

Digitalization for supply chain resilience perspectives from agricultural suppliers and farmers

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Abstract

Digital technology is helping farmers sell their crops, get fair prices, and grow their businesses. Tools like mobile apps, online payments, and weather tracking make farming easier.

But many farmers face problems like slow internet, high costs, and not knowing how to use these tools. Some do not trust online selling and prefer old ways. Many villages also do not have good internet.

The government and companies should help by giving better internet, cheaper tools, and training. Apps should be easy to use, and online payments must be safe. If more farmers use digital tools, they can earn more money, waste less food, and improve farming for everyone.

Keywords: Digital technology, farmers, supply chain resilience, mobile apps, internet access

Introduction

Agriculture is a fundamental pillar of human civilization, serving as a primary source of raw materials for industries and trade. It significantly contributes to national revenue

and provides substantial employment opportunities, making it a key driver of economic growth and development. Furthermore, sustainable agricultural practices play a crucial role in environmental conservation.

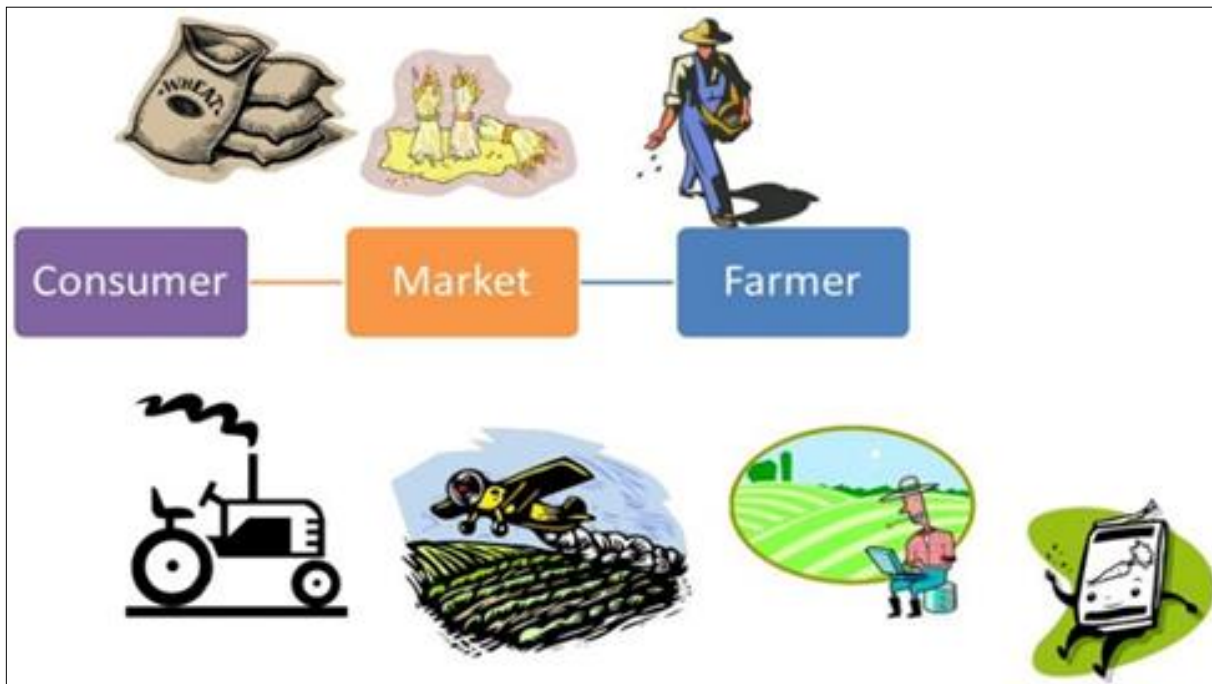


Fig 1

In recent years, digitalization has increasingly influenced agricultural practices in Maharashtra, enhancing the efficiency and reliability of supply chains. Farmers now utilize digital applications and tools to monitor crop health, assess weather conditions, and engage in direct marketing, thus bypassing intermediaries. Suppliers leverage digital platforms to streamline the timely delivery of essential inputs like seeds, fertilizers, and agricultural equipment. Additionally, service providers offer online advisory services, crop insurance, and simplified access to credit, facilitating better decision-making for farmers.

Bulk purchasers employ technology to evaluate product quality and trace produce throughout the supply chain, while artificial intelligence aids in predicting market demand, optimizing pricing strategies, and reducing wastage. The government has also actively supported these advancements through the development of digital trading platforms and improved resource management practices. These initiatives collectively strengthen the agricultural sector, minimize waste, and foster sustainable growth, ultimately contributing to the socio-economic advancement of Maharashtra's agricultural community.

Digitalization is improving agriculture in Maharashtra by making supply chains more efficient and reliable. Farmers use apps and tools to monitor crops, check the weather, and sell their produce directly, avoiding middlemen. Suppliers use digital platforms to deliver seeds, fertilizers, and

equipment on time. Service providers help farmers by offering online advice, crop insurance, and easy loans. Bulk buyers use technology to check quality and track produce, while AI helps predict market demand.

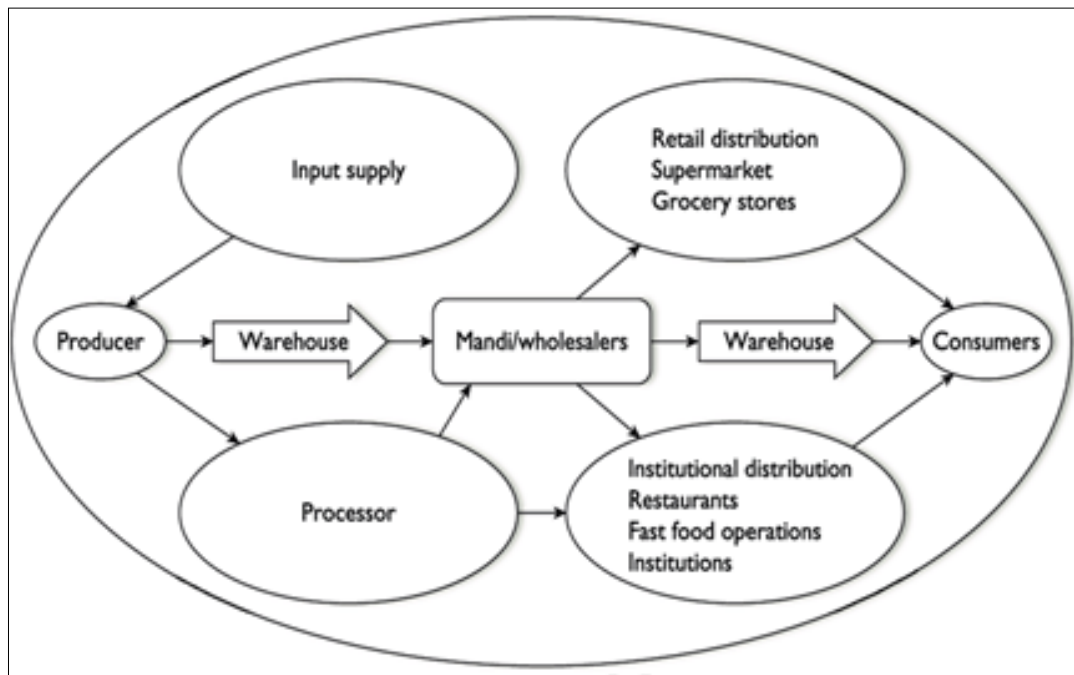


Fig 2

The government supports these efforts with digital trading platforms and better resource management. These changes make agriculture stronger, reduce waste, and support farmers' growth.

Objectives

1. To analyze how digital tools are used by agricultural suppliers, farmers, and other stakeholders in the supply chain.
2. To identify the key challenges faced by suppliers and farmers in adopting digital technologies.
3. To explore how digital platforms, improve market access and reduce dependency on intermediaries for farmers.
4. To assess the role of government initiatives in promoting digital adoption in the agricultural sector.

Literature review

Patel & Rani (2022) highlighted the benefits of farm management software in optimizing agricultural practices. Kumar & Verma (2023) examined the role of blockchain in enhancing transparency in agricultural supply chains in India. Ahmad & Awwad (2023) found a positive correlation between digitalization and profitability in the agri-food industry. Sharma & Gupta (2024) discussed how autonomous vehicles and AI-driven logistics improve efficiency in agricultural distribution. Singh & Malhotra (2023) explored the role of mobile technology in transforming rural agricultural practices by providing real-time weather updates and market prices. Suresh & Mehta (2022) studied the impact of IoT-based smart farming solutions in reducing resource wastage and improving productivity. Deshmukh & Iyer (2024) analyzed the

challenges faced in adopting e-commerce platforms for agricultural product sales, focusing on trust issues and digital payment barriers.

Research Methodology

This study employs a mixed-method approach, integrating both qualitative and quantitative research techniques to ensure a comprehensive understanding of digitalization in agricultural supply chains. The methodology is structured to capture diverse perspectives from key including Produce sellers, farmers, suppliers, and intermediaries.

Primary Data Collection The study gathered first-hand information through structured surveys and in-depth interviews with 107 respondents, comprising 50 suppliers and 57 farmers. The questionnaire focused on digital tool adoption, associated challenges, and perceived benefits.

Samples area	Size	percentage
Product Seller; Intermediary and Suppliers	50	46.72897196
Farmers	57	53.27102804
Total	107	100.00%

The Convenience Sampling method was employed in the initial stages to conduct preliminary interviews and obtain quick, accessible insights. Participants were selected based on their availability and willingness to share their experiences. While this approach may introduce some degree of bias, it provided valuable early insights into stakeholder perceptions of digitalization, serving as a foundation for more in-depth analysis.

Data Analysis

Table 1

Section A: Product Seller; Intermediary and Suppliers				
Questionnaire	mean	median	stdev.p	stdev.s
Q1.I use an online platform for buying and selling agricultural products (e.g., seeds, fertilizers, equipment).	3.92	5	1.47	1.48
Q2. I use mobile apps or online platforms to connect with farmers or buyers.	3.86	5	1.52	1.54
Q3.Before making a transaction, I use digital technology to track market prices.	2.02	2	0.79	0.8
Q4.Digital technologies help me reach more customers and grow my business	2.06	2	0.57	0.58
Q5.Online transactions and digital payments have made my business easier and more secure.	2.1	2	0.9	0.91
Q6.Digital technology has reduced inefficiencies caused by delays in the supply chain and stock shortages.	2.46	2	1.02	1.04
Q7.I find digital tools complicated and need training or assistance to use them efficiently.	2.34	2	1.02	1.04
Q8.I am aware of government-driven digital platforms for agricultural trade.	2.28	2	0.97	0.99
Q9. believe that digitalization will improve the efficiency and profitability of the agricultural supply chain.	2.18	2	0.96	0.98
Q10.Yes, your sentence is perfectly translated! If you need further help with anything else, feel free to ask.	2.12	2	0.8	0.81

Table 2

Section B: Farmers				
Questionnaire	mean	median	stdev.p	stdev.s
Q1.I use mobile apps or digital tools to monitor my crops and the weather.	2.91	3	1.21	1.22
Q2.I use technology-based platforms to buy seeds, fertilizers, or farm equipment.	2.63	3	1.14	1.15
Q3.I use an online platform to sell my product directly to buyers.	1.4	1	0.49	0.5
Q4.Digital tools have enabled me to lower farming expenses.	2.32	2	0.96	0.97
Q5.Using digital tools has helped me get better prices for my products.	2.28	2	0.98	0.99
Q6.I get timely updates about government schemes and grants through the digital platform.	2.3	2	0.93	0.94
Q7.I have applied for government agricultural grants or schemes using a digital platform.	2.74	3	0.94	0.95
Q8.Did you successfully receive the grant after applying through the digital platform?	0.737	1	0.44	0.44
Q9. Internet connectivity is a big problem in my area.	2.51	2	1.03	1.04
Q10.The cost of smart phones and internet services is too high for me.	2.18	2	0.98	0.98
Q11.I am aware of the digital platform created by the government for agriculture.	1.26	1	0.44	0.44
Q12.I believe that technology-based transformation will improve the future of agriculture.	2.04	2	0.84	0.85
Q13.How convenient was it to apply for government agricultural grants or schemes using a digital platform?	3.86	4	0.95	0.95

The analysis of responses show that many product sellers, middlemen, and suppliers are using digital tools, but mostly for basic activities. The highest average score was for using online platforms to buy or sell farming products (Q1), with a mean of 3.92 and median of 5, which means this is a common activity. Using digital platforms to connect with farmers or buyers (Q2) also had a high mean of 3.86, showing many people use these tools for communication. However, fewer people check market prices online before selling their products (Q3), which had a low mean of 2.02. This means most respondents are not using digital tools to compare or track prices. Also, digital tools are not helping much in reaching more customers or growing their business (Q4), with a mean of 2.06.

Some people said that online payments and transactions made their business easier and safer (Q5), but the average score was 2.10, showing only a small improvement. When asked if digital tools helped reduce delays in the supply chain or problems with stock, the average score was 2.46 (Q6), meaning few experienced this benefit.

Many people find digital tools difficult to use and need help or training (Q7), which had a mean of 2.34. Also, awareness of government digital platforms for farming was low, with a mean of 2.28 (Q8). Although some believe digital tools can improve agriculture and the supply chain (Q9), the average score of 2.18 shows this belief is not very strong yet. One question (Q10) did not seem to fit well with the rest of the survey, but its mean was 2.12, close to the other results.

In short, most respondents are using digital tools for simple things like buying, selling, and talking to others. But they are not using them much for more advanced things like tracking prices, growing their business, or reducing delays. This shows that there is a need for better training, more awareness, and support from the government or other groups to help people use digital tools more effectively in agriculture.

The analysis of responses from farmers reveals moderate adoption of digital tools in agricultural practices. A notable number of respondents indicated that applying for government agricultural grants or schemes through digital platforms was convenient, as reflected by a high mean score of 3.86 and a median of 4. This suggests a positive perception regarding the ease of application processes via digital means. Moreover, the usage of mobile applications to monitor weather and crop conditions (mean = 2.91) and the purchase of agricultural inputs like seeds and fertilizers through technology-based platforms (mean = 2.63) indicate a growing but still limited engagement with digital tools for operational activities. However, the use of online platforms for directly selling agricultural products remains low, with a mean score of only 1.4, pointing to limited adoption in this area.

While some farmers agreed that digital tools have helped reduce farming expenses (mean = 2.32) and improve product pricing (mean = 2.28), the responses remain mixed, suggesting only partial benefits. Access to government scheme updates through digital platforms also recorded a moderate mean score of 2.3. Interestingly, a fair proportion of farmers reported using digital platforms to apply for grants (mean = 2.74), yet the success rate of receiving these grants appears low, with a mean score of just 0.737,

highlighting a gap between application and actual benefit realization.

Challenges such as internet connectivity (mean = 2.51) and the high cost of smartphones and internet services (mean = 2.18) continue to hinder broader digital adoption.

Findings

1. The data shows how long people have been in business. 13 people have 1 to 5 years of experience and are still learning. 16 people have 5 to 10 years of experience and know some business skills. Another 13 people have 10 to 15 years of experience and have learned a lot. The most experienced group has 8 people with over 20 years in business.

A beginner might have just opened a shop, while someone with 10 to 15 years may have grown their business. Those with over 20 years are experts who have seen many changes in the market.

2. Most traders use online platforms to buy and sell agricultural products, but only a few do so regularly. One person uses them frequently, while 11 use them occasionally. Some traders rarely or never use these platforms, possibly due to lack of awareness or preference for traditional methods.

A trader who buys fertilizers might use an online platform occasionally to compare prices, while another trader still prefers to visit local suppliers in person.

3. Most traders do not use online platforms to sell their products directly to buyers. Only a smaller group does. This could be because they are unaware of these platforms, do not trust them, or prefer traditional selling methods. Educating them about the benefits of online selling could encourage more traders to use digital platforms.

A trader selling handmade baskets in a local market might not use an online platform because they are unfamiliar with how it works. If they learn how to sell online, they could reach more customers and grow their business.

4. Most traders use digital technology to check market prices before making a transaction. A majority rely on these tools, while only a few are neutral or do not use them. This shows that digital tools are important for making smart buying and selling decisions.

A trader selling rice checks market prices online before deciding how much to charge, ensuring they stay competitive.

5. Most traders believe that digital technologies help them find more customers and grow their business. While a few people are unsure, very few disagree. This shows that digital tools are useful for business expansion, but some traders may need training to use them effectively.

A trader selling fresh vegetables online reaches more customers than those selling only in local markets.

6. Most traders believe that online transactions and digital payments make their business easier and more secure.

While a few people are unsure or prefer traditional methods, no one strongly disagrees. This suggests that digital payments are widely accepted, but some traders may still have concerns or challenges.

A trader using digital payments can receive money quickly and securely, avoiding the risk of carrying cash.

7. Many traders believe that digital technology helps reduce delays and stock shortages in the supply chain. However, some are unsure about its impact, and a few feel it hasn't made much difference. This suggests that while digital tools are useful, not everyone fully understands or benefits from them yet.

A trader using digital tracking can see when stock is running low and reorder in time, avoiding delays.

8. Most traders know about government-run digital platforms for agricultural trade, but some are still unsure or unaware. This means that more awareness campaigns and training might help more people use these platforms effectively.

A trader who knows about a government digital platform can use it to find better prices and buyers, but those who don't may miss out on these opportunities.

9. Most traders believe that digitalization can make the agricultural supply chain more efficient and profitable. However, some are unsure or do not think it will help much. More education and real-life examples could help them see its benefits.

A trader using digital tools can track supply and demand easily, leading to better profits, while those who don't use digitalization might struggle with delays and missed opportunities.

10. Many farmers use mobile apps or digital tools to monitor their crops and the weather, but some do not use them at all. Only a few uses them frequently. This suggests that more awareness and training could help farmers make better use of these tools.

A farmer who checks weather updates on a mobile app can plan farming activities better, while someone who doesn't use digital tools might face unexpected weather problems.

11. Some farmers use technology to buy seeds, fertilizers, or farm equipment, but many still do not. No one uses these platforms frequently. This suggests that farmers may not fully trust or understand these tools yet. More education and incentives could help increase their use.

A farmer who buys seeds online can compare prices and find good deals, while a farmer who does not use technology may have to rely only on local stores, which could be more expensive.

12. Many farmers use mobile apps or online platforms to connect with others, but not all use them regularly. Some farmers still prefer traditional ways of communication, like meeting in person. More

awareness and training could help increase the use of online platforms.

A farmer who connects with buyers online can sell products faster, while another who does not use online platforms may take longer to find customers.

13. Most farmers check market prices online before making a sale or purchase. This helps them make better decisions. Only a small number do not use digital tools for this.

A farmer checks online prices before selling crops to ensure they get a good deal, while another who does not check might sell for a lower price.

14. Most farmers believe that digital tools help them get better prices for their products. Some are unsure, and only a few think these tools don't help.

A farmer checks online market rates before selling crops and finds a buyer offering a higher price, while another farmer who doesn't use digital tools sells at a lower price without knowing the best rates.

15. Most farmers get timely updates about government schemes and grants through digital platforms. Some are unsure, and a few feel they don't receive updates.

A farmer uses a mobile app to learn about a new subsidy and applies in time, while another farmer who doesn't use digital platforms misses the opportunity.

16. Most farmers apply for government agricultural grants or schemes using digital platforms like websites, e-service centers, or mobile apps. Only a small number have never used digital methods for this.

A farmer applies for a subsidy using a mobile app, while other visits a local e-service center to apply online.

17. Most farmers successfully received the grant after applying through a digital platform. However, some did not, which may indicate challenges in the process.

A farmer applied online for a government grant and successfully received it, but another farmer applied and did not get the grant.

18. Many farmers have internet problems in their area, but some do not. Some are unsure if it is a big issue.

A farmer wants to check market prices online, but the internet is slow. Another farmer has good internet and doesn't face this problem.

19. Many farmers think smartphones and internet services are too expensive. Some are unsure, and only a few believe the cost is not too high.

A farmer wants to use a mobile app to sell crops but cannot afford a smartphone or internet plan. If prices were lower, more farmers could use digital tools.

20. Most farmers know about the government's online platform for agriculture, but some do not. This means more people need to learn about it so they can use it.

If the government has a website that helps farmers with prices and grants, 42 farmers know about it and use it. But 15 farmers don't know, so they miss out. Teaching them about it can help.

21. Most farmers found it easy to apply for government agricultural grants online. Some were unsure, and a few found it hard. This means the online system is useful, but some farmers may need help.

Out of 57 farmers, 42 said applying online was easy or very easy. But 6 farmers found it difficult. Giving step-by-step guides or training can help those who struggle.

Suggestions & Recommendations

1. Traders can use online platforms more if they get the right support. Training can help them understand how to buy and sell online. Better internet service will make it easier to use these platforms. Safe and simple digital payments can build trust. Websites and apps should be easy to use so traders don't feel confused. If the government gives support or discounts, more traders might start using online platforms.
2. Traders can buy and sell products on digital platforms to reach more buyers and suppliers. Checking market prices through apps or websites helps traders make better pricing decisions. Mobile wallets and online transactions make payments faster and more secure. Attending workshops or online courses can help traders understand digital tools.
3. Training programs can teach traders how to sell their products online. Success stories and secure payment options can help traders feel safe using online platforms. Simple and user-friendly apps will help traders sell without confusion.
4. Farmers can compare prices on websites or apps before selling their crops. Selling directly to buyers online can help farmers avoid middlemen and get better prices. Apps can notify farmers when prices are high so they can sell at the right time. Training programs and subsidies can help farmers learn how to use digital tools effectively.
5. Training sessions can help farmers understand how to buy safely online. Secure payment options and customer reviews can make farmers feel more confident. Discounts or special offers for first-time users can encourage farmers to try online platforms. Awareness programs and subsidies can help farmers afford digital tools for purchasing.
6. Farmers can check official platforms regularly for new subsidies and grants. Many government programs send text alerts about new opportunities. Digital or community groups share important updates about schemes. Workshops can teach farmers how to use apps and websites for updates.
7. Companies can offer cheaper internet plans for farmers. Villages can have shared Wi-Fi centers for everyone to use. Expanding mobile networks like 4G and 5G can make internet faster. Satellite internet can also help in remote areas where signals are weak.

8. Farmers can install free apps that provide weather updates and crop advice. Some government and private services send weather and farming tips via text messages. Workshops can teach farmers how to use digital tools for better planning. Farmers can learn from others who already use mobile apps.
9. Many farmers find smartphones and the internet too expensive. The government can give discounts, and companies can offer cheaper data plans. Community internet centers and second-hand phones can help farmers save money.
10. Most farmers know about the government's online platform for agriculture, but some do not. This means more farmers need to learn about it so they can benefit. Teaching them about the platform can help more farmers take advantage of these services.
11. Some farmers may not know how to use the internet, have a weak internet connection, or not know about the online system. Simple guides, training, or help from experts can make it easier for them to apply and get the grants and schemes.

Conclusion

Digital technology is helping farmers and suppliers improve the agricultural supply chain by making trading, payments, and market access easier. This study looks at how they use digital tools and the problems they face, such as lack of internet, high costs, and not knowing how to use these tools. Government programs, online platforms, and training can help more people use digital technology. If these challenges are solved, digitalization can make farming and supply chains stronger, reduce middlemen, and help farmers earn more.

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