosts 150 chicken producers, comprising 62 out-growers and 88 commercial producers. Urban and peri-urban areas of the city employ three distinct production systems: large-scale commercial farms (exceeding 10,000 chickens), medium-scale operations (ranging from 1,001 to 10,000 chickens), and small-scale farms (maintaining 500 to 1,000 chickens).

Producers are classified based on farm type and chicken age, with out-growers specializing in raising chicks from day-old to 45 days and egg producers focusing on layer production. Information regarding broiler producers remains limited, and their numbers appear relatively small. Furthermore, significant variations exist among producers concerning technological adoption, management practices, and operational scale.

Chicken farming remains one of the most prevalent urban agricultural activities despite longstanding constraints that pose challenges to production. Onsite inspections conducted during the survey indicate a continued increase in chicken production over time, demonstrating its role as a viable income source for households and cooperative groups.

4.3.1.3. Poultry Management Practices

Housing

Housing is essential to improve chicken production and productivity. It protects hens from sunlight, predators, and theft. Chicken houses are constructed using different materials such as corrugated iron sheets, cemented floors, bricks, wood, and mud. To address housing challenges for small and medium-scale enterprises, Bahir Dar's Small and Medium Enterprises Office has facilitated housing construction, allowing selected producers to access these facilities through a rigorous selection process managed by the Kebele administration.

The orientation of the constructed houses follows a north-to-south direction, which contradicts the east-to-west orientation recommended by the Amhara Region Livestock and Fisheries Development Office guidelines for optimal chicken house design. Producers employ a deep litter system for both growers and layers, utilizing locally available materials such as sagatora, straw, and grass hay for bedding. To manage different flock groups, farmers partition housing spaces for chicks, pullets, and layers using **kenda** (plastic dividers). Despite these arrangements, farmers face a scarcity of houses to expand chicken production. According to experts and interviewees, producers expect to leave the houses provided by the Small and Medium Enterprises Development Office within five years. As a result, producers are responsible for constructing their own facilities and acquiring land from the city administration. However, interviewees and group discussants highlight that securing land for chicken housing remains a critical constraint, significantly limiting the expansion of poultry production and market growth.

Feeds, Feeding, and Watering

Chicken farmers unanimously recognize feed quality as the primary determinant of productivity. Feeding management practices vary between small- and large-scale farms. Small-scale operations follow extensive production methods, supplementing commercial concentrates with grains and household leftovers in minimal quantities. Conversely, large-scale farms rely exclusively on commercially formulated feed developed for different poultry classes.

Key feed suppliers—Alema Koudijs, ELF, Ethio-Chicken, and Soliana—are based in Debre Birhan City, though their products are manufactured and transported from other towns. The added transportation costs contribute to higher feed expenses, making poultry production increasingly costly. Farmers acknowledge significant variability in both the cost and quality of feed among different processors. Due to the absence of a feed laboratory in Debre Birhan, newly introduced feed products lack quality oversight. As a result, large-scale farmers conduct preliminary evaluations using chickens or other farm animals before purchasing feed in bulk.

Farms utilize plastic water and feed troughs that are purchased from the market. However, the rising cost of these materials poses an ongoing financial challenge, with prices rising over time. Although water scarcity remains a concern, farmers report access to tap water, with no significant complaints about its price or quality.

Health Management

Chicken farming is often perceived as high-risk by livestock farmers due to the prevalence of poultry diseases. Vaccines are available at the extension office, and their administration varies depending on the delivery method. Vaccines administered via drinking water are normally delivered by farm owners, while injectable vaccines are delivered by professional private veterinarians.

Large-scale producers report no issues regarding vaccine availability. However, small-scale village farms face accessibility challenges, as vaccines are packaged for batches exceeding 50 chickens, making them impractical for smaller operations.

In cases of suspected disease outbreaks, farmers buy antibiotics from drug dealers and administer treatments to their poultry independently. Despite the informal nature of this practice, no complaints have been raised regarding the pricing or quality of chicken treatments.

4.3.1.4. Environmental Impact of Urban Poultry Farming

Chicken production generates various wastes and by-products that contribute to environmental pollution. Discarded medications, containers, and post-production litter are frequently disposed of improperly in nearby areas, causing environmental risks. Additionally, many poultry farms are situated within residential neighborhoods, leading to the emission of unpleasant odors that frequently result in community complaints and conflicts.

Due to the small number of chickens kept and the extensive production system adopted by small-scale farms, chicken litter does not pose a significant environmental challenge. However, without the adoption of intensive housing systems, the expansion of village chicken production remains impractical. Furthermore, due to a lack of knowledge and technical abilities, chicken litter is frequently thrown rather than reused, despite its potential as ruminant feed or compost material. When properly managed, chicken litter can be a valuable resource, either as ruminant feed or as a component in compost production, helping to promote sustainable farming practices.

4.3.1.5. Constraints in Chicken Production

Feed Cost Challenges: Rising feed costs represent one of the most significant constraints in poultry production, exerting substantial financial pressure on producers. Over recent years, feed prices have escalated sharply, creating difficulties in maintaining economic viability. Notably, the increase in feed prices has outpaced the growth in the market value of live chickens and their products, which have exhibited comparatively slower price increments. Historical trends over the past five years (Figures 3 and 4) illustrate a persistent rise in feed costs, prompting suppliers of day-old chicks to adjust their pricing. However, the inflationary surge in feed expenses has disproportionately exceeded the price adjustments for day-old chicks, exacerbating production costs and economic pressure.

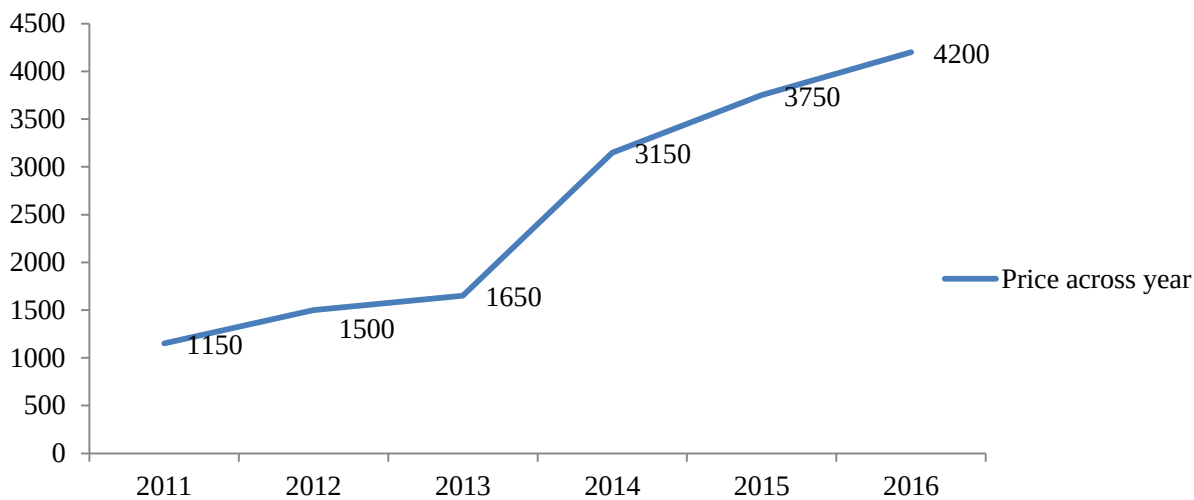


Figure 3: The Price Trend of Chicken Feed

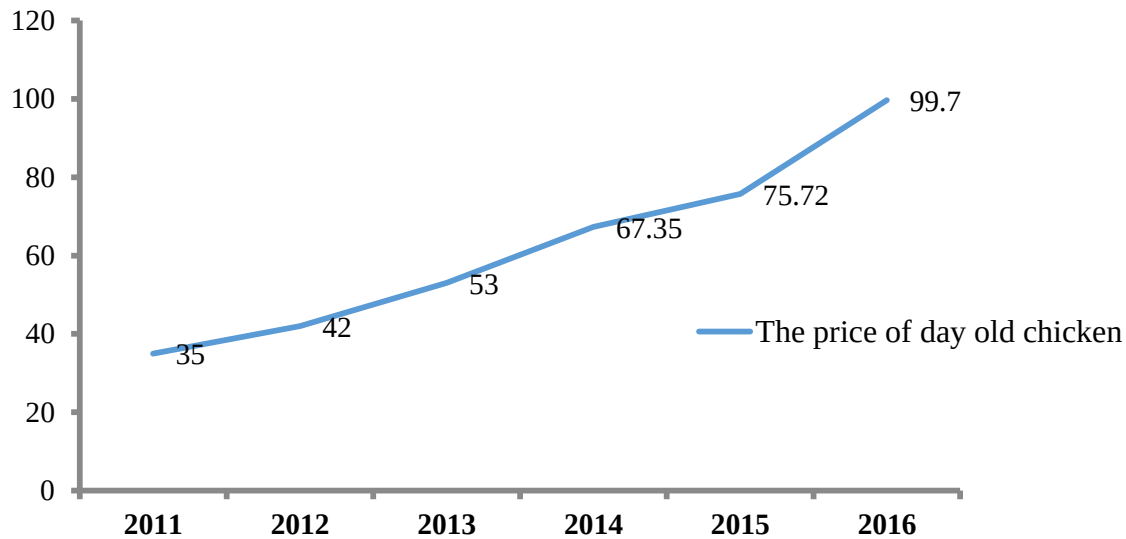


Figure 4: The Price Trend of Day-Old Chickens

Limited Access to Land: Urban poultry producers face considerable challenges in securing land for establishing or expanding their operations. Although land is available for entrepreneurs, its utilization is often restricted by time-limited leasing arrangements. These restrictions discourage long-term investment in infrastructure development and diminish the feasibility of adding value to existing production facilities.

Financial and Credit Limitations: Access to finance is crucial for poultry producers aiming to initiate or scale their operations, particularly for housing construction, procurement of day-old chicks, feed acquisition, and essential equipment such as feeders and water dispensers. However, formal financial institutions often require collateral for credit approval, posing significant barriers for producers with limited assets, thereby restricting business expansion.

Market Linkage Constraints: Efficient market access remains a fundamental challenge for out-growers and egg producers, who require structured and accessible markets near their production sites. The absence of a well-organized market system leads to additional costs due to broker fees and extended keeping periods, decreasing profitability and forcing some new producers out of business. Despite identified potential markets beyond the region, including Addis Ababa, Mekele, and Jigjiga, price volatility and decreased demand during fasting seasons hinder expansion efforts.

Lack of Insurance Coverage: Poultry production is inherently vulnerable to risks such as disease outbreaks and environmental hazards. The unavailability of poultry insurance discourages investment, restricting producers' ability to mitigate financial losses and sustain long-term business operations.

Health-Related Constraints: Urban poultry farmers encounter difficulties in accessing veterinary drugs due to rising medication costs and a shortage of trained animal health professionals. Additional challenges include limited veterinary services, insufficient public veterinary clinics, high service fees, inadequate attention to urban livestock health, weak sectoral collaboration, and the lack of disease surveillance mechanisms, particularly concerning zoonotic diseases.

Skill and Knowledge Gaps: Despite the importance of technical expertise, poultry producers often receive inadequate support from livestock extension professionals. The scarcity of trained personnel limits knowledge dissemination, leaving many producers without adequate guidance on best practices.

Infrastructure and Utility Limitations: Restricted access to essential utilities, such as clean water, electricity, and transportation networks, significantly impedes the efficiency and productivity of urban poultry farming operations.

Labor-demanding Cooking Practices: In some households, preparing chicken dishes is perceived as labor-intensive due to the substantial requirements for cooking oil, onions, and other ingredients. Consequently, demand for chicken meat tends to peak during festivals and holidays rather than being a staple in regular diets.

Training and Technology Utilization Gaps: Training programs for poultry producers are often provided only upon entry into the sector, with a primary focus on introductory guidance rather than comprehensive technical education. Many producers believed that the existing training programs lacked depth and failed to equip them with sufficient knowledge. While some farmers receive training to educate others, there is no formalized mechanism for knowledge-sharing. Large-scale farms have implemented minimal technological advancements, such as automatic water drinkers, while other modern poultry farming innovations remain underutilized. Housing structures are predominantly covered with corrugated iron sheets to protect chickens from cold weather; however, inadequate ventilation can lead to suffocation and ammonia accumulation. Incorporating ventilation systems, heating units and air circulators is essential for maintaining optimal farm conditions and preventing ammonia buildup.

Table 5: Major Constraints in Chicken Production

Constraints	Percent
Feed cost increment	30
Land access	15
Finance access	10
Poor market linkage	20
Lack of insurance	4
Lack medicaments and vaccine	8
Skill and knowledge gap	5
Limited infrastructure and utilities	3
Labor-demanding coking practices	5

Source: FGD result, 2024

4.3.2. Urban Dairy Farming

4.3.2.1. Input Supply

Access to Farmland: Land is a fundamental asset for establishing any livestock production activity. In the study area, most urban dairy producers are aware of the legal land acquisition processes. Livestock experts assess applicants based on land size, housing, skills, and operational knowledge before approving dairy farm establishment. The trade office facilitates legal registration, while the revenue authority oversees taxation procedures, including issuing tin numbers. Legal registration provides producers with essential benefits such as land access, business stability, market linkages, and operational guarantees.

However, challenges such as informal payments and high taxation rates imposed by revenue authorities hinder the licensing process, forcing many urban dairy producers into informal operations. In alignment with the findings of Abebe et al. (2021), most urban dairy producers in this study established their farms on privately owned land, though often unsuitable for dairy production due to the absence of designated land access. Consequently, acquiring land suitable for dairy operations remains prohibitively expensive. Respondents identified a lack of appropriate land access and inadequate infrastructure as the primary constraints to urban dairy production.

Land access and legal registration appear closely linked. In Debre Birhan town, dairy farms range in scale from small operations with 3–4 cows to large-scale enterprises housing up to 42 cows per farm. Small-scale farms are typically located within residential compounds, whereas medium and large-scale operations are positioned away from urban homesteads. As a result, land-related challenges vary by scale: small-scale farmers face severe land shortages, restricting their ability to operate dairy production as a primary business, while medium and large-scale farms experience fewer constraints regarding land availability.

Most medium and large-scale farms are established through government initiatives aimed at creating employment for unemployed youths and women. These enterprises follow a well-defined legal process to obtain land, though temporary ownership (five years) limits their ability to intensify production. Conversely, privately owned large-scale dairy farms benefit from permanent land allocation, making access to land less restrictive. Small-scale farms within residential compounds lack legal recognition and do not qualify for designated land acquisition.

Access to Capital and Credit Services: Access to credit is a crucial factor in establishing and expanding dairy farms, as financial institutions require collateral for loans. The availability of credit services directly impacts the profitability of livestock enterprises. Despite the presence of formal credit institutions such as Tsehay Bank, securing financing for dairy businesses remains challenging. Consequently, most urban dairy producers rely on personal savings to establish farms, which is insufficient for expansion.

Contrary to findings from Gebrekidan et al. (2014), this study indicates that urban dairy producers struggle to access formal credit services for business establishment. Similarly, Ayenew et al. (2011) reported that only 16% of dairy farms obtained credit, whereas 84% relied on personal capital for farm establishment and growth. Due to these limitations, urban dairy producers frequently resort to informal credit sources such as loans from friends and relatives to support business expansion.

The temporary nature of land ownership for large-scale dairy farmers and the lack of land access for small-scale producers discourage significant investment in farm infrastructure, thereby reducing demand for credit services. Existing capital is generally deemed sufficient for sustaining operations rather than scaling production. Only one enterprise has expressed interest in transitioning into dairy processing and requires financial support for expansion. However, high interest rates and stringent collateral requirements make credit services unattractive for most producers.

Access to Breeding Stock: Access to breeding stock is one of the most critical factors influencing the profitability of dairy farms. In the study area, Holstein Friesian crosses with local breeds are commonly used for artificial insemination. However, consistent with the findings of Welearegay et al. (2012), the exact genetic composition of these dairy cows remains unknown due to the absence of a proper recording system. This lack of documentation may hinder farm-level efforts to improve dairy cow productivity.

Unlike previous studies by Abebe et al. (2021), bull mating is not practiced among urban dairy producers in Bahir Dar City. Instead, dairy farm owners' purchase crossbred cows from Bahir Dar and nearby farms, with prices ranging from 35,000 to 250,000 ETB, reflecting a rising trend over time. Similarly, Gebreselassie (2019) identified the high cost of dairy cows as a major constraint for dairy production. While crossbred cows are relatively accessible for purchase, urban dairy producers report significant challenges in sourcing high-yielding cows for optimal milk production.

Access to Feed, Forage Seed/Seedlings, and Water: Reliable access to quality livestock feed and clean water is fundamental to dairy farm productivity. Improved feed availability enhances milk production potential, making it a critical component of dairy management. Dairy production in the study area incorporates both local and improved feed sources.

Consistent with studies by Welearegay et al. (2012) and Alemu (2019) in Hawassa and Mekele towns, major feed sources in Bahir Dar include formulated concentrate feeds, crop residues, grass hay, and local beverage by-products such as atela and birint, all of which are purchased locally and from surrounding areas. Improved forage varieties utilized by dairy farms include Elephant grass, Rhodes grass, Desho, Pigeon pea, Sesbania, and Alfalfa. Additionally, farmers incorporate local grasses to supplement dairy cattle nutrition.

Improved seeds and seedlings like Napier grass—typically acquired as root splits—are often obtained from research centers and private farms. However, institutions provide these resources on a limited seasonal basis, creating constraints on availability. Key constraints in forage seed utilization include seasonal fluctuations in availability, inconsistent seed quality, and low germination potential, all of which hinder sustainable dairy production.

Addressing these issues through improved seed distribution mechanisms and enhanced quality control measures could significantly benefit urban dairy enterprises. Dairy producers mainly purchase formulated concentrate feeds from Mule and Merkeb animal feed processing factories, both located in Bahir Dar City. Dairy farms usually utilize groundwater and tap water, with seasonal availability affecting their operations.

Access to Animal Health Services: Urban dairy producers purchase veterinary drugs and chemicals from private veterinary clinics, whereas vaccines are supplied exclusively by the government. Although veterinary medications remain costly, respondents reported no accessibility difficulties.

Access to Extension Services and Capacity Building: Extension services in Ethiopia strive to provide farmers with advice, information, and technical support to improve agricultural productivity and profitability. Government-employed extension agents work in Kebele administrations, focusing on essential agricultural disciplines such as animal production, animal health, crop production, and natural resource management.

Most respondents received extension services twice a month, with guidance on animal husbandry, feed management, and livestock health. However, not all urban dairy producers have access to extension services, and some have noted a decline in service quality in recent years.

In contrast to findings by Minten et al. (2020), which report significant improvements in extension delivery, urban dairy farmers in Bahir Dar attribute inconsistencies in service provision because of the high turnover and limited availability of livestock experts.

Capacity building is essential for strengthening dairy production. Pre-establishment training is advisable for new dairy enterprises, yet respondents reported that no formal training was provided before farm setup—contrary to the findings by Didanna et al. (2018). As a result, urban dairy producers emphasize the need for continuous capacity-building programs as a key factor for improving dairy farm efficiency.

Organizations such as SNV, Bahir Dar University, and the City Administration Agriculture Office coordinate training and knowledge-sharing initiatives in urban dairy production. While many respondents benefited from these programs, farmers identified regular visits and advanced training on cattle feeding, husbandry, breeding, and reproductive health management as critical areas needing greater attention. However, none of the respondents reported reading production manuals related to dairy farming, further highlighting gaps in formal knowledge dissemination.

Access to Labor: Labor is a fundamental component of dairy production that supports routine farm activities. Most urban dairy producers employ a mix of skilled and unskilled laborers, with family members frequently assisting in farm operations. While skilled experts are present at some farms, unskilled workers—ranging from one to seven per farm—handle various tasks, including feeding, cleaning, milking, marketing, and security. Skilled laborers receive monthly salaries ranging from 2,000 to 10,000 ETB, while unskilled workers earn between 2,000 and 3,000 ETB. Consistent with findings by Didanna et al. (2018), labor availability in urban dairy production fluctuates seasonally.

Respondents reported significant labor shortages during the summer period, with peak shortages occurring between October and November, the primary harvesting season. Labor turnover also presents a challenge, as newly hired workers frequently leave farms after acquiring skills. Large-scale farms typically employ two to four laborers, with monthly salaries ranging from 3,000 to 4,000 ETB.

Access to Technology and Utilization: Urban dairy producers integrate both traditional and modern technologies to enhance farm efficiencies. Commonly used modern equipment includes feed mixers, choppers, milk storage and measurement tools, and graded milk containers acquired through individual purchases or donations from organizations such as the SNV Project. Despite a strong interest in technological advancements, producers face challenges due to limited technical training in operating new equipment. Many farmers expressed a need for high-yield dairy breeds, milk churners, feed processors, and cream separators; however, restricted availability and high costs of these technologies present substantial barriers to their adoption in urban dairy production.

4.3.2.2. Production and Productivity in Dairy Farming

Milk yield is the primary indicator of farm productivity, making its assessment critical for determining profitability. The main driver for entering the dairy business is the substantial market demand fueled by rising milk and dairy product consumption. Dairy producers in the study area typically expand their herd size by using calves born on their farms as replacements.

The primary challenge for urban dairy producers was the lack of pedigree records and inaccurate individual cow performance data, which complicates cow selection for their herd management and during marketing. Additionally, respondents noted a shortage of bulls with high milk-yield maternal profiles, further limiting genetic improvement efforts.

Dairy cattle breeding present several challenges, including ineffective heat detection, high insemination costs (300 ETB per insemination), repeat breeding due to inefficient insemination, and low-quality semen caused by storage problems.

On average, urban dairy producers in the study area maintain four calves, six heifers, one bull, and four cows per farm annually. Compared to the findings by Welearegay et al. (2012), the number of cows owned by urban dairy producers in this study is lower. The average household milk yield is 14.5 liters per day, with individual cow production ranging from 7 to 24 liters per day.

These findings indicate a decline in dairy productivity compared to previous studies conducted in Hawassa City (20.31 liters per household) by Welearegay et al. (2012) and Bahir Dar City (43.0 liters per household) by Ayenew et al. (2009). Factors influencing this variability include breed type, feeding practices, disease prevalence, parasite infestation, and general farm management techniques.

Urban dairy producers primarily focus on feed quality improvements and optimized feeding methods to enhance milk production. However, key challenges persist, including limited access to high-yielding crossbreeds, inconsistent feed quality, rising feed costs, and market fluctuations due to security concerns. Urban dairy production is emerging as an essential component of the milk production system, offering various opportunities, such as:

- Preserving livestock genetic resources and advancing production systems
- Enhancing access to inputs, services, and land
- Expanding agricultural extension support and technological adoption
- Income generation and employment opportunities

4.3.2.3. Dairy Management Practices

Feeding, Watering, and Housing

Effective feeding and watering management are key determinants of dairy farm productivity, directly influencing milk yield. Urban dairy producers procure concentrate feeds and raw materials such as wheat bran, noug seed cake, lentil, bean, pea, vetch husk, and other crop residues to sustain their cattle. Feeding practices vary, with farmers either mixing formulated feed with soaked husk or providing formulated concentrate alone.

Hay and other crop residues serve as primary feed sources, with occasional supplementation using molasses and formulated concentrate. To ensure consistent feed availability, dairy producers purchase supplies from milk cooperatives and feed traders as needed. Despite the high cost of animal feed, farmers generally report satisfactory feed quality of the feed.

Although urban dairy producers believe their feeds are of high quality, Bitew et al. (2022) discovered energy deficits and fiber surpluses in urban dairy feeding practices, potentially affecting production. Furthermore, urban dairy farmers rarely practice silage feeding, which has been found to promote calf growth and milk production (Terefe et al., 2021).

Most dairy producers water their cattle twice a day or more, using concrete watering troughs that they clean daily. However, no formal water quality testing has been conducted. According to respondents, access to clean water remains one of the main constraints for urban dairy production, particularly during the rainy season (June to August), when seasonal flooding leads to deteriorating water quality, making it difficult to water cattle.

Urban dairy cattle housing typically features concrete floors with good drainage, iron sheet roofs, and feed troughs. However, poor waste disposal infrastructure remains a critical challenge. Dairy producers often use concrete and locally available plastic materials for water and feed troughs, offering better quality and longer service life at lower prices than commercially available options.

Purchased crop residues served as the primary basal diet, with wheat and barley straw being the most commonly used. Though prices have been increasing over time, there is access to buy crop residues. Producers recognize nutritional variations among crop species and varieties, with barley straw preferred over wheat straw due to its superior quality. However, most crop residues are sold as mixed bundles, limiting producers' ability to select preferred varieties.

Threshing crops using animals improves palatability, making residues more suitable for feeding, whereas crop residues harvested using a combine harvester are not preferable for feeding (requiring further chopping) due to their longer size, requiring additional chopping before use.

Common supplements used in urban dairy production include brewery spent grain, yeast, local brewery residue (Atela), maize grain, wheat bran, wheat middling, commercial concentrates, pulse bran and screenings, common salt, and oilseed cakes. Some farmers trained in brewery-spent grain utilization incorporate silage feeding into their practices, enhancing calf growth and overall milk production.

Due to the high quality and relatively lower cost of brewery spent grains, farmers in Debre Birhan and Gondar prefer them as primary dairy feed sources. However, variations in the availability and price of supplements cause significant differences in feeding management strategies among farms. Farmers feed dairy cattle using a total mixed ration, where crop residues serve as the basal diet and are combined with supplements and water to enhance palatability. Producers assume that mixing crop residues with supplementary feeds ensures adequate nutrition to support milk production. However, feeding practices primarily focus on milking cows, while calves, heifers, and pregnant cows often receive less attention in dietary management.

Almost all dairy farms rely on tap water, with no significant concerns regarding quality or pricing. However, water scarcity remains a critical challenge, as it is not consistently available. Producers manage shortages by adhering to water supply schedules and using water tankers as a contingency.

Source of Dairy Cattle

Urban dairy farms are initially established by purchasing a small number of crossbred dairy cows from the local market and surrounding villages. Farm expansion occurs primarily through retaining female offspring. Due to limited land availability, producers often sell cows at their productive age, limiting long-term herd growth.

Breeding System

Nearly all farms rely on artificial insemination (AI), though a few use bull services when cows fail to conceive through AI or lack access to AI services. Farmers pay 500 Birr per breeding service for bulls when required. The extension workers provide AI services, and while prices are considered fair, farmers report poor conception rates as a key constraint. Most respondents observed higher male birth rates among AI-conceived calves, with only one farm reporting predominantly female births.

Health Management

Private-sector providers primarily handle livestock veterinary services. Mastitis is the most commonly reported health issue across dairy farms, with available treatments demonstrating largely ineffective. However, farmers have no complaints regarding accessibility, pricing, or drug efficacy for other veterinary services.

4.3.2.4. Environmental Impact of Urban Dairy Farming

Assessing environmental impacts is a critical aspect of dairy farm establishment. In the study area, most urban dairy producers are aware of pollution risks arising from waste, chemicals, and dairy by-products. Common waste management practices include burying liquid waste in backyards and composting solid waste to enhance soil fertility for crop cultivation. Despite these efforts, producers report moderate environmental impacts due to inadequate waste handling and disposal practices.

Some farmers have adopted biogas plants as a dual-purpose solution to reduce pollution and generate energy. However, the city administration has not provided formal support for pollution control in urban dairy production, and new waste management technologies remain largely unutilized.

Key barriers to effective environmental management include:

- Lack of technical skills for waste treatment and pollution control
- Absence of organized infrastructure for waste collection and disposal
- Limited financial capital to implement sustainable pollution reduction strategies

Waste disposal presents a significant challenge, particularly for landless small-scale farms that lack designated areas for waste processing. Large-scale farms, benefiting from relatively larger land holdings, practice waste recycling using composting methods or drying manure for fuel production. Dairy waste has the potential to be used for biofuel generation, offering an alternative energy source. However, small-scale farms struggle with land scarcity, while large-scale farms face temporary land tenure, discouraging investments in silo construction for efficient waste management.

4.3.2.5. Constraints in Dairy Production

Urban dairy production in the study area faces multiple challenges that hinder efficiency and profitability. The most significant constraint, reported by 30% of producers, is limited access to land, which restricts farm expansion and investment in improved facilities. High feed costs, cited by 20% of respondents, remain another major barrier, increasing production expenses and reducing economic viability.

Access to improved dairy breeds, particularly high-yielding crossbreeds, is limited, affecting 15% of producers who struggle to obtain genetically superior cattle. Additionally, 10% of producers identified limited access to credit as a key financial obstacle, making it difficult to invest in feed, equipment, and infrastructure improvements. A similar 10% reported challenges with the low supply of milk processing machines, hampering value-added dairy production. Other challenges include poor market access and inadequate linkages, which affects 7% of respondents and lead to inefficiencies in milk distribution and profitability. Additionally, low levels of training reported by 5% of producers limit skill development and awareness of best practices in dairy production and management. Lastly, inadequate veterinary services, noted by 3% of respondents, pose a risk to herd health, with farmers facing difficulties in accessing timely and effective treatments.

Training and Technology Utilization Gaps: Despite the extension office's claims of conducting training programs on dairy production in partnership with various non-governmental organizations, some dairy producers have reported a lack of formal training. Farmers organized as enterprises receive introductory training from the Technical and Vocational College upon establishment, providing foundational knowledge.

Additionally, the Debre Birhan Agricultural Research Center has delivered specialized training on silage production using brewery-spent grain, offering practical insights for feed preservation. However, technological adoption remains inconsistent across farms, reflecting deficiencies in integration and dissemination. Beyond the extension office's initiatives, neither governmental nor non-governmental organizations provided sustained support for technology adoption in dairy production, underscoring a need for coordinated efforts to enhance accessibility and utilization.

These constraints collectively impact the productivity, profitability, and sustainability of urban dairy farming, emphasizing the need for policy interventions, infrastructure improvements, and enhanced technical support to address these challenges effectively.

Table 6: The Major Constraints of Dairy Production

No	Constraints	Percent
1	Lack of improved dairy breed	15
2	High feed cost	20
3	Limited land access	30
4	Limited training access	5
5	Limited credit access	10
6	Poor market access and inadequate linkages	7
7	Low supply of milk processing machine	10
8	Inadequate veterinary service	3

4.3.3. Cattle and Sheep Fattening

4.3.3.1. Input Supply

Access to Feeds: Cattle fatteners rely on a diverse range of feed sources, including grass hay, cereal and pulse straws, hulls, bran, oilseed cakes, formulated concentrates, and local alcohol by-products such as brint and atela. In Debre Birhan and Gondar, brewery-spent grain residues serve as additional feed sources. These feeds are primarily obtained from farmers, dealers, and processing factories. While most feed types are readily available in markets and surrounding rural areas, straw availability fluctuates seasonally, with shortages occurring between April and June, whereas supplies are more accessible from December to February.

Access to Water: Tap water is the primary source for watering cattle in most urban fattening operations, with higher availability from June to August. However, in Bahir Dar, water quality is sometimes poor to groundwater, as observed by farmers. In contrast, Debre Birhan does not report similar concerns. In Gondar, river water is also used for fattening operations.

Housing: Fattening houses are commonly constructed using wood, cement concrete floors, thin roofs, and partially mud-plastered ground with open walls. Proper housing design must incorporate drainage systems to manage urine and liquid waste, ensuring hygienic conditions for livestock.

Access to Labor: Fattening farms require a consistent and reliable workforce throughout the year. In the study areas, beef cattle fatteners employ up to seven laborers, including both hired workers and family members, with roles divided into permanent and casual employment. Labor availability fluctuates seasonally, affecting farm operations. The monthly salary for casual unskilled labor reaches 1500 ETB and lives together with owners, whereas permanent skilled and unskilled labor receives a monthly salary of 3000 ETB. Labor intensiveness, high labor turnover, and not being available throughout the year were the most common problems associated with labor for beef farms.

Access to Farmland: Urban cattle fatteners often acquire land through inheritance from parents or temporary government allocations. In Bahir Dar, land for fattening is designated in Tana (Kebele 13) and Atse Tewodros (Ghion and Bezawit Kebeles), a practice mirrored in other major towns. However, land obtained from the government lacks legal standing and is costly to acquire. Key challenges in land access include limited availability for fattening operations, high rental prices, lack of government attention to urban agricultural needs, and failure to implement urban agricultural policy.

Access to Capital and Credit Services: Cattle fatteners primarily self-finance their farms, with limited access to formal and informal loans, restricting business expansion. Credit availability is minimal, with Tseday Bank (ACSI) being the only institution offering loans through a revolving fund, though farmers lack collateral to secure financing.

Access to Extension Services and Capacity Building: Most cattle fatteners do not receive regular extension services from city livestock experts. However, some farmers receive guidance twice a year, focusing on feeding and fattening management.

Access to Capacity Building: Fatteners learn agricultural management skills informally from family members and peers. Despite their interest in beef cattle selection techniques, health management, feeding strategies, and general farm management, they fail to read beef production manuals and have limited access to formal training and experience-sharing opportunities. Critical problems in training and capacity development include insufficient focus on the fattening sector, limited extension services from development agents (DAs) and professionals, and a lack of structured training programs.

Access to Technology and Utilization: Most fattening farms do not utilize advanced technology due to limited awareness and market scarcity. Essential technologies such as hay harvesters, chopper machines, silage preparation equipment, and molasses processing tools remain largely inaccessible due to high material costs, limited experience in technology use, and feed waste management challenges.

4.3.3.2. Production and Productivity

Breeds and Source of Animals

Quantifying beef productivity per head at the fattener level remains challenging, as finisher cattle are not consistently weighed, with assessments often based on personal observations rather than precise measurements.

To fatten cattle, producers utilize both local and crossbred animals, with Holstein Friesian crosses being particularly common. The number and duration of fattening cycles vary depending on farm capacity, animal body condition, breed type, market dynamics, feed quality, and overall management practices.

Producers acquire crossbred and local cattle from local markets, with Debre Birhan farmers preferring crossbred cattle due to their larger size, faster growth rate, and superior carcass yield. In small ruminant fattening, Menz sheep crossed with Awassi are predominantly fattened, while producers prefer crossbred sheep sourced from nearby local markets.

According to respondents in Bahir Dar town, farms produce an average of 45 fattened cattle per year, completing three fattening cycles annually. These cattle are sold both at the market and directly from the farm gate. Additionally, experts estimate that a single bull weighing 400 kg live weight yields approximately 140 kg of meat.

Several factors influence cattle productivity, including feed availability and feeding practices, disease prevalence and parasite infestations, management competence, physical risks to animals, and geographical origin of purchased cattle, with those from colder regions often exhibiting different growth characteristics.

4.3.3.3. Management Practices

Feeding, Watering, and Housing

Feeds and Feeding: Producers employ both individual feed types and mixed rations for fattening cattle. In Bahir Dar, the mixed ration typically consists of 3 kg grass pea hull, 3 kg wheat bran, 3 kg bean hull, 10 liters of brint, salt, and water. The mixture is kept for 30 minutes before feeding to prevent stomach bloating, as reported by respondents. Feeding crop residues and exposing cattle to sunlight is a common practice.

In Debre Birhan, fattening begins with brewery spent grain and local brewery residue as primary supplements, followed by food grains and lentil screenings to enhance meat quality. While most feed is of high quality, occasional mold formation on wheat bran and oilseed cakes presents a challenge. Interestingly, traders and butchers can predict meat quality based on animal conditions and skin palpation.

Feed prices fluctuate based on market conditions, with notable increases observed. For instance, wheat bran increased from 3 to 18 ETB/kg, noug seed cake reached 28 ETB/kg, formulated concentrate feed increased to 32 ETB/kg, and grass hay cost 13,500 ETB/vehicle. Key challenges in fattening diets include high feed costs, inconsistent supply, lack of structured feeding practices, and occasional poor-quality feed (particularly mold formation on wheat bran and noug seed cake).

Water and Watering: Almost all fattening farms rely on tap water, though availability and quality remain inconsistent. During a tap water scarcity, there are additional costs for water purchase and delivery. The price is 3 ETB per 30 liters, with transportation costs varying by distance. Fatteners provide ad libitum water access to cattle, though availability and quality remain inconsistent.

Housing: Proper housing is essential for protecting animals from predators, theft, and extreme weather conditions. Fattening houses are typically constructed using wood, cement concrete floors, corrugated iron sheet roofs, and partially mud-covered walls, with open sections for ventilation. Facilities include drainage systems, individual pens, feed troughs, and water troughs. The primary challenge in housing is limited space for farm expansion.

Health Management

The most commonly reported disease in cattle fattening is foot and mouth disease, while liver fluke is the predominant internal parasite. Cattle and sheep undergo internal and external parasite treatments before fattening. In Debre Birhan, sheep are traditionally sheared using a knife before fattening. Some farmers routinely washed cattle and sheep every 15 days throughout the fattening period. Fasinex and Albendazole are used to treat internal parasites, whereas Ivermectin is used for internal and external parasites. The respondents did not report any concerns regarding drug pricing or efficacy.

4.3.3.4. Environmental Impact of Urban Fattening Practice

Cattle fattening operations generate various byproducts, including dung, urine, rumination gases, feed refusal, and drug containers, all of which contribute to environmental pollution. Waste disposal practices vary, with dung repurposed as fuel or compost to enhance soil fertility, either for on-farm use or sale at 15 ETB per quintal. Drug containers are typically burned or buried, though the exact level of pollution resulting from these practices remains uncertain. Despite the environmental risks posed by these waste materials, city authorities provide minimal support for pollution mitigation. As a result, communities near fattening farms face increased exposure to diseases such as asthma and high fly populations, exacerbating public health concerns. Implementing structured waste management systems, biogas production, and sustainable disposal methods could significantly reduce environmental hazards while improving resource efficiency in urban cattle fattening operations.

4.3.3.5. Constraints in Fattening Operations

Limited Access to Land: Land is a fundamental resource for expanding fattening operations, supporting forage production, and sustaining essential inputs. In the study cities, fatteners typically acquire land through rental agreements or short-term leases lasting five years. However, limited land availability, high rental costs, and insufficient government attention to urban agriculture policies pose significant challenges. These constraints restrict farm expansion and hinder effective management practices.

Financial and Credit Constraints: Capital availability directly influences the scale and efficiency of fattening enterprises. Most fatteners rely on self-financing, utilizing personal savings or family resources to sustain their operations. Due to restricted access to formal credit mechanisms, farms face challenges in scaling up, improving production systems, and adopting better management strategies—ultimately limiting productivity and economic sustainability.

Feed Shortages and Escalating Costs: Feed availability is highly seasonal, causing price fluctuations throughout the year. Farmers produce sufficient hay from late October to early December when prices remain stable. However, between April and September, declining hay availability leads to sharp price increases. Similarly, the availability and cost of concentrate feeds vary across seasons, further complicating resource allocation and financial planning for fattening operations.

Lack of Professional Support: Limited access to extension services and veterinary expertise poses significant challenges for fatteners. Respondents reported insufficient technical guidance and restricted availability of animal health professionals, resulting in inadequate disease management and productivity constraints.

Marketing and Infrastructure Challenges: Livestock fattening in urban and rural settings follows distinct seasonal trends, with production cycles primarily targeting local markets. Rural farmers often fatten cattle for Christmas using crop residues and grain screenings, whereas urban fatteners concentrate on Easter and summer periods, particularly the Ethiopian New Year. However, market access remains fragmented, and infrastructure limitations increase operational costs, reducing profitability.

Limited Government Focus on Urban Agriculture: Urban agriculture policies lack sufficient emphasis on supporting sustainable fattening enterprises. Addressing existing policy gaps, including land allocation, financial assistance, and market integration, could significantly enhance the viability of urban fattening operations, fostering economic growth and resilience within the sector.

4.3.4. Aquaculture Production

Aquaculture ponds are predominantly rectangular, ranging from 100m² to 300m² in size, with bottoms lined using concrete, earthen materials, or polyethylene geo-membrane for durability and water retention. Water sources primarily include Lake Tana, the Blue Nile, and nearby rivers. The dominant species stocked is Nile Tilapia (*Oreochromis niloticus*), preferred for its growth rate and market demand, with fingerlings supplied by the Bahir Dar Fishery and Aquatic Life Research Center (BFALRC). Many ponds integrate aquaculture with fruit, vegetable, and poultry farming, optimizing water use and enhancing farm revenue streams. Farmers often sell fish and fingerlings, especially when overstocked, to neighbors and new adopters. Harvesting is labor-intensive and inconsistent, as farmers commonly use Zanzira nets, originally distributed for malaria prevention, due to limited access to proper fishing gear. Feeding is irregular, relying on locally available feed ingredients, and management practices are low-input, classifying the system as extensive aquaculture.

Certain water bodies in Debre Birhan town also present aquaculture potential, offering high-quality protein sources and economic opportunities. Fingerlings of tilapia and carp, sourced from Ziway and Sebeta, have successfully adapted to cold seasonal variations despite originating in warmer habitats. While some farmers purchase feed to supplement natural food sources, others engage in traditional fish gathering and selling, contributing to local food security and economic activity.

4.3.4.1. Fish Feed and Other Inputs

The success of aquaculture largely depends on nutritional management and access to appropriate harvesting tools. While some farmers attempt to supply feed, many do not follow systematic feeding schedules, significantly impacting fish growth rates.

Challenges associated with fish feed include:

- **Inconsistent feeding practices:** Many farmers feed their fish only occasionally, limiting optimal growth.
- **Reliance on cow manure as a primary feed source:** Although cow dung can serve as a natural nutrient enhancer, current application methods are inefficient. Farmers often place sacks of cow dung in ponds for extended periods without refreshing the water, leading to degraded water quality, odor issues, pathogen buildup, and oxygen depletion—ultimately reducing phytoplankton and zooplankton populations essential for fish nutrition.

4.3.4.2. Constraints in Aquaculture Production

Despite the region’s considerable potential for aquaculture development, its expansion remains limited due to numerous systemic challenges. These constraints span environmental, technical, economic, and institutional dimensions, each posing significant impediments to sustainable growth. The key constraints affecting urban aquaculture production are outlined below.

Site Selection Challenges: The success of aquaculture is highly dependent on appropriate site selection, yet urban expansion and land use conflicts hinder the optimal placement of fish farming operations. Poorly selected sites contribute to inefficient water management, low oxygen levels, increased sedimentation, and restricted integration with other urban agricultural activities. Additionally, the lack of standardized guidelines for pond placement leads to suboptimal pond conditions and reduced fish productivity.

Defects in Pond Design: Findings from key informant interviews and semi-structured surveys indicated that many aquaculture ponds suffer from inadequate inlet and outlet designs, complicating water flow management and integration with complementary agricultural activities such as vegetable and fruit farming. Poorly designed ponds increase operational costs, necessitating additional expenditures on water pumps and fuel, ultimately reducing profitability.

Water Quality and Availability: Access to quality water is a significant challenge for aquaculture. Many aquaculture ponds rely on urban water supplies, which can be inconsistent and expensive. Besides, the water quality is often compromised by high levels of pollutants from industrial and residential runoff. Poor water management practices, such as excessive accumulation of organic waste and inadequate aeration, result in oxygen depletion, algal blooms, and an increased susceptibility to fish diseases.

Constraints in Feed Availability and Nutritional Management: Fish feed is a critical determinant of aquaculture productivity, yet its accessibility and affordability remain crucial concerns. Challenges include:

- **Limited access to commercial fish feed:** Many farmers lack supply chains to acquire scientifically formulated fish feed, relying instead on locally available alternatives, which often lack essential nutrients.
- **Low feed composition:** Many farmers use cow excrement as a primary nutrient source, often submerging it in ponds for prolonged periods without replacement. This inefficient practice degrades water quality, introduces harmful bacteria, and reduces phytoplankton populations necessary for sustaining fish growth.
- **Seasonal feed shortages:** The availability of raw materials for fish feed production fluctuates, particularly during drought periods, exacerbating nutritional deficiencies and reducing fish yield.

Limited Availability of Fishing Equipment: The success of aquaculture depends mainly on access to fishing inputs. Farmers rely on locally available fishing gear, often using mosquito nets (locally known as Zanzira) for fish collection, which is inefficient and unsuitable for commercial harvesting. A lack of modern harvesting techniques and equipment further restricts the commercialization of aquaculture operations.

Production and Market Challenges: Despite growing demand for fish—especially during fasting seasons—market accessibility remains a significant challenge. Many small-scale producers struggle to sustain production year-round, leading to supply shortages and unreliable market engagement.

Inconsistent production cycles and unreliable market supply discourage farmers from expanding operations or investing in long-term aquaculture development. However, outside these periods, many farmers remain focused on activities with immediate financial returns, which limit long-term aquaculture development. The absence of market stability and economic incentives poses a significant barrier to pond-based fish farming and impedes broader sector growth.

Post-Harvest Handling and Storage Deficiencies: Urban aquaculture lacks proper post-harvest handling and storage infrastructure. Farmers frequently struggle with the absence of cold storage facilities, limited access to hygienic processing centers for fish cleaning and packaging, and inadequate transportation networks for timely market distribution.

Skill Gaps and Technical Limitations: Despite efforts from government extension services, training programs are insufficient, leaving farmers reliant on external expertise for routine management decisions. Many urban fish farmers possess limited technical knowledge of key aspects of aquaculture, including optimal stocking densities, feeding techniques, fish processing, harvesting methods, disease prevention and water management, and consumer demand dynamics. Their reliance on fishery experts for basic tasks underscores a need for structured knowledge transfer and enhanced self-sufficiency, which are critical for long-term sustainability.

Institutional and Policy Limitations: Although the government recognizes the importance of the fishery sector, it receives relatively less institutional attention and remains underfunded compared to crop and livestock farming. Key institutional gaps include a lack of model aquaculture ponds at the farmer level for beginners, the absence of designated aquaculture zones to attract investors, and suboptimal site selection for commercial projects, making integration difficult. These institutional shortcomings negatively impact aquaculture sector growth, reducing aquaculture's viability as a sustainable food source and economic enterprise.

Addressing these constraints requires better feed management strategies, enhanced training programs, and improved input accessibility. Strengthening institutional support and market frameworks will also contribute to the long-term viability of the aquaculture sector.

4.3.5. Major Constraints in Urban Livestock Farming Systems

Urban livestock production faces multiple challenges, yet it offers opportunities for strategic interventions that enhance sustainability and efficiency. Below are the key constraints affecting urban livestock farming.

- **Limited Land Availability:** Rapid urbanization and population growth have significantly reduced the availability of suitable land for livestock production.
- **Restricted Access to Credit Services:** Credit mechanisms for urban agriculture, particularly in livestock production, remain underdeveloped. A lack of awareness among producers and financial institutions further hampers accessibility.
- **Water Scarcity:** Urban farmers struggle with limited water availability, affecting irrigation for forage development, feed preparation, drinking water for livestock, barn sanitation, and animal hygiene.
- **Limited Access to Improved Seeds:** The availability and affordability of high-quality forage seeds are critical constraints. Producers often need to procure seeds from research centers and private sectors.
- **Shortage of Animal Feed:** Feed shortage is a critical constraint affecting the production and productivity of urban livestock farming, driven by both quality and quantity deficiencies. Limited feed access during the dry season is particularly problematic, as farmers primarily depend on crop residues rather than supplementing essential nutrients. The most severe feed deficit occurs between March and June, resulting from multiple factors, including insufficient raw materials for hay preparation, reduced pasture growth due to inadequate rainfall, and high feed costs restricting farmers' ability to secure adequate supplies.
- **Livestock Diseases:** Disease prevalence significantly impacts urban livestock productivity and requires better veterinary care and management strategies.
- **Insufficient Policy Support:** Despite its potential to enhance food security and complement rural agricultural systems, urban agriculture—particularly livestock farming—receives limited government policy attention, restricting sectoral growth and development.
- **Lack of Training and Technical Assistance:** Urban livestock producers often lack access to adequate training, expertise, and continuous technical support in production and animal health management.

- **Weak Extension Services:** Extension programs for modern livestock production, technology adoption, and marketing systems are insufficient, reducing efficiency in urban agricultural enterprises. The extension services provided by different experts for the producers and other customers are not as effective & efficient as expected.
- **Limited Availability of Improved Breeds:** Crossbred dairy and fattening animals are in short supply, impacting productivity. Native cattle dominate milk production despite their lower yield and fertility rates.
- **Infrastructure Deficiencies:** Urban livestock production suffers from inadequate irrigation infrastructure, limited cooling and storage facilities for feed and veterinary supplies, and restricted adoption of modern agricultural technologies such as vertical farming and hydroponics.

Addressing these constraints requires targeted interventions, including improved credit access, optimized feed management strategies, enhanced veterinary support, better extension services, and infrastructural improvements. Strengthening policy frameworks and promoting modern agricultural technologies will further improve the resilience and viability of urban livestock farming systems.

4.3.6. Opportunities in Urban Livestock Farming

Urban livestock production presents several opportunities for growth and sustainability:

- **Rich Genetic Resources:** Vast genetic diversity in livestock, offering significant potential for breeding improvements and productivity enhancements.
- **Abundant Labor Supply:** The availability of a large workforce can support various agricultural activities, from production to value addition and distribution.
- **Favorable Agroecology:** The region's diverse agro-ecological conditions are conducive to the production of forage and livestock, including dairy farming, poultry production, and cattle fattening.
- **Adequate Water Resources:** Urban agricultural enterprises can tap into multiple water sources, including rivers, tap water, and underground reserves, to support sustainable production.
- **Accessible Extension Services:** Urban farmers can benefit from agricultural extension services and technical support provided by the Bureau of Agriculture (BoA) experts as needed.
- **Training and Knowledge Sharing:** Opportunities exist for experience sharing, capacity building, and technical training through collaborations with NGOs and research centers.

- **Credit Accessibility:** Various financial institutions within the town offer credit services, enabling urban farmers to invest in improved production systems.
- **Cluster-Based Development:** Establishing integrated clusters for dairy farming, poultry, and cattle fattening can enhance efficiency, resource utilization, and market access.
- **Reliable Access to Fertilizers:** Strong linkages with urban agricultural offices and private compost producers facilitate timely access to both chemical and organic fertilizers.
- **Fisheries Development Potential:** The presence of Lake Tana, the Blue Nile River, and underground water sources offers significant opportunities for fisheries development, including pond farming, cage aquaculture, and pen culture.
- **Rising Livestock Products Demand:** Increasing livestock product consumption has elevated market prices, creating lucrative opportunities for investment in urban livestock production.
- **Availability of Agrochemicals:** Urban agricultural enterprises can access essential agrochemicals to support livestock production.

4.3.6.1. Opportunities in Aquaculture Production

Despite existing challenges, urban areas present several opportunities for aquaculture development, including:

- **Abundant Water Resources:** The presence of Lake Tana, the Blue Nile River, and groundwater reserves supports sustainable fisheries development, including pond aquaculture, cage farming, and pen culture systems.
- **Diverse Fish Stocks:** Suitable fish species for aquaculture are readily available, creating potential for investment in sustainable production systems.
- **Affordable Labor Supply:** The area benefits from cheap and accessible labor, facilitating the expansion of aquaculture enterprises.
- **Ideal Agroecology:** Bahir Dar's favorable climatic and environmental conditions provide an excellent foundation for fish farming and integrated aquaculture practices.

4.3.7. Strategic Interventions for Urban Livestock Farming Systems

To overcome challenges and leverage opportunities in urban livestock production, targeted interventions are essential:

- **Improve Access to Land and Capital:** Strengthen land allocation mechanisms and financial support systems to enable urban farmers to secure suitable production spaces and investment resources. To improve food security, nutrition, and economic opportunities, urban agriculture must be prioritized in the region's major cities by designating extensive, well-planned agricultural areas.

Bahir Dar presents a particularly compelling case, as its potential for urban agriculture is remarkably high. The southeastern areas of the city, including Sebat Amit, Andassa, Tis-Abay, and Wondata, are endowed with highly favorable conditions for agricultural productivity. These areas feature fertile luvisol soils, abundant water sources from the Abay, Andassa, and Ezana Rivers, and substantial groundwater reserves, creating a unique opportunity for long-term sustainable food production. With proper management, these areas could sustainably support Bahir Dar's population for centuries. Beyond food production, urban agriculture in this area could generate significant employment opportunities, benefiting thousands of residents. Furthermore, the area's natural advantages make it equally suitable for livestock enterprises, further strengthening local food systems and economic resilience.

Given these considerations, city administrations and policymakers must take decisive action to protect and prioritize these agricultural areas. Preventing industrial and residential expansion into these critical areas is essential to safeguard Bahir Dar's future food security, economic stability, and environmental sustainability.

- **Enhance Livestock Breeds and Feed Supply:** Facilitate the availability of improved livestock breeds and enhance feed supply chains by strengthening input distribution networks.
- **Strengthen Collaborative Efforts:** Foster cooperation among stakeholders to improve input supply, capacity development, and market linkages for urban livestock enterprises.
- **Promote Urban-Based Innovation:** Support innovative urban agriculture solutions, including feed processing enterprises, day-old chick multiplication centers, and strategic cross-breeding programs.
- **Expand Extension Services and Training:** Enhance access to agricultural extension services and training programs to improve technical expertise and best practices in urban livestock production.

- **Establish Dedicated Platforms:** Create forums and networking platforms that facilitate knowledge **sharing**, stakeholder engagement, and collective problem-solving.
- **Facilitate Access to Modern Technologies:** Increase adoption of advanced livestock technologies through targeted training initiatives and subsidy programs.
- **Implement Strict Quality Control Measures:** Strengthen regulatory frameworks to ensure high-quality production standards in urban livestock farming.
- **Develop and Enforce Supportive Policies:** Advocate for policy reforms that prioritize urban livestock production, including measures to regulate input costs and stabilize market conditions.

4.3.7.1. Targeted Interventions in Aquaculture

To overcome current challenges and foster a sustainable aquaculture sector, a series of strategic interventions must be implemented. These interventions will enhance productivity, economic viability, and environmental resilience.

- **Enhancing Access to Essential Equipment and Post-Harvest Technologies:** Providing fish farmers with appropriate fishing gear and post-harvest handling technologies is crucial for improving harvesting efficiency and market readiness. Cost-effective leasing mechanisms or direct subsidies should be established to ensure accessibility, particularly for small-scale producers.
- **Implementing Comprehensive Training and Capacity-Building Programs:** Comprehensive training and capacity-building programs should be implemented to cover essential aspects such as site selection, pond construction, optimal stocking densities, feeding techniques, disease prevention, water quality management, and efficient harvesting and storage practices.
- **Strengthening Nutritional Management and Feeding Practices:** Enhancing fish nutrition is crucial for increasing growth rates and overall yield. Farmers need greater awareness of proper feeding techniques and should be encouraged to utilize locally available feed sources such as poultry excreta, animal manure, and organic food waste, especially when commercial feed options are limited.
- **Enhancing Pond Management and Water Quality Control:** Intensive follow-up and technical support should be provided to improve pond management, ensuring optimal water quality and fish health while preventing nutrient imbalances and environmental contamination.

- **Establishing Fingerling Transfer Programs for Stocking Efficiency:** Overpopulation in production ponds reduces growth rates and depletes resources. Implementing structured fingerling transfer programs will optimize stocking densities, prevent overcrowding, and maintain ecological balance.
- **Expanding Fisheries Expertise through Professional Development:** Fisheries professionals and extension agents require advanced training in aquaculture management. Structured short-term and long-term programs should be developed to strengthen technical expertise, improve advisory services for fish farmers, and enhance aquaculture research and development capacity.
- **Developing Model Aquaculture Ponds for Demonstration and Innovation:** Establishing model aquaculture ponds will serve as learning hubs for farmers, investors, and researchers. These sites should showcase best practices in pond construction, feeding efficiency, disease control, and integrated farming approaches.
- **Creating Clustered Aquaculture Zones for Investment and Sectoral Growth:** Developing clustered aquaculture zones can facilitate investment and sectoral growth by providing designated areas with essential infrastructure, structured support, and access to resources tailored to fish farming needs. Aquaculture clusters will foster economies of scale, attract investors, and facilitate knowledge-sharing among fish farmers. These designated zones should provide essential infrastructure, input supply systems, and technical support.
- **Advancing Feed Formulation Technologies Using Local Ingredients:** Investing in locally sourced feed formulation technologies is critical for reducing production costs and ensuring feed sustainability. Research institutions and agricultural cooperatives should collaborate to develop affordable, nutritionally balanced feed alternatives.
- **Expanding Pond Sizes to Enhance Natural Habitat Conditions:** Expanding pond sizes will enhance natural habitat conditions, improving fish survival rates, oxygenation dynamics, and overall ecosystem stability. Larger ponds more closely mimic natural aquatic environments, reducing stress-related mortality and supporting healthier fish populations.

By implementing these strategic interventions, urban livestock farming and aquaculture sectors will undergo significant transformation, leading to improved food security, economic resilience, and environmental sustainability. These initiatives will foster innovation, enhance livelihoods, and strengthen integrated agricultural systems, ensuring long-term prosperity for urban communities.

4.4. Crop Product Safety Practices, Constraints and Interventions

4.4.1. Crop Product Safety Practices

Food safety encompasses a wide range of concerns beyond preventing foodborne pathogens, chemical toxicants, and physical hazards—it also includes nutrition, food quality, and proper labeling. Ensuring food quantity, nutritional adequacy, and safety has become increasingly complex, requiring coordinated efforts from both government and private sectors (National Academy Press, 1998).

The food system has evolved from providing minimally processed raw commodities for home meal preparation to delivering highly processed, ready-to-eat products. As a result, food safety risks can emerge at various stages across the value chain, including production, transportation, storage, processing, distribution, and consumption. Faulty handling of a product at any point of this value chain can transform a safe product into one that can cause health risks associated with food products. Therefore, this assessment focused on the food safety practices implemented on urban agriculture products and the main constraints in major cities of Amhara regions, specifically Bahir Dar and Dessie.

Pest and Disease Management: Most respondents managed pests and diseases through chemical applications, ash treatments, sun drying, soil ventilation, and minimizing food contact with soil. However, some reported inefficacy in pesticide use due to limited training on pesticide types, application techniques, protective equipment, storage methods for residual chemicals, and post-application harvesting timelines. In general, they did not adopt good agricultural practices (GAP) to manage pests and diseases, instead relying on indigenous knowledge. Additionally, no formal professional structures existed at the woreda and kebele levels to provide food safety expertise. There was a lack of on-the-job training on good agricultural practices and pest and disease management practices, though some experts in Bahir Dar city administration operated knowledge transfer to farmers, particularly in food safety practices.

Water and Irrigation Management: Most producers recognized the risks associated with irrigation water in fruit and vegetable production. In Bahir Dar, waste from municipalities, hotels, and universities, as well as dirty soil and water posed significant risks to the irrigation water source. Some respondents attempted to improve water safety using physical filtration methods, such as screening and cloth filtration.

Soil Management: According to agricultural experts from the Bahir Dar city administration, contaminated land presents a significant challenge to urban agriculture. Most producers did not conduct formal soil testing; instead, they relied on indigenous knowledge, including visual assessments, burning, crop rotation, and yield evaluation, to enhance soil health. Many producers applied fermented compost as an organic soil amendment to mitigate contamination risks.

Food Handling and Storage Practices: Most producers lacked proper handling and storage practices, including adherence to the First-In, First-Out (FIFO) principle, temperature control, standardized guidelines, tracking systems, and hygienic handling protocols. However, some producers employed cleaning, sorting, and grading methods, selling products immediately to minimize storage risks. During harvesting, producers use plastic sheets to prevent contamination and perform a visual inspection to remove damaged or infected products. Furthermore, they handle fruits in wooden containers and use beds for storage.

Despite these efforts, producers exhibited gaps in storage knowledge, preservation techniques, pesticide effectiveness, optimal harvesting timelines, and ripening methods. Nearly all relied on plastic bags for packaging, transportation, and storage of fruits and vegetables.

Conversely, consumers implemented safety measures such as purchasing clean produce, screening damaged items, keeping produce in a dry and clean place, storing different items separately, using FIFO principles, and monitoring the quality and conditions of products. Additionally, they practiced cleaning, sorting, washing, drying, and refrigeration to extend product shelf life and prevent spoilage. They also did sensory assessments, including smelling, tasting, and visual inspection, to help them identify spoilage risks.

However, consumers faced challenges maintaining food safety, including they did not have any specific guidelines or protocols to follow when handling and storing agricultural products; fresh products were not always available in the market, increasing product prices; chemical contamination of vegetables; low-quality vegetables during the winter season; and unclean handling materials on the producer side. Furthermore, most consumers did not practice adequate hygiene measures such as hand washing, wearing gloves, or sanitizing tools and equipment despite having access to hand washing or sanitation solutions in the working areas.

Food Safety Awareness and Support: Due to a lack of targeted food safety training, most urban producers and consumers lacked familiarity with proper safety guidelines. Producers primarily relied on indigenous safety practices, such as observation, sorting, grading, washing, and applying pesticides or compost. Consumers conducted basic inspections, stored food in clean environments, and used lemon and salt for vegetable preservation.

Although fruit and vegetable consumers recognized potential contamination risks—including high temperatures, humidity, dust, unclean water, personal hygiene, bacteria, and fungi—they received minimal institutional support. Bahir Dar city administration agricultural experts did not provide organized food safety training to producers at the kebele level, as they themselves lacked substantial instruction on standard protocols.

4.4.2. Constraints in Crop Product Safety

Several constraints hinder crop product safety, including:

- **Limited awareness and knowledge** of Good Agricultural Practices (GAP), food safety, and post-harvest handling
- **Lack of post-harvest technologies**, including evaporative coolers, cooling chambers, storage, preservation, and packaging solutions
- **Weak enforcement of urban development plans** affecting agricultural sustainability
- **Restricted access to clean water sources** for irrigation and processing
- **Limited availability, effectiveness, and quality of pesticides**
- **Land insecurity and tenure challenges**
- **Insufficient government and technical support** for urban agriculture
- **Unstructured expert systems** at district and kebele levels
- **Limited market access** affecting sales and distribution

4.4.3. Strategic Interventions for Crop Product Safety

To address these challenges, the following measures should be implemented:

- **Awareness training programs** on Good Agricultural Practices (GAP), post-harvest handling, food safety, preservation, and utilization for stakeholders across the value chain

- **Pest and disease management improvements**, including adherence to recommended pesticide application methods and timelines
- **Implementation of post-pesticide harvest intervals** based on safety recommendations
- **Enforcement of waste management regulations** for hotels, universities, and industries to minimize contamination risks
- **Provision of safe land and clean water access** for urban producers
- **Introduction of advanced post-harvest handling, storage, and preservation technologies**

4.5. Livestock Product Safety Practices, Constraints and Interventions

4.5.1. Livestock Product Safety Practices

Food safety practices and the factors affecting livestock products were assessed through interviews with fifteen key informants, including experts, producers, processors, and consumers, across two kebeles in Bahir Dar City. The findings are summarized below.

Dairy Products

The study revealed that respondents initially planned regular cleaning schedules and sanitation procedures to ensure product safety. In most cases, quality defects primarily existed during production, processing, and transportation, necessitating strict attention to these stages. To prevent cross-contamination and spoilage, milk producers sanitized milk containers with cleaning agents, ensured proper drying, wore protective gear—including uniforms, shoes, gloves, and face masks—and washed cows' udders before milking.

Due to the lack of refrigerators or coolers at the production level, collected milk was transported to processing plants within two to three hours for further handling or storage. Milk processors assessed quality using visual inspections and testing instruments, such as the clot-on-boiling test (to determine acidic content), lactometers, lacto scans, and alcohol tests. However, due to a shortage of appropriate materials and knowledge gaps at the producer and consumer levels, specific guidelines for milk safety during handling and storage were not consistently followed.

The processors in Dessie knew the potential sources of contamination in their farm. Before harvesting and handling their farm products, to ensure product safety, workers sanitized their hands and cleaned containers with detergents that do not compromise milk quality.

Quality monitoring began at the purchasing stage, where milk was tested with lacto scans or alcohol methods and stored under a cooling machine. Some processors store milk for up to two months before selling. To ensure the cleanliness and safety of the products, they do frequent monitoring, quality and safety tests, and use appropriate testing materials.

Poultry Products

Respondents gathered eggs at least twice a day to avoid contamination, breakage, and loss of inner quality. To preserve the protective bloom on eggshells, which reduces bacterial vulnerability and air getting in, eggs were cleaned using dry scrubbing to clean dirty eggs. Hand hygiene was practiced by washing hands with soap to control bacterial contamination of the eggshell. Nesting boxes were also regularly cleaned and replaced with new nesting material. A First-In, First-Out (FIFO) system was employed in egg storage and distribution to minimize product waste.

Fish Products

Respondents ensured fish safety by sourcing products from reputable suppliers. To prevent cross-contamination, they maintained a strict separation between raw and cooked fish and practiced proper hand hygiene before handling seafood. Additionally, they selected fish with clear, shiny eyes, firm skin, and red gills while avoiding those with unpleasant odors to ensure high-quality standards.

Fish products were consumed within one to two days to maintain freshness. When respondents stored raw fish in the refrigerator, they wrapped it tightly and stored it away from other foods to prevent cross-contamination. If handlers came into contact with raw fish, they practiced strict hygiene by washing their hands with hot water and soap.

Food Safety Awareness and Support

Most key informants exhibited gaps in fundamental food safety knowledge, risk-reducing practices, and personal hygiene measures, such as maintaining a clean work environment and controlling cooking temperatures. Consumers often purchase food from supermarkets without verifying safety and quality.

However, they were familiar with hand washing before food handling and preparation and after visiting the restroom to reduce the risk of food contamination. Factors associated with a lack of food safety knowledge and poor food handling practice were level of education, profession, food safety training, overall experience in the food service sector, and attitudes toward food safety.

There were also limitations in the case of food safety support and awareness of safety issues for the key informants from the respective experts and stakeholders. While food and nutrition extension services were available, they were insufficient to meet respondents' needs. The issue was exacerbated by the absence of food and nutrition experts in livestock production systems, even at the zonal level.

Conversely, processors in Dessie demonstrated a stronger awareness of food safety practices and urban agriculture guidelines, primarily due to the training and education they had received. However, the implementation of these initiatives remained inconsistent. Some processors established protocols for personal hygiene before handling or managing the agri-products. So, they stored their agricultural products based on the knowledge gained from training and established protocols.

4.5.2. Constraints in Livestock Product Safety

Several challenges hinder livestock product safety, including:

- **Lack of professional expertise** in food safety and hygienic practices
- **Limited awareness and knowledge** of food safety measures among producers, processors, and consumers
- **Absence of refrigerator-mounted vehicles** for long-distance transportation, particularly in Dessie
- **Inadequate training programs** on food safety and proper handling practices
- **Weak enforcement of safety and quality standards**
- **Insufficient storage materials** to maintain product integrity
- **Unsuitable workplace conditions** for dairy production and fish processing
- **Limited access to quality feed** affects livestock production and productivity
- **Absence of modern marketing infrastructure**, including dedicated shops and storage facilities
- **Weak market linkages** affecting product distribution and sales
- **Restricted credit access** for livestock producers and processors
- **Inadequate supply of safe and clean water** for production and processing
- **Security concerns** affecting operational stability

4.5.3. Strategic Interventions for Livestock Product Safety

To address these constraints, the following interventions should be implemented:

- **Recruitment of food safety professionals** and the organization of comprehensive training programs for experts, producers, processors, and consumers to enhance knowledge and minimize product contamination and foodborne risks
- **Land allocation by city administrations** to establish safe and suitable sites for dairy, poultry, and fish processing, alongside improved access to clean water
- **Capacity-building initiatives** led by universities, colleges, and research centers to train urban farmers and agricultural stakeholders on food safety and quality standards
- **Strict enforcement of food safety regulations** by relevant authorities to ensure compliance and risk reduction
- **Government and NGO support for the sector**, including the provision of training, refrigerated transport vehicles, advanced storage facilities, and experience-sharing programs

4.6. Partnership and Institutional Support

4.6.1. Legal Status of the Urban Farming

Urban farmers in Bahir Dar largely operate without formal legal recognition of land ownership, as most land is either inherited or rented without official documentation. The enforcement of land tenure, taxation, and investment regulations remains weak, leading to ineffective policy implementation. Despite these challenges, livestock farming receives more institutional support than crop production, mainly through cooperative structures. The Labor and Training Bureau facilitate the transition of micro and small enterprises into medium-sized entities, while larger enterprises fall under the management of the Industry and Investment Bureau. Consequently, city administrations prioritize livestock farming over crop and horticultural production in legal recognition efforts. However, bureaucratic hurdles continue to pose significant challenges in acquiring legal status.

Farmers must form groups and register through the Small and Micro-Enterprise Office to obtain legal recognition. Following registration, this office worked with the city administration to help farmers get land for urban agriculture. In certain areas, over 200 farmers are actively engaged in fruit, vegetable, fattening, and dairy production, yet none are officially registered due to the requirement for group-based legal status.

In other areas, the government temporarily allocated land to youth groups and male farmers without issuing legal certificates. If farmers, youth groups, and cooperatives were formally registered and certified, they would benefit from enhanced market integration, value chain cooperation, improved credit access, infrastructure development support, and the ability to scale up existing production activities with greater confidence.

Land is a critical asset for establishing livestock enterprises. Most urban dairy producers in Bahir Dar are familiar with the legal land acquisition process for dairy farming. Livestock experts assessed applicants based on the requested land size, housing conditions, and farming competencies. The trade office then manages legal registrations, while the revenue authority formalizes taxation processes by issuing taxpayer identification numbers. Legal registration offers advantages such as land access, business stability, market linkages, and operational guarantees. However, informal payments and high taxation rates imposed by revenue authorities hinder licensing processes, forcing many urban dairy producers into informal operations.

Consistent with findings reported by Abebe et al. (2021), most urban dairy producers establish their farms on privately owned land, which is often unsuitable for dairy operations due to the lack of designated land for such purposes. According to respondents, the high cost of acquiring appropriate land and inadequate infrastructure remain significant barriers to urban dairy production.

Dairy farming in Debre Birhan ranges from small-scale operations, with 3–4 cows per farm, to large-scale enterprises housing up to 42 cows. Small-scale farms are typically established within the owner's compound and operate in residential areas, while medium and large-scale farms are located away from residential settings. Consequently, land availability and related challenges vary by farm size.

Land scarcity is a key barrier for small-scale farms located near homesteads, making it difficult to conduct dairy production as a standalone operation. However, for medium and large-scale farms, land scarcity is less of a concern. Most dairy farms in Debre Birhan are established by the government as enterprises designed to create job opportunities for unemployed youth and women. These enterprises follow a defined legal procedure to obtain legal entities and access land. Despite this framework, medium and large-scale enterprise farms face obstacles in land ownership, as farms are only temporarily allocated land for five years.

In contrast, large-scale private dairy farms—structured as Private Limited Companies (PLCs)—benefit from permanent land allocation, eliminating land constraints. Small-scale farms located within residential compounds lack legal status and formal land access for dairy production.

Urban poultry farming in Debre Birhan is conducted both within residential compounds and as separate farms away from urban centers. Poultry farms vary in scale, with small-scale (village) poultry production typically involving fewer than 10 birds, mainly for household consumption, with occasional sales for supplemental income. Large-scale poultry farms house between 300 and 1,500 birds and specialize in broiler meat and egg production for commercial markets.

Large-scale poultry farms fall into two categories:

- Some operate without legal status or formal land access, relying on family-owned property.
- Others are structured as enterprises, possessing legal recognition and accessing government-allocated land on a temporary five-year basis.

Government-constructed poultry sheds are allocated to enterprises for five-year periods to support new businesses until they accumulate sufficient capital to invest independently. These sheds, situated within a single compound with approximately 10 meters between units, pose challenges for biosecurity measures.

Unlike dairy and poultry production, livestock fattening in Debre Birhan has been mostly conducted as a sideline activity within residential compounds, lacking formal legal registration. Only one private cattle fattener in the town has secured land access and official registration. Typically, farmers fatten between 1 and 10 cattle and between 3 and 26 sheep, predominantly selecting male livestock for fattening, though older female cattle and sheep are also included in fattening. While fattening is mainly conducted for commercial purposes, at least one small ruminant is slaughtered and consumed within households during holidays. Additionally, fattened cattle are often slaughtered collectively, with farmers distributing meat among group members at a lower price than traditional butcher houses.

In Gondar, an individual seeking legal land ownership must first be confirmed as a resident of the respective kebele or district and must not hold land in any other kebele. The process of attaining legal status begins at the kebele level and progresses to the city administration for full recognition.

Approximately 70% of farms in Gondar are legally registered, while some remain unregistered due to various factors, including failure to complete formal land acquisition procedures, unauthorized land control without official documentation, limited space, and efforts to evade taxation.

Legal registration in urban farming offers several advantages. Registered farms benefit from security and stability, allowing land to be transferred within families as a gift. Additionally, legal recognition facilitates market linkages, provides farmers with land certificates, and grants access to extension services, training programs, experience-sharing opportunities, credit services, material support from government and NGOs, improved seed varieties, and modern agricultural technologies.

In Dessie City, the process of attaining legal land registration begins with the kebele land administration committee and progresses to the city administration for full recognition. Most farmers confirmed that their land holds a government certificate designating it for agricultural purposes, though some remain unregistered due to various factors, including unauthorized land control without official documentation, site plan restrictions prohibiting urban farming, and efforts to evade land taxation. In this area, ‘owned’ land is technically state-owned, with farmers granted certificates allowing them to use the land throughout their lifetime.

These certificates provide property rights but do not permit land sales or transfers to third parties outside the family. Despite this restriction, farmers often ‘sell’ their plots informally to individuals seeking residential construction opportunities. Farmers reported that their legally registered farms have fixed boundaries, identifiable through metering, which helps reduce conflicts with neighboring landholders. Legal registration offers several advantages, including land security, market access, extension services, improved seed varieties, and access to modern agricultural technologies.

4.6.2. Agricultural Extension Services and Access to Technologies

Bahir Dar City comprises six sub-cities, 32 urban and 12 rural kebeles. Despite this extensive coverage, the Bahir Dar Special Zone is staffed by only six experts, with no dedicated agricultural professionals at the kebele level for urban areas. As a result, extension services are primarily delivered by a limited number of zonal-level experts, which is insufficient to meet the advisory, training, and support needs of urban agriculture participants across the city.

Urban agriculture, particularly vegetable production, requires specialized expertise in improved seed selection, disease and pest management, seedling preparation, and agronomic best practices. These aspects necessitate continuous follow-up and advisory services to ensure sustainable production.

Based on the insights from key informants, including zonal experts and producers, only two kebeles recently participated in Feed the Future project-facilitated training sessions focused on water management and disease and pest control. However, participants reported that the training was inadequate to meet their practical needs, highlighting gaps in coverage and accessibility.

Experts involved in the key informant (KI) interviews identified several challenges within the training programs, including:

- **Limited participant inclusion**, restricting broader farmer engagement
- **Lack of alignment with training need assessments (TNA)**, reducing relevance and impact
- **Overemphasis on theoretical instruction**, with minimal practical application

Technology plays a fundamental role in enhancing agricultural productivity and efficiency. However, in Bahir Dar City, urban agriculture producers face limitations in both technology access and utilization. Based on researchers' observations and respondents' feedback during the assessment, the primary technologies available to producers included fuel-powered motor pumps, improved seeds, pesticides, and herbicides.

Respondents expressed a strong demand for additional technologies, such as electric motor pumps, modern small-scale irrigation systems, electric power installations, and improved vegetable crop varieties. Beyond accessibility, producers reported challenges in technology utilization, particularly in operating motor pumps and sprayers. Frequent motor pump malfunctions led to high maintenance costs, highlighting the need for technical training. To address these concerns, farmers should receive training on technology utilization and basic maintenance to optimize efficiency and reduce operational expenses.

In Bahir Dar, most respondents accessed extension services related to animal husbandry, feed management, and livestock health twice a month, which they found highly beneficial. Government livestock and animal health experts facilitated these services, particularly in dairy production and health management. However, not all urban dairy producers had access to these extension programs.

Respondent farmers noted a decline in extension services over the past few years, contrasting with findings by Minten et al. (2020), which suggested an overall improvement in service quality. The inconsistency in extension support for urban dairy producers stemmed from several factors, including budget constraints within the Bahir Dar City livestock office, high turnover among qualified professionals, and the absence of dedicated livestock experts for urban dairy production.

Capacity building is crucial for strengthening urban dairy farming. Training before farm establishment is advisable, as it enhances farmers' ability to manage production efficiently. However, contrary to reports by Didanna et al. (2018), urban dairy producers indicated that no formal training sessions were provided before establishing their farms. Recognizing this gap, dairy producers emphasized the importance of capacity-building initiatives as a critical factor for the success of urban dairy production.

Urban dairy producers in the study area have benefited from training sessions and knowledge-sharing initiatives coordinated by SNV, Bahir Dar University, and the City Administration Agriculture Office. This training program focused on animal production and health, has contributed to improved dairy farming practices. However, respondents identified a need for more frequent visits and specialized training sessions covering key aspects such as dairy cattle feeding, husbandry, breeding, and reproductive health management. Despite the availability of training, none of the respondents had read production manuals related to dairy farming, and the absence of institutions providing regular knowledge exchange and training opportunities was highlighted as a major obstacle to urban dairy production.

Urban dairy producers in Bahir Dar employ both traditional and modern technologies in their operations. Modern tools, including feed millers, choppers, milk-containment, measuring equipment, and graded milk-measuring plastics, are acquired through personal purchases or donations from non-governmental organizations like the SNV project. While producers expressed a strong interest in adopting advanced dairy technologies—such as high-yield milk-producing breeds, milk churners, feed mixers, and cream separators—limited access and high costs remain significant barriers to adoption, impeding urban dairy production efficiency.

In Bahir Dar, most cattle fatteners receive little to no extension services from the city's livestock experts. Some fatteners reported receiving advisory support twice per year, primarily on feeding and farm management. However, most fatteners relied on skills passed down from family members or shared by fellow fatteners. The absence of training and experience-sharing initiatives has hindered knowledge development in key areas such as beef cattle selection, health management, feeding strategies, and general farm operations. Existing challenges within the fattening sector include limited institutional support, inadequate extension services, and a lack of targeted training programs. Additionally, nearly all fattening farms have not integrated modern technology due to limited awareness and availability in the market.

Essential technologies such as hay harvesters, chopper machines, silage preparation systems, and molasses utilization remain inaccessible. Unavailability, high costs, limited technical skills, and feed wastage due to the absence of mechanized solutions are the primary constraints affecting beef farm technology adoption.

Livestock experts in Bahir Dar provide advisory support to poultry farms, offering guidance on house construction, biosecurity measures, feeding strategies, and health management. According to interviewees and focus group discussants, experts visit poultry farms approximately once every three to six months. Most interviewees had received training on chicken production and management at least once, primarily through non-governmental projects such as Feed the Future. Many farm owners supplement their learning through experience-sharing with fellow poultry farmers or by reading production and management manuals. Respondents expressed a strong need for additional training and experience-sharing opportunities, particularly in egg production, processing, and management—especially during fasting seasons when market demand and consumption patterns fluctuate.

Among crop producers surveyed in Debre Birhan, only three producers had received apple cultivation training, which was provided by the Debre Birhan Agricultural Research Centre. Despite this, most respondents emphasized an urgent need for extended training programs, particularly in crop cultivation techniques and variety selection suited to their specific farm conditions. None of the surveyed farmers had participated in experience-sharing programs, further limiting knowledge exchange opportunities. Key training topics identified by respondents included a variety of selection practices, effective use of agricultural inputs, land preparation techniques, and post-harvest handling and storage methods. Expanding structured training programs, incorporating practical learning opportunities, and facilitating farmer-to-farmer experience-sharing initiatives would significantly enhance crop production efficiency in Debre Birhan.

In Debre Birhan, farmers organized as enterprises receive introductory training from the Technical and Vocational College upon establishment. Some dairy farmers have also received training on brewery spent grain silage preparation, facilitated by the Debre Birhan Agricultural Research Center. However, there is no universal technology utilization among farms, and support beyond the extension office is largely absent, with limited involvement from governmental or non-governmental organizations.

Poultry production training is primarily provided when enterprises enter the business, serving as an introductory program rather than a comprehensive educational initiative. Farmers reported that the training lacked depth and failed to provide sufficient information. While a few received training to pass knowledge on to others, no formal knowledge-sharing mechanism exists. Poultry producers require advanced training and experience-sharing opportunities to modernize operations and enhance productivity.

At large-scale poultry farms, some farmers have adopted automatic water drinkers, but there are no other technologies used in the farms. To protect chickens from cold weather, most houses are covered with corrugated sheets, leading to suffocation risks. Therefore, proper house construction should incorporate airflow mechanisms, heaters for temperature regulation, and ventilators to prevent ammonia accumulation.

Sheep and cattle fattening in Debre Birhan is conducted using traditional methods, with no formal training available on fattening practices. Additionally, no modern technologies are utilized in fattening operations. Farmers expressed a need for training and access to essential fattening technologies such as hay harvesters, chopper machines, silage preparation equipment, and molasses utilization systems.

In Gondar, extension services primarily focus on farm management and product handling until items reach consumers. However, these services are infrequent. Some farmers have received training organized by NGOs and agricultural offices, including sessions facilitated by Gondar University, Gondar TEVT College, SNV, and Feed the Future in collaboration with the Agricultural Offices on production manuals and advisory services for urban agriculture producers. Farmers use a combination of traditional, modern, and vertical farming techniques yet face challenges in acquiring technology due to high costs and insufficient skilled labor for operation. Key technological needs include improved seed varieties, irrigation systems, motorized equipment, row planters, and water harvesting mechanisms.

Extension services in Dessie cover topics, such as forest nursery establishment, poultry production, and farm product handling. These services provide essential knowledge on management practices, planting schedules, watering frequency, quality maintenance, animal health protection, product processing, and post-harvest handling. However, they are not provided regularly. Farmers in Dessie primarily acquire farming skills through family members and fellow farmers. Some have received training from NGOs and agricultural offices, including Wollo University, Woyizero Sihen TEVT College, and SNV, in collaboration with the local Agricultural Office.

Additionally, SNV, CCA, and the Agricultural Office offer training for experts, though experience-sharing among professionals remains limited. While experts have access to production manuals, they require further training in modernized farming practices. Farmers cited barriers to technology adoption, including limited awareness, high costs, and inadequate government support. Farmers need technologies like water pumps, tractors, and combine harvesters.

Forest seedling producers in Dessie receive training and experience-sharing opportunities from Kombolcha seedling producer cooperatives and the Senayit Ornamental Plant Garden. Farmers emphasized the need for additional training on productivity enhancement, product processing, farm management, post-harvest handling, quality assurance, and asset-building strategies. Development agents and agricultural experts receive training from the Bureau of Agriculture and gain experience-sharing opportunities through non-governmental organizations. However, additional training in agroforestry practices is required to strengthen expertise.

4.6.3. Capital Availability for Urban Farming

Based on the researcher's observations and the responses of farmers engaged in urban agriculture, most farms in Bahir Dar's urban areas are characterized by traditional production methods, small land sizes, and limited crop diversity—primarily Swiss chard, lettuce, and kale. The primary challenge contributing to these limitations is a lack of capital, which restricts farmers' ability to modernize and expand their operations. Farmers reported that urban agriculture currently lacks access to credit services, which they view as essential for scaling up their activities. Agricultural experts also emphasized the need to facilitate credit services in urban areas to encourage new participants in the sector and support sustainable agricultural development.

In Bahir Dar, access to credit is a fundamental factor in the establishment and expansion of dairy businesses, as it enables farmers to secure financial resources from institutions through collateral-based schemes. The availability of credit services plays a crucial role in determining the profitability and sustainability of livestock farming. Despite the presence of formal credit institutions such as Tsedey Bank and other financial providers in the study area, dairy producers face significant challenges in obtaining financing. As a result, most urban dairy farmers rely solely on personal capital, which often proves insufficient for business expansion.

Contrary to the current findings, Gebrekidane et al. (2014) reported that urban dairy producers had access to credit services for their business establishment. Similarly, Ayenew et al. (2011) found that 16% of dairy farms secured credit for their initial setup, whereas 84% depended on personal funds for farm establishment and growth. Due to limited access to formal financial support, urban dairy producers frequently turn to informal credit services from friends and relatives to facilitate business expansion.

In Bahir Dar, chicken farms primarily rely on personal savings and financial support from relatives and friends through donations or informal borrowing to secure start-up capital. Access to credit services is crucial for the growth and commercialization of poultry farming. However, low-income groups and young entrepreneurs face difficulties in obtaining financial support, despite a strong demand for credit services to enter the industry. Commercial banks require substantial collateral—typically urban houses or other fixed assets—for loan approval, making it challenging for aspiring poultry farmers to access funding. Additionally, high interest rates further restrict financial accessibility.

The Development Bank of Ethiopia, a state-owned financial institution responsible for supporting national development projects, currently prioritizes credit services for sesame and haricot bean commercial farms in Ethiopia's lowland regions, rather than for poultry farming. As a result, access to financial resources remains a major constraint for starting and expanding chicken farming businesses.

Similarly, in Bahir Dar, cattle fatteners primarily rely on personal capital to establish their farms, with minimal support from formal and informal credit sources. However, these funds are insufficient for business expansion. Credit accessibility remains highly limited, with Tsedey Bank (ACSI) being the sole provider of credit through revolving funds—though this option remains inaccessible to those lacking collateral.

In **Debre Birhan**, most urban farmers relied on personal capital to establish their agricultural ventures, except for three producers who secured microfinance loans ranging from 50,000 to 90,000 birr for purchasing water pumps and other necessities. While some farmers were aware of credit sources, such as banks and microfinance institutions, they expressed dissatisfaction with the complex procedural requirements, leading them to avoid formal credit options altogether. Despite this reluctance, the financial demands of urban agriculture are significant. For instance, the cost of renting one hectare of land can reach up to 50,000 birr, with variations depending on soil fertility.

Additionally, labor wages for essential farming activities—such as land preparation, weeding, harvesting, loading, and unloading—represent a considerable expense. Female labor participation is particularly high in weeding and vegetable cleaning tasks. On average, daily wages range from 350–500 birr for male workers and 180–350 birr for female workers. To sustain and expand urban agriculture, 75% of respondents indicated a need for financial support ranging from 500,000 birr to 1.5 million birr. Small-scale dairy producers cited land scarcity as a major barrier, while large-scale dairy farmers reported temporary land ownership constraints that discourage investment in farm improvements.

As a result, most urban dairy producers do not seek credit services, as existing capital is deemed sufficient to maintain operations. Only one enterprise expressed interest in transitioning into dairy processing and required financial support. Access to credit remains critical for poultry producers, who face financial challenges due to seasonal market fluctuations. Since poultry products are stored for extended periods in anticipation of better prices, producers lack a steady income stream to cover feed costs. Consequently, many poultry farmers purchase feed on credit and repay their loans after selling their products.

Thus, adequate financial resources and improved credit access are essential for the profitability and sustainability of poultry farming. In contrast, capital requirements for cattle fattening practices are generally met through family members' personal savings or financial assistance. Young farmers, in particular, receive support from relatives when expanding their operations. Many farmers found credit services unattractive when comparing profit margins to prevailing interest rates.

In Gondar, urban agriculture is primarily financed through personal savings and family donations. Producers require additional capital to sustain and expand their farming operations and to adopt modern agricultural technologies. Among surveyed respondents, 99% relied on personal funds to establish their farms, with no access to formal credit when needed. Additionally, 80% reported insufficient capital to maintain or scale their farms, citing the need for financial resources to purchase dairy cows and oxen for fattening, modernize farm infrastructure, and expand fruit cultivation.

Credit availability in Gondar exists in both formal and informal forms:

- **Formal credit** is provided by microfinance institutions, such as ACSI, which offers loans at an interest rate exceeding **17%**.
- **Informal credit** is sourced from friends and relatives, serving as an alternative financial support system for farmers.

Limited access to affordable credit remains a significant barrier to urban agricultural development, restricting investment in improved technologies and farm expansion. Strengthening financial support mechanisms, including tailored credit programs and lower-interest financing options, would enhance the sustainability and productivity of urban agriculture in Gondar.

In Dessie, urban agriculture is financed through both personal savings and credit services. Credit availability exists in formal sources, such as banks and microfinance institutions, and informal sources, including friends, relatives, and money lenders. Most farmers rely on personal funds to establish their farms, expressing concerns about credit services due to high interest rates. Some farmers have accessed credit from ACSI, Tseday Bank, and Wisdom Microfinance, with interest rates exceeding 12%. Despite these financial options, farmers require additional capital to sustain and expand their farming operations, invest in modern agricultural technologies, and improve productivity. Strengthening financial support mechanisms, including affordable credit programs and lower-interest financing, would enhance urban agriculture development in Dessie.

4.6.4. Gender Roles and Participation in Urban Farming

Bahir Dar City

In Bahir Dar, both men and women participate in chicken production, though their responsibilities differ. Men handle tasks such as procuring chickens, loading and unloading during sales, feeding, cleaning the house post-production, and securing market access. Women, on the other hand, take charge of routine tasks such as cleaning feeders and water equipment, providing food and water, and monitoring chicken health daily. Despite female participation, the majority of labor in poultry farms is carried out by men.

Family members, both male and female, are engaged in dairy farming. Men and boys primarily manage daily dairy operations, while women and girls focus on feeding the animals and cleaning the barn. The division of labor is influenced by seasonal workforce availability and cultural norms that traditionally associate cattle management with male responsibilities.

Gender-disaggregated roles in fattening farms are clearly defined:

- **Men and boys** oversee farm management, cut and feed green fodder and grass hay, clean animal housing, wash livestock, administer medications, prepare feeding troughs, water animals, and manage sales.
- **Women and girls** support the farm by cleaning animal housing, feeding and watering livestock, and purchasing grains for local beverage processing, and assisting men when needed.

The workload in beef farms tends to be more demanding for women and girls than for men and boys, highlighting disparities in labor intensity and accessibility in livestock production.

Gondar City

In Gondar City, women bear a disproportionate responsibility for unpaid care and domestic work, limiting their time and labor availability for agricultural engagement. Gender-based labor divisions and social norms further restrict women's ownership and management of agricultural machinery. Urban agriculture in Gondar involves all family members, with men being the primary participants, followed by women, and then youth. Despite women's substantial contributions, their ability to fully engage in farming activities is constrained by household responsibilities and societal expectations.

Dessie City

Urban farming in Dessie is predominantly a family enterprise, with women playing a key role, particularly in home gardening. Their participation in farming may be attributed to the flexibility of agricultural and selling activities, which can be more easily integrated into household tasks.

4.6.5. Environmental Impact of Urban Farming

Environmental Impact of Urban Agriculture in Bahir Dar City

Urban agriculture in Bahir Dar contributes to sustainable food production, yet poses challenges to ecosystems through land use, water consumption, and waste generation. Perspectives on its environmental impact vary among farmers, consumers, and experts. Many farmers lack awareness of the environmental consequences of urban agriculture and receive insufficient support from governmental and non-governmental entities. Despite the absence of immediate environmental crises, there is a shortage of innovative technologies to mitigate pollution.

Some farmers argue that vegetable and horticultural crop wastage has minimal environmental impact, attributing concerns primarily to chemical containers used for pesticides and fertilizers. These containers often improperly disposed of—either burned or discarded in ditches—contribute to environmental degradation and pose risks to human health.

Consumers are aware of chemical contamination in vegetables due to pesticide use, often detecting it through unpleasant odors and poor packaging quality. However, purchasing decisions are frequently based on product scent, with a positive aroma influencing their choices. Despite recognizing contamination risks, many consumers lack awareness of the broader environmental implications of urban agriculture, highlighting the need for education and awareness campaigns to address pollution concerns.

Experts caution that urban agriculture may lead to long-term environmental issues, including human health risks, ecosystem degradation, and climate variability, though these effects are not yet visibly apparent. Environmental regulation enforcement remains ineffective due to corruption, with policies suffering from poor implementation and weak enforcement, exacerbating ecological challenges. Strengthening regulatory frameworks and promoting sustainable agricultural practices are essential to mitigating environmental risks in Bahir Dar.

Urban chicken production in Bahir Dar generates waste and by-products that contribute to environmental pollution. Post-production litter, medicaments, and containers are often disposed of improperly, leading to contamination in surrounding areas. Additionally, many chicken farms are situated within residential neighborhoods, where odor emissions create discomfort, causing community complaints and conflicts.

Urban dairy producers generally recognize the environmental impact of waste, chemicals, and by-products from dairy cattle. Some mitigate pollution by burying liquid waste or composting solid waste for organic crop cultivation. However, due to inadequate waste management practices, respondents reported a moderate environmental impact from dairy operations.

A few dairy producers have implemented biogas plants to both reduce pollution and generate energy. Despite these efforts, the city administration provides no support for pollution control, and producers lack access to modern technologies that could mitigate environmental harm. Key constraints include a lack of technical skills, organized infrastructure, and financial resources for waste management.

In beef farms, waste by-products such as cattle dung, urine, rumination gases, feed refusals, and drug containers contribute to environmental concerns. Some farmers sell dung as fertilizer (one quintal for 15 ETB) or burn drug containers for disposal. Due to inadequate support from the City Administration, farmers are exposed to health risks such as asthma and increased fly populations.

Environmental Impact of Urban Agriculture in Debre Birhan City

In Debre Birhan, waste disposal is a significant constraint, particularly for landless small-scale dairy farms. Large-scale farms, with more space, recycle dairy waste through composting or dry manure for fuel production. Although dairy waste could be used for biofuel generation, the lack of land ownership among small-scale farms discourages investment in waste management technologies, such as silos.

Poultry litter is not a major issue due to the small number of birds and extensive farming systems practiced by local farmers. However, expanding village poultry production requires intensive housing systems. Due to limited awareness and technical skills, poultry litter is often discarded, though it could be repurposed as ruminant feed or compost. Cattle and sheep waste are primarily used as organic fertilizer, with cattle manure dried and sold for fuel.

Environmental Impact of Urban Agriculture in Gondar and Dessie Cities

In Gondar, urban agricultural pollution is minimal due to the efficient use of farm by-products. Vegetable and fruit waste are repurposed as animal feed, while livestock by-products serve as compost or fuel sources. As a result, pollution from urban farms remains negligible.

Similarly, in Dessie, agricultural waste is systematically reused for animal feed and composting, ensuring that urban farms generate minimal environmental pollution. Horticultural crop residues and forestry waste are repurposed for compost, while poultry waste is utilized as animal feed and organic fertilizer. Additionally, biogas production from crop residues is actively supported by city administration funding, helping mitigate environmental concerns.

4.7. Marketing, Consumption and Processing in Urban Farming

4.7.1. Horticultural Crop Marketing

The major marketing agents in urban agriculture, particularly in the horticultural crop marketing system, can be broadly categorized into three groups, such as Producers, Middlemen, and Consumers.

Throughout the marketing channels, various factors contribute to different and complementary marketing functions, including production, facilitation, buying and selling, transportation, packaging, and processing. As products move along the value chain from production to consumption, their utility increases, making them more accessible to end users.

Primary Actors in Horticultural Value Chain

The key participants in Bahir Dar's horticultural crop (fruit and vegetable) value chain include: Horticultural crop producers, Collectors, Retail traders, Wholesalers, Hotels, Small-scale businessmen (locally known as *Gulit* in Amharic), and Individual consumers. Each of these actors plays a distinct role in the horticultural crop market, as described below:

Producers

Smallholder horticultural crop producers in Bahir Dar allocate land, labor, and investment costs to cultivate fruits such as avocado, mango, guava, coffee, grapes, and cherry, as well as vegetables including head cabbage, tomato, carrot, onion, garlic, green chili, and red root. These producers supply their products to various market actors within the city.

Individual Consumers

Individual consumers represent a significant segment of Bahir Dar's horticultural crop market. They purchase vegetables and fruits from producers and traders. While most consumers are urban dwellers, some non-producing farmers and individuals who experience crop losses also participate in consumption.

Vegetables such as head cabbage, tomato, carrot, onion, garlic, green chili, and red root are widely consumed locally, alongside fruits like avocado, mango, guava, coffee, grapes, and cherry. Notably, demand for horticultural crops increases during fasting seasons, as they are essential ingredients in traditional fasting meals.

Assemblers

Assemblers are unlicensed urban traders who collect vegetable crops during main market days at fields or designated market points. They primarily deliver produce to wholesalers, sometimes based on prior agreements, though transactions may also occur without formal arrangements.

Retail Traders

Retail traders may or may not be legally licensed and typically sell a variety of fruits and vegetables rather than specializing in a single product. They play a critical role in urban horticultural marketing by ensuring direct access to consumers. Retailers purchase smaller quantities from producers or wholesalers and sell them on weekly or daily market days. Many small traders have extensive market experience, allowing them to identify crop demand among different buyers. They also coordinate pricing, ensuring uniformity in market rates. Some producers engage in retail trade themselves, with women participating more actively than men in direct sales.

Wholesalers

Wholesalers are licensed traders who purchase large quantities of horticultural crops from individual producers, retailers, and assemblers. They store bulk produce and distribute it within Bahir Dar, particularly onions and tomatoes. Additionally, wholesalers outside Bahir Dar operate at terminal markets, sourcing vegetables from woreda-level wholesalers, especially from Fogera and Mecha woredas.

Small-Scale Processors ("Juice")

Small-scale fruit processors in Bahir Dar specialize in juice production, primarily using avocado and mango. While they play a significant role in the fruit crop market chain, most of the fruits they process are sourced from southern Ethiopia.

Marketing Channels in Bahir Dar

The length of marketing channels varies depending on the product and distribution network, affecting the time required for goods to move from production to consumption. The primary marketing channels in Bahir Dar City include:

1. **Producer → Consumer**
2. **Producer → Retailer → Consumer**
3. **Producer → Collector → Retailer → Consumer**
4. **Producer → Collector → Wholesaler → Retailer → Consumer**

Understanding these channels helps optimize market efficiency, ensuring better access to horticultural products for urban consumers.

Market Dynamics and Pricing Trends

Evidence from producers, consumers, and experts indicates irregular buyer-seller interactions in Bahir Dar's horticultural market. Vendors often sell to any interested buyer, accepting higher prices when possible. According to respondents, 75% of fruit production and 90% of vegetable production is supplied to Bahir Dar's consumption market. Vegetable prices tend to rise alongside other food costs, with most consumers purchasing vegetables weekly, while fruit purchases occur less frequently.

Despite demand, high costs and limited awareness of new fruit varieties (e.g., kiwis) hinder market expansion. Prices for horticultural crops vary based on quality standards, with street vendors offering fixed prices for high-quality items, while lower-quality produce is sold at discounted rates. Transportation methods include carts, vehicles, and manual carrying, ensuring freshness. Sorting and rapid inspection help maintain product quality before sale.

Challenges in Urban Agriculture Marketing

Urban agriculture faces several marketing challenges, including:

- **High perishability** of crops, requiring rapid sales
- **Weak market chain infrastructure**
- **Limited processing capacity** for urban farm products
- **Lack of retail spaces near farms**, restricting direct sales

Producers often receive low prices for their goods. For instance, coffee is sold at 350 birr per kg, significantly below optimal pricing. Farmers advocate for government-supported retail stores, enabling direct sales at fair prices. Additionally, producers seek government intervention to collect and export their goods, ensuring higher revenue generation for the nation.

Processing and Value Addition

Value addition transforms raw products into higher-value goods, offering benefits such as improved nutrition, increased producer income, expanded market access, enhanced packaging and storage, reduced post-harvest losses, lower import dependency, boosted exports, and growth of subsidiary industries. Despite these advantages, horticultural producers in Bahir Dar do not engage in processing or value addition due to several constraints, including:

- **Lack of processing infrastructure** (e.g., grading systems, packaging facilities)
- **Limited knowledge and awareness** of value-added techniques
- **Quarantine restrictions** affecting product movement
- **Non-uniform quality** of processed goods
- **Irregular supply chains**, failing to meet local demand or attract buyers

Market Channels in Debre Birhan

In Debre Birhan, most producers sell their goods at both market stalls and farm gates. Home garden farmers typically sell directly at street markets, as their small-scale vegetable production allows for easy transport using family labor. Enterprise-based urban farmers follow longer marketing chains, involving:

- **Producer → Broker → Collector and/or Wholesaler**

Respondents reported that broker involvement negatively impacts pricing, often reducing expected profits. Except for direct-to-consumer sellers, all respondents stated that traders ultimately determine product prices.

4.7.2. Livestock Product Marketing

4.7.2.1. Chicken and Egg Marketing, Processing, and Consumption

Chicken producers market eggs, chicks, and pullets through various channels, including farm gates, local markets, hospitals, and universities. Annually, approximately 10 to 12 million eggs are sold to consumers, with 10 million eggs purchased by traders and 2 million acquired by institutions (Urban Livestock Development Office, 2016). Producers maintain egg quality by ensuring hygienic housing and surrounding conditions and applying chemical disinfectants.

Egg prices vary depending on breed, with local eggs commanding higher prices than exotic ones. Pricing is primarily set by sellers; however, bulk purchasers may negotiate rates. Brokers facilitate transactions, earning commissions of 0.50 to 1 birr per egg and 5 to 10 birr per hen. Poultry and egg products are typically transported via Bajaj, and sellers primarily rely on direct customer interaction for promotion.

Egg Market Channels and Consumption Trends

The egg market chain comprises 12 distinct channels, with wholesalers receiving the highest volume of products. Hotels and cafes constitute the second-largest buyers, whereas direct consumer purchases from producers remain limited, suggesting significant intermediary involvement. Non-marketable eggs, such as broken eggs, are consumed by sellers, who often recognize their nutritional value. Producers also distribute eggs as gifts, with some households giving between three hens and 100 eggs annually to neighbors and relatives.

Egg consumption is steadily increasing. On average, each family member consumes approximately 0.13 eggs per day. Urban dwellers predominantly consume poultry products during annual holidays and special occasions. Consumer preferences for egg quality vary by breed. Eggs from exotic poultry are generally preferred due to their freshness, given their origin is in urban areas and the possibility of shorter storage durations. Conversely, eggs from local poultry are considered lower in quality, primarily due to their rural origin and the likelihood of extended storage periods.

4.7.2.2. Dairy Products Marketing, Processing, and Consumption

Urban dairy producers have been marketing live animals, milk, and dairy products. Dairy farming is primarily oriented toward commercial milk production, with cows mainly maintained for this purpose. Meanwhile, calves, heifers, and bulls are raised for sale. Farmers commonly prefer selling male calves over females, as crossbred female calves command higher prices and are kept for herd replacement. Additionally, keeping male calves incurs extra costs due to their milk consumption.

Milk producers distribute their products through direct home sales or designated marketplaces such as shops and dairy cooperatives. The formal milk market operates under specific by-laws, ensuring regulated milk distribution to consumers. Dairy cooperatives play an important role in milk quality control, using alcohol testing and lactometer measurements as standard procedures.

While the primary function of dairy cooperatives is to collect milk from their members, they have also established retail milk shops for direct consumer sales. Pricing for raw milk and dairy products is determined by cooperative committees, factoring in dairy feed costs. Price differentiation occurs based on purchase volume—for instance, the price per liter of milk in Addis Ababa is 37 birr, whereas in Bahir Dar, it is 45 birr.

In contrast, non-cooperative dairy producers sell milk and dairy products directly to consumers at their destinations, with pricing determined through negotiation, favoring seller bargaining power. Milk producers facilitated milk delivery using bicycles or Bajaj, while dairy cooperatives utilized dedicated vehicles for distribution to retail shops.

Milk Market Actors

Input Suppliers: Input suppliers provide essential resources for dairy production. Agro dealers supply feed, urban water, and sanitation offices ensure water access, microfinance institutions offer credit services, and both government and private clinics deliver veterinary services to the dairy sector.

Milk Producers: Urban small- and medium-scale dairy farmers contribute to milk production in the city, with most producers being members of dairy cooperatives.

Dairy Cooperatives: The Bahir Dar Dairy Development and Marketing Cooperative is the largest and most established cooperative in and around the city, alongside others such as Tis Abay, Zenzelima, and Werba, which supply milk to urban consumers. To ensure milk quality, the cooperative conducts alcohol and lactometer tests for each cooperative member's milk, eliminating returns except for cases related to dairy feed issues. The Bahir Dar Cooperative had eight collection centers, 13 distribution shops, two vehicles, 60 aluminum cans, two chillers (2000-liter and 5000-liter capacity), three lacto scans, one cream separator, and one balance.

Wholesalers: Large-scale milk processors, primarily located outside Bahir Dar, purchase significant milk volumes and distribute products in Addis Ababa.

Retailers: Urban youths engage in small-scale milk retail, purchasing raw milk from producers and selling it door-to-door by bicycle. They also purchase butter from dairy cooperatives and sell it to consumers.

Processors: Milk processing was primarily carried out by dairy cooperatives, with the Bahir Dar Dairy Cooperative being a major contributor. Additionally, milk processors based in Addis Ababa conducted processing and distributed dairy products to their customers.

Hotels and Supermarkets: Urban hotels and supermarkets source milk and dairy products from cooperatives and processors to meet consumer demand.

Consumers: Milk consumption is widespread among urban dwellers, with babies and youths being primary consumers. Institutional staff, including employees of universities, hospitals, and civil service organizations, also contributes to milk demand.

Value Chain Map of Milk and Milk Products

The milk market operates through eight major distribution channels.

- 75% of milk produced enters the formal market, primarily through dairy cooperatives. While 35 established milk shops serve urban consumers, the largest volumes are sold to wholesalers.
- 25% of milk is marketed informally through direct consumer sales.
- Dairy cooperatives regularly sell raw milk, butter, and yogurt at farm gates and markets, while cheese and mozzarella are primarily distributed through supermarkets.

Dairy Processing and Value Addition

Raw milk is processed for both home consumption and commercial sales. Urban dairy producers traditionally process milk into yogurt and butter for household use. While milk collection remains the primary function of dairy cooperatives, some engage in small-scale processing.

For instance, the Bahir Dar Dairy Cooperative collects 3,500 liters of milk per day but processes only 10–15% of the total volume, as most milk is sold to wholesalers. Processed dairy products, including yogurt, butter, cream, and mozzarella cheese, are prioritized during fasting periods when milk consumption declines. Although large-scale processing is not feasible for cooperatives, it reduces market-related losses. The cooperative packages yogurt, cream, and mozzarella cheese for sale.

Consumption of Milk Products

Urban dairy products consumers include producers themselves, relatives, and urban dwellers.

- Milk producers consumed 3.2% of their total milk production, while the rest entered the market.
- Families with young children consume raw milk daily, while other dairy products are more commonly consumed during non-fasting days. During these periods, individual daily consumption averages 0.17 liters of milk, 0.06 liters of yogurt, and 0.015 kg of cheese per family member.
- Households with higher purchasing power annually purchased 5–10 kg of butter, which they processed (spiced), stored, and consumed.
- Per capita milk consumption among urban consumers is 34.05 liters, aligning with national consumption patterns (Yilma Z. et al., 2017).

4.7.2.3. Beef Marketing, Processing, and Consumption

Beef producers engage in cattle fattening, selling 15 to 100 cattle annually. With well-established fattening practices, producers achieve market-ready cattle within three months. Live animals are primarily sold to Addis Ababa through brokers, often securing high prices. Approximately 70% of the beef produced in Bahir Dar is transported to the national market in Addis Ababa, while 30% is consumed locally (Bahir Dar Urban Livestock Office, 2016). Beef is sold at both marketplaces and farm gates, with 10% of total production supplied to wholesalers and 90% directly sold to consumers.

Transport modes for cattle marketing vary:

- **Trucks** are used for long-distance transport beyond Bahir Dar.
- **Trekking** is the primary mode for local market distribution within the city.

The national market offers attractive pricing, but recent security challenges have disrupted transportation, limiting high-volume sales. Beef prices are market-driven and continue to increase over time, with price variation based on cattle weight and quality (assessed via physical observation). The beef market is particularly active during major Ethiopian Orthodox holidays—Christmas, New Year, and Easter. However, post-holiday sales can be challenging, often requiring two to three weeks to secure buyers.

Most beef producers do not actively promote or advertise their products, except for one producer utilizing Facebook and Telegram for marketing. Unlike milk and egg markets, brokers play a significant role in beef trading, influencing price negotiations. Brokers typically receive commissions of 500–1,000 birr per ox. In addition to brokers, butchers sometimes mediate cattle transactions, further impacting price determination. The high number of butchers in Bahir Dar fosters a competitive meat market, leading to the establishment of a meat processing cooperative.

Beef Market Actors

Input Suppliers: Beef cattle producers supply selected animals to the market, while agro-dealers and local breweries provide feed.

Beef Producers: Beef production is dominated by experienced, mature individuals with established capital investment. Youth groups, supported by small-scale enterprise offices, also engaged in cattle fattening.

Traders: Independent traders participate in local and national beef trading, purchasing one or multiple cattle for resale.

Retailers: Retailers—either individuals or groups—purchase, slaughter, and sell meat through roadside stalls or established meat shops.

Hotels: Numerous hotels in Bahir Dar process and serve beef-based dishes to customers.

Consumers: Beef consumption is prevalent among urban residents. Additionally, universities procure beef cattle to supply students with meat products.

Beef Market Channels

The beef market is characterized by a limited number of short distribution channels, with only three primary pathways identified:

1. **Direct Sales** – Producers sell beef directly to consumers.
2. **Trader-Mediated Sales** – Producers sell beef to traders, who then distribute it to consumers.
3. **Hotel Supply Chain** – Producers supply beef to hotels, which process and sell it to consumers.

Beef Processing and Value Addition

Beef producers enhance cattle value through feeding, improved health management, and optimized housing conditions. This study highlights how producers integrate Indigenous feed formulation knowledge with expert recommendations to maximize cattle fattening efficiency. The feeding process involves blending crop husk, wheat/maize bran, water, salt and local beverage by-products, allowing the mixture to settle for 30 minutes before feeding.

Beyond adding value to live animals, individual butchers slaughter cattle and sell meat along roadsides, while hotels process beef into various cuts according to consumer preferences. Hotels offer spiced meat dishes, *wote*-based beef preparations, and fried meat slices. Additionally, they sell raw meat, packaged for home consumption.

Hotels and meat shops categorize beef into three standardized quality tiers:

- **High-quality beef** – 1,400 birr per kg
- **Medium-quality beef** – 1,100 birr per kg
- **Lower-quality beef** – 900 birr per kg

Hotels slaughter approximately 1.5 cattle per week, employing butchers at 700 birr per ox. Butchers report that while oxen purchasing prices have increased, meat prices have not followed the same trend due to concerns about perishability and consumer price sensitivity.

Urban Agriculture Market Dynamics in Debre Birhan City

Dairy Market: In Debre Birhan, dairy farms are established primarily for commercial milk production, with minimal processing for household consumption (traditional butter and cheese). Despite some direct-to-consumer sales, the majority of raw milk is supplied to collectors, who dictate pricing. Raw milk prices are determined by milk collectors, with rates ranging from 40 to 49 birr per liter. While dairy producers prefer two specific collectors, they have limited flexibility in choosing buyers. Despite the high cost of commercial concentrate, raw milk prices in Debre Birhan (40–49 birr per liter) remain substantially lower than those in Addis Ababa (90–100 birr per liter). This price disparity discourages dairy farmers from improving productivity, leading some to shift to other agricultural sectors or explore non-agricultural ventures.

Poultry Market Challenges: Despite a significant rise in poultry feed costs, egg prices remain stagnant and decline further during fasting seasons. Poultry product consumption is highly seasonal, peaking before fasting periods and surging again post-fasting. To mitigate financial losses, farmers store eggs for over a month, risking quality deterioration. Government policies aimed at restricting foreign exchange allocations for luxury goods, including poultry products, initially boosted broiler prices. However, broiler prices dropped sharply when poultry imports resumed, undercutting local production.

Cattle and Sheep Fattening: Cattle and sheep are primarily fattened for the local market, with seasonal fattening cycles aligned with major public holidays. Rural farmers traditionally fatten livestock for Christmas using crop residues and grain screenings, but Christmas fattening often proves economically unfeasible. Consequently, urban farmers prioritize livestock fattening for Easter and summertime holidays (Ethiopian New Year), when market demand and price conditions are more favorable.

Urban Agriculture Market Dynamics in Gondar City

Urban agriculture producers in Gondar City primarily sell their products in local markets and nearby areas, with some reaching larger markets such as Addis Ababa, expanding their consumer base. Horticultural, dairy, and poultry products are highly perishable and market-oriented, requiring efficient distribution.

Market opportunities for urban agriculture have grown due to the increasing presence of fruit, vegetable, egg, and milk retailers and consumers in the city. Most producers deliver fresh products to nearby markets, selling directly to neighbors, farm gate buyers, retailers, and wholesalers. However, value-added processing for horticultural crops is nonexistent in the city.

Livestock products are primarily sold at farm gates, through local shops, markets, hotels, supermarkets, and processors. Market challenges arise during fasting periods, affecting animal product demand, while crop producers sometimes struggle to sell seasonal surpluses of onions and tomatoes at peak harvest times.

Urban agriculture product prices fluctuate, primarily determined through negotiation between buyers and sellers. Producers promote their products using business cards, quality assurances, and product samples, enhancing market demand. To maintain product quality, farmers store produce in suitable weather conditions and protect it from contamination. Price variability exists for horticultural products, reflecting differences in quality and standards, whereas animal product pricing remains uniform.

Unlike rural agriculture, urban farming benefits from shorter transportation distances. Producers commonly deliver products using Bajaj or public transport. Distribution channels follow multiple pathways:

1. **Producer → Wholesaler → Retailer → Consumer**
2. **Producer → Retailer → Consumer**
3. **Producer → Consumer (direct sales)**

Over 75% of urban agriculture products are produced for local market sales, while smaller portions are reserved for home consumption and given as gifts to relatives and neighbors. Consumption trends for farm products have increased over time. However, several environmental and public health challenges persist:

- Pollution risks from wastewater irrigation and poor hygiene practices may expose consumers to pathogenic diseases.
- The city administration has struggled to address urban agriculture-related pollution.
- Waste disposal remains a **cost** burden rather than an income-generating opportunity.

The traditional management of agricultural by-products often involves waste disposal and composting. Legal frameworks should be introduced to mitigate health risks to farmers and the environment. Ongoing pollution concerns include:

- Lack of by-product management strategies
- Insufficient oversight by city administrators and NGOs
- Rising complaints from neighbors regarding pollution

However, certain vegetable products pose minimal environmental risks, contributing to more sustainable urban agriculture practices.

Urban Agriculture Market Dynamics in Dessie City

Urban agriculture in Dessie operates with minimal marketing costs, as food products require little to no packaging, storage, or long-distance transportation. Farmers typically deliver harvested crops to market outlets on the same day or the next, ensuring freshness. Market opportunities for urban horticulture are expanding due to the growing number of fruit and vegetable collectors and retailers. Most vegetable producers sell products at farm gates or in nearby markets, including:

- The major Dessie market (Monday and Wednesday)
- Haik and Kombolcha markets

Producers primarily sell fresh products to consumers, brokers, and wholesalers, with no significant processing or value-added practices for horticultural crops. Forest seedling producers market their products at farm gates and local markets, supplying farmers, companies, and institutions. Livestock products are sold at farm gates, in neighboring towns, local shops, markets, hotels, supermarkets, and processing facilities. Most sales involve fresh products, though some producers offer processed dairy items (e.g., yogurt and butter) and cooked products (e.g., boiled eggs sold on streets).

Market fluctuations occur during fasting seasons, reducing consumer demand for animal products. Additionally, producers sometimes struggle to secure buyers or wholesalers at peak harvesting times, particularly for highly seasonal vegetables like onions and tomatoes. Urban agriculture product prices fluctuate, determined through negotiation between producers and consumers. Farmers promote their products by:

- Ensuring high-quality production
- Providing product samples to attract buyers

Producers maintain freshness by storing farm products in suitable weather conditions and preventing contamination. Price variability exists for horticultural products, though animal product pricing remains consistent. Retailers and brokers play a critical role in vegetable market pricing, often setting prices without accounting for production costs or producer interests. Government intervention is needed to regulate brokers' influence on price determination. Unlike rural agriculture, urban farming benefits from shorter transportation distances. Products are delivered using:

- Small vehicles or handcarts
- Public transport, taxis, or donkeys (in rural kebeles)
- Panniers carried by female farmers

Occasionally, transactions take place directly at farms, allowing consumers to purchase fresh products at the source. The primary distribution chains include:

1. Producer → Wholesaler → Retailer → Consumer
2. Producer → Retailer → Consumer
3. Producer → Consumer (direct sales)

Most urban agriculture farmers in Dessie report that over 75% of their vegetable, dairy, and poultry production is sold commercially, with smaller portions reserved for home consumption and gifting. Consumption trends have steadily increased, reflecting growing community awareness of diet diversification needs. However, several environmental and pollution challenges persist, including:

- Wastewater use in irrigation and washing increases pathogenic disease risks
- Animal farming in residential areas contributes to sanitation issues and contamination risks
- Farm by-product disposal challenges

Despite city administration efforts, urban agriculture waste removal remains a financial burden rather than an income-generating opportunity. Poor sanitation and unregulated waste disposal heighten the risk of infectious disease transmission from farm animals and their by-products to humans. Farmers largely rely on traditional waste management, using by-products as waste or compost, though technological advancements remain limited. Improved strategies and legal frameworks are necessary to:

- Enhance environmentally friendly practices
- Address health risks affecting farmers and urban residents
- Regulate urban agriculture waste disposal

5. Conclusions

Urban agriculture in the Amhara Region has emerged as a transformative force, addressing critical challenges related to food security, economic resilience, and environmental sustainability. The findings of this study indicate that cities such as Bahir Dar, Gondar, Debre Birhan, and Dessie possess untapped potential in urban farming, yet face systemic constraints that hinder productivity, market access, and technological innovation.

A multi-sectoral approach is essential to elevate urban agriculture into a formalized and sustainable sector. Policy and governance must prioritize the legal recognition of urban agriculture through zoning regulations, secure land tenure, and investment-friendly frameworks. Governments must integrate urban farming into urban planning policies, ensuring designated agricultural spaces while providing financial incentives for farmers and agribusinesses. Strengthened institutional collaboration will be vital in connecting urban farmers with research institutions, extension services, and technology providers to support capacity-building initiatives.

Economic implications demonstrate that urban agriculture has the potential to generate employment, stabilize food prices, and foster micro-enterprise development. Expanding financial access through tailored credit schemes and cooperative-led funding will empower farmers to scale operations, invest in innovative techniques, and enhance production efficiency. Strengthened market linkages—including dedicated urban farmer retail outlets, improved logistics, and digital platforms—will improve profitability and reduce dependency on intermediaries.

A forward-looking perspective necessitates investment in technological advancements that optimize space utilization and resource efficiency. Climate-smart innovations, such as hydroponics, aquaponics, and vertical farming, will redefine urban food production, making agriculture feasible even within dense city landscapes. Additionally, precision farming, AI-driven soil analysis, and automated irrigation systems can enhance productivity while mitigating environmental risks.

Beyond production, food safety and environmental sustainability demand urgent attention. Urban farming must align with strict hygiene protocols, waste management regulations, and pesticide control measures to ensure consumer health and ecological preservation. Adopting circular economy principles—such as composting organic waste, recycling irrigation water, and integrating biogas systems—can significantly reduce urban pollution while enhancing resource utilization.

Achieving these objectives requires stakeholder collaboration across governmental agencies, private investors, research institutions, and local communities. Multi-stakeholder engagement will facilitate knowledge exchange, improve input accessibility, and accelerate the adoption of sustainable farming practices. Gender and social inclusion must also be central to urban farming strategies, ensuring equitable opportunities for women, youth, and marginalized populations.

Ultimately, urban agriculture has the potential to become a pillar of economic stability, food security, and environmental resilience in the Amhara Region. Its success depends on structured investments in land accessibility, irrigation infrastructure, input distribution, market development, and technology integration. A holistic and multi-sectoral approach that integrates financial services, policy reforms, technological innovation, and grassroots engagement will be crucial in ensuring urban agriculture evolves into a thriving, productive, and sustainable sector.

6. Proposed Strategic Solutions

The assessment of urban agriculture in major cities of the Amhara Region highlights significant potential alongside critical challenges that require strategic intervention. To enhance the sustainability and efficiency of urban farming systems, the following recommendations are proposed:

1. Policy and Institutional Support

- **Formalize Urban Agriculture:** Establish clear policy frameworks recognizing urban agriculture as a legitimate land-use category, ensuring legal tenure for urban farmers.
- **Improve Stakeholder Collaboration:** Strengthen coordination between government agencies, universities, research institutions, NGOs, and local farmer associations to facilitate knowledge exchange and support services.
- **Facilitate Access to Credit and Financial Services:** Expand financial support for urban farmers through microfinance institutions, cooperatives, and grant programs tailored to agricultural enterprises.

2. Sustainable Resource Management

- **Enhance Land Accessibility:** Allocate designated urban farming zones and provide tenure security for farmers.
- **Optimize Water Management:** Develop irrigation infrastructure, including modern diversion canals, water storage facilities, and wastewater treatment systems for safe agricultural use.
- **Promote Efficient Input Supply:** Strengthen distribution networks for quality agricultural inputs, such as improved seeds, fertilizers, and organic soil amendments.

3. Agricultural Technology and Innovation

- **Adopt Innovative Farming Techniques:** Encourage hydroponics, aquaponics, vertical farming, rooftop gardening, and greenhouse systems to maximize space efficiency.

- **Expand Training Programs:** Universities and research centers should provide technical training to urban farmers on modern production methods, resource optimization, and sustainable practices.
- **Improve Pest and Disease Management:** Support integrated pest management (IPM) strategies through farmer training and access to bio-pesticides.

4. Livestock and Aquaculture Development

- **Strengthen Livestock Feed Supply Chains:** Facilitate access to affordable and nutritionally balanced feed for poultry, dairy cattle, and fattening operations.
- **Improve Livestock Health Services:** Enhance veterinary care access, strengthen vaccination programs, and promote biosecurity measures.
- **Expand Aquaculture Opportunities:** Support the development of integrated aquaculture systems, including structured fish feed management and improved harvesting techniques.

5. Marketing and Value Addition

- **Establish Market Linkages:** Develop cooperative marketing systems to connect urban farmers with retailers, supermarkets, and institutional buyers.
- **Invest in Processing Infrastructure:** Encourage value addition through juice production, dairy processing, and meat packaging for increased profitability.
- **Improve Retail Spaces:** Allocate organized market areas dedicated to urban farmers to facilitate direct sales and enhance income generation.

6. Food Safety and Environmental Sustainability

- **Ensure Safe Production Practices:** Implement food safety regulations governing pesticide use, irrigation water quality, and post-harvest handling.
- **Develop Waste Management Systems:** Promote composting, biogas utilization, and environmentally friendly disposal practices to mitigate environmental pollution risks.
- **Strengthen Environmental Regulations:** Encourage sustainable agricultural practices that minimize resource depletion and urban pollution.

7. Gender and Social Inclusion

- **Empower Women and Youth in Agriculture:** Support gender-inclusive initiatives that enhance women's participation in urban farming and agribusiness development.
- **Provide Targeted Support to Marginalized Communities:** Develop social programs that facilitate access to training, credit, and market opportunities for vulnerable urban populations.

In general, executing these recommendations will require a multi-stakeholder approach that integrates government policies, institutional support, innovative technologies, and farmer-led efforts. Strengthening urban agriculture would improve food security and economic stability in the Amhara Region while also contributing to long-term environmental resilience and sustainable urban development.

6.1. Impact of Strategic Solutions

The proposed strategic solutions for urban farming aim to improve food security, economic stability, and environmental sustainability. These initiatives will create resilient agricultural frameworks capable of supporting urban populations for future generations by improving production systems, optimizing resource utilization, and stimulating technological breakthroughs.

1. Food Security and Economic Growth

Prioritizing well-planned urban agricultural zones will ensure stable food production, reducing dependency on external supply chains while improving access to nutritious food. Enhanced crop and livestock productivity will contribute to dietary diversity, supporting both protein availability and market expansion. Additionally, increased production efficiency will stabilize food prices, mitigating economic volatility.

2. Job Creation and Livelihood Enhancement

Expanding urban farming and aquaculture businesses will create significant employment opportunities across various sectors, including breeding centers, feed processing industries, extension services, and aquaculture operations.

By improving market access and encouraging collaboration among stakeholders, these initiatives will empower farmers and entrepreneurs, promoting economic independence and long-term financial stability.

3. Technological Innovation and Capacity Building

Strengthening extension services and professional training programs will equip farmers with advanced technical expertise in sustainable farming practices. The adoption of improved technologies will maximize production efficiency while minimizing environmental degradation. Demonstration hubs and clustered agriculture zones will further encourage knowledge-sharing and sectoral innovation.

4. Environmental Sustainability and Resource Optimization

Structured resource management strategies—including responsible land allocation, water conservation techniques, and ecological stocking densities—will prevent environmental depletion while supporting long-term agricultural viability. Fingerling transfer programs, improved waste utilization in livestock feed, and expanded pond sizes will enhance ecosystem balance, reducing pollution risks and ensuring sustainable production cycles.

5. Market Stability and Policy Integration

Developing regulatory frameworks for quality assurance, pricing stability, and production standards will safeguard consumer interests while strengthening market competitiveness. Policy reforms prioritizing urban agricultural investment and crop-livestock integration will create structured support systems for input supply, subsidy allocation, and technological adoption, ensuring resilient food systems adaptable to future demands.

In conclusion, by integrating urban crop and livestock farming interventions into a cohesive agricultural strategy, cities can secure long-term food security, foster economic resilience, and promote environmental sustainability. These initiatives will elevate productivity, create equitable employment opportunities, and drive innovation, ensuring that urban agricultural systems remain dynamic, inclusive, and ecologically balanced.

7. References

- Abebe, M., Tassew, A., & Asmare, B. (2021). Appraisal of milk production, processing, and marketing in selected urban and peri-urban dairy production systems of northwestern Ethiopia. *Scientific Papers Animal Science and Biotechnologies*, 54(1), 204-204.
- Abera, G. S. (2022). Review on poultry production, processing, and utilization in Ethiopia. *International Journal of Agricultural Science and Food Technology*, 8(2), 147-152.
- Agbebi, F. O. (2011). Impact of fish farming on poverty alleviation in Ekiti-State. *International Journal of Science and Nature*, 2(3), 456-460.
- Alemu, M. M. (2019). Urban and peri-urban dairy cattle production in Ethiopia: A review. *Online Journal of Animal Feed Research*, 9(4), 173-177.
- Ashagrie, G., Getahun, A., & Mengistou, S. (2008). Effect of stocking density on the growth performance and yield of Nile tilapia (*Oreochromis niloticus*, L., 1758) in a cage culture system in Lake Kuriftu. *Aquaculture Research*, 39, 1450-1460. <https://doi.org/10.1111/j.1365-2109.2008.02021.x>
- Ayenew, Y. A., Wurzinger, M., Tegegne, A., & Zollitsch, W. (2009). Handling, processing, and marketing of milk in the northwestern Ethiopian highlands. *Livestock Research for Rural Development*, 21(7), 97.
- Ayenew, Y. A., Wurzinger, M., Tegegne, A., & Zollitsch, W. (2011). Socioeconomic characteristics of urban and peri-urban dairy production systems in the northwestern Ethiopian highlands. *Tropical Animal Health and Production*, 43, 1145-1152.
- Bitew, A., Tesfa, A., Tilahun, M., Meseret, M., Lakew, E., Bimrew, T., Kassahun, D., & Galmessa, U. (2022). Nutritional status of dairy cows in intensive production systems based on milk urea nitrogen concentration and milk compositions. *Livestock Research Results*, 242.
- Berihun, T., & Goshu, G. (2010). Integrating aquaculture with traditional farming systems: Socioeconomic assessment in the Amhara Region, Ethiopia. *Ecohydrology and Hydrobiology*, 10(2-4), 223-230.
- Birhane, T., Solomon, S., Seifu, H., & Sarla, M. K. (2014). Urban food insecurity in the context of high food prices: A community-based cross-sectional study in Addis Ababa, Ethiopia. *BMC Public Health*, 14, 1-8.
- Boonyabancha, S., & Kerr, T. (2018). Lessons from CODI on co-production. *Environment and Urbanization*, 30(2), 444-460. <https://doi.org/10.1177/0956247818791239>
- Central Statistical Agency. (2021). *Livestock and livestock characteristics (private peasant holdings), Agricultural Sample Survey*. Addis Ababa, Ethiopia.
- Dereje, D., Prabha, L. D., Sreenivasa, V., & Abebe, G. (2015). The growth performance of Nile tilapia in earthen ponds located at different altitudes of Toke Kutaye Woreda, Ethiopia. *International Journal of Aquaculture*, 5(34), 1-7. <https://doi.org/10.5376/ija.2015.05.0034>
- Demie, T. G., & Gessese, G. T. (2023). Household food insecurity and hunger status in Debre Birhan town, Central Ethiopia: Community-based cross-sectional study. *Frontiers in Nutrition*, 1-10. <https://doi.org/10.3389/fnut.2023.1035591>

- Derso, A., Bizuneh, H., Keleb, A., Ademas, A., & Adane, M. (2021). Food insecurity status and determinants among Urban Productive Safety Net Program beneficiary households in Addis Ababa, Ethiopia. *PLoS ONE*, 16(9), 1–17. <https://doi.org/10.1371/journal.pone.0256634>
- Didanna, H. L., Wossen, A. M., Worako, T. K., & Shano, B. K. (2018). Factors influencing intensification of dairy production systems in Ethiopia. *Outlook on Agriculture*, 47(2), 133-140.
- Dinku, A. M., Mekonnen, T. C., & Adilu, G. S. (2023). Urban food systems: Factors associated with food insecurity in urban settings—Evidence from Dessie and Combolcha cities, north-central Ethiopia. *Heliyon*, 9(3), e14482. <https://doi.org/10.1016/j.heliyon.2023.e14482>
- FAO. (2014). *Family poultry development: Issues, opportunities, and constraints*. Animal Production and Health Working Paper No. 12. Rome.
- FAO. (2020). *The future of livestock in Ethiopia: Emerging public health risks in urban and peri-urban areas*. Rome.
- Gebrekidane, T., Bhardwaj, R. K., & Gangwar, S. K. (2014). Constraints and opportunities of urban and peri-urban dairy production in central Tigray of northern Ethiopia. *The Security of Water, Food, Energy, and Livability of Cities: Challenges and Opportunities for Peri-Urban Futures*, 291-299.
- Gebreselassie, L. (2019). Review on dairy production system, constraints, and opportunities in Ethiopia. *Journal of Scientific and Innovative Research*, 8(4), 108-111.
- Gordon, A., Sewmehon, D., & Melaku, T. (2007). *Marketing systems for fish from Lake Tana, Ethiopia: Opportunities for marketing and livelihoods*. Nairobi, Kenya.
- Headey, D., Dereje, M., & Taffesse, A. S. (2014). Land constraints and agricultural intensification in Ethiopia: A village-level analysis of high-potential areas. *Food Policy*, 48, 129–141. <https://doi.org/10.1016/j.foodpol.2014.01.008>
- Hussein, A., Alayu, Y., & Ermias, M. (2012). Fish resource survey in Benishangul-Gumuz Regional State. In *The Fourth Annual Conference of the Ethiopian Fisheries and Aquatic Sciences Association (EFASA): The role of aquatic resources for food security in Ethiopia* (pp. 219–245). Addis Ababa, Ethiopia.
- Management Entity. (2021). *Ethiopia's livestock systems: Overview and areas of inquiry*. Feed the Future Innovation Lab for Livestock Systems, Gainesville, FL, USA.
- Minten, B., Habte, Y., Tamru, S., & Tesfaye, A. (2020). The transforming dairy sector in Ethiopia. *PLoS ONE*, 15(8), e0237456.
- Olaoye, O. J., Adegbite, D. A., Oluwala, E. O., Vaughan, I. O., Odebiyi, C. O., & Adediji, A. P. (2014). Comparative evaluation of economic benefits of earthen fish ponds and concrete tanks in aquaculture enterprises in Oyo State, Nigeria. *Croatian Journal of Fisheries*, 72, 107–117.
- Oumer, A. M., Burton, M., Hailu, A., & Mugera, A. (2020). Sustainable agricultural intensification practices and cost efficiency in smallholder maize farms: Evidence from Ethiopia. *Agricultural Economics*, 51(6), 841–856. <https://doi.org/10.1111/agec.12595>
- PID. (2022). *The World Bank Food Systems Resilience Program for Eastern and Southern Africa (P178566)*. Project Information Document (PID).
- Pretty, J., & Bharucha, Z. P. (2014). Sustainable intensification in agricultural systems. *Annals of Botany*, 114, 1571–1596.

Sabarathnam, V. E. (1988). *Manual of field experience training for ARS scientists*. NAARM, Hyderabad.

Sileshi, A. (2015). Rethinking fisheries and aquaculture development in Ethiopia: Systemic and innovative approach to addressing industry challenges. In M. Seyoum (Ed.), *Sustainable fish production, societal welfare, and development goals of Ethiopia* (pp. 49–59). The Ethiopian Fisheries and Aquatic Sciences Association, Arba Minch.

Terefe, G., Kitaw, G., Walelegne, M., Fekadu, D., Kehaliew, A., Dejene, M., Mekonnen, B., & Yadesssa, E. (2021). Growth performance of Jersey calves fed maize stover silage-based total mixed ration compared to calves fed hay and concentrate separately. *Ethiopian Journal of Agricultural Sciences*, 31(1), 93-100.

Tamire, Z. (2016). Welcoming speech: Proceedings of the Eighth Annual Conference and Workshop of EFASA, 12-13 Feb. 2016.

Ulfina, G., Jiregna, D., Alganesh, T., Shiv, P., & Mulugeta, K. (2013). Dairy production potential and challenges in Western Oromia milk value chain, Oromia, Ethiopia. *Journal of Agriculture and Sustainability*, 2(1), 1-21.

Welearegay, H., Yilma, Z., & Tekle-Giorgis, Y. (2012). Challenges and opportunities of milk production under different urban dairy farm sizes in Hawassa City, Southern Ethiopia. *African Journal of Agricultural Research*, 7(26), 3860-3866.

Yilma, Z., Hailu, Y., Wolkaro, T., & Eshetu, M. (2017). The Ethiopian dairy value chain with a particular focus on cattle and camel milk: Current scenarios and investment opportunities. *East African Journal of Sciences*, 11(2), 81-92.



The Amhara Agricultural Research Institute (ARARI) works towards building a more productive, resilient, and prosperous agricultural sector in the Amhara Region.



The Food System Resilience Program (FSRP) works to improve the resilience of food systems and increase preparedness against food insecurity in Ethiopia.

ISBN 978-99944-930-1-2



9 789994 493012 >