

Review Article

# Barriers to Commercializing Publicly Funded Agricultural Innovations in Ethiopia: Policy and Institutional Challenges

Nahom Mesfin Kebede\*

Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia

## Abstract

Agriculture is vital to Ethiopia's economy, accounting for a significant share of employment and GDP. Publicly funded agricultural technologies play a crucial role in addressing challenges within the agriculture sector by improving productivity and sustainability. The commercialization of these technologies is essential for translating research into marketable solutions. This study identifies key challenges impeding the effective commercialization of publicly funded agricultural innovations in Ethiopia, including inadequate funding, regulatory hurdles, market acceptance issues, and collaboration barriers between public and private sectors. A systematic literature review was conducted in this review. Insufficient financial support limits the development and scaling of agricultural technologies. Regulatory processes, particularly for genetically modified organisms, can be lengthy and complex, hindering innovation adoption. Additionally, consumer skepticism and cultural resistance towards new technologies pose significant barriers. The low level of collaboration between public research institutions and private entities further complicates technology transfer, while researchers often lack the entrepreneurial mindset necessary for commercialization. The study concludes with recommendations to enhance commercialization strategies, including the development of standardized regulatory frameworks, public awareness campaigns, and increased funding access. By addressing these challenges, the commercialization of the Ethiopian public research outputs can foster a more conducive environment for agricultural innovation, ultimately contributing to improved food security and economic resilience in Ethiopia.

## Keywords

Commercialization, Agricultural Technologies, Public Funded Research, Ethiopia

## 1. Introduction

Agriculture is a cornerstone of the Ethiopian economy. It provides 90% of the country's raw materials for manufacturing, 72.7% of employment opportunities, and 32.5% of the country's gross domestic product [1]. Over the years, publicly funded agricultural technologies have emerged as vital tools in addressing the myriad challenges facing the agricultural sector. It encompasses a wide range of innovations designed to improve cultivation, enhance productivity, and promote

sustainability. These technologies can be broadly categorized into; crop breeding, animal improvement, sustainable practices, precision agriculture, pest and disease management, agricultural machineries, and water management technologies [2]. The effectiveness and reach of these technologies, however, hinge significantly on their commercialization.

Commercialization is the process through which research findings and technological innovations are translated into

\*Corresponding author: [nahommk1990@gmail.com](mailto:nahommk1990@gmail.com) (Nahom Mesfin Kebede)

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marketable products and services. It plays a critical role in the innovation transfer process, bridging the gap between research and practical application. The importance of commercialization in the context of publicly funded agricultural technologies can be highlighted through several key points [3]; one it maximizes the impacts of research investments and leads to tangible improvements in agricultural productivity and sustainability [4]. Second, commercialization can drive economic growth by creating new markets and job opportunities within the agricultural sector.

Third, it can generate revenue that can be reinvested into further research and development. Fourth, it involves collaboration between public research institutions and private companies. Fifth, researchers can gain insights into market demands and consumer preferences, allowing for the refinement and adaptation of technologies to better meet the needs of farmers and the agriculture industry.

In general, publicly funded agricultural technologies are essential for addressing the challenges of modern agriculture [5]. However, their potential can only be fully realized through effective commercialization strategies that facilitate innovation transfer. By bridging the gap between research and practical application, commercialization ensures that these technologies contribute to sustainable agricultural practices and improved food security worldwide.

## 2. Objective

The objective of this study is to identify challenges of commercializing publicly funded agricultural innovations, and to provide recommendation that enhances the effectiveness of agricultural research.

## 3. Methodology

The paper adopted a systematic literature review of related peer-reviewed articles which focus on the commercialization of agricultural research outputs.

## 4. Literature Review

The commercialization of publicly funded agricultural technologies is critical for translating research innovations into practical applications that can benefit farmers and enhance food security. However, this process is fraught with challenges that can impede the successful transfer of technology from research institutions to end users.

Several studies emphasize the importance of adequate funding in the commercialization process. Publicly funded agricultural technologies often face a critical gap in financing

the transition from research to market. Many innovations lack sufficient post-research funding for further development, testing, and scaling [6]. This funding gap can lead to promising technologies being shelved rather than brought to market. Furthermore, governmental budget constraints and shifting policy priorities can further exacerbate these funding challenges.

Regulatory challenges are a significant hurdle in the commercialization of agricultural technologies. The approval processes for new agricultural products, especially genetically modified organisms (GMOs), can be lengthy and complex. Strict regulatory frameworks can deter investment and slow down the introduction of innovative technologies.

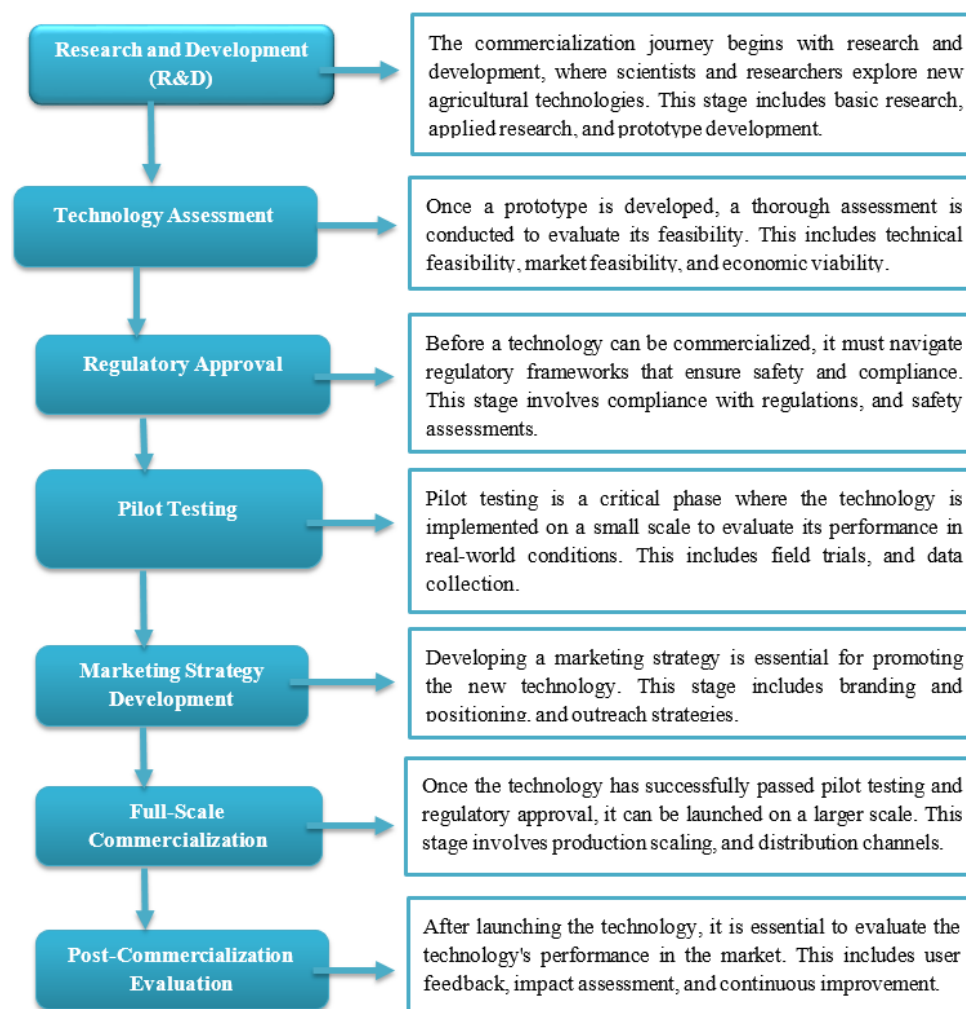
Market acceptance is crucial for the successful commercialization of agricultural technologies. Research indicates that consumer attitudes toward new technologies, especially GMOs, can significantly affect their adoption by farmers. Negative public perceptions and concerns about food safety can impede the acceptance of biotechnological innovations [7]. Additionally, farmers may be hesitant to adopt new technologies due to uncertainties about their benefits and profitability [8]. Effective commercialization often requires collaboration between public research institutions and private sector entities. However, several studies point to challenges in fostering these collaborations. Differing objectives between public and private entities can hinder effective partnerships [9]. Additionally, the lack of clear communication and knowledge transfer mechanisms can lead to a disconnect between research outputs and market needs [10].

The successful commercialization of agricultural technologies also depends on their compatibility with existing farming practices and the engagement of farmers. Technologies that require significant changes in farming practices may face resistance from farmers who are accustomed to traditional methods [11]. Furthermore, effective engagement strategies are necessary to educate farmers about the benefits of new technologies [12].

The commercialization of publicly funded agricultural technologies is essential for maximizing their impact on food security and agricultural sustainability.

## 5. Agricultural Innovation Commercialization Process

The commercialization process for agricultural technologies involves several stages that transition innovations from research and development to practical application in the market. Understanding this process is crucial for stakeholders aiming to bring agricultural innovations to farmers and consumers effectively.



*Figure 1. Agricultural innovation commercialization process flow.*

## 6. Discussion on Challenges of Agricultural Technology Commercialization

### 6.1. Inadequate Legislations

Agricultural commercialization is believed to play a significant role in national economic growth and has received special attention in the revised agricultural and rural development policy of Ethiopia. However, implementing agricultural legislations does not provide clear provision about the commercialization of research outputs. One of the legislations is the current Plant Breeders' Rights Proclamation No. 1068/2010. Article 7, Sub-Articles 1 and 2 of this proclamation does not encourage private sector participation. This lack of encouragement has negatively impacted the implementation of agricultural commercialization as outlined in the Agricultural and Rural Development policy [13].

The existing intellectual property rights (IPR) legal

frameworks of Ethiopia, which is incompatible with international conventions such as TRIPS and UPOV [14]. This incompatibility restricts the involvement of the private sector, international organizations, and government research institutions in the commercialization of research and development ideas, particularly regarding global market participation. Furthermore, the patent protection term set out in Article 16 of the Invention, minor invention and industrial design proclamation number 123/1995 is not aligned with international practice, which is 15 years [15].

### 6.2. Low Level of Agricultural R&D Funding

The budget data from Ethiopian institute of agricultural research (EIAR) and seven regional agricultural research institutes (RARI's) which is supplemented by national agricultural GDP and inflation data were used for this study [16]. Data were analyzed using descriptive statistics. The study revealed that, agricultural research in Ethiopia is still predominantly funded by the government (77%) and total public agricultural research expenditure had increased by 57% from birr 0.8 billion in 2015 to birr 1.8 billion in 2020. The total

expenditure by EIAR constitutes about 46 and 52% of the total agricultural research expenditure in Ethiopia in 2015 and 2020, respectively.

Agricultural research intensity ratio dropped below 0.3% which is below the investment target of 1% or more of agriculture GDP into agricultural research. To meet this lower target in 2019, Ethiopia would need to have invested birr 6.5 billion or an additional birr 4.93 billion (current prices). Agricultural research spending over the period 2015 - 2020 revealed some degree of volatility in research spending from one year to the other. The drastic decline in investment and delay in disbursement were the major challenges confronting the public research institutions.

### 6.3. Low Number of Innovative Researchers and Scientists

Ethiopia's pool of agricultural researchers continued to expand substantially, reaching more than 3,500 in 2023. This growth occurred evenly across EIAR, the RARIs, and the higher education agencies. Ethiopia has one of the fastest growing, yet youngest and least-qualified pools of agricultural researchers in Africa. As of 2023, more than half the country's agricultural researchers held MSc degree, and 31% were under 35 years old. In contrast, nearly 40% of PhD qualified researchers were over 50 years old [17].

### 6.4. Low Level of R&D Collaboration Between Public and Private Institutions

The level of collaboration between public and private institutions in the country is practically non-existent. Government RDIs do not have the flexibility, accountability, incentives, and fiscal autonomy to create opportunities for cooperative research with the private sector, or with the universities [18]. On the other hand, the private sector proves null in responding to opportunities particularly in business ventures requiring the use of new technologies.

Cultural barriers exist between government academia and RDIs and the industry, and entrepreneurs and business leaders have been slow to embrace academic entrepreneurship. Collaboration among local RDIs will be necessary for improving national R&D capacity and for increasing R&D budget efficiency. In the Philippines specific policy measures targeting the promotion of R&D from abroad thus impeding collaboration with R&D institutions of developed countries [19].

### 6.5. Researchers Mindset Remains a Challenge

Researchers have no enough understanding on IP and commercialization of IP assets. They thought that the IP protection and commercialization processes are tedious and want to focus only on research, believing that technologies developed using public funds should be made available to everyone for public good. There is also an apparent lack of entrepre-

neurship culture among researchers with most of them not equipped with business managerial or marketing skill, and therefore not comfortable in doing the job. Financial resource also comes into the picture as one of the impediments, hence the need for financial aid.

According to study reports, scientists use patents/invention disclosures as signals to gain reputation more than financial benefits [20]. Other studies show that university scientists may be motivated to patent and pursue commercialization if they perceive that it can enhance their reputation and progress their research.

### 6.6. Financial Constraints

The commercialization of agricultural technologies is pivotal for enhancing productivity, sustainability, and food security. However, financial issues often pose significant constraints throughout the commercialization process. This detailed explanation outlines the various dimensions of financial challenges that impact the successful transition of agricultural innovations from research to market.

Publicly funded agricultural technologies typically begin with R&D funded by government grants or academic institutions. However, the initial funding often covers only the early stages of research. This insufficient funding can restrict the breadth and depth of research, leading to incomplete or suboptimal technological solutions. After the initial R&D phase, many technologies face a funding gap during the transition to commercialization. This stage often requires substantial investment for further development, marketing, and scaling.

The other problem is the regulatory landscape to gain necessary approvals is a costly process. Compliance with safety, environmental, and quality regulations often requires significant financial investment. Lengthy approval processes can delay commercialization, increasing the overall cost of bringing a product to market. The high costs associated with compliance can deter companies from pursuing certain technologies, particularly those with uncertain market prospects.

Moreover, once a technology is ready for market, substantial financial resources are needed for scaling production, marketing, and distribution. Companies may face high initial costs associated with setting up production facilities or scaling operations to meet anticipated demand. Smallholder farmers and startups often struggle to access financial resources necessary for adopting new technologies.

The agricultural sector is often subject to economic fluctuations, including changes in commodity prices, climate conditions, and global market trends. Economic instability may lead to reduced investment in agricultural technologies, as potential investors perceive higher risks. Unpredictable market conditions can affect the financial returns of new technologies, making it difficult for companies to justify the initial investment.

Financial issues are a critical constraint in the commer-



cialization of agricultural technologies, affecting all stages from R&D to market entry. The inadequate funding for research, gaps in post-research financing, high compliance costs, and barriers to accessing financial resources all contribute to the challenges faced in bringing innovations to market. Addressing these financial constraints through enhanced funding mechanisms, public-private partnerships, and targeted financial support for smallholders and startups is essential for unlocking the full potential of agricultural technologies and ensuring their widespread adoption.

## 6.7. Regulatory Barriers

The commercialization of agricultural technologies is essential for enhancing productivity, sustainability, and food security. However, various regulatory barriers can impede this process. Understanding these barriers is crucial for stakeholders, including policymakers, researchers, and businesses. Regulatory approval processes for new agricultural technologies, such as genetically modified organisms (GMOs) or novel pesticides can be lengthy and complex. This can delay market entry and increase costs [21].

Different countries have varying regulatory frameworks, leading to inconsistencies in approval processes. This can create confusion and additional hurdles for companies looking to enter multiple markets. Many jurisdictions require extensive testing to demonstrate the safety and efficacy of new agricultural technologies. Regulatory bodies often demand substantial data on environmental impact, human health, and agronomic performance. Intellectual property management, impact assessments, biodiversity concerns, trade policies, funding and support mechanisms, consumer acceptance and labeling requirements, coordination among agencies, and other factors are some of the main factors that affect the commercialization of agricultural innovations.

Addressing regulatory barriers is crucial for the successful commercialization of agricultural technologies. Policymakers should aim for a balanced approach that ensures safety and efficacy while fostering innovation. Streamlining approval processes, harmonizing regulations across regions, and providing support for research and development can help overcome these barriers, ultimately benefiting farmers, consumers, and the agricultural sector as a whole.

## 6.8. Market Acceptance

Market acceptability is a key factor in the successful commercialization of agricultural innovations, in addition to regulatory approval. This acceptability may be hampered by a number of variables, which could present difficulties for firms and entrepreneurs. Many consumers have limited knowledge about agricultural technologies, such as genetically modified organisms (GMOs) or precision agriculture tools. This lack of understanding can lead to skepticism and resistance. Misinformation about the safety and benefits of agricultural tech-

nologies can create fear and rejection among consumers [22]. Different cultures have varied beliefs regarding food production and technology use. Technologies perceived as lacking transparency, such as GMOs, may face resistance if consumers feel uninformed about their use. Stringent labeling requirements can complicate marketing efforts. Companies may struggle to communicate the benefits of their technologies effectively while adhering to these regulations.

The presence of organic or traditional farming methods as alternatives can impact the acceptance of new technologies. Established agricultural practices can be deeply rooted, making it challenging for new technologies to gain traction in the market. Farmers may be resistant to change without clear evidence of benefits. The initial investment required for new agricultural technologies can deter adoption. Farmers may be hesitant to invest in technologies that they perceive as costly or risky without guaranteed returns [23].

Environmental and consumer advocacy groups can significantly impact public opinion and acceptance of agricultural technologies. Negative campaigns can foster distrust and resistance among consumers. Farmers often rely on peer recommendations and experiences [24]. The complexity and cost of meeting regulatory requirements can create barriers for companies. If farmers perceive compliance as burdensome, they may be less likely to adopt new technologies. Fluctuating regulations can create uncertainty in the market, making consumers and producers hesitant to embrace new agricultural technologies.

Overcoming market acceptance challenges is crucial for the successful commercialization of agricultural technologies. Stakeholders, including developers, policymakers, and farmers, need to engage in transparent communication, education, and outreach to build consumer trust. Addressing ethical concerns, providing clear information about benefits, and facilitating access to technologies can help improve acceptance and drive the adoption of innovative solutions in agriculture.

## 6.9. Collaboration Issues

Collaboration among stakeholders is essential for the successful commercialization of agricultural technologies. However, various challenges can impede effective collaboration, affecting innovation and market entry.

Different stakeholders, such as farmers, researchers, agribusinesses, and policymakers, often have conflicting objectives. While researchers may prioritize scientific advancement, farmers may focus on immediate economic benefits. Stakeholders may have different timelines and priorities that can complicate collaborative efforts. The use of specialized terminology in scientific discussions can alienate non-experts, such as farmers or policymakers, leading to misunderstandings and reduced collaboration. Unequal access to information can create power imbalances among stakeholders.

Stakeholders must prioritize open communication, mutual

understanding, and trust-building efforts to foster effective partnerships. By aligning interests, sharing resources, and navigating regulatory landscapes together, stakeholders can enhance collaboration, drive innovation, and ultimately improve agricultural productivity and sustainability.

## 7. Conclusion and Recommendations

Ethiopia struggles with commercializing agricultural innovation and protecting intellectual property, particularly within public research and development institutions (RDIs) and higher learning institutions (HLIs). Many valuable agricultural innovations remain under-utilized due to insufficient R&D funding and a lack of entrepreneurial focus among researchers. Challenges include inadequate industry support, inconsistent IP policies, low funding, and a lack of incentives.

Currently, there is no clear legal framework allowing institutions funded by the government to commercialize research and retain revenues. To improve commercialization, RDIs and HLIs have initiated pre-commercialization programs focusing on IP protection, market studies, and business planning.

To overcome these challenges, a multi-faceted approach is needed, emphasizing policy improvements, public engagement, collaboration, increased funding, and effective monitoring. These strategies aim to foster innovation and enhance food security and economic resilience in Ethiopia's agricultural sector.

To enhance the commercialization of agricultural technologies, this study proposes the following policy recommendations:

- 1) Simplify regulations to create a more predictable approval process for agricultural technologies.
- 2) Establish a system to inform consumers about the benefits and safety of agricultural technologies, involving farmers and advocacy groups to build trust.
- 3) Foster partnerships among researchers, agribusinesses, and farmers to enhance innovation and resource sharing, and support smallholder farmers with access to resources and training.
- 4) Develop grants, low-interest loans, and subsidies to encourage the development and adoption of innovative agricultural technologies, particularly for startups and small enterprises, while promoting private sector investments.
- 5) Create clear metrics to assess the effectiveness of agricultural technologies and collaborative projects, allowing for feedback and continuous improvement.

## Abbreviations

GDP	Gross Domestic Product
EIAR	Ethiopian Institute of Agricultural Research
RARIs	Regional Agricultural Research Institutions
RDIs	Research and Development Institutions

R&D	Research and Development
GMOs	Genetically Modified Organisms
HLIs	Higher Learning Institutions

## Author Contributions

Nahom Mesfin Kebede is the sole author. The author read and approved the final manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest.

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