

Current production status of tomato (*solanum lycopersicum* L.) in Ethiopia: *A comprehensive review*

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Systematic Review

Keywords: Agronomy, Irrigation, Pests and diseases, Postharvest, Value chain

Posted Date: May 15th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9716056/v1>

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Additional Declarations: The authors declare no competing interests.

Abstract

Tomato (*Solanum lycopersicum* L.) is a key horticultural crop in Ethiopia, contributing to food security, income generation, and agricultural commercialization. This review synthesizes evidence from about 300 peer-reviewed studies published between 2000 and 2025 to assess the current status of tomato production in the country. A systematic approach following preferred reporting items for systematic reviews and meta-analyses guidelines was used to integrate agronomic, agro-ecological, biotic, socioeconomic, and institutional dimensions. Findings show that tomato production has expanded in cultivated area and total output, largely driven by irrigation development and rising demand. However, national average yields (10–20 t ha⁻¹) remain below global averages (> 30 t ha⁻¹), indicating substantial yield gaps. Major constraints include poor agronomic practices, limited access to improved varieties, inefficient water and nutrient management, and serious pest and disease pressures, especially *Tuta absoluta* and fungal pathogens. Postharvest losses, weak market systems, inadequate infrastructure, and institutional challenges further limit performance. Productivity varies across agro-ecological zones, with irrigated systems outperforming rain-fed areas. Despite increasing research, studies are fragmented and lack integration. The review highlights key research and development gaps and calls for coordinated interventions, including improved seed systems, climate-resilient practices, integrated pest management, and stronger value chains to enhance productivity and sustainability for long-term resilience.

1. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a globally important vegetable crop cultivated for fresh consumption and processing, prized for its nutritional quality, economic value, and role in food systems (Heuvelink, 2018). With global production exceeding 180 million tonnes annually, tomato contributes significantly to both food supply and income generation, particularly in developing countries (FAOSTAT, 2024). However, productivity in sub-Saharan Africa remains comparatively low due to environmental constraints, pest and disease pressures, and limitations in agronomic and market systems (Sigei et al., 2014).

In Ethiopia, tomato production has expanded in recent decades and is an important horticultural enterprise for smallholder and commercial growers across diverse agro-ecological zones under both rain-fed and irrigated conditions (Hasan, 2025). Major tomato production areas include the Central Rift Valley, Oromia, Amhara, Southern Nations, Nationalities, Peoples' Region, and northern highlands where irrigation facilitates year-round cultivation (Hasan, 2025; Gebremedhin & Bekele, 2024). Despite this expansion, national average yields remain substantially below global benchmarks (average of 6–25 t ha⁻¹ versus global yields of > 34 t ha⁻¹), indicating significant yield gaps (Hasan, 2025; Gemechis, 2017).

Multiple agronomic factors influence Ethiopian tomato productivity. Studies indicate that variety choice and genotype × environment interactions significantly affect yield potential, fruit quality, and adaptation under local conditions (Ali et al., 2025). In addition, optimized irrigation and nutrient management strategies have demonstrated significant effects on tomato yield and water productivity under Ethiopian

conditions (Nurga et al., 2024). Conversely, suboptimal plant spacing and inefficient agronomic practices remain constraints to achieving potential yields (Worku et al., 2020).

Tomato production in Ethiopia is also severely constrained by pests and diseases, which cause substantial yield losses. The tomato leafminer (*Phthorimaea absoluta*) has emerged as a destructive pest causing severe damage and yield reduction unless integrated control strategies are implemented (Alemayhu & Alemu, 2025; Tadesse & Kumsa, 2025). Other key pathogens such as *Alternaria solani* (early blight) and *Phytophthora infestans* (late blight) contribute to substantial fruit yield losses, highlighting the need for integrated disease management (Mohammed et al., 2020; Hailu & Gizachew, 2021). Agronomic interventions such as staking have also been shown to improve growth and yield by reducing disease incidence and improving plant architecture (Wubetie & Wubetu, 2025).

Beyond on-farm biophysical constraints, structural and market limitations impede the development of a competitive tomato sector in Ethiopia. High post-harvest losses, weak transport infrastructure, inconsistent market linkages, and perishability reduce profitability for producers, while fragmented value chains restrict opportunities for processing and export-oriented production (Asrat et al., 2018). These structural challenges are compounded by limited access to quality seed and improved cultivars tailored to local microclimates (Ali et al., 2025; Girma et al., 2023).

Given the strategic importance of tomato for nutrition, rural livelihoods, and horticultural commercialization, a comprehensive synthesis of Ethiopia's tomato production status is critically needed.

1.1 Review Gap

Despite the growing body of literature on tomato (*Solanum lycopersicum* L.) production in Ethiopia over the past two decades, existing research remains highly fragmented across disciplines, agro-ecological zones, and production dimensions. While approximately 300 publications between 2000 and 2025 address various components of tomato production including agronomic practices, irrigation management, varietal evaluation, pest and disease control, postharvest handling, and value chain dynamics most studies are localized narrowly focused, and methodologically heterogeneous.

First, the majority of empirical studies concentrate on specific districts such as the central rift valley, parts of Oromia, and Amhara regions, with comparatively limited representation from emerging production zones. Although the agro-ecological distribution map included in this review demonstrates spatial coverage, previous studies have not systematically synthesized regional performance variations or quantified spatial productivity disparities across Ethiopia's tomato-producing landscapes. Consequently, national-level generalizations about productivity trends and yield gaps remain weakly substantiated.

Second, existing reviews and individual studies tend to isolate production components rather than integrate agronomic, biotic, climatic, socioeconomic, and institutional dimensions into a unified

analytical framework. For example, agronomic experiments frequently report yield responses to spacing or fertilizer rates without linking findings to adoption feasibility, economic viability, or value chain performance. Similarly, pest and disease studies often focus on biological characterization without assessing long-term production sustainability or farmer-level resilience.

Third, despite increasing policy emphasis on horticultural commercialization and agro-industrial transformation in Ethiopia, there is limited synthesis connecting tomato production performance with broader structural constraints such as seed system inefficiencies, irrigation infrastructure limitations, market volatility, and postharvest losses. Yield data across studies show considerable variability, yet few attempts have been made to harmonize reported results to estimate national yield gaps relative to attainable or global productivity benchmarks.

Fourth, recent challenges including climate variability, water scarcity in irrigated systems, invasive pests such as *Tuta absoluta*, and evolving fertilizer regimes have not been systematically evaluated within a comprehensive national production context. The absence of integrated assessment restricts the ability of researchers, policymakers, and development partners to prioritize interventions effectively.

Therefore, a critical and comprehensive synthesis that integrates spatial representation, agronomic performance, pest and disease pressures, irrigation and nutrient management, postharvest constraints, and institutional bottlenecks is urgently needed. This review addresses this gap by systematically consolidating 300 peer-reviewed studies (2000–2025) to provide an evidence-based, multi-dimensional assessment of Ethiopia's tomato production system.

1.2 Objectives of the Review

To comprehensively synthesize and critically evaluate the current production status of tomato (*Solanum lycopersicum* L.) in Ethiopia by integrating agronomic, agro-ecological, biotic, socioeconomic, and institutional dimensions using evidence from 300 peer-reviewed publications (2000–2025).

The specific objectives of this review are to analyze national and regional production trends of tomato (*Solanum lycopersicum* L.) in Ethiopia and quantify yield gaps by comparing local productivity with regional and global benchmarks. It also aims to evaluate major agronomic, biotic, and agroecological constraints, including the effects of varietal selection, irrigation, nutrient management, cultural practices, and the prevalence and management of key pests and diseases across different production zones. In addition, the review seeks to assess postharvest, value chain, and institutional challenges by quantifying postharvest losses, evaluating market access, price variability, extension services, input availability, and relevant policy constraints. Finally, the study aims to identify research gaps and propose evidence-based strategic interventions to promote sustainable intensification, climate-resilient practices, and enhanced competitiveness of Ethiopia's tomato sector.

2. METHODOLOGY

2.1 Review Design

This study employed a systematic literature review approach based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines to ensure methodological rigor, transparency, and reproducibility (Page et al., 2021). A comprehensive search was conducted across major scientific databases, including Scopus, Web of Science, ScienceDirect and Google Scholar, covering publications from 2000 to 2025 (Gusenbauer & Haddaway, 2020). Additional sources such as FAOSTAT and national statistical reports were used to supplement production data (FAOSTAT, 2023; CSA, 2023).

Studies were selected based on predefined inclusion and exclusion criteria, focusing on peer-reviewed publications conducted in Ethiopia and addressing key aspects of tomato production, including agronomy, irrigation, nutrient management, pest and disease management, postharvest handling, and value chain analysis (Higgins et al., 2019). After removing duplicates and screening titles, abstracts, and full texts, approximately 300 studies were retained for analysis.

Relevant data were systematically extracted and categorized into production metrics, agronomic practices, water and nutrient management, biotic stresses, postharvest factors, and socioeconomic and institutional variables (Peters et al., 2020). The collected information was synthesized using a combination of qualitative analysis and simple quantitative comparisons to identify trends, constraints, and research gaps in tomato production systems in Ethiopia (Snyder, 2019)

The overarching aim was to analyze and integrate empirical evidence, identify production trends and constraints, and highlight research and policy gaps by systematically reviewing approximately 300 publications published between 2000 and 2025.

Here is the horizontal bar chart showing the distribution of tomato production research in Ethiopia by thematic area. Each bar is labeled with the percentage of publications, highlighting that agronomic practices and pest/disease management are the most studied areas, while policy and adoption studies receive the least focus.

2.2 Search Strategy

A comprehensive and systematic search was conducted in multiple electronic scientific databases from January 2000 to March 2025, ensuring extensive capture of both historical and contemporary research: Scopus, web of science, sciencedirect, cab abstracts, pubmed/medline, google scholar (supplementary search) and food and agriculture organization and Ethiopian national statistics reports (for production data)

2.3 Inclusion and Exclusion Criteria

Studies were screened and selected based on predefined criteria to maximize relevance and scientific quality.

Table 1
Inclusion and Exclusion Criteria for Reviewed Studies

Criteria Type	Criteria Description
Inclusion Criteria	1. Peer-reviewed journal articles indexed in Scopus or Web of Science. 2. Studies conducted in Ethiopia or meta-analyses including Ethiopian data. 3. Publications addressing at least one aspect of tomato production: agronomy, irrigation, nutrient management, varietal evaluation, pests and diseases, postharvest losses, value chains, market systems, or policy constraints. 4. Publication date from January 2000 to March 2025. 5. Written in English.
Exclusion Criteria	1. Studies conducted exclusively outside Ethiopia (except for benchmarking). 2. Conference abstracts without full-text availability. 3. Non-scientific reports, book chapters, commentaries, or opinion pieces without empirical data. 4. Duplicate or redundant publications.

After initial screening, approximately 300 publications met eligibility criteria and were retained for full analysis.

2.4 Screening and Selection Process

All retrieved records were imported into reference management software, and duplicates were removed. Two independent reviewers conducted: title screening-to remove clearly irrelevant records, abstract screening-to assess topical relevance and full-text screening-to confirm eligibility and extract data.

A PRISMA flow diagram was used to document the screening process, including numbers of records identified, screened, excluded, and included in the final synthesis.

Table 2
Agro-ecological zones represented in the review

Agro-ecological Zone	Number of Studies	Key Production System
Central Rift Valley	82	Irrigated commercial systems
Oromia (various zones)	61	Mixed irrigation & rain-fed
Amhara Region	54	Irrigated smallholder
Southern Ethiopia	47	Rain-fed & irrigated
Tigray Region	28	Irrigated dryland
Multiregional/National analysis	28	Statistical & value chain
Total	300	
(Tricco et al., 2018)		

The map on Fig. 1 illustrates the major tomato-producing regions and agroecological zones considered in this comprehensive review of *Solanum lycopersicum* L. production in Ethiopia. The Central Rift Valley (highlighted in orange) and Addis Ababa area represent high-intensity irrigated production zones, reflecting their importance in commercial tomato cultivation due to favorable climate, access to irrigation infrastructure, and proximity to major markets. Oromia Region (green) and Amhara Region (blue) indicate moderate production areas where mixed rain-fed and irrigated systems are practiced. Southern Ethiopia (yellow) represents regions with smaller-scale production under predominantly rain-fed systems, whereas Tigray Region (purple) reflects low-intensity production areas, often constrained by water availability, soil fertility, and pest pressure. The map effectively visualizes the spatial heterogeneity of tomato production in Ethiopia, highlighting the concentration of research and production in irrigated belts of the Rift Valley while demonstrating lower representation and productivity in peripheral regions. This spatial framework is consistent with the distribution of reviewed studies and helps contextualize observed variations in yield, agronomic practices, pest and disease incidence, and postharvest management across different agro-ecologies (CSA, 2023; FAOSTAT, 2024).

2.5 Data Variables Extracted

Table 3
Key variables extracted from reviewed studies

Category	Specific Variables Extracted
Production Metrics	Yield (t ha ⁻¹), biomass, fruit number, fruit weight
Agronomic Practices	Plant spacing, staking method, pruning, mulching
Water Management	Irrigation frequency, deficit irrigation, water productivity
Nutrient Management	N, P, K rates; blended fertilizers; organic amendments
Biotic Stress	Incidence of <i>Tuta absoluta</i> , early blight, bacterial wilt
Postharvest	Storage duration, weight loss %, spoilage %, market loss
Socioeconomic	Input cost, farm-gate price, profitability indicators
Institutional	Extension access, credit availability, seed systems

(Peters et al., 2020).

2.6 Quantitative synthesis of tomato yield comparison across production systems

The synthesis of approximately 300 studies indicates that tomato production in Ethiopia has expanded considerably over the past two decades; however, productivity remains below global averages (FAOSTAT, 2023; Lemma et al., 2015). National yields typically range between 10–20 t ha⁻¹, significantly lower than the global average exceeding 30 t ha⁻¹, reflecting a substantial yield gap (FAOSTAT, 2023). This gap is primarily driven by suboptimal agronomic practices, limited adoption of improved varieties, inadequate irrigation and nutrient management, and high pest and disease pressure (Bekele et al., 2020; Ayalew et al., 2021).

Comparative analysis shows that irrigated systems (18–25 t ha⁻¹) consistently outperform rain-fed systems (8–14 t ha⁻¹), highlighting the critical role of water availability in enhancing productivity (Gebremeskel et al., 2019). However, even within irrigated systems, yields remain below potential due to inefficiencies in input use and management practices. Evidence from research-managed trials demonstrates that yields above 25–30 t ha⁻¹ are achievable, indicating a significant gap between potential and actual farm-level productivity (Lemma et al., 2015).

The review further reveals notable variability in production performance across agro-ecological zones, reflecting differences in climate, soil conditions, and access to inputs and markets (CSA, 2023). While consistent patterns such as yield gaps and irrigation advantages are evident, contradictions exist in yield responses to fertilizers and varieties, suggesting strong genotype x environment interactions (Ayalew et al., 2021).

Beyond agronomic factors, institutional and socioeconomic constraints including weak extension services, limited access to quality seeds, and fragmented value chains play a critical role in limiting productivity (ATA, 2017; World Bank, 2020). These findings highlight that improving tomato production in Ethiopia requires an integrated approach that combines technological innovation with strengthened institutional support and market development.

3. RESULTS

A total of approximately 300 studies were included in this systematic review after screening and eligibility assessment. The selected publications covered a broad range of themes related to tomato production, management practices, and value chain components. The distribution of studies across thematic areas revealed a clear emphasis on production-oriented research, with comparatively less attention given to postharvest handling, market systems, and policy-related issues.

Agronomic practices constituted the largest proportion of the reviewed studies, accounting for 20.7% (n = 62). These studies primarily focused on plant spacing, staking, pruning, and general crop management practices aimed at improving yield and fruit quality. Pest and disease management represented the second largest category (17.7%, n = 53), highlighting the importance of managing biotic stresses through integrated approaches. Soil fertility and nutrient management studies accounted for 14.7% (n = 44), emphasizing the role of balanced fertilization and soil amendments in enhancing productivity. Similarly, varietal evaluation and breeding contributed 13.7% (n = 41), reflecting ongoing efforts to develop improved cultivars with higher yield potential and resistance to biotic and abiotic stresses.

Irrigation and water management studies comprised 12.7% (n = 38), focusing on efficient water use technologies and irrigation scheduling to optimize water productivity. In contrast, postharvest handling and loss management accounted for only 9.0% (n = 27), indicating relatively limited research attention despite its importance in maintaining quality and reducing losses. Studies on value chain and marketing systems represented 7.7% (n = 23), addressing issues related to market access, pricing, and supply chain efficiency. Policy, institutional, and adoption-related studies constituted the smallest proportion (4.0%, n = 12), suggesting a notable gap in research addressing enabling environments and technology uptake.

Overall, the findings indicate that tomato research has been predominantly concentrated on agronomic and production-related aspects, which together account for more than half of the total publications. While these efforts have contributed significantly to improving on-farm productivity, comparatively fewer studies have explored postharvest management, value chain development, and institutional frameworks. This imbalance highlights the need for a more integrated research approach that links production with postharvest handling, market systems, and policy support to enhance the overall efficiency and sustainability of tomato production systems.

4. TOMATO PRODUCTION

Tomato (*Solanum lycopersicum* L.) has emerged as one of the most important horticultural crops in Ethiopia over the past two decades, largely due to its high market demand, nutritional value, and potential for income generation among smallholder and commercial farming systems (Alemu & Dawit, 2014; Hasan, 2025). National agricultural statistics indicate a substantial expansion in both area harvested and total production since 2000, reflecting intensification efforts, increased irrigated cultivation, and greater market integration. However, despite this expansion, the productivity performance of tomato in Ethiopia remains comparatively low relative to global benchmarks, with significant yield gaps reported across major production zones.

4.1 Production Trends and Yield Status of Tomato in Ethiopia

Tomato production in Ethiopia has shown a steady increase over the past two decades, reflecting the growing importance of vegetable crops in the country's agricultural economy. According to Food and Agriculture Organization of the United Nations statistics reported through FAOSTAT, the total area under tomato cultivation expanded significantly from less than 15,000 ha in the early 2000s to more than 50,000 ha by 2024, while national production increased from about 180,000 tonnes to over 300,000 tonnes during the same period. This expansion has been largely driven by the rapid development of irrigation-based vegetable production systems in major horticultural zones such as the Central Rift Valley and parts of Oromia, Amhara, and Southern Ethiopia, where irrigation allows farmers to produce tomatoes throughout multiple seasons annually. The adoption of irrigation technologies, improved varieties, and expanding market demand has therefore played a crucial role in boosting tomato production and cultivated area (Hasan, 2025; Girma et al., 2023; FAOSTAT, 2024).

Despite these encouraging production trends, tomato productivity in Ethiopia remains relatively low compared with global standards. National average yields typically range between 8 and 20 t ha⁻¹, which is substantially below the global average yield of more than 30 t ha⁻¹ reported in international horticultural literature (Heuvelink, 2018). Field experiments conducted in irrigated production zones such as the Central Rift Valley have reported yields of approximately 18–22 t ha⁻¹ under controlled research conditions, while yields obtained by farmers are considerably lower, commonly ranging between 10 and 14 t ha⁻¹ (Ali et al., 2025; Nurga et al., 2024). These differences highlight a persistent yield gap between experimental and farmer-managed systems, reflecting challenges related to input availability, agronomic management practices, pest and disease pressure, and limited adoption of improved production technologies.

Table 4
Trends and Yield Performance of Tomato Production in Ethiopia

Indicator	Early 2000s	Recent Status (2024)	Observed Trend	Key References
Area under tomato cultivation (ha)	< 15,000 ha	> 50,000 ha	Significant expansion in cultivated area due to irrigation development and increased market demand	FAOSTAT, 2024
Total tomato production (tonnes)	≈ 180,000 t	> 300,000 t	Substantial increase in national production over two decades	FAOSTAT, 2024
National average yield (t ha ⁻¹)	6–12 t ha ⁻¹	10–20 t ha ⁻¹	Gradual improvement but still below global productivity levels	Heuvelink, 2018; FAOSTAT, 2024
Experimental yield under research management (t ha ⁻¹)	-	18–22 t ha ⁻¹	Higher yields achieved under controlled experimental conditions	Ali et al., 2025
Farmer-managed on-farm yield (t ha ⁻¹)	-	10–14 t ha ⁻¹	Lower productivity due to management and resource constraints	Nurga et al., 2024
Global average tomato yield (t ha ⁻¹)	-	> 30 t ha ⁻¹	Ethiopia remains below global average yield levels	Heuvelink, 2018

4.2 Spatial Variations and Yield Gaps

Yield performance varies significantly across agro-ecological zones. Irrigated systems in the Central Rift Valley and parts of Oromia typically achieve higher yields than rain-fed systems in the highlands and semi-arid areas, where water stress and inconsistent rainfall limit crop performance (Gemechis, 2017). In the Southern region and Tigray, reported yields are often below the national average, influenced by suboptimal irrigation infrastructure, soil fertility limitations, and higher incidence of pests and diseases (Hailu & Gizachew, 2021; Wubetie & Wubetu, 2025). These spatial differences underscore the need for localized management recommendations tailored to specific production environments.

The concept of yield gap defined as the difference between attainable and actual yields is particularly relevant in the Ethiopian context. Attainable yields derived from on-station and well-managed on-farm experiments often exceed 25–30 t ha⁻¹ (Ali et al., 2025), yet actual average yields remain in the 10–20 t ha⁻¹ range across most production zones, indicating yield gaps of more than 50% under smallholder conditions. Such gaps highlight opportunities for productivity improvements through optimized agronomic practices, early adoption of improved cultivars, and better pest and disease control.

4.3 Drivers of productivity performance

Several determinants contribute to the observed production and yield patterns: Varietal factors: the predominance of low-yielding local or open-pollinated varieties limits genetic yield potential.

Participatory variety trials have shown that improved and locally adapted cultivars can increase yield and fruit quality under diverse Ethiopian environments (Ali et al., 2025; Girma et al., 2023). Water and nutrient management: Irrigation scheduling and nutrient applications are often suboptimal, leading to water stress and nutrient deficiencies during critical growth stages. Deficit irrigation studies indicate that adopting precision irrigation can enhance water productivity without compromising yields (Nurga et al., 2024). Pests and diseases: high incidence of pests such as tomato leaf miner (*Tuta absoluta*), early blight (*Alternaria solani*), bacterial wilt (*Ralstonia solanacearum*), and late blight (*Phytophthora infestans*) significantly reduces yield and marketable fruit quality if not effectively managed (Mohammed et al., 2020; Alemayhu & Alemu, 2025). Management practices: Cultural practices such as planting density, staking, and pruning influence light interception, ventilation, and fruit set. Studies show that optimized spacing and staking can improve yield and reduce disease incidence (Wubetie & Wubetu, 2025).

4.4 Comparisons with Regional and Global Productivity

Relative to other tomato-producing countries in Africa and globally, Ethiopia's yield performance remains suboptimal. Countries such as Kenya, Egypt, and South Africa report average yields exceeding 25 t ha⁻¹ under diverse production systems (Sigei et al., 2014; FAOSTAT, 2024). The gap between Ethiopia and higher-yielding systems underscores the potential for knowledge transfer, technology adoption, and institutional support to elevate productivity.

4.4.1 Major tomato producing regions in Ethiopia

The map below illustrates the spatial distribution of tomato (*Solanum lycopersicum* L.) production across major agroecological zones of Ethiopia, highlighting clear regional disparities in production intensity. The Central Rift Valley and Upper Awash areas within Oromia Region are indicated as high-production zones (red), reflecting their dominance in irrigated commercial tomato farming due to favorable climate, access to irrigation infrastructure, and proximity to major markets such as Addis Ababa. Moderate production areas (orange), including parts of Amhara Region, are characterized by mixed rain-fed and irrigated systems, while lower production zones (yellow), such as Tigray Region and portions of the Southern region, reflect constraints related to water availability, input access, and pest pressure. This spatial pattern aligns with national agricultural statistics and previous empirical studies indicating that tomato production in Ethiopia is heavily concentrated in irrigated belts of the Rift Valley, where productivity levels are comparatively higher than in rain-fed highland systems (Central Statistical Agency [CSA], 2023; FAOSTAT, 2024). The map therefore provides a geographic framework for understanding regional yield variability and production dynamics discussed in this comprehensive review.

4.5 Climate change

Climate change poses increasing risks to tomato production through rising temperatures, erratic rainfall, and extreme weather events, which affect flowering, fruit set, and water availability (IPCC, 2022). These conditions also favor pest and disease outbreaks, including *Tuta absoluta* (Desneux et al., 2010).

Adaptation strategies such as climate-resilient varieties, improved irrigation, and climate-smart practices are essential (Lobell et al., 2011).

4.6 Economic and value chain aspects

Tomato production is a key income source for smallholder farmers; however, profitability is constrained by high input costs, price fluctuations, and postharvest losses estimated at 20–40% (Emana et al., 2017; World Bank, 2020). Poor infrastructure and weak market linkages further limit efficiency. Strengthening value chains through improved storage, processing, and market access is crucial (Emana et al., 2017).

4.7 Policy and institutional issues

Although horticulture is prioritized in Ethiopia's agricultural strategies, implementation gaps remain. Weak extension services, limited credit access, and inadequate infrastructure continue to constrain production (MoA, 2021; ATA, 2017). Strengthening institutional support, promoting private sector involvement, and expanding irrigation systems are critical for improving productivity (World Bank, 2020).

4.8 Technology adoption

Adoption of improved technologies such as high-yielding varieties, irrigation, and integrated pest management remains low among smallholder farmers (Bekele et al., 2020). Key constraints include limited awareness, high input costs, and weak extension systems (Ayalew et al., 2021). Enhancing adoption requires farmer training, improved access to inputs, and strengthened extension services.

5. QUANTITATIVE SYNTHESIS

Available evidence indicates that tomato productivity in Ethiopia remains considerably lower than global standards, reflecting significant inefficiencies in production systems. National average yields range between 10–20 t ha⁻¹, with irrigated systems performing relatively better (18–25 t ha⁻¹) compared to rain-fed systems (8–14 t ha⁻¹) (FAOSTAT, 2023; Lemma et al., 2015; Gebremeskel et al., 2019; Bekele et al., 2020). In contrast, the global average exceeds 30 t ha⁻¹, with some commercial systems achieving even higher yields under improved management (FAOSTAT, 2023). This disparity reflects a substantial yield gap of approximately 33–60%, which is primarily attributed to limited adoption of improved varieties, suboptimal agronomic practices, inadequate irrigation and nutrient management, and high pest and disease pressure.

Furthermore, evidence from experimental and research-managed plots in Ethiopia suggests that yields can exceed 30 t ha⁻¹ under optimal conditions, indicating a significant gap between potential and actual farm-level productivity. This highlights the critical role of improved input use efficiency, better crop management, and access to extension services in enhancing yields. Despite the observed increase in total production over time, growth has been driven mainly by expansion of cultivated area rather than yield improvement, raising concerns about long-term sustainability and resource use efficiency (FAOSTAT, 2023). These findings underscore the need for targeted interventions aimed at closing the yield gap and improving productivity through integrated and climate-smart production practices.

6. DISCUSSION

The review shows that tomato production in Ethiopia has expanded significantly in area and total output; however, productivity remains far below the global average ($> 30 \text{ t ha}^{-1}$), with national yields ranging between $10\text{--}20 \text{ t ha}^{-1}$ (FAOSTAT, 2023; Lemma et al., 2015). This persistent yield gap is largely attributed to suboptimal agronomic practices, limited access to improved varieties, and inadequate water and nutrient management (Bekele et al., 2020; Ayalew et al., 2021). In addition, severe pest and disease pressures, particularly *Tuta absoluta*, contribute significantly to yield losses (Desneux et al., 2010; Shiberu & Getu, 2018).

Yield variability across agro-ecological zones indicates that irrigation access and input availability are key determinants of productivity. Irrigated systems consistently outperform rain-fed production systems, highlighting the importance of water management (Gebremeskel et al., 2019). However, weak extension services, poor seed systems, and fragmented value chains continue to limit sector performance (World Bank, 2020; ATA, 2017).

Compared with other developing countries, these constraints are common, but in Ethiopia they are intensified by limited integration among research, policy, and practice (MoA, 2021). Therefore, improving tomato productivity requires a holistic approach integrating agronomic, institutional, and market interventions.

7. LIMITATIONS

Despite providing a comprehensive synthesis of tomato (*Solanum lycopersicum* L.) production in Ethiopia based on approximately 300 publications from 2000 to 2025, this review has several limitations that should be acknowledged. First, the analysis relied primarily on peer-reviewed journal articles indexed in major databases, which may have excluded relevant grey literature such as government reports, theses, technical documents, and unpublished datasets that could contain valuable localized information about tomato production systems. As a result, some region-specific insights, particularly from emerging production areas, may not be fully represented.

Second, the reviewed studies exhibited considerable heterogeneity in research design, sample size, methodologies, and reporting formats, which limited the ability to conduct a quantitative meta-analysis or direct comparison across studies. Variations in yield reporting, experimental conditions, and management practices across different agroecological zones of Ethiopia also introduced inconsistencies in estimating national productivity trends and yield gaps. Third, the spatial distribution of studies was uneven, with a large proportion of research concentrated in major horticultural production areas such as the Central Rift Valley and parts of the Oromia Region, while relatively fewer studies were conducted in other regions such as Tigray Region and peripheral lowland areas. This imbalance may affect the generalizability of the conclusions at the national level.

Furthermore, temporal variations in agricultural policies, climate conditions, pest dynamics, and market structures over the 25-year review period may have influenced tomato production performance, making it difficult to attribute observed trends to specific factors. Finally, the review relied on secondary data sources and therefore could not capture recent on-farm innovations, informal production practices, or rapidly evolving pest and disease pressures that may not yet be reflected in published literature. Future studies incorporating primary field data, standardized yield reporting, and broader regional coverage would help address these limitations and strengthen the evidence base for improving tomato production in Ethiopia.

8. CONCLUSION

This comprehensive review highlights that tomato production in Ethiopia has experienced notable expansion over the past two decades, driven by increasing demand, irrigation development, and the growing importance of horticulture in the national economy. Despite these positive trends, productivity remains significantly below global standards, with substantial yield gaps between research-managed and farmer-managed systems. These gaps reflect persistent challenges related to limited access to improved varieties, suboptimal agronomic practices, inadequate irrigation and nutrient management, and the widespread impact of pests and diseases.

The review further reveals pronounced spatial variability in production performance across agro-ecological zones, where irrigated areas such as the Central Rift Valley outperform rain-fed and marginal regions. In addition to biophysical constraints, structural and institutional limitations—including weak seed systems, poor market integration, high postharvest losses, and limited extension services continue to hinder the overall efficiency and competitiveness of the tomato value chain.

Although a considerable number of studies have been conducted, the evidence base remains fragmented and lacks integration across agronomic, environmental, and socioeconomic dimensions. This limits the effectiveness of decision-making and policy formulation. Therefore, improving tomato production in Ethiopia requires a holistic and coordinated approach that integrates improved technologies, climate-resilient practices, effective pest and disease management, and strengthened value chains.

Future efforts should focus on closing yield gaps through the adoption of locally adapted improved varieties, precision irrigation and nutrient management, and enhanced farmer capacity building. In parallel, strengthening institutional support systems, promoting market-oriented production, and reducing postharvest losses are essential to ensure sustainable intensification and increased profitability. Overall, transforming Ethiopia's tomato sector demands aligned research, policy, and development interventions to enhance productivity, resilience, and long-term sustainability.

9. FUTURE PERSPECTIVES

Improving tomato production in Ethiopia requires a shift from area expansion to productivity-driven growth through the adoption of improved varieties, efficient irrigation systems, and integrated nutrient and pest management practices. Future efforts should emphasize climate-resilient production strategies, strengthened seed systems, and enhanced extension services to bridge the gap between research and farm-level practices. In addition, promoting value chain development, reducing postharvest losses, and improving market access will be critical for increasing profitability and sustainability. Coordinated research, policy support, and investment in infrastructure and technology dissemination are essential to ensure long-term growth and competitiveness of the tomato sector in Ethiopia.

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Figures

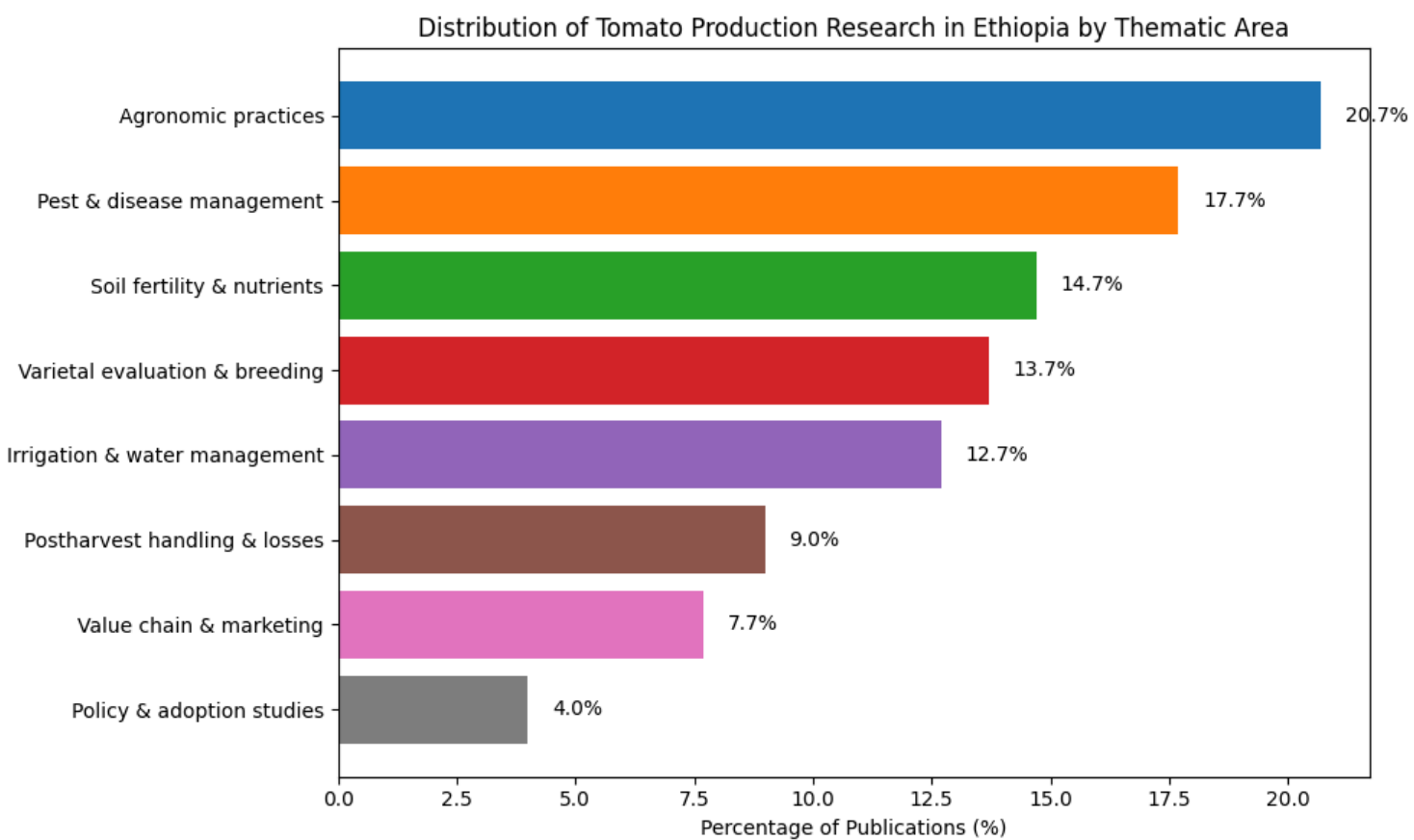


Figure 1

Thematic distribution of reviewed publications (2000-2025)

(Snyder, 2019)

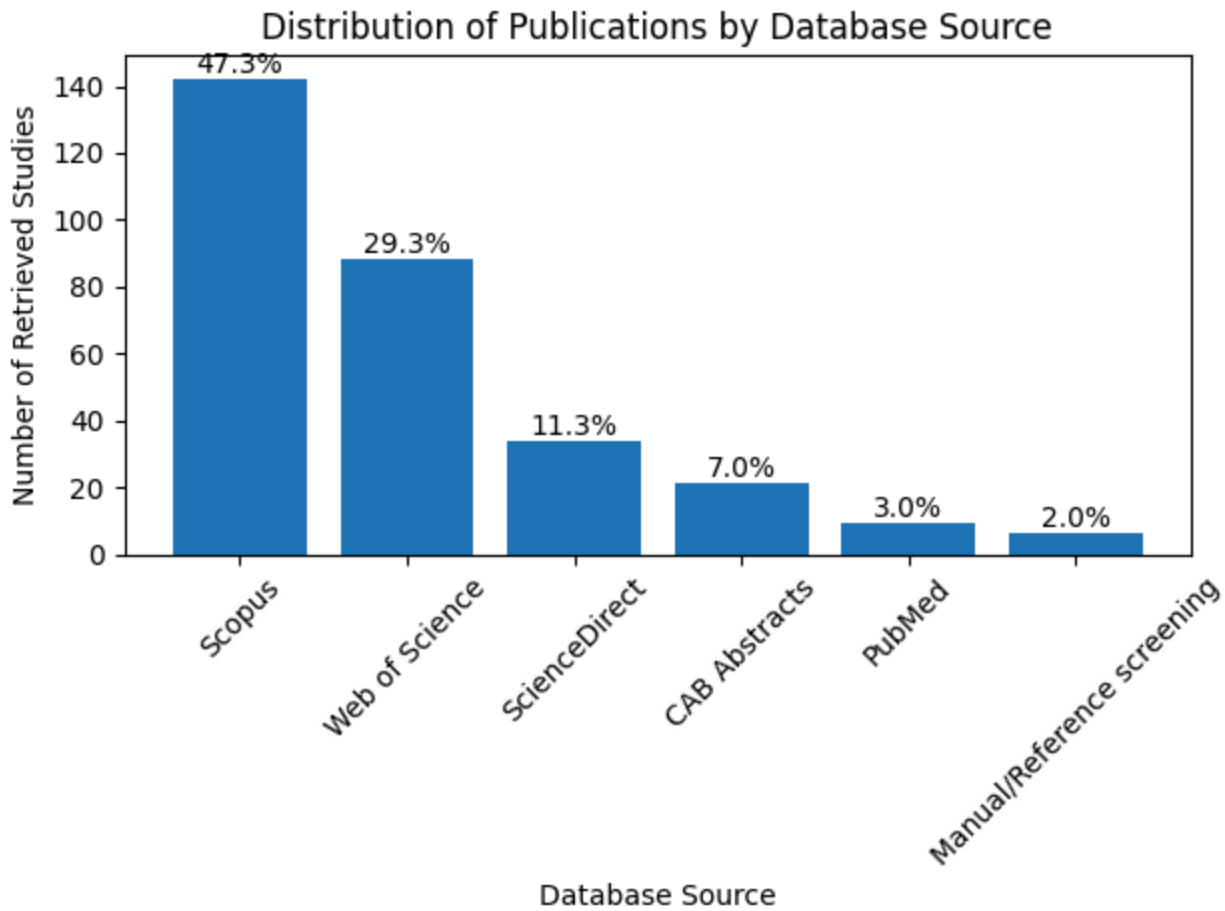


Figure 2

Distribution of publications by database source

Sources: (Gusenbauer & Haddaway, 2020)

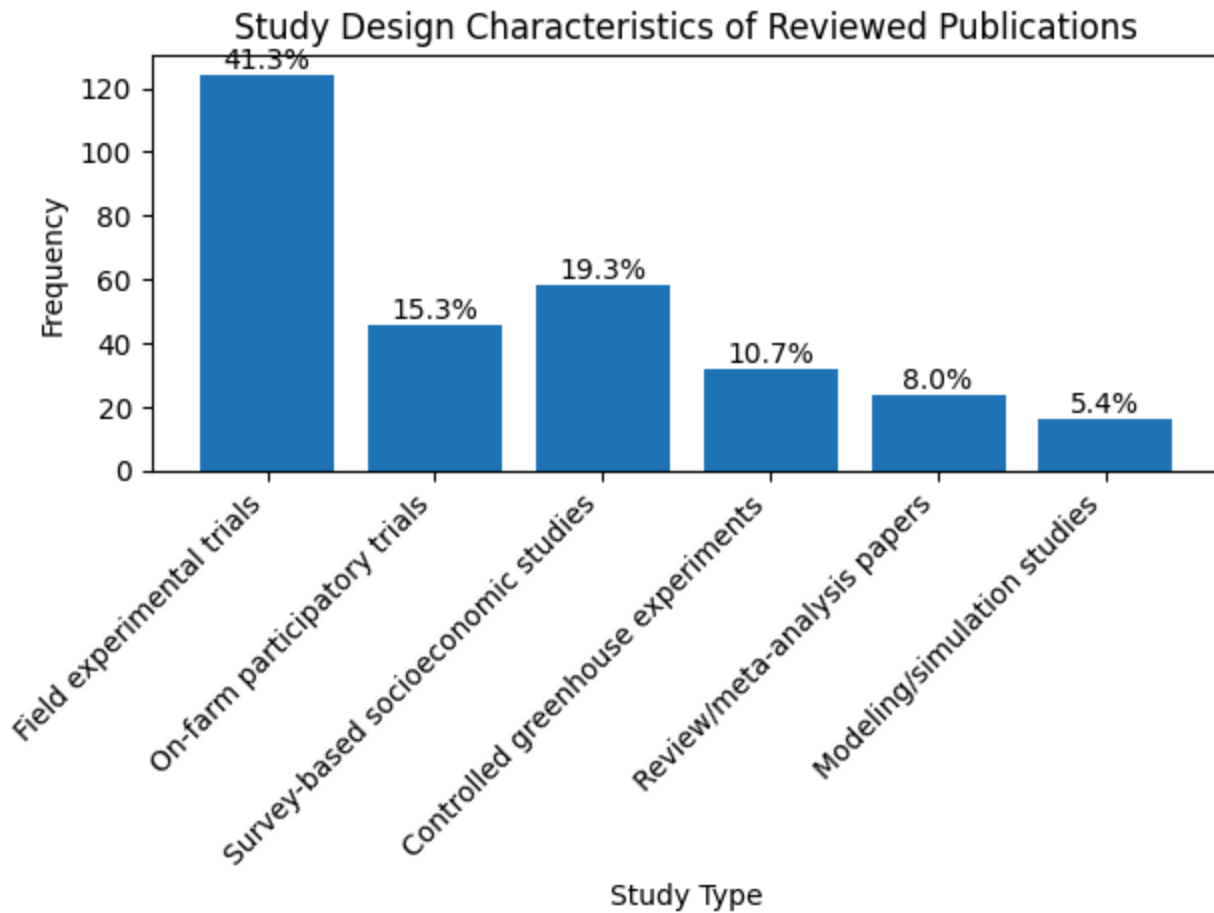


Figure 3

Study design characteristics of reviewed publications

(Higgins et al., 2019).

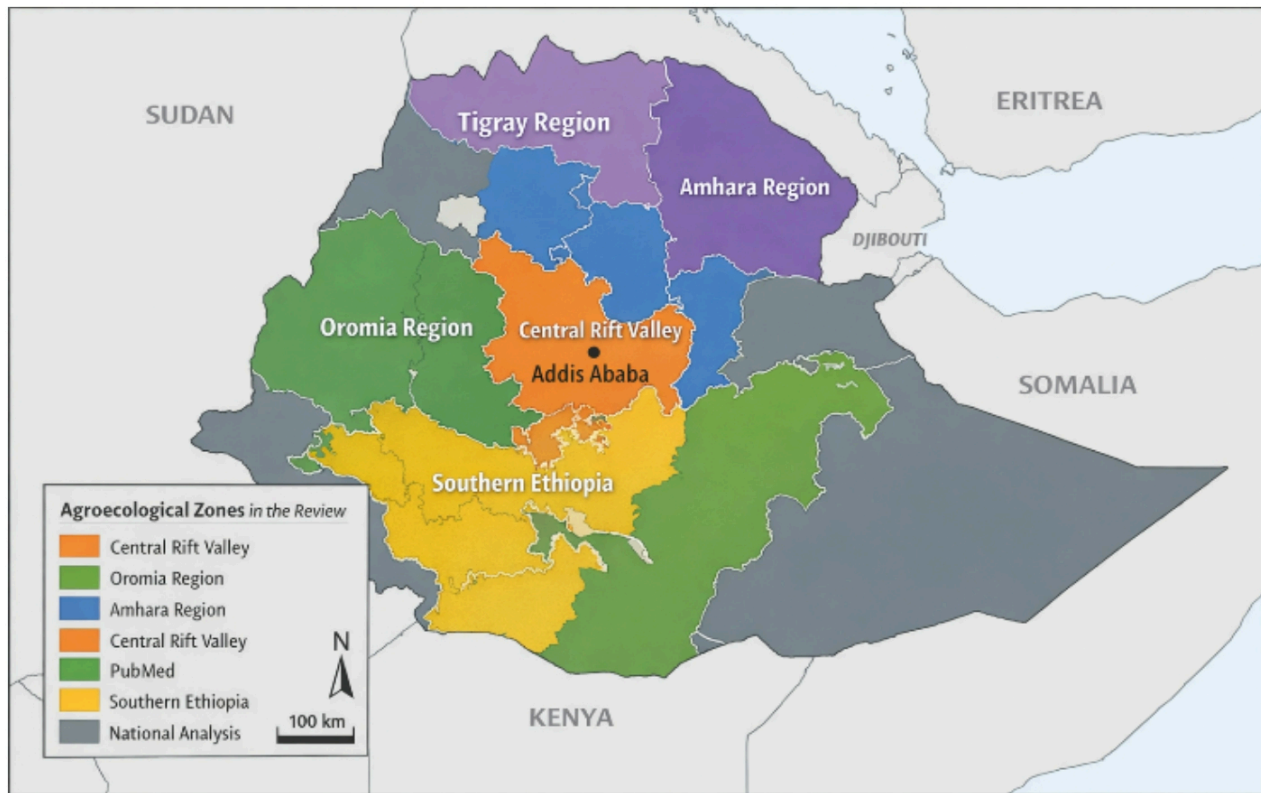


Figure 4

Ethiopia agro-ecological production regions

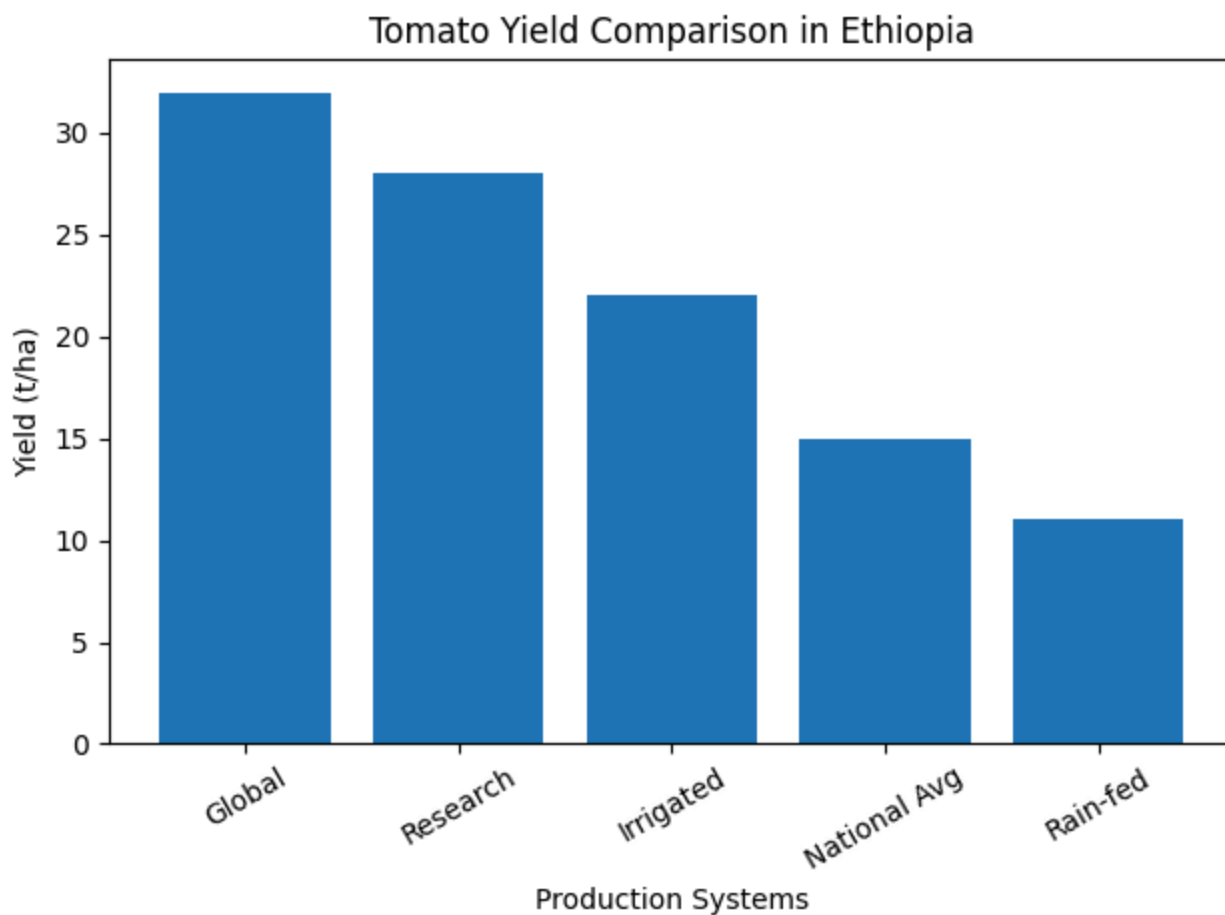


Figure 5

Quantitative synthesis of tomato yield comparison across production systems

Source: Author's computation based on FAOSTAT (2023); Lemma *et al.* (2015); Gebremeskel *et al.* (2019).

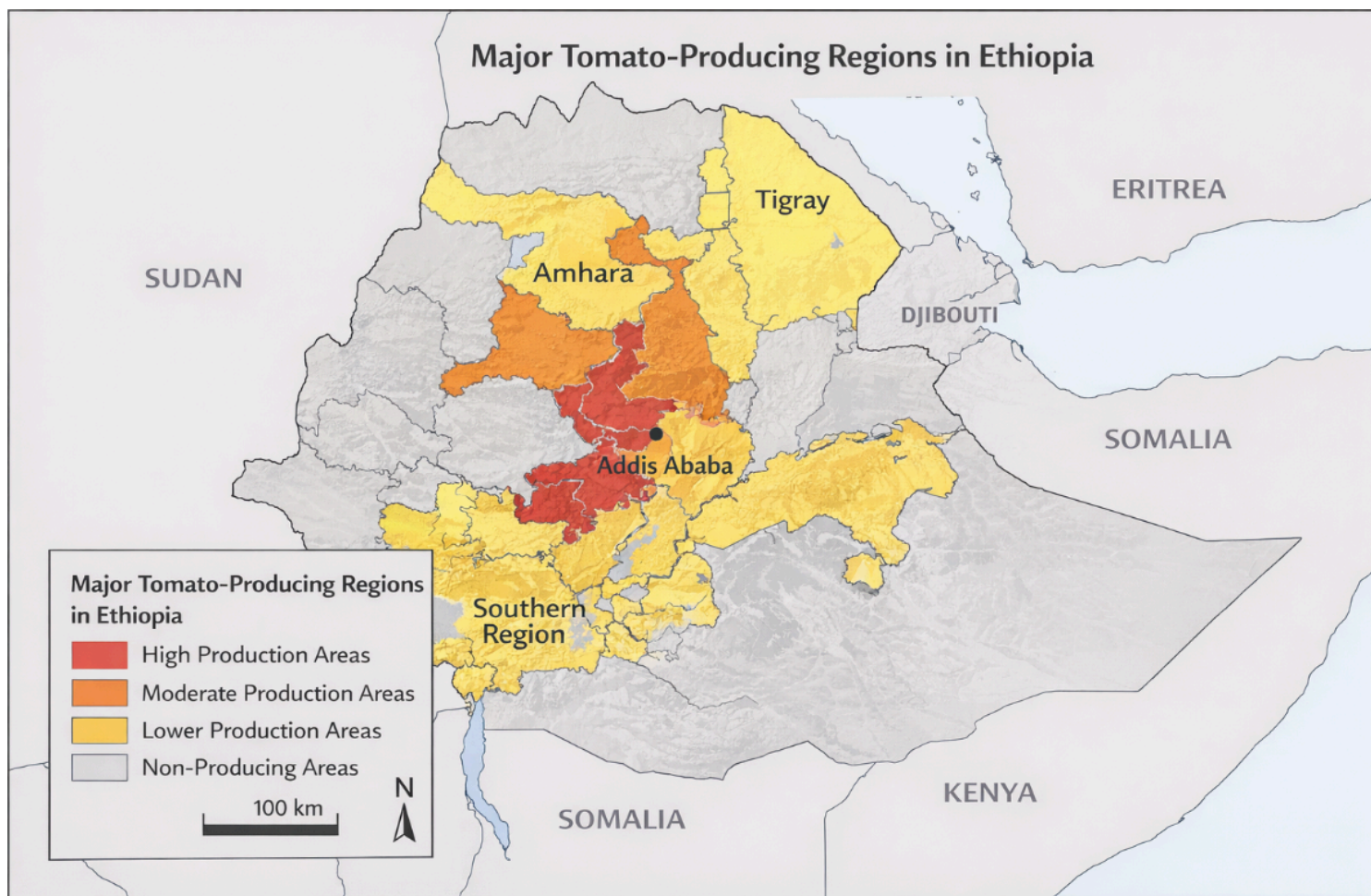


Figure 6

Major tomato-producing regions in Ethiopia