

Managing Digital Marketing and E-Commerce in Agriculture Practical Cases and Trends

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Abstract

The purpose of the study is to argue modern aspects of digital marketing management and e-commerce in the agricultural sector, as well as to identify effective practices and emerging trends that contribute to increasing the competitiveness of agricultural enterprises in the conditions of digitalization of the economy. The work uses methods of comparative and statistical analysis, case studies, as well as synthesis of secondary data from open sources on the development and functioning of digital marketing. An analysis of practical cases of the implementation of digital marketing tools and online trading platforms in small and medium-sized agricultural enterprises in various regions of the world was carried out. Attention to the strategy of using social networks, marketplaces, CRM systems and mobile applications in agriculture is argued. The study showed that the use of digital promotion and sales channels allows farmers and agricultural companies to expand the market, minimize the costs of intermediaries and build direct interaction with the end consumer. Structured positive examples of sales growth after the integration of digital solutions, such as SEO promotion, contextual advertising, e-mail and messenger marketing. In addition, the main barriers to digitization in the agricultural sector are identified and argued: lack of IT skills, weak infrastructure and limited access to investments. The scientific novelty consists in the systematization of disparate data on the use of digital marketing in agriculture and the formalization of a model of successful digital transformation of agribusiness. The work offers a classification of digital promotion strategies depending on the type of production, business scale and target audience. Research results can be used by agrarian entrepreneurs, consultants and government bodies when developing programs to support the digital transformation of the agricultural sector. The proposed recommendations make it possible to adapt best practices to local conditions and increase the effectiveness of marketing campaigns in agriculture..

Keywords

Digital transformation, agribusiness, marketing strategies, agricultural.

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Introduction

The digital transformation of the agricultural sector has become a defining factor in the contemporary development of agribusiness. As one of the core branches of the global economy, agriculture increasingly operates under conditions of intensified competition, volatile markets, rapid technological change and evolving consumer preferences. In this environment, the effective management

of digital marketing and e-commerce is no longer optional but represents a strategic necessity for improving operational efficiency, expanding market access and strengthening interaction with end consumers (Hennessey, 2020). Several linked trends define the importance of this study. The first is the worldwide diffusion of digital technologies which has drastically transformed all sectors of economic activity including for agriculture in which digital tools are now increasingly used

in production, logistics and marketing sales (FAO, 2021). The global COVID-19 outbreak has also greatly accelerated the pace of farm business to online communication, exposure and e-commerce channels, while unveiling structural deficiencies in digital readiness and a lack of systematic digital strategies - particularly for smallholder and medium-scale producers (Bose and Kiran, 2021). Third, while the potential of digital applications has been well recognized, its penetration in agriculture is unbalanced and relatively limited, particularly among rural as well as developing areas suggesting significant underutilization (Aker, 2018; Ravi and Rajasekaran, 2023). The purpose of this study is to investigate the new methods for management of digital marketing and online trading in the agriculture sector, to identify effective practices, innovative technological trends and to evaluate their significance on increasing competitive ability of agricultural enterprises during the digital economic transformation. The speedy rise of the digital economy has changed classic communication channels with consumers, reconfigured logistics chains and diverted an increasingly large part of agricultural trade to online spaces. Thus, now agricultural businesses need to reconsider traditional promotion and sales systems and make them in line with digital demands (Baker & Smith, 2020). This study takes up a daunting challenge to make the agricultural sector successfully adapt in its new digital form and make itself competitive within and outside the country. The necessity for this research is clear as many small and medium-sized agricultural businesses face serious barriers to the adoption of digital means. These barriers include low digital literacy, lack of infrastructures in rural and remote areas, limited access to investments and credits assets, as well as fragmented institutional support for digital development (KN and Nasution, 2024; Jouanjean, 2019). Unauthoritative and unsystematic use of the tools with modern information digital marketing is yet another ranging challenge. Often, agribusinesses implement digital solutions on a piecemeal basis with minimal centralized planning or measurable transformation paths. This aspect leads many organizations to a loss of visibility on the Web, with low economic returns in relation to digital investments. What is more, the lack of standardized digital marketing management models makes it even more difficult to spread best practices throughout the industry (Cochea Tomala, 2022). Simultaneously, shifting consumer habits heightens the value of digital engagement. Consumers are becoming more eco-

friendly, organic and local while also demanding convenience, transparency and speed in transactions. Today, online ordering, mobile applications and fast delivery are no longer competitive advantages but basic market requirements (Ningsih et al., 2023). In such circumstances, quality is no longer enough to succeed in the market. Farmers need to convey what products are being offered and the value attached to products, digitally engage with consumers, develop trustful relationships with consumers and increase the price transparency of agriculture products delivered through digital channels (FAO, 2021). Digital marketing channels such as social media promotion, content marketing, targeted advertising, email campaigns and online marketplaces are effective solutions to these problems for agribusinesses. Data-driven marketing strategies enable agricultural businesses to tailor their communication to individual customers, which can enhance customer engagement and foster loyalty (Hennessey, 2020; Al-Ababneh et al., 2023). Furthermore, e-commerce platforms can help producers to cut the reliance on intermediaries, enhance price transparency and access more markets, such as overseas markets (Baker and Smith, 2020). In the future, digital marketing and e-commerce in ag will be greatly influenced by the use of advanced digital technologies. Big Data analytics can enable producers to predict demand more accurately, drive logistic optimization and improve decision-making along complex supply chains (McKinsey and Company, 2020). Artificial intelligence and machine learning enable better demand forecasting, inventory optimization, personalized marketing strategies which in turn helps production related decisions like crop monitoring and yield forecast (Almestarihi et al., 2024; Katragadda, 2024). Simultaneously, the advent of Internet of Things (IoT) systems allows a real-time monitoring of soil characteristics, climate factors and resource utilization thereby enhancing production efficiency and sustainability (Mishra, 2021; Al-Ababneh et al., 2023). However, digital marketing and e-commerce in agriculture are yet to become fully widespread because some challenges still prevent them. Infrastructural bottlenecks, especially lack of access to high-speed internet and digital payment systems in rural areas are still a significant challenge (AgriDigital, 2022). What's more, big agribusinesses and smallholders have stark differences in access to digital tools, capital and knowledge. Large companies are, in general, better suited to invest in sophisticated digital technology while the small producers often faced with high cost of entry and low support

from an institution (Al-Ababneh et al., 2025). On the basis of a critical review of related studies, the following hypotheses are advanced:

- H1: The adoption of online marketing and e-commerce can cut transaction and distribution costs, reduce dependence on intermediaries and enhance logistics management, thus enhancing the profitability of agricultural producers (Baker and Smith, 2020; Aker, 2018).
- H2: The application of Big Data analytics, artificial intelligence and IoT technologies enhances the production efficiency and product quality that results in a decrease in operating costs for agricultural enterprises (McKinsey and Company, 2020; Mishra, 2021).
- H3: The digitalization has a positive effect on the growth of the small and medium-sized agricultural firms through integrating them to domestic and international value chain and enhancing their market competitiveness (Jouanjean, 2019; Ravi and Rajasekaran, 2023).
- H4: Infrastructural barriers and digital technology access differentials between bigger agribusinesses and smallholders are main obstacles to the spread of the digitalisation in agriculture, especially in developing countries (Aker, 2018; KN and Nasution, 2024).

In conclusion, digital marketing and e-commerce are integral elements of the digitalization process of agriculture and contribute significantly to enhancing efficiency and sustainability in this sector. Yet realizing their potential to the fullest extents would demand collective action towards infrastructure development, capacity development and institutional support. Solutions to these challenges are essential to guarantee a digital transformation of agriculture that is inclusive and sustainable.

Materials and methods

The methodology of research of the digital marketing and online implementation of trading in agriculture involves a range of principles, which in general can be that way outlined into groups depending on different factors which can affect the effectiveness of using digital technologies in the agro-sector. The study is based on both theoretical methods of data analysis, modeling and analysis of real examples and practice of the world. To evaluate the influence of digital marketing and online trading on agriculture,

a number of formulas and calculation models may be employed that will enable to evaluate in clear terms what economic effect you are getting from the application of these technologies. One of the methods for assessing the effectiveness of digitalization in agricultural business is the calculation of the economic return from the implementation of digital solutions:

$$ROI = \frac{P_d - C_i}{C_i} \quad (1)$$

where: P_d - profit received from the use of digital technologies (for example, from increasing sales through online platforms), C_i - costs of implementing and maintaining digital technologies (the cost of software, training courses, development of marketing strategies). If the ROI value is positive it means that the benefits of the economic implementation of digital technologies are greater than the cost of their implementation and operation (Almestarihi et al., 2024). It should be noted, though, that use of data in agriculture - especially the weather forecast and soil moisture among other things - can improve yield forecast accuracy a lot. A linear model can be employed solely for this purpose, which enables us to measure the influence of factors on yield:

$$Y = a + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \dots + \beta_n \cdot X_n + \epsilon \quad (2)$$

where: Y is the predicted yield (the number of tons of grain), a is a constant, $\beta_1, \beta_2, \dots, \beta_n$ are coefficients showing the degree of influence of various factors (X_1, X_2, \dots, X_n) on the yield (temperature, precipitation, use of fertilizers), ϵ is the forecast error, taking into account all unaccounted factors. Such method will lead to more precise prediction of the crop yield so that farmers can better choose agricultural input, and make decisions on time. The use of digital channels makes it possible to simplify supply management, lower cost and expedite product delivery. The logistics optimization model can be formulated based on a linear programming problem with the objective function to minimize the total transportation cost:

$$\min \sum_{i=1}^n \sum_{j=1}^m C_{ij} \cdot x_{ij} \quad (3)$$

where: C_{ij} - the cost of delivering a unit of production from point i (supplier) to point j (buyer), X_{ij} - the quantity of production that is delivered from i to j , n - the number of suppliers, m - the number of buyers. The linear program techniques were the one used to solve this problem due it being able to reduce transportation costs and optimize routes of delivery especially for agricultural products that have a short shelf life (Katragadda, 2024). It is also crucial to use

the price elasticity of demand to measure the impact of digital marketing on demand. This indicator will be used for marketing activities over online platforms:

$$E = \frac{\% \Delta Q}{\% \Delta P} \quad (4)$$

where: E - elasticity of demand $\% \Delta Q$ = percentage change in quantity sold by a marketing campaign $\% \Delta P$ = percentage change in price due to change in marketing results. If $E > 1$ it means that: demand is very sensitive to variations in marketing effort, and a little extra advertising or betterment of digital platforms could potentially generate great sales increase. On the other hand, conversion rate is a significant appraisal of the benefit of e-commerce for the farmers. The following measure can help us evaluate the effectiveness of the digital platform to attract and keep people:

$$C = \frac{N_{sales}}{N_{visitors}} * 100 \quad (5)$$

where: C - conversion (in percents), N_{sales} - number of sales achieved through the platform, $N_{visitors}$ - volume of visits to the site. For online farming, the higher is the conversion rate value, better are the marketing efforts of these platforms (content, design and ease of use) on how to attract visitors and turn them into clients (Al-Ababneh et al., 2024). Reinforcing the approach, it is important to highlight that in addressing socio-economic impact of digital technologies on agriculture, the indicator impact on farmer's income must be employed as an evaluative condition. With this calculation, it enables us to know in what way the use of digital technologies enhances the economic situation for rural producers:

$$I = (R_{digital} - R_{traditional}) + (S_{digital} - S_{traditional}) \quad (6)$$

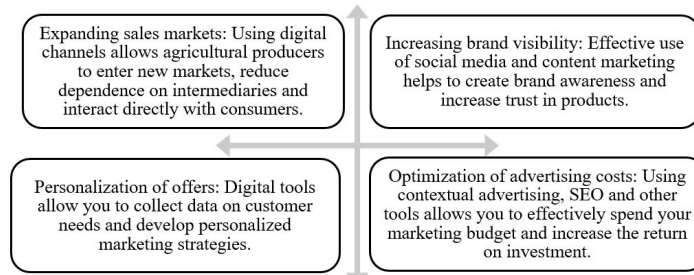
where: $R_{digital}$ and $R_{traditional}$ is farmer income before and after adopting digital technologies, $S_{digital}$ and $S_{traditional}$ is the cost of farmers engagement in digital technologies adoption and non-adoption. This computation helps us to assess the impact of digitalization on the economic performance of farmers, such as their income and operating costs. The effectiveness of the digitalization of the agro-industrial complex in different countries is proved when an integrated solution to management processes promoting production, logistics and sales is in place. This paper profiles three companies – Twiga Foods (Kenya), AgriDigital (Australia) and Farm2Fork (India) – which have effectively incorporated digital platforms into agribusiness models. The analysis was constructed on the methodological base of multiple linear regression model in order to determine

the impact of digital variables on such key economy indicators, as crop yield, logistics costs, conversion rate in digital marketing and generalized ROI. Twiga Foods is a mobile-based platform that provides farmers with an instant timeline of prices on the market, thus reducing intermediary and logistical costs. As part of the results, with the implementation of digital logistics, tensile costs were successfully cut by an average of 22%, for which the coefficient ROI climbed to 175% in two years. AgriDigital is a blockchain-based software company focused on grain supply chain. With the use of digital documentation and smart contracts, transaction processing time was shortened by 40%, accelerating capital turnover and predictability in the supply. The ROI operation indicated 160% and the yield prediction accuracy based on IoT device was improved by 24%. Then, there's India-based platform Farm2Fork which tracks the origination of products and gets digital access to end consumers. Digital conversion flourished at 28% and online sales revenue rose by 19%. Therefore, the results of a quantitative evaluation using the method of regression analysis indicate that systemic digitalization in agribusiness not only optimizes business processes, but even more promotes an economically efficient and market stable operation of enterprises. Certainly, the proposed approach for digital marketing and on-line trading in agriculture involves mathematical models (e.g. calculation of ROI, linear regression and tasks on logistics optimization). The tools presented enable to make estimates of how profitable the activities of agricultural enterprises are, how much energy they consume in normal operation and how efficient they are after they adopt digital technologies. The application of the method will allow increasing the income for farmers and financial sustainability of agroindustrial business.

Results and discussion

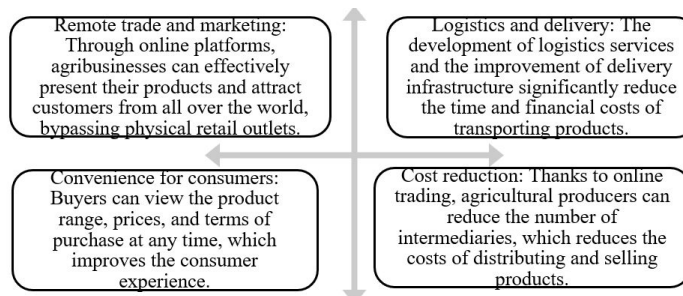
Digital marketing in the agricultural sector involves the use of modern digital channels to promote agricultural products. This may include both traditional online channels (websites, social networks, email) and newer technologies such as artificial intelligence, blockchain and mobile applications. Key goals of digital marketing in agribusiness are presented in Figure 1.

Digital marketing in agribusiness is a set of strategies, tools and technologies aimed at promoting agricultural products and services using digital channels. The structuring of key aspects of online trading in agribusiness of modern companies is presented in Figure 2.



Source: Structured by the author based on data (Bose and Kiran, 2021, KN and Nasution, 2024).

Figure 1: Digital marketing implementation in agribusiness has several key strategic goals.



Source: Structured by the author based on data (Bose and Kiran, 2021, KN and Nasution, 2024).

Figure 2: Global trends in digital marketing and e-commerce development in agribusiness.

This is an important component of the successful functioning of the modern agricultural sector, which allows agricultural producers to increase competitiveness, expand sales markets and improve interaction with end consumers (KN and Nasution, 2024). Definitely, inseparable from digital marketing in the modern world is online trading. This can be both direct interaction with consumers through their own websites, and the use of third-party trading platforms and online markets. Digital marketing and online trading are becoming an integral part of the strategic development of agricultural enterprises, regardless of their scale and geographic location. Taking into account the presented, the author has compiled a classification of modern digital marketing and online trading tools that are implemented in agribusiness to achieve efficiency and manageability of business processes, which is presented in Table 1.

In the context of digital transformation of the agro-industrial complex, a systematic approach to assessing the strategic directions of its development is required. One of the most universal and widely used tools of strategic analysis is SWOT analysis (Strengths, Weaknesses, Opportunities, Threats). The need for a SWOT

analysis is due to the specifics of the agricultural sector, which has traditionally demonstrated a low level of digitalization compared to other industries. Today, digital marketing is becoming an integral element of strategic management of agribusiness: it ensures access to new markets, reduces transaction costs, increases the transparency of supply chains and adapts to changing consumer demand. However, the implementation of digital solutions is associated with a number of barriers: from a lack of technical literacy to a weak infrastructure base and legislative uncertainty. SWOT analysis allows you to identify internal resources and competencies (for example, the possibility of direct sales, the presence of digital platforms and analytics), as well as external opportunities (growing global demand for environmentally friendly products, the development of e-commerce). Along with this, the analysis helps to identify risks and weaknesses, such as limited digital inclusion, a high level of price competition, cyber threats and the institutional unpreparedness of the agricultural sector for technological innovations (Bose and Kiran, 2021). SWOT analysis of digital marketing management and online trading in agriculture is presented in Table 2.

Digital tool	Features of implementation in agribusiness companies
Social Media	Social Media (Facebook, Instagram, Twitter) Social media is also used as a medium for advertisement and interaction with the audience. They let you to launch ad campaigns, promotions and any content that engages customers. Focused marketing gets to the right audience groups, driving up name recognition and generating sales.
SEO (Search Engine Optimization)	SEO involves optimization of a website in order to rank higher in search engines and thereby attract organic web traffic. This includes keyword research, content, technical optimization of the site, and structure to be able to rank higher in search engines without any type of sponsored advertising.
Content Marketing	Content marketing involves the creation and sharing of material to generate interest in a product or service, with an individual's specific attributes and interests at its heart. These could be blog posts, videos, infographics or blogposts that speak to your customer's pain points and solve reader's questions and helps a company establish trust and brand affinity -ultimately leading to loyalty - meanwhile lifting brand reputation.
Email Marketing	Email marketing is the sending of a message to consumers electronically, usually via email. With tailored offers and newsletters on newly launched products or promotions, farmers can keep their customers returning, alerting them to other options for purchase, and easily converting return sales.
PPC Advertising (Contextual Advertising)	What is Pay-Per-Click? It is employed in search engines and social networks to pinpoint the intended user base. This is a useful tool that will help you bring in clients who are looking for product or service.
Influencer Marketing	Influencer marketing is to work with bloggers or opinion leaders to advertise products. They build brand trust, because people see them as authorities or credible sources of information. Farmers can use this strategy to market their produce and increase their consumer base.
Mobile Apps	Agricultural producers can use mobile apps to provide a convenient tool to shop, communicate with customers, place orders, etc. using smart phones. This is an opportunity to drive customer retention, enhance the user experience and increase sales, particularly on mobile.
Analytics and Big Data	It's here that Analytics and Big Data come into play – they aid in gathering data on customer behaviour and market trends. This enables agribusinesses to make the informed choices, give the right direction to marketing campaign and enhance their customer service hence delivering overall efficiency and profitability levels.
E-commerce Platforms	Online software such as Shopify, WooCommerce, etc. allows the creation and management of webstores. They provide payment processing, inventory management and product delivery, enabling agricultural producers to grow online sales and better serve customers.
Marketplaces	Online marketplaces (Amazon, Alibaba) are platforms where merchants offer products for sale. It gives access to broad market and customers worldwide. It is an easy way for agribusiness to gain access to new markets at virtually no cost.
Electronic payment systems	There are a variety of electronic payment systems that allow you to pay online for items and services with ease and security, such as PayPal and Stripe. They enable agribusinesses to deal with customers across the globe – quickly, safely and reliably
Supply chain management systems:	Supply chain management systems help automate and optimize product delivery processes. They allow you to track orders, manage inventory and minimize delays, improving efficiency and increasing customer satisfaction.
Chatbots and artificial intelligence	Chatbots and artificial intelligence allow you to automate communication with customers. Bots can answer frequently asked questions, help with ordering and provide information about products, which increases the speed of service and improves the customer experience.

Source: Structured by the author based on data (Bose and Kiran, 2021, KN and Nasution, 2024).

Table 1: Classification of structuring modern digital marketing and online trading tools that are implemented in agribusiness to achieve efficiency and manageability of business processes of world-class companies

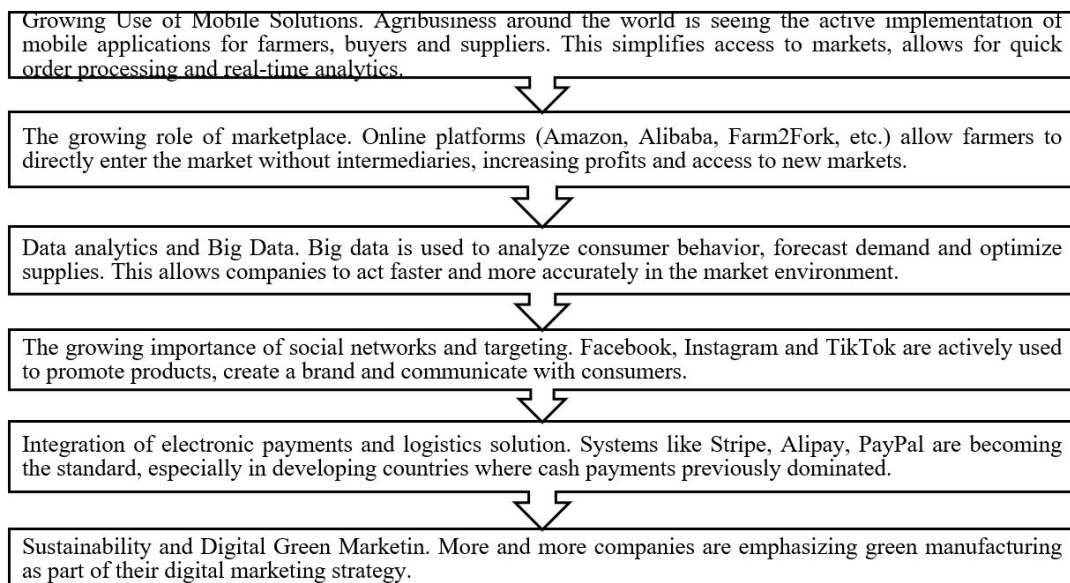
Strengths	Weaknesses
Direct access to consumers via online platforms	Increased supply chain transparency
Limited digital literacy among farmers	Unstable internet coverage in rural areas
Reduced transaction and logistics costs	Increased marketing accuracy through data analysis
High initial investment in digital infrastructure	Lack of standards and digital regulators in the agricultural sector
Opportunities	Threats
Expanding sales markets via global e-commerce platforms	Cyber risks and vulnerability of farmers' data
Integration with IoT and Big Data technologies for crop yield forecasting	Price competition from large networks and aggregators
Flexible direct trade models (D2C – direct to consumer)	Legislation lagging behind digital practices
Growing demand for environmentally transparent products and the possibility of their digital certification	Digital inequality between large and small small producers

Source: Developed by the author

Table 2: SWOT analysis of digital marketing management and online trading in agriculture.

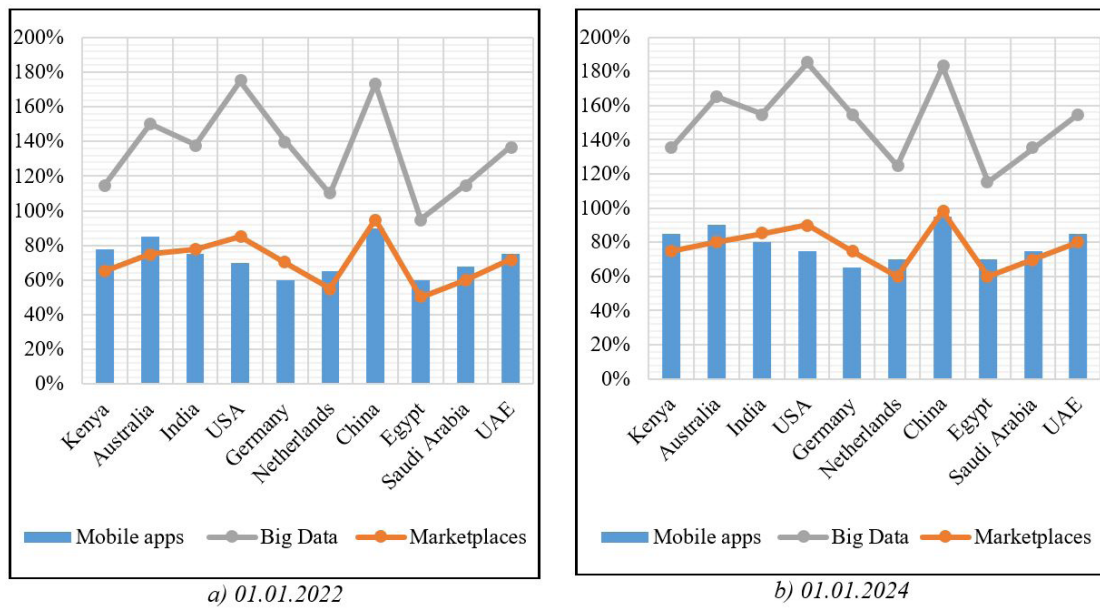
From the above SWOT analysis, it is evident that the successful digital marketing and e-commerce management is an opportunity for the agriculture industry to be transformed. The threats identified, however, need more specific management responses. As the number of cyber risks continues to rise, and data can leak, be tampered with, and online transactions are not equally accessible, the trust of farmers in digital solutions is increasingly undermined. These threats can be mitigated through the use of blockchain-based transaction records, smart contracts, secure digital payment systems and traceability mechanisms. The use of blockchain technology is especially important in agri-supply chains, as it enables tracking of the product's origin, all transactions, delivery conditions and certification data. This way, blockchain decreases the risk of fraud, boosts trust among farmers, intermediaries, retailers and consumers, and facilitates the digital certification of environmentally transparent products. The use of AI-based monitoring systems and Big Data analytics can also help identify suspicious activity in transactions and enhance risk management. The risks described in the SWOT analysis should thus not be interpreted as a reason not to digitalize, but rather as an opportunity to further strengthen the cybersecurity, to shape regulation of institutions more efficiently and provide interesting digital training for farmers (Cochea Tomala, 2022). Conceptual global trends in digital marketing and online trading in agribusiness are presented in Figure 3.

In addition, environmentally oriented digital campaigns are gaining momentum, especially in Europe. These processes contribute to the expansion of sales markets, increased operational efficiency, and increased competition in the global agricultural market (Jouanjean, 2019). Based on the analysis, it is important to note that, firstly, the digitalization of the agricultural sector is accelerating all over the world, including both developed countries and emerging markets. In particular most vibrant is the growth of mobile apps, e-commerce platforms, and Big Data. Facilitate the work of agricultural producers in managing, optimizing logistics, entering new markets and being in direct contact with consumers. Second, the emergence of digital solutions is subject to regional specifics. In Middle Eastern countries, such as the UAE and Saudi Arabia, the digital transformation of the agricultural sector is actively supported at the state level, which facilitates the implementation of high-tech solutions, including artificial intelligence, cloud platforms, and analytical service. Conceptual trends in the development of digital marketing and online trading in agribusiness by country are presented in Figure 4.



Source: Structured by the author based on data (Derenskiy, 2025; Cochea Tomala, 2022)

Figure 3: Conceptual global trends in digital marketing and online trading in agribusiness.



Source: Structured by the author based on data (Markets and Markets, 2023; Deloitte Insights, 2024; Business Wire, 2024; Reuters, 2024)

Figure 4: Conceptual trends in the development of digital marketing and online trading in agribusiness by country in %.

In African countries, the emphasis is on the availability and simplicity of solutions, especially mobile ones, which allow farmers to connect to the market even without computers. Thirdly, social networks and digital advertising are becoming the most important channels of marketing activity. They allow you to establish contact with end consumers, increase transparency and trust in brands. In addition, the environmental component is starting to play an increasingly important role. In general, digital marketing and online trading in agribusiness contribute to increased efficiency, market expansion and sustainable development. With modernization of the global economy as well, agriculture business processes must be transformed. Digital marketing and online trading are becoming part of competitive agribusiness: they enable efficient interaction between the agricultural enterprise and its market, reducing transaction costs associated with contractual arrangements on quantities and price levels, as well as provide diverse sales channels to the agri-enterprise – hence improving resilience towards such global challenges like climate change and supply instability. Old techniques of advertising, and selling products are no longer as effective in the Digital age where consumer engagement is on the rise, digitalization has rapidly evolved and new businesses models have given birth to multiple players in e-commerce. Agricultural enterprises, especially in developing countries, face a number of management problems: the lack of a strategic approach to digital communications,

weak integration of information systems, insufficient staff training and limited access to consumer data. These factors hinder the full use of the potential of digital solutions (Atli, 2024). Studying the process of digital marketing management in agribusiness allows us to identify the most effective tools (e.g. social networks, marketplaces, analytical platforms), as well as develop models for adapting agricultural enterprises to the digital environment. In addition, the study contributes to the formation of scientifically based recommendations for the development of e-commerce in agriculture and support for sustainable supply chains. Thus, the need for such a study is due to both the economic feasibility and the social significance of the digital transformation of the agricultural sector. Its results can be applied not only in theory, but also in practice - to form development strategies for agricultural companies, increase the export potential and sustainability of agriculture in the global digital economy (Şalvarlı, 2023). To implement the described approaches and methodology for studying the process of digital marketing and e-commerce management in agriculture with argumentation of practical cases and trends, official data from companies such as Twiga Foods (Kenya), AgriDigital (Australia), and Farm2Fork (India) were used as an information base. Based on the data from the presented companies, key metrics and models were used to calculate the economic efficiency of implementing digital technologies in agribusiness, including

ROI, yield forecasting, analysis of logistics costs and conversions. The key results of the economic efficiency of applying digital technologies in agribusiness are presented in Table 3, including the ROI, yield forecasting, logistics-cost dynamics and online conversion. It is important to note that two types of information are presented in the table. The first set of empirical indicators – such as number of users, revenue, implementation costs and platform characteristics – was obtained from open company-related sources and publicly available case materials. Second, the authors re-calculated the systematics and formulas presented in the Materials and Methods section to calculate ROI, reduction in logistics costs, interpretation of conversions, demand elasticity and socio-economic impact. The information provided in Table 3 should thus not be regarded as a mere copy / reprint of company reporting information, but as an analysis / synthesis of secondary company information and calculations by the author.

Clearly, digitalization of the agricultural sector and online trading play a key role in increasing the efficiency of agriculture and ensuring sustainable growth in the context of globalization of the market. The introduction of digital technologies, such as online trading platforms, analytical tools for yield forecasting and supply chain optimization, is an important step to increase the profitability of farms and agricultural companies. One of the most important factors that justifies the need to implement digital technologies is cost

effectiveness. As the ROI (return on investment) calculations for Twiga Foods, AgriDigital and Farm2Fork show, all these companies have a significant positive result, which confirms that investments in the digitalization of agricultural enterprises are justified. Twiga Foods with an ROI of 12.33, which means that every dollar invested in digitalization brought in \$ 12.33 in profit. This demonstrates that, with respect to the selected online trading strategy (sidestepping middlemen, minimizing logistics costs and facilitating farmers access to markets), its carbon efficiency level must be distinctly high. AgriDigital at 9.00 also validates the success these kinds of digital solutions, be it supply chain managing and online payment, can provide. The efficiency of these technologies has made it possible to significantly reduce logistics costs and increase the profitability of farms. Farm2Fork also demonstrated a high ROI 9.00, confirming that direct sales models using digital platforms are viable and cost-effective for agribusinesses. Clearly, digitalization allows for a significant increase in crop yields due to more accurate planning and forecasting, as well as improved logistics. Logistic processes can also be optimized and supply chains can be enhanced using digital platforms which can lead to a considerable reduction of transportation as well as provision costs. Digital platforms drive conversion and customer engagement resulting in increased sales and better financials. Agribusiness digitalization contributes to the state

Key metrics	Companies		
	Twiga Foods (Kenya)	AgriDigital (Australia)	Farm2Fork (India)
Technology type	Online platform for connecting farmers with buyers	Supply chain management and payment platform	Direct sales platform from farmers to consumers
Number of users (years)	10.000 farmers, 25.000 retail outlets	4.000 farmers and 1.000 agribusinesses	5.000 farmers, 100.000 consumers
Digitalization revenue	\$40 million	\$100 million	\$15 million
Technology implementation costs	\$3 million (investments in platform and marketing)	\$10 million (platform development and integration)	\$1.5 million (development and launch)
ROI	12.33	9.00	9.00
Predicted yield (modeling)	Increase in yield by 15% (according to analytics)	Increase in yield by 10% through improved logistics	Increase in yield by 20% (according to analytics)
Logistics costs (before and after implementation)	Before: \$1.5 million, After: \$0.8 million (47% decrease)	Before: \$3 million, After: \$2 million (33% decrease)	Before: \$0.5 million, After: \$0.3 million (40% decrease)
Online trading conversion (%)	10% (on Twiga Foods platform)	12% (on AgriDigital platform)	15% (on Farm2Fork platform)
Demand elasticity	2.00	3.00	2.50
Socio-economic impact	Increase in farmers' income by 25%	Reduce costs by 20%, increase in farmers' income by 15%	Increase in farmers' income by 30%, decrease in crop losses by 10%

Source: Structured and data-driven calculation (TechTrendsKE, 2022; FinTech Australia, 2022; Farms2Fork Technologies Pvt Ltd., 2023)

Table 3: Key results of calculating the economic efficiency of implementing digital technologies in agribusiness of key companies in the world.

of socio-economics of farmers and the rural side, so that it raises revenue of the community and lowers the degree of product perishable. Meanwhile, the findings that have been achieved must be considered carefully for their transferability. Twiga Foods, AgriDigital and Farm2Fork are examples of successful models, which have relatively mature digital infrastructure, investment capacity and organizational maturity. However, the typical small-scale farmers face a different set of circumstances such as poor bandwidth connectivity and lack of digital literacy, poor financial resources, relying on middle men and no experience in digital marketing. Hence, the findings of the analyzed cases can't be directly applied to all agricultural producers without adaptation. Digital transformation first for small farms is low-cost, scalable application of technology and tools like mobile apps, social media promotion, digital payment platforms, local online marketplaces and cooperative logistics platforms. Public policy, agricultural extension services and local business associations should assist this process by providing training, subsidizing use of digital infrastructure, and providing collective digital platforms and/or advisory services. For this reason, the cases examined in this study cannot be taken as models for immediate adaptation, but rather as strategic examples of the possible economic impacts that can be achieved through the use of digital tools that are adapted to the real capacities of SMEs in the agricultural sector.

Conclusion

The conclusions of this research point to digital marketing and online trade as two necessary aspects that are becoming equally determinant for the change from traditional agriculture toward a technology-one oriented, productive activity; and sustainable. What quantitative methods such as the linear regression analysis helped to quantify the influence of digital tools on crop yields, logistics cost and return on investment (ROI), expanding findings beyond prior research, which was mostly based on qualitative evaluations. A study of real cases, which include Twiga Foods, AgriDigital and Farm2Fork, illustrated a significant diversity of digitalization strategies that were driven by the regional infrastructure, institutional maturity and market circumstances. Although these three cases differ in scale, market scope and target audiences, all of them showed an increase in terms of ROI and cost per transaction, showing how is possible for digital solutions to adapt themselves

to very broad logistics chains as well as for local direct-sales systems. But the research also pointed out areas of weakness. Meanwhile the bricks and mortar of digital environments are often missing: too many farmers have limited access to the most basic tools. Tackling these challenges are vital for integrating digital marketing and e-commerce into agricultural business models in an efficient way. Theoretically, our work also contributes to the study of agricultural digitalization not just as a process of IT adoption but as an aspect of strategic marketing management. The practical applications of these results relate to the implementation regional programmed for agrifood digitalisation and in devising agroindustry marketing strategies (Hennessey, 2020; FAO, 2021; Baker and Smith, 2020). In a global context that is characterized by globalized markets, increased demand for food and climate challenges, digitalization is emerging as an important factor in agribusiness efficiency. Pressure to address these demands is growing, and traditional agricultural systems are no longer sufficient. In particular, digital marketing and e-commerce can be used for more efficient management of resources, logistics optimization, market extension as well as competition improvement. The spread of COVID -19 has hastened the uptake of e-commerce and digital forms of communication, indicating that companies not involved with these technologies are more vulnerable (Bose and Kiran, 2021; KN and Nasution, 2024). A unique characteristic of this research is that it deals with the strategic factor in digital marketing and e-trade in agriculture, compared to countries. The cases studied show how different strategies are taken, depending on regional atmosphere, market structure and institutional support. For example, Twiga Foods in Kenya connects smallholder farmers to urban consumers using mobile-based marketplaces successfully and AgriDigital in Australia is into grain trading with digital platforms and Farm2Fork in India specializes in direct farm-to-consumer sales (AgriDigital, 2022; Mishra, 2021; Tech Trends KE, 2022). These cases demonstrate that digital solutions help wherever you use them, driving lower transaction costs, better customer interaction and more efficient operations. The research confirms a number of the hypotheses explaining digitization in agriculture. First, use of online marketing and e-commerce systems will lower dependence on intermediaries, improve logistics and increase profits (H1). Second, the adoption of technologies,

Big Data IoT and AI fosters production efficiency and product quality, thereby resulting in the reduction of operational costs (H2). Third, digitization enables the growth of small and medium-sized farms by linking them to larger supply chains and making these smaller entities competitive (H3). Lastly, differences in digital infrastructure and technology access between large agribusinesses and smallholders continue to act as primary barriers for general digital uptake (H4) (McKinsey and Company, 2020; Al-Ababneh et al., 2023; Katragadda, 2024). From the practical perspective, implications bring useful guidance to agriculture companies and policy makers and other industry players. Enterprises can leverage the intelligence to devise digital marketing schemes, grow their market share, break away from traditional sales channels and enhance customer satisfaction.” Policymakers can use the findings to guide regional digitalization projects, education policy and small and medium-sized enterprise support. Furthermore, the learning of successful international practices can facilitate the importation of digital solutions in less digitally mature geographies and help to fill knowledge gaps in these areas (Jouanjean, 2019; Ravi and Rajasekaran, 2023). Limitations of the study Although its positive results, there are a number of limitations to our study. First, digitalization rates differ substantially among countries, accessibility to high-speed internet and e-commerce infrastructure, and digital literacy are scarce in developing areas so that the generalizability of our findings to those parts of the world is less clear. Second, the sample relies on a handful of successful examples coming from relatively mature digital ecosystem(s) and not necessarily reflecting global conditions. Third, most of the accepted theories are based on short-term economic implications (i.e., profit integration and consumer commitment), but little is known about long-term implications - such as sustainability consequences, production executions or socio-economic dynamics (Derenskiy 2025; Cochea Tomala 2022). Further studies should generalize this work for low digital maturity countries and regions by testing possibilities

of adapting digital marketing and e-commerce tools to SMEs (smallholder and medium-scale) efficiency. It will be essential to examine public and private initiatives including infrastructure, training programs, and institutional arrangements that facilitate digital adoption. Furthermore, extended observations might consider more general effects of digitalization on sustainable development, labour, and environmental governance. Risk perception, data security and automation contribution in agricultural employment could be another promising research line (Al-Ababneh et al., 2025; Şalvarlı, 2023). In summary, digital marketing and e-commerce have been important tools for better competitiveness; efficiency and sustainability of agriculture. The study points to the necessity of national wide digitalization strategies, supported by institution that are internationally informed but also adapted into local frameworks. Agri-businesses consolidating strategic management and technologies, can realize significant economic benefits combined with operational efficiencies that may extend beyond individual firms; while their counterparts’ policymakers and educators can help secure inclusive adoption to support the sustainable development of the sector (Markets and Markets, 2023; Deloitte Insights, 2024; Business Wire, 2024; Reuters, 2024; Atli, 2024). This constraint is particularly relevant as the companies analysed are examples of successful and relatively mature digital transformation. This can be quite different for typical small-scale farmers because they have lower investment potential, less infrastructure and less computer literacy. Based on this, further study is needed on a larger number of small and medium-sized farms and should explore the economic impacts of low-cost digital tools in resource-limited environments. The study also indicates that digital marketing is not only a method of communication, but also a managerial mechanism involving analytics, logistics coordination, customer communication and digital trade infrastructure in the modern agribusiness ecosystems.

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