

Sectoral Innovation Systems for Agro-Industrial Transformation in Ethiopia: A Systematic Review of Integrated Agro-Industrial Parks and Global Value Chains

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Abstract

Ethiopia's agro-industrial transformation, driven by Integrated Agro-Industrial Parks (IAIPs), is central to agricultural modernization and economic growth. However, the role of Sectoral Innovation Systems (SIS) in supporting IAIPs, particularly in their integration into Global Value Chains (GVCs), remains underexplored. This systematic review examines the influence of SIS on Ethiopia's agro-industrial transformation, with a focus on IAIPs and GVC participation. Based on 40 peer-reviewed studies published between 2000 and 2024, the review identifies how SIS can address key challenges, such as infrastructure deficits, market access, and innovation within IAIPs. Findings highlight that IAIPs contribute significantly to value addition, export growth, and agricultural commercialization, facilitating Ethiopia's GVC integration. However, barriers like weak institutional frameworks, limited technological adoption, and inefficiencies in logistics impede their full potential. To optimize IAIPs, the review stresses the importance of strategic investments in infrastructure, strengthening institutional frameworks, and fostering public-private collaborations. Additionally, policy interventions that prioritize technological innovation, particularly in digital agriculture, are critical for enhancing competitiveness. The study offers valuable insights for other developing countries aiming to utilize IAIPs and SIS for sustainable economic development.

Keywords: Sectoral Innovation Systems, Integrated Agro-Industrial Parks, Global Value Chains, Agro-industrial Transformation, Innovation Systems, Sustainable Development.

JEL Classification: O13, O14, Q16

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1. Introduction

Agro-industrial transformation is essential for driving economic growth, creating jobs, and ensuring food security, particularly in developing nations aligned with global frameworks such as the United Nations Sustainable Development Goals (Kadomtseva, 2024; Lestari & Faisal, 2022). By modernizing agricultural practices, increasing value addition, and promoting rural development, agro-industrial initiatives contribute significantly to poverty reduction and sustainable economic development (Margulis, 2012; OECD, 2019). In Ethiopia, where agriculture is a key pillar of the economy, agro-industrial transformation provides a strategic opportunity for economic diversification, export growth, and resilience to global market fluctuations (Mazungunye, 2020; Woldemichael, A., Salami, A., Mukasa, A., Simpasa, A., & Shimeles, A., 2017).

Sectoral Innovation Systems (SIS), introduced by Malerba (2002), offer a critical framework for fostering innovation within specific sectors, including agro-industry. SIS focuses on the unique institutional and structural features of each sector, acknowledging that the diffusion of ideas is deeply influenced by these characteristics. It involves various actors such as firms, research institutions, government agencies, and industry associations, aiming to address sector-specific needs, leverage technological advancements, and tackle policy constraints to promote innovation and competitiveness (Fieldsend et al., 2020; Malerba, 2005).

In Ethiopia, Integrated Agro-Industrial Parks (IAIPs) have become a cornerstone of agro-industrial transformation. These parks integrate production, processing, and marketing activities to modernize agriculture and enhance competitiveness. IAIPs align with Ethiopia's Agricultural Development-Led Industrialization (ADLI) strategy and Growth and Transformation Plans (GTPs), with the goal of stimulating innovation, generating value-added products, and integrating Ethiopian agro-products into global value chains (UNIDO, 2022). By concentrating agro-processing activities in designated zones, IAIPs offer economies of scale, reduce transaction costs, and foster collaboration among stakeholders, thereby promoting technological advancement, improving market access, and including smallholder farmers in modern value chains (Guteta G. & Worku H., 2022; Trendov et al., 2019). IAIPs also address issues such as low productivity, limited market access, and inadequate infrastructure while creating over 400,000 direct jobs in regions like Oromia, Amhara, Sidama, and Tigray (ILO, 2022; UNIDO, 2022).

Despite their potential, the success of IAIPs relies heavily on the strength of the SIS supporting them. The Ethiopian agro-industrial sector faces several challenges, including limited technological innovation, weak institutional frameworks, and low participation in Global Value Chains (GVCs) (Ambaw, 2024). SIS can play a crucial role in addressing these issues by enabling targeted policy interventions, fostering collaboration, and leveraging technological capabilities to enhance competitiveness (Bowman & Chisoro, 2024; Brasesco et al., 2019a; Wolfert et al., 2023). Ethiopia's Industrial Policy Framework and GTPs stress the importance of innovation and competitiveness for agro-industrial transformation (Admassie et al., 2016; Rompel, 2023); yet, the effectiveness of these frameworks is contingent on a robust SIS to maximize the impact of IAIPs on innovation, productivity, and GVC integration.

Despite growing recognition of IAIPs' role in Ethiopia's transformation, significant research gaps remain, particularly regarding the interaction between SIS and IAIPs. Much existing research treats IAIPs and SIS in isolation, limiting the understanding of their combined impact on socio-economic transformation. Moreover, the integration of IAIPs into GVCs remains underexplored, despite its importance for the success of these parks. To fill these gaps, this review takes multidisciplinary approach, synthesizing the ontological, epistemological, and practical implications of SIS on IAIPs to enhance Ethiopia's agro-industrial transformation. This review is structured around three key research questions:

- **RQ1⁴**: How do Sectoral Innovation Systems (SIS) influence the success and sustainability of Integrated Agro-Industrial Parks (IAIPs) in Ethiopia?
- **RQ2⁵**: What is the relationship between IAIPs and Ethiopia's integration into Global Value Chains (GVCs)?
- **RQ3⁶**: What policy and institutional frameworks are needed to strengthen SIS and optimize the role of IAIPs in Ethiopia's agro-industrial transformation?

⁴ RQ1: Research Question 1

⁵ RQ2: Research Question 2

⁶ RQ3: Research Question 3

2. Method

This systematic review follows PRISMA guidelines (Moher et al., 2009) and synthesizes studies on sectoral innovation systems (SIS) and Integrated Agro-Industrial Parks (IAIPs) in Ethiopia. It includes studies focusing on Ethiopia or using it as a case study, along with comparative studies offering insights into SIS or IAIPs.

2.1 Inclusion and Exclusion criteria

The inclusion and exclusion criteria, detailed in Table 1, ensure the selection of high-quality, contextually relevant studies.

Table 1: Eligibility Criteria

Criterion	Inclusion Criteria	Exclusion Criteria
Geographical Focus	Studies focused on Ethiopia or using it as a case study.	Studies solely focused on other countries with no comparative relevance to Ethiopia.
Scope of the Sector	Research on agricultural value chains, IAIPs, agro-industrial transformation, agro-processing technology, sustainability, and sectoral innovation systems.	Studies unrelated to agriculture or non-agricultural sectors, or those focused only on manufacturing without agro-linkages.
Type of Publication	Working papers, peer-reviewed journal articles, and review articles.	Opinion pieces, editorials, blogs, non-academic documents, or conference abstracts without full-text access.
Time Frame	Studies published from 2000-2024.	Studies published before 2000.
Methodological Rigor	Empirical studies using clear methodologies (qualitative, quantitative, mixed methods, case studies, reviews).	Studies with unclear methodologies or low-quality data.
Relevance to Key Themes	Studies on IAIP performance, GVC integration, agro-industry innovation, and industrial policy frameworks.	Studies not related to SIS, IAIPs, or GVCs in Ethiopia.

2.2 Search Strategy

The search for relevant studies was conducted using well-established electronic databases, such as Google Scholar, Scopus, Web of Science, and JSTOR. Targeted keywords, including “Sectoral Innovation Systems,” “Integrated Agro-Industrial Parks,” “Ethiopian Agro-Industrial Transformation,” and “Global Value Chains,” were used to ensure comprehensive coverage of relevant topics. Only studies published between 2000 and 2024 were included to capture current trends in Ethiopia’s agro-industrial transformation.

2.3 Study Selection Process

The study selection adhered to PRISMA 2020 guidelines to ensure a transparent and systematic process (Moher et al., 2009; Page et al., 2021; Parums, 2021). Two independent reviewers assessed the titles and abstracts of the identified studies against the inclusion criteria. Full-text articles deemed potentially relevant were retrieved for further evaluation. Any disagreements between reviewers were resolved through discussion or by consulting a third reviewer. Zotero software was used for reference management, ensuring an organized and duplicate-free dataset. A PRISMA flow diagram visually represented the screening and selection process (Page et al., 2021; Parums, 2021). Ultimately, 40 studies met the eligibility criteria and were included in the review.

2.4 Data Extraction, Quality Assessment, and Synthesis

Data extraction followed a structured process to maintain consistency and minimize bias. Key study details, such as objectives, methods, sample sizes, and findings, were extracted using a standardized form in Microsoft Excel. To reduce bias, two reviewers independently performed data extraction, with disagreements resolved through discussion. The studies were assessed for methodological quality, rigor, and transparency. Only high-quality studies were included, ensuring the validity of the review’s findings. A narrative synthesis was conducted to summarize the role of Sectoral Innovation Systems (SIS) in Integrated Agro-Industrial Parks (IAIPs), their integration into Global Value Chains (GVCs), and the policy implications for Ethiopia’s agro-industrial transformation.

3. Results

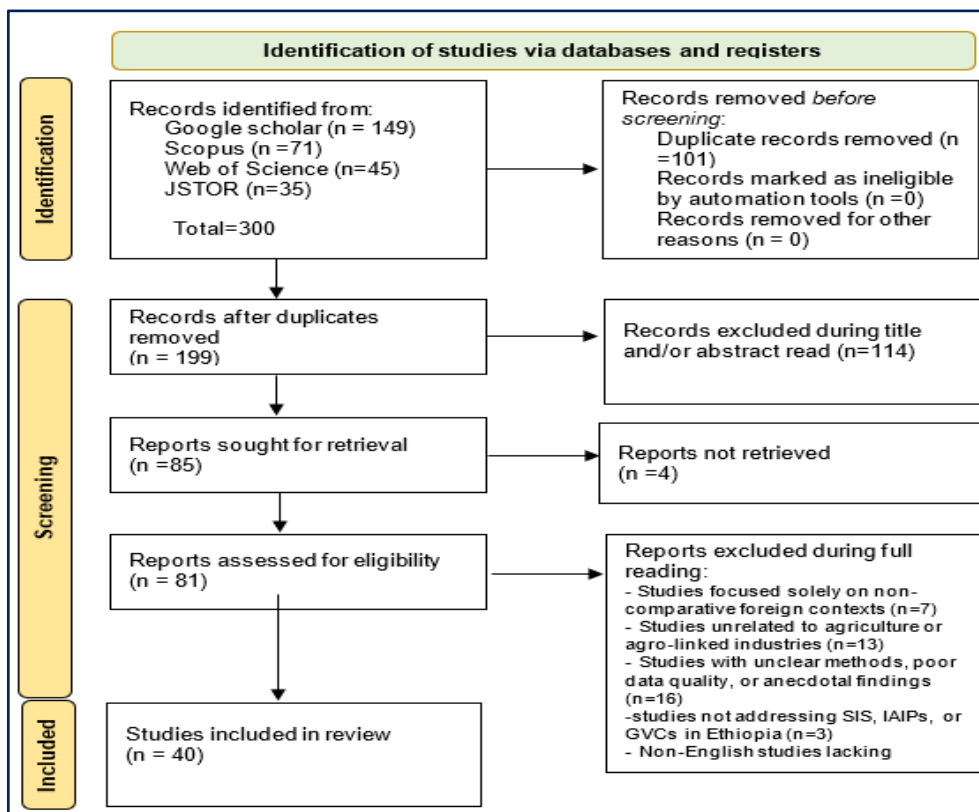
3.1. Search Results

A total of 300 studies on sectoral innovation systems (SIS) and integrated agro-industrial parks (IAIPs) were retrieved from Google Scholar, Scopus, Web of Science, and JSTOR. After excluding 101 duplicates and 114 irrelevant studies based on titles and abstracts, 81 studies underwent full reading. Following the review, 41 studies were excluded for focusing on non-Ethiopian contexts, unrelated topics, unclear methodologies, or for not addressing SIS and IAIPs.

3.2. General Characteristics of the Studies

Ultimately, 40 studies were selected for analysis. These studies spanned from 2000 to 2024, with publications increasing notably in 2021 (8 studies) and 2023–2024 (8 studies) (see Figures 1 & 2).

Figure 1: Study selection process using PRISMA 20220 flow diagram



As far as the research method or approach is concerned, 14 studies adopted a qualitative approach, 11 studies used a mixed-methods approach, 9 studies employed a quantitative approach, 4 studies are review-based, and the remaining 2 studies utilized a case study approach (see Table 2 and Figure 3). Moreover, the details of the included studies, such as objectives, methodology employed, key findings, and the relevance of the studies to the review, are depicted in Table 2.

Figure 2: Articles distribution by year of publication

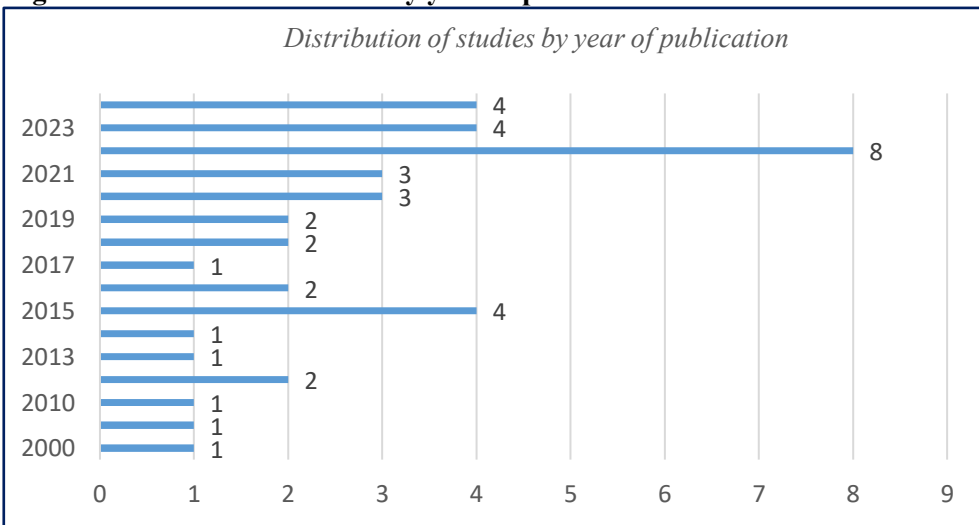


Figure 3: Articles distribution by research method/approach

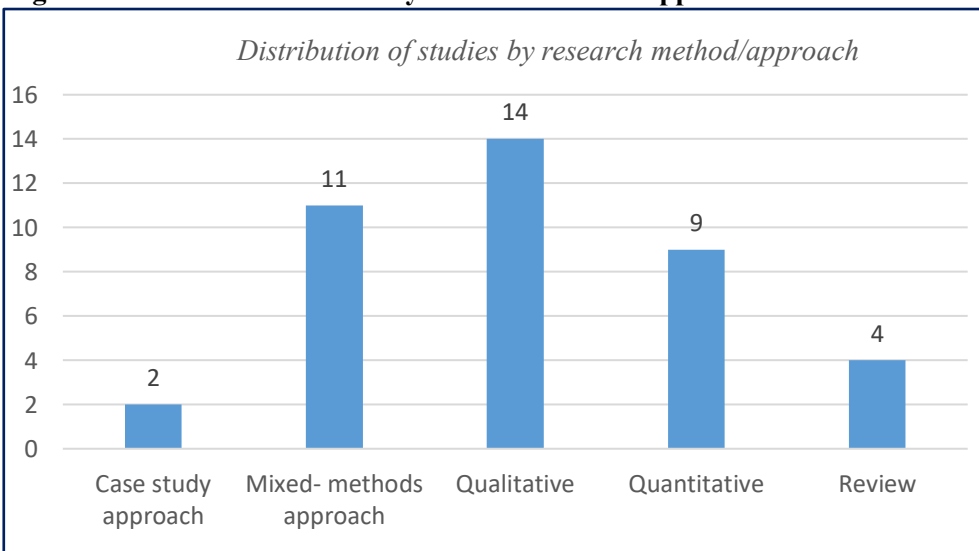


Table 2: List of reviewed studies

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
1. Holloway et al. (2000)	<i>Agro-industrialization through institutional innovation: Transaction costs, cooperatives, and milk-market development in the East-African Highlands</i>	Examines factors affecting small-scale dairy production and the role of cooperatives in reducing transaction costs in Ethiopia.	Quantitative	Cross-bred cows, education, and infrastructure drive dairy market participation; policies needed to improve stock access.	Aligns with RQ1 on innovation in agro-industrial systems, RQ2 on market integration, RQ3 on institutional frameworks like cooperatives.
2. Lemma et al. (2008)	<i>Moving Ethiopian smallholder dairy along a sustainable commercialization path: Missing links in the Innovation systems</i>	Investigates why Ethiopian smallholder dairy hasn't achieved sustainable commercialization despite interventions.	Review	Weak innovation systems, missing linkages, and lack of coordination between R&D and practice.	Aligns with RQ1 on gaps in SIS, RQ2 on commercialization pathways, RQ3 on the need for better linkages and coordination.
3. Mellor & Dorosh (2010)	<i>Agriculture and the economic transformation of Ethiopia</i>	Analyzes agricultural growth, policy reforms, and their implications on Ethiopia's economy.	Mixed-methods	Engaging middle farmers and improving infrastructure (roads, telecom) drive growth; key policy reforms needed.	Relates to RQ1 on SIS, RQ2 on GVC impacts, RQ3 on reforms to enhance agro-industrial transformation.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
4. Woodhill et al. (2011)	<i>Market Linked Innovation Systems: Opportunities for Strengthening Agricultural Development in Ethiopia</i>	Explores strategies to strengthen market-linked innovation systems, supporting Ethiopia's Economic Growth and Transformation Plan.	Mixed-methods	Identifies effective innovation processes and integrates technical, market, and institutional strategies; strengthens universities and ATVETs.	Focuses on SIS, IAIPs, and GVC integration, supporting agro-industrial transformation.
5. Spielman et al. (2011)	<i>Rural innovation systems and networks: Findings from a study of Ethiopian smallholders</i>	Examines changes in Ethiopian agriculture to improve smallholders' capacity for innovation and welfare.	Mixed-methods	Public extension services dominate smallholder networks, creating a need for more market and civil society actors.	Explores innovation systems and networks that influence IAIPs and Ethiopia's agro-industrial transformation.
6. Gebreeyesus (2013)	<i>Industrial policy and development in Ethiopia: Evolution and present experimentation</i>	Examines Ethiopia's industrial policy choices, implementation, and outcomes.	Case study	Ethiopia is an early adopter of comprehensive industrial policy, implemented during internationally controversial times.	Informs on policy frameworks needed to strengthen SIS and optimize IAIPs for agro-industrial transformation.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
7. Balcha & Serbeh-Yiadom (2014)	<i>The Need for Agro-Based Value-chain Industrial Clustering in Ethiopia</i>	Identifies the rationale for developing exclusive agro-based value-chain industrial clusters.	Mixed-methods	Existing industrial zones lack clustering qualities like multi-functional connections and value-chain integration.	Aligns with the review's focus on the role of IAIPs and clustering for agro-industrial transformation.
8. Ayalew et al. (2015)	<i>An analysis of agricultural linkage and technology innovation system: Special focus on Ethiopia</i>	Analyzes the linkage between agricultural actors and the current status of technology innovation systems in Ethiopia.	Review	Weak linkages between stakeholders and innovation actors; weak technological innovation in agriculture.	Emphasizes strengthening connections to enhance technological innovation, supporting SIS and agro-industrial transformation.
9. Schaefer, F. & Abebe, G. (2015)	<i>The Case for Industrial Policy and its Application in the Ethiopian Cut Flower Sector</i>	Examines the rationale for agro-based value-chain industrial clusters in Ethiopia.	Mixed-methods	The floriculture industry in Ethiopia has expanded through government support but requires continuous regulatory reforms.	Aligns with RQ3, highlighting the role of industrial policy and innovation systems in agro-industrial transformation.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
10. Oqubay, A. (2015)	<i>Made in Africa: Industrial Policy in Ethiopia</i>	Analyzes industrial policies in Ethiopia's cement, leather, and floriculture sectors.	Mixed-methods	Sector-specific outcomes vary, with challenges in integrating into global value chains, emphasizing the need for sectoral lessons.	Aligns with RQ3, addressing integration challenges into GVCs and the need for effective policy frameworks for IAIPs.
11. Zewdie, B. B. (2015)	<i>Analysis of ADLI Policy Effectiveness in Ethiopia</i>	Assesses the effectiveness of Ethiopia's Agricultural Development-Led Industrialization (ADLI) policy.	Mixed-methods	ADLI faces challenges such as low implementation capacity, poor pastoral focus, and weak coordination.	Aligns with RQ3, addressing ADLI policy implementation challenges to strengthen SIS and IAIPs.
12. Gebreeyesus, M., Wakeford, J. J., Ginbo, T., & Yimer, (2016)	<i>Assessment of Ethiopia's Innovation Systems for Green Industrialization</i>	Explores Ethiopia's industrial policies and green economy strategies, focusing on the role of national innovation systems.	Qualitative	Ethiopia's innovation system holds potential for supporting green industrial development, requiring policy reforms.	Aligns with RQ3, examining policy reforms to strengthen innovation systems for sustainable industrialization, including IAIPs.
13. Staritz, C., Plank, L., & Morris, M. (2016)	<i>Global Value Chains, Industrial Policy, and Sustainable Development: Ethiopia's Apparel Export Sector</i>	Evaluates Ethiopia's apparel sector achievements and the impact of government industrial policy.	Qualitative	The apparel sector has grown due to state-driven policies supporting foreign and local firms.	Aligns with RQ2, discussing state-driven policies and GVC integration in Ethiopia's apparel sector.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
14. Woldemichael, A., Salami, A., Mukasa, A., Simpasa, A., & Shimeles, A. (2017)	<i>Transforming Africa's Agriculture through Agro-Industrialization</i>	Examines Africa's economic growth, highlighting the role of agro-industrialization in overcoming growth challenges.	Quantitative	Africa's growth has been largely jobless, with rising poverty and inequality.	Aligns with RQ1, addressing the need for agro-industrialization to tackle jobless growth and poverty.
15. Sisay, M. & Tilahun, H. (2018)	<i>Agriculture-Industry Linkage and Technology Adoption in Ethiopia</i>	Reviews agriculture-industry linkages and technology adoption challenges in Ethiopia.	Review	Weak linkages, poor market access, and ineffective technology transfer hinder progress.	Aligns with RQ1, exploring how weak linkages and technology challenges affect Ethiopia's agro-industrial development.
16. Poli, M. (2018)	<i>The Ethiopian Way to Agrarian Transformation: Agricultural Clusters in South Wollo</i>	Examines Ethiopia's ADLI strategy, focusing on agrarian transformation processes.	Qualitative	ADLI integrates smallholder farmers into value chains for economic development and poverty eradication.	Aligns with RQ1, exploring smallholder integration into value chains for agro-industrial transformation.
17. Brasesco, F., Asgedom, D., & Casari, G. (2019)	<i>Strategic Analysis and Intervention Plan for Potatoes and Potato Products in the Agro-Commodities Procurement Zone of the Pilot Integrated Agro-Industrial Park</i>	Evaluate how IAIPs drive Ethiopia's shift to an industrial economy, reduce rural poverty, and promote agro-processing investments.	Qualitative	IAIPs are central to Ethiopia's development strategy, with pilot Agro-Industrial Growth Corridors aimed at boosting agro-processing and investment.	Aligns with RQ1 and RQ2, examining how IAIPs support Ethiopia's industrial shift, reduce poverty, and enhance agro-processing for GVC integration.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
18. Kebebe, E. (2019)	<i>Bridging Technology Adoption Gaps in Livestock Sector in Ethiopia: An Innovation System Perspective</i>	Assess the role of economic, social, political, and organizational processes in technology adoption in Ethiopia's smallholder livestock production systems.	Qualitative	Low technology adoption in the livestock sector is due to weak innovation systems, gaps in entrepreneurship, knowledge diffusion, and market/policy limitations.	Aligns with RQ1, highlighting how weak innovation systems hinder technology adoption, affecting agro-industrial development and IAIPs.
19. Debelo, W. B., Minale, M., Fisha, H., Tedla, A., & Eshetu, R. (2020)	<i>Review on Roles and Challenges of Agricultural Extension System in Ethiopia</i>	Examine Ethiopia's agricultural extension system, focusing on technology transfer, participatory approaches, and rural development.	Qualitative	Agricultural services face challenges like limited access to inputs and technologies, hindering productivity growth.	Aligns with RQ1, addressing agricultural extension challenges that affect IAIPs and agro-industrial development.
20. Eyasu, A. M., & Endale, M. (2020)	<i>Corporate Social Responsibility in Agro-Processing and Garment Industry: Evidence from Ethiopia</i>	Explore the causal relationship between stakeholders and CSR in Ethiopia's agro-processing and garment industries.	Quantitative	Environmental, customer, owner, and community factors boost CSR; employee influence is negative. Managers need to address these to improve CSR.	Aligns with RQ3, examining how stakeholder factors influence CSR, important for optimizing IAIP institutional frameworks.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
21. Gebremariam, F. M., & Feyisa, B. D. (2020)	<i>Assessing Post-1991 Ethiopia's Industrialization and Industrial Policy</i>	Assess Ethiopia's industrial policy and its industrialization experience after 1991.	Qualitative	Ethiopia's manufacturing sector grew but faces challenges in labor, capital, infrastructure, and governance.	Aligns with RQ3, highlighting challenges in industrial policy that need to be addressed to strengthen IAIPs.
22. Gavrilova, N. G., & Mukhametzyanov, R. R. (2021)	<i>Integrated Agro-Industrial Park as a Promising Model for the Development of Agriculture in Africa</i>	Focus on Ethiopia's implementation of IAIPs to modernize agriculture, drive structural transformation, and commercialize agriculture.	Quantitative	IAIPs aim to address agricultural issues like poverty and underdeveloped infrastructure, focusing on increasing production, food security, exports, and value-added goods.	Aligns with RQ1 and RQ2, showcasing IAIPs as a model for modernizing agriculture and enhancing GVC integration.
23. Ghione, A. (2021)	<i>The Political Economy of Industrial Policies in Ethiopia: Structural Change, Policy Process, and the Role of Donors</i>	Analyze Ethiopia's IAIPs as a strategy for agricultural modernization and structural transformation.	Case study	The 2018 regime change enabled policy dialogue, with lessons from pilot IAIPs emphasizing a participatory, multi-stakeholder approach.	Aligns with RQ3, emphasizing the shift to a participatory, multi-stakeholder approach in IAIPs post-2018.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
24. Zerssa, G., Feysa, D., Kim, D. G., & Eichler-Lö (2021)	<i>Challenges of Smallholder Farming in Ethiopia and Opportunities by Adopting Climate-Smart Agriculture</i>	Examines opportunities and challenges of CSA practices in Ethiopia to address soil degradation and climate change in smallholder farming.	Qualitative	CSA practices enhance resilience and income, but land issues and slow returns hinder adoption. Recommendations include utilizing degraded lands and improving soil management.	Aligns with RQ1, highlighting CSA's role in addressing challenges and promoting sustainability in Ethiopia's smallholder farming, crucial for IAIP success.
25. Abay, T. (2022)	<i>Identification of the Critical Success Factors for Export-Oriented Agro-Processing Projects in Ethiopia</i>	Identifies critical success factors (CSFs) and their relationships in Ethiopia's export-oriented agro-processing projects.	Qualitative	Key CSFs include raw material supply, infrastructure, skilled labor, and market intelligence.	Aligns with RQ1, pinpointing essential CSFs like raw materials, infrastructure, and skilled labor, critical for Ethiopia's agro-industrial projects and IAIP success.
26. Adato, A. A. (2022)	<i>Evaluating the Effectiveness of Inventory Management Practice and Its Challenges on Manufacturing Companies in Yirgalem Agro-Industrial Park, Ethiopia</i>	Assesses inventory management practices and challenges in manufacturing companies at Yirgalem agro-industrial park.	Quantitative	Inventory management was moderately effective; EOQ, JIT, ABC, and MRP were used, but more supplier linkages are needed.	Aligns with RQ1, evaluating inventory practices at Yirgalem and stressing the importance of improved supplier linkages for IAIP effectiveness.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
27. Alemnew, W. (2022)	<i>Determinants of Research-Extension-Farmers Linkage in the Process of Technology Transfer: The Case of dangila District, Ethiopia</i>	Examines factors influencing farmers' participation in technology demonstrations and the role of linkages in technology transfer in Dangila district.	Quantitative	Weak linkages, minimal farmer involvement in research, and poor use of linkage mechanisms hinder technology transfer.	Aligns with RQ1, focusing on weak linkages that impact technology adoption and IAIP success in Ethiopia.
28. Hailu, M., Tolossa, D., Girma, A., & Kassa, B. (2022)	<i>Exploration of Systemic Barriers to Tef Research and Development in Central Ethiopia: A Coupled Structural-Functional Innovation Systems Analysis</i>	Investigates systemic barriers to tef research and development in Ethiopia's innovation system.	Qualitative	Constraints like limited actor capacity, weak partnerships, and poor institutional enforcement hinder tef innovation.	Aligns with RQ1, identifying systemic barriers in Ethiopia's tef innovation system that affect agricultural innovation and IAIP success.
29. Jenane, C., Ulimwengu, J. M., Ono, T., & Kirui, O. K. (2022)	<i>Agro-parks as Drivers of the African Food Processing Sector: Review of Conditions for Success</i>	Assesses conditions for success in agro-parks and their role in agricultural investment, hunger reduction, and resilience in Africa.	Review	CAADP and the Malabo Declaration promote agricultural investment and intra-African trade, with key stakeholder support.	Aligns with RQ2, discussing agro-parks' role in agricultural investment, trade, and resilience, essential for Ethiopia's GVC integration.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
30. Negesa, D., Cong, W., Cheng, L., & Shi, L. (2022)	<i>Development of Eco-Industrial Parks in Ethiopia: The Case of Hawassa Industrial Park</i>	Evaluates the development and outcomes of Hawassa Industrial Park (HIP) as an eco-industrial park in Ethiopia.	Qualitative	HIP aligns with sustainable development strategies. Success factors include actor roles, the learning process, and indicator system standards.	Aligns with RQ1 and RQ3, assessing HIP's development as an eco-industrial park and its relevance to IAIP development in Ethiopia.
31. Tamene, Lulseged D.; Ashenafi, Ali (2022)	<i>Digital agriculture profile: Ethiopia</i>	Explores the potential, constraints, and enabling environments for transforming Ethiopian agriculture through digital solutions to boost productivity and reduce environmental impacts.	Qualitative	Limited access to digital farming solutions in Ethiopia is due to weak infrastructure, low digital literacy, inadequate financing, weak data policies, and insufficient technical support for smallholder farmers.	It aligns with RQ1, addressing constraints in digital agriculture in Ethiopia, which hinder agricultural productivity and innovation within IAIPs.
32. Tsehay, S., Adane, Z., & Feto, A. (2022)	<i>Agriculture-Industry Linkages for Employment and Economic Transformation in Ethiopia</i>	Examines sectoral linkages between agriculture and agro-processing in Ethiopia to assess the potential for structural transformation	Quantitative	Weak linkages between agriculture and agro-processing (2005-2016), with strong backward but weak forward	It aligns with RQ1, highlighting weak agriculture-agro-processing linkages, which limit the success of IAIPs in

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
33. Sun, X., & Yusuf, S. (2023)	<i>Policies at the End of the Global Value Chain Rainbow</i>	and job creation in the economy. Assess the relevance and effectiveness of Global Value Chains (GVCs) as a tool for policy analysis and development, focusing on their application in four countries—Ethiopia, Bangladesh, Côte d’Ivoire, and Vietnam.	Mixed-methods approach	linkages, limiting agro-processing sectors’ use of domestically produced agricultural outputs. The GVC framework maps value addition across economies but has not expanded policy tools or effectiveness, particularly in countries like Ethiopia. Policy recommendations remain conventional, highlighting the need for better implementation of existing policies to drive export-led growth.	driving Ethiopia’s structural transformation and job creation. It aligns with RQ2 and RQ3, explores how GVC frameworks impact Ethiopia’s integration into global value chains and the effectiveness of related policies.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
34. Tesfaw, Desta (2023)	<i>The Effects of Industrial Park Development on Manufacturing Firms' Performance in Ethiopia</i>	Examines the effects of industrial parks on export earnings, employment creation, and FDI attraction in Ethiopia.	Quantitative	Industrial parks boost export earnings, employment, and FDI, but face challenges like low labor productivity, raw material supply issues, weak linkages, high transport costs, and institutional weaknesses.	It highlighting challenges like low productivity and weak linkages, relevant to RQ1 on IAIPs' success.
35. Tamru, Seneshaw; Minten, Bart (2023)	<i>Value addition and farmers: Evidence from coffee in Ethiopia</i>	- Investigate the reasons behind the stagnation of washed coffee exports in Ethiopia.	Mixed-methods approach	-Coffee value-addition through washing offers a premium price but has stagnated in Ethiopia. -Low labor productivity in producing red cherries and high opportunity costs reduce adoption.	It emphasizes low labor productivity and high opportunity costs, relevant to RQ1 on factors affecting agro-industrial success.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
36. Guteta, G.; Worku, H. (2023a) Hailu (2023)	<i>Sustainable industrial parks development in Ethiopia: Analysis of policy framework gaps</i>	- Investigate the policy framework gaps hindering the development of sustainable industrial parks in Ethiopia.	Mixed-methods approach	-Weak social sustainability frameworks and governance practices, Weak institutional linkages and capacity to adapt to global trends.	It focuses on weak governance, social sustainability, and institutional linkages, relevant to RQ3 on the needed policy and institutional frameworks.
37. Urugo M. et al., (2024)	<i>Addressing post-harvest losses through agro-processing for sustainable development in Ethiopia</i>	Investigate Ethiopia's potential in agro-processing and its alignment with agricultural policies	Qualitative	Postharvest losses in Ethiopia (15–45%) threaten food security and growth; agro-processing techniques like drying, canning, freezing, and packaging can reduce losses and add value.	It explores how agro-processing can address post-harvest losses and align with agricultural policies, relevant to RQ1 on the influence of Sectoral Innovation Systems (SIS) on agro-industrial transformation
38. Hussein, Abdulbasit (2024)	<i>Climate smart agriculture strategies for enhanced agricultural resilience and food security under a changing climate in Ethiopia</i>	Examine the impact of CSA on agricultural productivity, food security, and climate resilience in Ethiopia.	Qualitative	- CSA strategies in Ethiopia include resilient crop breeds, conservation agriculture, advanced livestock practices, and water management systems.	It examines CSA strategies in Ethiopia, contributing to RQ1 on SIS's role in agro-industrial sustainability.

Author(s) and Year	Title of the Study	Objectives/Key Focus	Method	Key Findings	Relevance to the Review
39. Berhanu, A., et al. (2024)	<i>Impact of climate-smart agricultural practices on smallholder farmers' resilience in Ethiopia</i>	-Examine the impact of CSAPs on the resilience of smallholder farmers in Ethiopia. -Identify factors that determine farmers' resilience to climate change.	Mixed-methods approach	-Key factors influencing resilience include household head education, livestock size, and agricultural extension worker visits.	It analyzes CSA impacts on farmers' resilience, contributing to RQ1 on sectoral innovation systems' influence on sustainability.
40. Kassahun, E., et al., (2024)	<i>Utilization, efficiency, health, and environmental performance assessment of Ethiopian Agro-Processors</i>	Investigate the utilization prospects, health, and environmental performance of afro-food processing industries in Ethiopia.	Quantitative	In Ethiopia, peanut oil processing has the highest efficiency and utilization, while sunflower oil has the lowest. Most cereal and oil processors have quality control labs (59.57% and 70.83%, respectively) and solid waste disposal systems (91.48% for cereals, 87.5% for oil).	It evaluates agro-processors' efficiency, contributing to RQ1 by assessing the sustainability of agro-industrial parks through sectoral innovation systems.

3.2.1. Sectoral Innovation Systems (SIS) and Agro-Industrial Transformation in Ethiopia

Ethiopia's strategy to modernize agriculture and enhance agro-industrial productivity is significantly centered around the development of Integrated Agro-Industrial Parks (IAIPs), as they are key to addressing systemic challenges, including inadequate infrastructure, limited market access, and food insecurity (Gavrilova & Mukhametzyanov, 2021). IAIPs provide a structured framework for adding value to agricultural raw materials, enhancing rural-urban linkages, and boosting export potential. As highlighted by Guteta, G. and Worku, H. (2023a), they focus on market-oriented innovation systems designed to foster technological capabilities, attract strategic investments, and promote agricultural development aligned with Ethiopia's Economic Growth and Transformation Plan (EGTP). The EGTP is geared towards fostering agricultural growth through improved market linkages and innovation capacities, thereby supporting the sector's transition into a more competitive and commercialized industry (Woodhill et al., 2011).

The success of IAIPs hinges on strong actor networks and institutional frameworks. While institutional support is vital, gaps in regulatory mechanisms, weak enforcement, and poor integration with local value chains remain significant hurdles. Effective regulations addressing value chain integration, land acquisition, and investor selection are necessary to stimulate innovation. Actor networks, encompassing local communities, government agencies, and private investors, play a pivotal role in resource mobilization and knowledge exchange (Ayalew et al., 2015; Jenane et al., 2022). Additionally, the involvement of Micro and Small Enterprises (MSEs) in local value chains bolsters technological capabilities, overcomes structural barriers, improves supply networks, and supports agro-processing growth (Hailu et al., 2022).

Despite these efforts, systemic barriers within Ethiopia's SIS persist. Hailu et al. (2022) emphasize that poor infrastructure, limited entrepreneurial activity, and weak actor interactions undermine IAIPs' full operational potential. Comparative studies suggest that Ethiopia's IAIP model offers a scalable framework for addressing similar challenges in other African countries like Zambia and Zimbabwe (Gavrilova & Mukhametzyanov, 2021). However, inadequate collaboration between research institutions, universities, and industry limits effective technology transfer, resulting in low adoption rates and stunted innovation (Sisay, 2018; Zerssa, G., Feyssa, D., Kim, D. G., & Eichler-Löbermann, B., 2021). Furthermore, public extension services often dominate smallholder networks, excluding potential contributions

from market-based and civil society actors that could drive innovation (Spielman et al., 2011). For sustainable agro-industrial transformation, strategic innovation and collaborative efforts are critical.

3.2.2. The Role of IAIPs in Enhancing Competitiveness and Global Value Chains

IAIPs play a central role in Ethiopia's strategy to enhance agro-industrial competitiveness and integrate into global value chains. These parks process agricultural raw materials, transforming them into higher-value products that meet international standards, thereby improving Ethiopia's export potential, especially in key sectors such as coffee and wheat (Tesfaw, 2023). IAIPs also address systemic challenges like infrastructure deficits, limited market access, and low agricultural productivity (Tamru & Minten, 2023).

By providing smallholder farmers with centralized platforms for collaboration with agribusinesses, IAIPs facilitate the shift from subsistence farming to commercial agriculture, thus enabling local producers to engage in global supply chains (Usman & Callo-Concha, 2021). Furthermore, IAIPs reduce logistical inefficiencies, enhancing Ethiopia's ability to reach international markets more effectively and boosting its integration into global value chains (Balcha & Serbeh-Yiadom, 2014). However, the parks' success in improving competitiveness depends on overcoming challenges such as weak institutional frameworks and limited access to funding for smallholder farmers (Sun & Yusuf, 2023; Tesfaw, 2023).

In addition to value addition and market access, IAIPs play an important role in job creation and socioeconomic development, particularly in rural areas. These parks contribute significantly to reducing unemployment and support eco-industrial growth by generating environmentally sustainable jobs and improving the social impact of agro-industrial activities (Gebreyesus et al., 2016). Nevertheless, challenges such as logistical inefficiencies and weak linkages between local producers and agro-industrial firms continue to limit the parks' sustainability (Tesfaw, 2023). Strengthening both backward and forward linkages within IAIPs is essential for ensuring a steady supply of raw materials and enhancing Ethiopia's competitive advantage in global markets (Tamru & Minten, 2023).

3.2.3. Innovation and Global Value Chain Integration

Innovation within IAIPs is crucial for Ethiopia's integration into global value chains. Technological advancements, including modern processing methods and digital agriculture, are enhancing agricultural productivity and product quality, enabling Ethiopian products to meet international standards (Ayalew et al., 2015; Gebreeyesus et al., 2016). Innovations in precision farming, data analytics, and blockchain technology are streamlining supply chains and improving inventory management (Kebebe, E. 2019; Woldemichael, A., Salami, A., Mukasa, A., Simpasa, A., & Shimeles, A., 2017). Moreover, industrial clustering and vertical coordination among producers, processors, and retailers are aligning Ethiopia's agricultural products with global market demands (Balcha et al., 2014; Hussein, 2024). Despite these advances, challenges such as inadequate infrastructure and weak institutional frameworks continue to hinder the full potential of IAIPs in global value chain integration (Sun & Yusuf, 2023).

Recognizing the importance of technological innovation, the Ethiopian government has implemented policies to foster innovation and improve supply chain systems (Urugo *et al.*, 2024). Policies focused on reducing food waste, improving product quality, and boosting exports emphasize agricultural research, especially in post-harvest technologies (Eyasu & Endale, 2020; Kassahun et al., 2024). Digital agriculture solutions such as automated irrigation systems and data-driven crop monitoring have demonstrated significant potential in increasing agricultural output, optimizing resource use, and reducing post-harvest losses (Negesa, D., Cong, W., Cheng, L., & Shi, L., 2022). These innovations not only enhance domestic production but also enable Ethiopia to meet the demands of international buyers, improving its competitiveness in global value chains (Abay, 2022; Tsehay, S., Adane, Z., & Feto, A., 2022).

3.2.4. Policy and Institutional Support for SIS and IAIPs

Ethiopia's policy framework, including strategies like Agricultural Development-Led Industrialization (ADLI) and the Growth and Transformation Plan (GTP), prioritizes the establishment of IAIPs as hubs for agro-industrial growth (Sun & Yusuf, 2023; Woodhill et al., 2011). ADLI aims to revolutionize agriculture to support industrial growth, fostering synergy between agriculture and industry to promote long-term innovation (Gebreeyesus, 2013; Staritz, C., Plank, L., & Morris, M., 2016).

Institutionally, the Ministry of Science and Technology plays a pivotal role in implementing innovation policies, while public-private partnerships are encouraged to provide the infrastructure needed for IAIPs' success (Adato, 2022; Schaefer & Abebe, 2015). The Industrial Parks Development Corporation (IPDC) supervises the planning and implementation of IAIPs, with parks like Adama and Hawassa successfully integrating regional value chains into international markets (Guteta, G. & Worku, H., 2023a). However, challenges such as poor infrastructure, logistical constraints, and governance gaps persist, limiting the full potential of IAIPs (Ghione, 2021; Zewdie B. B., 2015).

Ethiopia continues to face challenges in policy implementation, including regional disparities and insufficient capacity-building programs (Gebremariam & Feyisa, 2020; Oqubay, 2015). Experts recommend enhancing infrastructure, ensuring policy coherence, and promoting multi-stakeholder engagement to address these challenges (Ferede et al., 2022; Guteta G. & Worku, H., 2023a). Continuous policy adaptation and evaluation are vital to the success of IAIPs and SIS in boosting Ethiopia's agro-industrial competitiveness (Sun & Yusuf, 2023).

3.3. Comprehensive Synthesis of Findings

This study investigates the critical role of Integrated Agro-Industrial Parks (IAIPs) in Ethiopia's agro-industrial transformation, particularly in addressing systemic challenges such as infrastructure deficits and limited market access. These factors are fundamental to the success and sustainability of IAIPs (RQ1) (Gavrilova & Mukhametzyanov, 2021; Tamru & Minten, 2023). IAIPs contribute significantly to value addition, enhance export potential, and facilitate the integration of smallholder farmers into global value chains (GVCs), aligning with Ethiopia's broader objectives for GVC integration (RQ2) (Guteta, G. & Worku, H., 2023b; Usman & Callo-Concha, 2021).

However, the study identifies critical barriers impeding the full potential of IAIPs, including weak institutional frameworks, poor regulatory enforcement, and limited collaboration between research institutions and industry. These limitations constrain innovation and technology transfer, which are key to the sustainability of IAIPs (RQ1) (Sisay, 2018; Hailu et al., 2022). Furthermore, policy gaps, regional disparities, and inadequate capacity-building efforts hinder effective implementation and limit Ethiopia's integration into GVCs (RQ2) (Oqubay, 2015; Ferede et al., 2022). The findings suggest that the effectiveness of Sectoral Innovation Systems

(SIS), when supported by robust institutional frameworks and stakeholder collaboration, can bridge these gaps and stimulate sustainable growth.

To unlock the full potential of IAIPs, Ethiopia must prioritize strategic investments in infrastructure, enhance regulatory frameworks, and foster public-private partnerships. Policy interventions focusing on technological innovation, particularly in digital agriculture, are critical for improving competitiveness. These measures are essential for optimizing IAIPs' role and ensuring the sustainable growth of Ethiopia's agro-industrial sector (RQ3) (Sun & Yusuf, 2023). Additionally, future studies must focus on further exploring the role of SIS in the agro-industrial sector, particularly within the context of IAIPs.

4. Discussion

This review systematically examines the role of sectoral innovation systems (SIS) in driving Ethiopia's agro-industrial transformation through Integrated Agro-Industrial Parks (IAIPs). The analyzed studies demonstrate that IAIPs significantly support market access, value addition, and innovation, aligning with Ethiopia's national efforts to modernize agriculture and stimulate economic growth. These findings underscore the critical interaction between innovation systems, institutional support, and policy frameworks in fostering agro-industrial development. This is consistent with existing literature on the potential of SIS and IAIPs to enhance agro-industrial competitiveness globally. For instance, Farole (2011) emphasizes the need to align agro-industrial parks with national policies and ensure a market-driven design, which mirrors Ethiopia's approach to modernizing agriculture through IAIPs. Additionally, Bräutigam and Tang (2014) highlight how foreign investments, as seen in Tanzania's agricultural sector, enhance infrastructure and industrial capabilities. Although Ethiopia has made progress in this area, challenges such as inadequate funding and weak institutional frameworks persist, as observed by Mellor and Dorosh (2010), Sisay (2018), and Tamene and Ashenafi (2022).

The review further affirms the importance of strong institutional support and stakeholder collaboration in promoting value addition and integrating Ethiopia into global value chains (GVCs). This aligns with studies from South Africa and Kenya (Sakyi & Tadesse, 2023; Park & Gachukia, 2021). However, unlike China and Malaysia (Zeng, 2021), where digital agriculture and modern technology have enhanced GVC competitiveness, Ethiopia lags in technological adoption. This disparity may be attributed to differences in infrastructure, institutional capacity, and coherent policy frameworks, as highlighted across the reviewed studies. While

innovation, particularly in digital agriculture and technical advancements, facilitates GVC integration, Ethiopia's IAIPs face challenges in fully optimizing these opportunities due to institutional weaknesses, lack of funding, and infrastructure deficits.

This review's strengths lie in its comprehensive analysis of SIS and IAIPs in Ethiopia, incorporating diverse data sources and highlighting underexplored topics like digital agriculture and eco-industrial growth. By linking innovation within IAIPs to global value chain integration, it offers a valuable framework for understanding local innovation systems' interaction with global market dynamics. However, the review is limited by its focus on Ethiopia, restricting generalizability. Future studies should explore cross-country comparisons and include non-English studies while also investigating the impact of emerging technologies like blockchain and artificial intelligence on GVCs.

5. Conclusion and Policy Implications

This review underscores the transformative potential of Ethiopia's Integrated Agro-Industrial Parks (IAIPs) in driving agro-industrial growth and global competitiveness. IAIPs are central to addressing key challenges such as low productivity, limited market access, and infrastructure deficits while enhancing value addition, export potential, and job creation. However, the full realization of their potential is constrained by persistent barriers, including inadequate financing, weak institutional frameworks, and low technological adoption.

The findings suggest that the effectiveness of sectoral Innovation Systems (SIS), when supported by robust institutional frameworks and stakeholder collaboration, can bridge these structural gaps and stimulate sustainable growth. To unlock the full potential of IAIPs, Ethiopia must prioritize strategic investments in infrastructure, enhance regulatory frameworks, and foster public-private partnerships. Policy interventions focusing on technological innovation, particularly in digital agriculture, are critical for improving competitiveness.

By addressing these challenges, Ethiopia has the opportunity to transform its agro-industrial sector, integrating more effectively into global value chains and becoming a model for sustainable industrialization in the Global South. Coordinated efforts are essential to overcome existing barriers, fostering long-term economic growth and global agro-industrial development.

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