

# AgroTech E-Commerce Innovation: Financial Inclusion Via E-Commerce in Agrotech

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## ABSTRACT

Financial inclusion has become a global priority for enhancing economic growth and reducing poverty, especially in developing countries. Integrating e-commerce into agricultural technology (Agrotech) presents transformative opportunities to improve access to financial services for farmers, agribusinesses, and rural populations. E-commerce platforms, which combine digital marketplaces, mobile payments, and innovative financial products, play a pivotal role in bridging the gap between rural communities and financial ecosystems. By enabling smallholder farmers to connect directly with consumers and financial institutions, these platforms foster increased market participation, reduce transaction costs, and enhance income stability. Furthermore, fintech innovations linked with e-commerce promote alternative credit scoring systems, crop insurance products, and mobile-based microloans, broadening financial opportunities for traditionally unbanked populations. This paper reviews the impact of these platforms on financial inclusion within Agrotech, delving into how they drive economic participation while overcoming systemic barriers. We explore current challenges—such as digital literacy, infrastructure deficits, and regulatory frameworks—and offer insights into potential policy and technological strategies that can advance this sector. By synthesizing case studies and recent innovations, this review underscores the transformative potential of Agrotech in promoting equitable economic growth and reducing financial exclusion in rural economies. Financial inclusion has become a global priority for enhancing economic growth and reducing poverty, especially in developing countries. Integrating e-commerce into agricultural technology (Agrotech) presents transformative opportunities to improve access to financial services for farmers, agribusinesses, and rural populations. This paper reviews the impact of e-commerce platforms on financial inclusion in Agrotech, exploring the mechanisms through which digital marketplaces, mobile payments, and innovative financial products promote economic participation. We analyze challenges, opportunities, and future directions in this rapidly evolving sector.

## 1. INTRODUCTION

Agriculture has long been recognized as a cornerstone of economic development and a critical driver of food security, particularly in emerging economies where a significant portion of the population relies on farming for their livelihoods. According to the Food and Agriculture Organization (FAO), smallholder farmers contribute nearly 70% of the global food supply, yet they often remain

marginalized within traditional financial and economic systems. These farmers face significant barriers to accessing formal financial services, including credit, savings, insurance, and payment systems. The inability to access these resources limits their ability to invest in modern farming techniques, purchase high-quality inputs, and adopt innovative technologies that could enhance productivity and profitability. Additionally, without access to financial safety nets, smallholders are highly vulnerable to economic shocks, market fluctuations, and climate-related risks.

The digital transformation of the agricultural sector presents new opportunities to overcome these challenges.

This paper aims to explore the intersection of Agrotech, e-commerce, and financial inclusion, analyzing how innovative digital marketplaces are transforming traditional agricultural practices and enabling the financial empowerment of smallholder farmers. It will review existing solutions, identify gaps in current systems, and propose future innovations that could further bridge the digital and financial divides in the agricultural sector. By examining successful case studies, technological advancements, and policy frameworks, this research seeks to highlight the potential of integrated e-commerce and financial solutions to drive inclusive and sustainable agricultural growth.

## 2. Conceptual Framework

### 2.1. Financial Inclusion

Financial inclusion is a concept that focuses on ensuring that all individuals, particularly those in vulnerable or underserved groups, have access to affordable and appropriate financial services. In an ideal scenario, every person, regardless of their socio-economic status or geographical location, should have the ability to access banking services, savings accounts, credit, insurance, and a reliable payment system. The ultimate goal of financial inclusion is to improve economic opportunities, reduce poverty, and address systemic inequalities in society.

In many developing countries, particularly in rural areas, smallholder farmers and individuals working in the informal sector often face exclusion from the formal financial system. They may lack the documentation or collateral required by traditional financial institutions to qualify for loans, or they may be located in regions with limited access to banks and financial services. This exclusion leaves them vulnerable to economic shocks, unable to access financial tools to grow their businesses or protect themselves from risks such as crop failure or illness.

Financial inclusion seeks to overcome these barriers by providing access to a wide range of financial products

designed to meet the specific needs of underserved communities. These products typically include:

- **Banking:** Access to basic bank accounts, savings accounts, and transaction accounts.
- **Credit:** Loans and credit lines that can be used for investment in assets, education, health, or business development.
- **Insurance:** Risk management tools, such as health, life, crop, and weather-related insurance, which provide a safety net against unpredictable events.
- **Payment systems:** Digital payment solutions that allow individuals to make and receive payments securely, even without a traditional bank account.

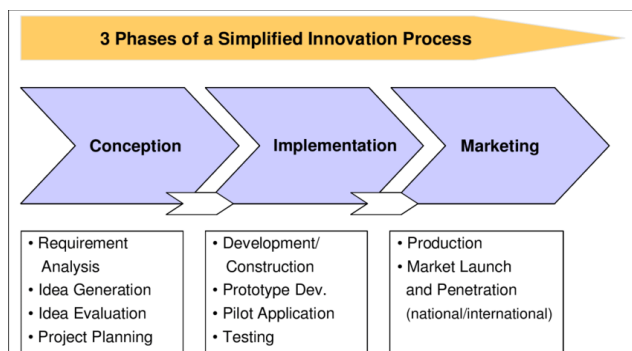
By ensuring financial inclusion, individuals can smooth consumption during times of financial strain, invest in opportunities that improve their livelihoods, and build savings for future needs. Moreover, financial inclusion enables more people to enter the formal economy, thus contributing to broader economic growth and reducing inequality. Digital financial services have become a key enabler of financial inclusion, especially for rural and remote communities, where physical banks and institutions are scarce.

## 2.2. E-Commerce in Agrotech

**E-commerce in Agrotech** refers to the use of online platforms and digital technologies to facilitate the trade of agricultural products, services, and inputs, connecting farmers with suppliers, service providers, and consumers. This digital transformation has revolutionized the agricultural sector by breaking down geographical barriers, improving market access, and reducing dependency on traditional intermediaries such as local traders and middlemen. Through e-commerce, farmers can connect with a wider range of buyers and sellers, access quality inputs at better prices, and streamline their operations.

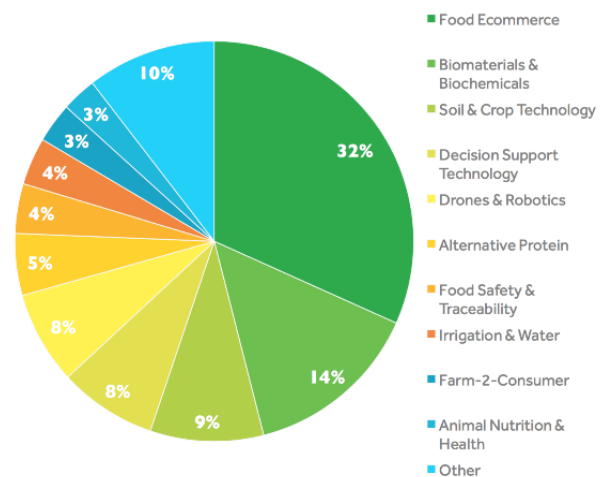
Key elements of e-commerce in Agrotech include:

- **Market Access:** Traditionally, smallholder farmers would rely on local markets or middlemen to sell their produce. However, e-commerce platforms enable farmers to directly sell their products to regional, national, or even international buyers. This direct market access increases transparency and often allows farmers to receive better prices for their goods.



- **Agricultural Inputs and Services:** E-commerce platforms are also used to trade agricultural inputs like seeds, fertilizers, pesticides, equipment, and machinery. These platforms connect farmers to trusted suppliers and service providers, often allowing for bulk purchasing at lower prices. In addition, digital platforms

can provide access to agricultural services such as crop advisory, pest management, and farm management consulting. These services can be critical for improving farm productivity and efficiency.



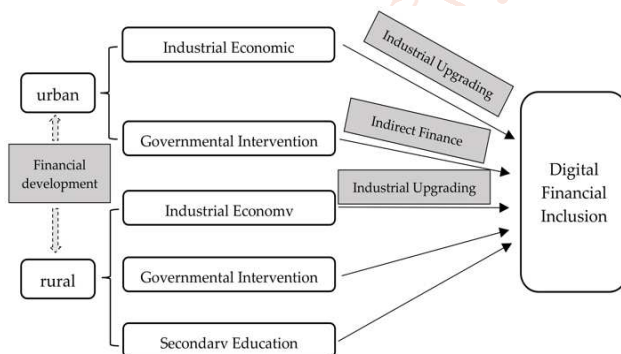
- **Mobile Technology:** In many rural and remote areas, access to high-speed internet may be limited. However, the use of mobile phones and SMS-based services has bridged this gap. Many e-commerce platforms are designed with mobile technology in mind, allowing farmers to engage in commerce via smartphones or feature phones. Farmers can browse product catalogs, place orders, receive payment notifications, and access market information through their mobile devices. This has made e-commerce a powerful tool even in regions with low internet penetration.
- **Digital Payments:** Digital payment systems are integrated into e-commerce platforms to ensure that transactions are secure, fast, and efficient. In regions with low banking penetration, mobile money services such as **M-Pesa** in Kenya or **G-Cash** in the Philippines allow farmers to receive payments, pay for goods and services, and manage their finances without needing a traditional bank account. These digital payment systems facilitate easier trade, improve financial inclusion, and streamline supply chain operations.
- **Price Transparency and Market Information:** Digital platforms often provide real-time information about market prices, weather conditions, and commodity trends. This is particularly valuable for farmers who typically have limited access to market intelligence, which can make pricing their produce more difficult. With access to price data, farmers can make better-informed decisions about when to sell, which markets to target, and how to negotiate with buyers.
- **Logistics and Supply Chain Optimization:** E-commerce in Agrotech can also optimize the agricultural supply chain. By connecting farmers to logistics providers, e-commerce platforms can help farmers with the transportation of goods from farms to markets, reducing the cost and time associated with reaching buyers. Additionally, platforms can track and manage inventory, ensuring that supply and demand are better aligned.
- Overall, e-commerce in Agrotech provides a more efficient, transparent, and accessible way for farmers to engage in trade and access services that were previously

difficult or expensive to obtain. These digital solutions contribute to greater economic empowerment for farmers by increasing their market access, reducing operational costs, and providing them with new tools and information to make more informed decisions. Furthermore, the rise of e-commerce platforms opens up new opportunities for entrepreneurs, agri-businesses, and tech companies to collaborate and innovate, leading to a more resilient and sustainable agricultural sector.

### 2.3. Mechanisms Linking E-Commerce and Financial Inclusion

#### 1. Digital Payments:

- Digital payments have transformed how people, especially in rural and underserved areas, can access financial services. Mobile money services like M-Pesa or PayPal allow individuals to send, receive, and store money via their smartphones, bypassing the need for traditional banking infrastructure.
- For farmers and small-scale entrepreneurs, receiving payments through mobile money or e-wallets is a game-changer. They don't need a bank account to complete financial transactions, reducing the barriers to financial inclusion.
- With mobile payments, farmers can easily purchase inputs like seeds or fertilizers and sell their products online, receiving payments quickly and securely. This enhances their ability to operate and scale their businesses.



#### 2. Insurance Services: Digital Platforms Offering Weather-Based and Yield-Based Insurance

- One of the most pressing challenges for smallholder farmers is the risk posed by unpredictable weather conditions, pest outbreaks, or other natural events. In many developing countries, access to traditional insurance products is limited due to high costs and the complexity of processes.
- E-commerce platforms have enabled the development of digital insurance products that are specifically designed to meet the needs of farmers and rural communities. These insurance products are often weather-based or yield-based, meaning they are tied directly to climatic conditions or agricultural yields.
- Weather-based insurance provides farmers with financial protection against specific weather events like droughts or floods. For instance, if there is insufficient rainfall during a planting season, a farmer could receive compensation to mitigate the loss of crops.
- Yield-based insurance compensates farmers when their yield falls below a certain threshold due to factors like

pests, disease, or unfavorable weather. These insurance products often use data from e-commerce platforms (such as sales data or weather reports) and remote sensing technology (like satellite imagery) to monitor crop health and determine payouts.

- These digital insurance platforms are usually more affordable than traditional insurance products and offer simpler, more accessible claims processes. With e-commerce platforms providing data and communication tools, farmers can receive timely notifications about weather patterns, crop conditions, and insurance options, enhancing their ability to protect their livelihoods.

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### 3. Literature Review

#### 3.1. Digital Payment Systems

**Digital payment systems** have revolutionized the way financial transactions are conducted, particularly in developing regions where traditional banking infrastructure is often lacking. These systems allow individuals, including smallholder farmers, to make and receive payments through mobile phones or digital wallets without the need for a bank account. **Mobile money services**, such as **M-Pesa** in Kenya, have had a transformative impact on financial inclusion, especially in rural areas. M-Pesa, for instance, allows users to send money, pay bills, and make purchases via mobile phones using a network of agents and mobile apps.

In rural communities, where access to banking services can be limited or non-existent, mobile money services have provided an accessible alternative. Mobile money services allow farmers to conduct financial transactions safely, securely, and in real-time. This is particularly important in agricultural markets, where cash transactions can be slow, insecure, and inefficient. Digital payment systems enhance **liquidity** by enabling faster payments, which improves the efficiency of agricultural trade, as farmers can receive payment for their produce quickly and directly into their mobile wallets.

Moreover, integrating **digital payment systems** with agricultural marketplaces facilitates smoother and more transparent financial transactions between farmers and buyers. By enabling farmers to make and receive payments digitally, these platforms reduce transaction costs associated with traditional cash handling. These systems also lower the risk of fraud and theft, which is prevalent in cash-based transactions. Farmers can make secure payments for agricultural inputs (seeds, fertilizers, equipment) and pay for services (transportation, consulting) directly through digital channels. Mobile payment systems also support micro-transactions, which are often needed in small-scale agriculture. With digital payment systems, farmers can access more **financial services** and improve their overall financial health, fostering a more inclusive economy.

### 3.2. E-Commerce Marketplaces

**E-commerce marketplaces** have played a significant role in transforming agriculture by providing smallholder farmers with direct access to larger markets, both locally and globally. In traditional agricultural markets, farmers are often forced to sell their products through intermediaries, who take a significant portion of the profit. By participating in e-commerce platforms, farmers can directly connect with buyers, eliminating the need for middlemen and enhancing price transparency.

One notable example is **Alibaba's Rural Taobao**, a Chinese e-commerce platform aimed at rural farmers, which connects them with suppliers of agricultural products and buyers for their goods. This platform has provided smallholder farmers with access to a broader customer base, allowing them to sell their products at better prices, thereby improving their income. **DeHaat**, an Indian platform, connects farmers with a wide range of agricultural services, such as inputs (seeds, fertilizers), financing options, and access to buyers, including large wholesalers and food processors. Platforms like these reduce the dependence on intermediaries, which are often unreliable and exploitative.

Participation in digital marketplaces allows farmers to gain better **price transparency**. Farmers are empowered to make more informed decisions about when and where to sell their products, improving profitability. Studies have shown that farmers who use e-commerce platforms are able to access markets at higher prices, especially when compared to those relying on local, traditional markets. E-commerce also enables **efficient supply chains** by allowing farmers to streamline logistics, manage inventory, and even track sales, reducing waste and ensuring a quicker time to market.

These platforms also offer enhanced **data insights**, such as price trends, demand forecasting, and market intelligence, which help farmers make better production and sales decisions. Overall, e-commerce marketplaces enable smallholder farmers to overcome the barriers to market

access, making agriculture more profitable, efficient, and sustainable.

### 3.3. Credit and Lending Innovations

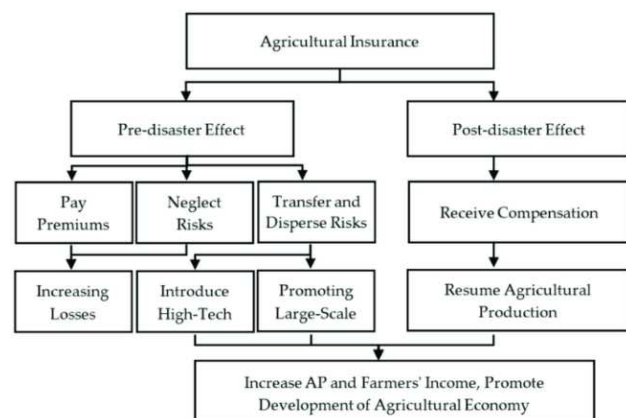
Access to credit remains one of the major challenges faced by smallholder farmers. Traditional lending institutions often perceive farmers as high-risk borrowers due to the lack of collateral, formal income documentation, or a credit history. However, **digital platforms** have enabled **credit and lending innovations** that are tailored to the needs of farmers. These platforms leverage alternative data sources, such as transaction data from e-commerce platforms, mobile payment systems, and even weather patterns, to assess the creditworthiness of borrowers.

**FarmDrive** and **Juhudi Kilimo** are two examples of platforms that use **alternative data** to extend credit to farmers. FarmDrive collects data on a farmer's mobile transaction history, sales patterns, and even soil health information to create a credit score. This allows lenders to offer small loans for purchasing inputs such as seeds, fertilizers, and equipment, which can lead to increased productivity. **Juhudi Kilimo** uses similar data, alongside insights from agricultural experts, to assess risk and offer loans to farmers in Kenya. This approach makes credit more accessible to smallholder farmers who would otherwise be excluded from traditional lending systems.

By using **data-driven lending models**, digital platforms make credit more affordable and inclusive. These platforms also offer flexible repayment terms and lower interest rates, which helps farmers repay loans without putting their livelihoods at risk. In turn, this enhances **financial inclusion** by giving farmers the capital they need to invest in improving their agricultural practices, increasing productivity, and mitigating the impact of economic shocks.

### 3.4. Agricultural Insurance

Agriculture is an inherently risky business, with farmers facing threats from weather fluctuations, pests, diseases, and market volatility. To mitigate these risks, farmers need access to reliable insurance products. However, traditional agricultural insurance is often expensive, difficult to access, and cumbersome to implement, particularly for smallholder farmers. **Innovations in digital insurance** have made it easier and more affordable for farmers to manage risk.



**3.5. Weather-indexed insurance** is one of the most promising digital insurance products. This type of insurance pays out based on specific weather parameters, such as rainfall levels or temperature, rather than requiring on-site assessments of crop damage. For example, if a drought or excessive rainfall

occurs within a specific region, farmers receive payouts that help them recover losses without the need for complicated paperwork or lengthy claims processes. Weather-indexed insurance reduces the administrative costs and time delays associated with traditional insurance, making it more accessible and efficient for farmers.

Platforms like **Pula** and **ACRE Africa** have pioneered the use of digital insurance services tailored for smallholder farmers in sub-Saharan Africa. **Pula** offers weather-indexed crop insurance that is linked to mobile money systems, allowing farmers to receive automatic payouts via mobile wallets when adverse weather conditions are detected. **ACRE Africa** provides similar services, offering affordable, digital insurance products that cover multiple crops and risks. These digital insurance products provide farmers with a safety net, enabling them to invest in their farms with greater confidence, knowing they are protected from financial ruin in case of unexpected risks.

By integrating **digital insurance** with mobile and e-commerce platforms, these innovations increase the **resilience** of smallholder farmers to external shocks, such as climate change, and enhance their ability to recover from losses. Affordable insurance products also encourage farmers to adopt better agricultural practices, as they are less worried about financial instability due to unforeseen events.

| Weather Risk                        | Potential Period to Be Covered | Percentage of Responses to Period Coverage of Particular Weather Risk (%) |
|-------------------------------------|--------------------------------|---|
| Drought (87 respondents)            | April–May                      | 28.7  |
|                                     | May–June                       | 39.1  |
|                                     | June–July                      | 57.5  |
|                                     | July–August                    | 34.5  |
| Excess rainfall (29 respondents)    | July–August                    | 24.1  |
|                                     | August–September               | 44.8  |
|                                     | September–October              | 69.0  |
| Extreme temperature (2 respondents) | June–July                      | 50.0  |
|                                     | July–August                    | 50.0  |
| Floods (40 respondents)             | September–October              | 82.5  |
|                                     | October–November               | 40.0  |

#### 4. Challenges

##### Challenges Hindering E-Commerce and Financial Inclusion

##### 4.1. Infrastructure and Connectivity: Limited Internet Penetration and Mobile Network Coverage

- **Rural-Urban Divide:** In many developing and rural areas, internet penetration and mobile network coverage are inadequate. This digital divide limits the ability of rural populations to access e-commerce platforms and digital financial services, excluding them from the benefits of the digital economy.
- **Cost and Accessibility:** Installing the necessary infrastructure, such as cell towers or high-speed internet cables, in remote areas is often expensive and logistically challenging. Consequently, internet service providers may focus on urban centers, where the return on investment is higher, leaving rural areas underserved.
- **Electricity and Maintenance Issues:** In some regions, even basic electricity supply is inconsistent, further complicating the deployment and maintenance of digital infrastructure like mobile base stations and internet equipment.
- **Impact on E-Commerce:** Limited connectivity means potential users cannot browse, shop, or sell on e-

commerce platforms effectively. It also hinders the use of mobile money services, digital wallets, and other financial tools that rely on stable internet or mobile networks.

##### 4.2. Solutions to Address Connectivity Issues:

- Governments and private sectors can collaborate to expand broadband coverage through public-private partnerships (PPPs).
- Alternative technologies such as satellite internet and low-power wide-area networks (LPWANs) can be deployed to connect hard-to-reach areas.
- Subsidizing infrastructure costs and incentivizing telecom companies to operate in rural areas can bridge this.

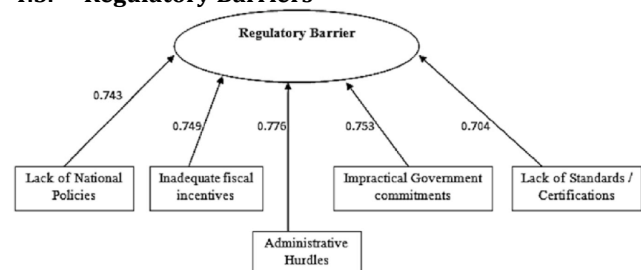
##### 4.3. Digital Literacy: Low Levels Hindering Adoption

- **Understanding Digital Tools:** Many individuals, particularly in rural and underserved regions, lack the necessary knowledge to use digital tools and platforms effectively. This includes understanding how to navigate e-commerce websites, use mobile payment systems, or safeguard themselves against online fraud.
- **Cultural and Educational Barriers:** For populations with limited formal education, the concept of digital transactions or online marketplaces may feel intimidating or inaccessible. Mistrust of digital systems due to fear of scams or lack of personal interaction can further discourage adoption.
- **Language Barriers:** E-commerce platforms and financial tools are often designed in dominant languages, which may not be understood by local populations. This linguistic mismatch creates an additional layer of exclusion.
- **Impact on E-Commerce and Financial Inclusion:** Without digital literacy, individuals are unable to fully participate in e-commerce ecosystems, limiting their opportunities for income generation and financial empowerment.

##### 4.4. Solutions to Enhance Digital Literacy:

- Conduct community-based training programs to teach individuals how to use digital tools, emphasizing user-friendly designs in local languages.
- Promote digital literacy through partnerships with schools, non-governmental organizations, and local community leaders.
- Develop simplified user interfaces with visual aids to make e-commerce platforms and digital financial tools accessible to non-literate users.

##### 4.5. Regulatory Barriers



- **Fragmented Regulatory Frameworks:** Different countries and regions often have varying laws governing e-commerce, digital payments, and data protection. This

lack of harmonization complicates cross-border e-commerce and stifles innovation in financial technology.

- **Licensing and Compliance Costs:** For small businesses and startups, the regulatory requirements for operating in the digital economy, such as obtaining licenses or adhering to strict compliance measures, can be prohibitively expensive and complex.
- **Consumer Protection:** Weak regulatory frameworks may fail to adequately address consumer rights, data privacy, and fraud prevention. This lack of trust in the system can discourage users from adopting digital platforms.
- **Cross-Border Trade:** Regulatory barriers often make it difficult for businesses to engage in cross-border e-commerce. Issues such as tariffs, differing customs rules, and taxation policies create hurdles for small businesses that want to expand internationally.

#### 4.6. Solutions to Address Regulatory Barriers:

- **Simplify licensing and compliance processes,** particularly for small businesses and startups, to encourage participation in the digital economy.
- **Harmonize e-commerce and digital finance regulations** across borders to enable smoother cross-border trade and investment.
- **Strengthen consumer protection laws and build robust frameworks** for data privacy, fraud detection, and dispute resolution to foster trust in the system.
- **Foster dialogue between governments, industry players, and international organizations** to create a balanced regulatory environment that supports innovation while ensuring fair practices.

#### 5. Conclusion

In conclusion, addressing the key barriers of infrastructure, digital literacy, and regulatory frameworks is essential for maximizing the potential of e-commerce to advance financial inclusion. Reliable internet access and mobile network coverage are foundational for rural populations to participate in the digital economy, while investments in community-driven digital literacy programs help individuals navigate e-commerce platforms and financial services effectively. Collaborative efforts between governments, private sectors, and development organizations can drive infrastructure expansion and educational initiatives, ensuring that underserved communities are not left behind.

Equally important is the need for clear, harmonized regulatory frameworks that balance innovation with consumer protection. Simplifying compliance for small businesses and strengthening cross-border trade regulations enable broader participation in the global marketplace. When these challenges are tackled holistically, e-commerce can serve as a powerful catalyst for economic growth, improved livelihoods, and social equity, creating a more inclusive and connected world where everyone can access the benefits of the digital economy.

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