Analysing the Impact of Digital Marketplaces on Farmer Livelihoods

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Abstract:

The rise of e-commerce and advent of digital marketplaces has revolutionised the agriculture sector, offering farmers new avenues for market access, information exchange and financial transactions. This research delves into this transformational influence of digital marketplaces on farmer's livelihoods, aiming to provide a comprehensive understanding of opportunities and challenges they present. Drawing on a combination of qualitative and quantitative research methods, the study examines the socioeconomic implications of digital marketplaces for farmers across diverse geographical and socioeconomic contexts. Furthermore, the research investigates the role of smart logistic systems contributing to success of agro-based digital marketplaces and the role of digital literacy, infrastructure and institutional support in mediating the impact of digital marketplaces on livelihoods of small holder farmers. Adding further into the bucket, this research assesses the broader implications of digitalization in agriculture, including its effects on market dynamics, value chains, and rural

development. It explores potential risks involved dealing with perishable goods while also exploring strategies to mitigate these challenges and maximize the benefits for smallholder farmers.

1. Introduction:

1.1 Background and Context

The advent of technology has opened new doors of opportunities and challenges for businesses across the globe. New business models have come to being by identifying new set of market levers. Within this context, digital marketplaces have emerged as transformative agents which are aiding in reshaping agricultural landscape and livelihoods of millions of farmers worldwide.

In many developing countries, Agriculture remains to be the main contributing sector towards economy. For example, 17 % of combined African Gross Domestic Product (GDP) and 40 % of total exports stems up from agriculture [1]. Though the massive contribution towards economy, most of the farmers who are the backbone of this entire industry remain to be extremely poor living in rural areas and earning almost less than a dollar a day. Establishment of digital marketplaces brings greater transparency in entire purchasing process and continue to expand market opportunities for farmers.

Due to a range of intermediaries in supply chain of agriculture products who commonly known as the middleman, the farmers remain to be disadvantaged because of the extremely low prices they receive in lieu of their hard work. Moreover, several digital marketplaces exist for agriculture products, distribution of agriculture products is still a commonly faced problem because of it being perishable goods requiring faster delivery cycles which increases

the cost of delivery resulting in lower to none profit margins. It is prime time for agriculture sector to review the mechanism of operating these digital marketplaces to market and sell by incorporating a business use case which is beneficial for all stakeholders involved.

1.2 Research Objectives

The primary objective of this study is to analyse the impact of digital marketplaces instead of conventional marketplace mechanisms on livelihoods of smallholder farmers with a focus on understanding process improvement, technology infusion, market access, and robust mechanism. To be more specific, the research objective are as follows:

a. Examine socio-economic profiling of farmers in digital marketplaces, including demographic characteristics, farming practises, and level of digital literacy.

b. To investigate the role of digital platforms in facilitating market access and participation for farmers, exploring factors such as geographical reach, product diversity, and price transparency.

c. To evaluate the risks and challenges associated with digitalization in agriculture, including issues related to data privacy, third party logistical services, market concentration, and digital divide.

d. Provide evidence-based recommendations in form of a proposed model for policymakers, development practitioners, and stakeholders aimed at fostering inclusive and sustainable smart agriculture practices.

1.3 Scope and Methodology

The research is supported by two qualitative methods. The primary one is literature review, followed by cross cross-case analysis.

Qualitative method: Literature Review

The literature review within this research lays a very robust foundation for understanding the intricate relationship dynamics between digital marketplaces and livelihoods of farmers. It offers a thorough examination of previous research, theoretical frameworks, and empirical evidence, drawing from a diverse array of peer-reviewed articles, academic journals, and scholarly sources.

It analyses different business models like B2B and B2C within the framework of digital marketplace and synresearch pivotal findings and identifies potential knowledge gaps. It also highlights the role of data analytics and artificial intelligence in further enhancing the capabilities of such marketplaces while enhancing customer experience. It underscores how technology intervention can improve decision making processes for farmers, optimise resource allocation, and provide greater market participation opportunities while mitigating market associated risks.

In recent years, there has been much discussion about socio-economic implications of these marketplaces especially on marginalised communities, especially in terms of gender dynamics. Understanding how these marketplaces intersect with broader societal challenges can offer more valuable insights regarding how to design more sustainable and equitable policies in the future.

An interesting area of inquiry within the literature review revolves around investigating the sustainability of digital marketplaces in agriculture. It investigates how these platforms can promote sustainable farming practices, reduce carbon footprints, and make use of fintech to operate contracts for supply chain management and logistics. Data privacy and ethical considerations have

also been made part of this literature review to further understand the potential imbalance between farmers and platform providers.

Furthermore, it provides insights into the emerging trends, challenges, and opportunities in the field of digital agriculture in form of SWOT analysis, informing the research questions and guiding the interpretation of empirical findings. Most importantly, it sets the stage for the cross-case analysis by offering a theoretical lens through which to interpret the qualitative data gathered from multiple case studies and sources.

Qualitative method: Cross-Case Analysis

Within the cross-case analysis, Case 1 offers a comprehensive examination of digital marketplaces operating within African context, while Case 2 scrutinizes their counterparts in European Union. By analysing these two different regions aids in understanding the differences, similarities, and underlying factors especially the interactions between the farmers and digital marketplaces.

Case 1 delves deeper into the challenges and opportunities inherent in African digital marketplaces, highlighting issues such as lack of infrastructure, varied levels of digital literacy across the continent and the prevalence of informal economy. It seeks to understand how these marketplaces can exist and contribute to improving the livelihoods of farmers amidst these challenges.

On the other hand, Case 2 explores the regulatory frameworks adopted in EU, the technological advancements and market dynamics that drive digital marketplaces. Access to venture capital funding and evolving consumer preferences has also been analysed.

Through a comparative lens, the cross-case analysis serves to provide deeper insights into the efficacy of digital marketplaces for the livelihoods of the farmers

while offering more actionable insights, informing policy interventions, and guiding future research endeavours in dynamic filed of digital agriculture.

2. Literature Review

2.1 Definition of Digital Marketplace

A digital marketplace is an online platform or website where goods or services are bought, sold, or exchanged electronically. It serves as virtual marketplace facilitating transactions among the buyers and sellers while leveraging technology such as internet [2]. One of the key features of digital marketplaces is its accommodation of multiple sellers offering their product or service to multiple buyers at the same time. It promotes competition and provides choices to consumers for more informed decision making.

2.2 Evolution of Digital Marketplaces in Agriculture

Digital marketplaces in agriculture have undergone significant evolution over the past few decades, mainly driven by technological advancements in technology, changing consumer behaviours, and the need for more efficient agriculture practices for growing global population.

According to Harvard Business Review, many benefits of digitalisation in agriculture business were realised early on including market transparency and reduction in transaction costs [3]. From a historical perspective, the first digital marketplaces emerged with the advent of the internet, primarily serving as online classified to connect farmers with buyers and sellers of agriculture commodities. Such platforms included Agri-Bazaar (India), Agrisource (USA), and FarmMatch (Global) were early market entrants offering a transactional facilitation [4]. As ecommerce industry grew, digital marketplaces evolved to enable online transactions, offering more advanced

features like online ordering, one-tap payment processing, and 10 min delivery in B2C model of operations. Companies like FarmDrop (UK), Agroo (Brazil) and AgriWebb (Australia) leveraged out these technologies greatly for streamlining the process of buying and selling [5]. By 2000, one in 25 US farms had bought or sold agricultural products on the internet.

With the recent data and AI boom, digital marketplaces are further evolving as these platforms are now utilising data-driven insights to optimise the supply chains, improve decision making processes, and enhancing agriculture productivity than just being trading or order fulfilment platforms. Startups like AgUnity and many others are leveraging out the capabilities of data analytics to provide farmers with valuable information on crop yields, market trends and best agronomic practices based on geographical locations of farming lands [6].

In future, these agricultural marketplaces will become part of broader ecosystems where it will merge at the crossroads of other cutting-edge technologies like IoT (Internet of Things), blockchain, and precision agriculture. These integrated platforms will be one door solution for farmers offering a complete set of solutions for farm management, crop monitoring, effective traceability, and transparency in agriculture supply chain.

2.3 Theoretical Frameworks for Analysing Farmer Livelihoods

Understanding how impactful digital marketplaces are on farmer's livelihoods necessitates a comprehensive theoretical framework that could help us understand the inherent dynamics that shape up agronomics and eventually impact livelihoods of farmers. In this section, some of these theoretical frameworks are explored that provide insights into how digital marketplaces influence economic, social, and environmental well-being.

2.3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), proposed by Davis, offers a valuable lens for understanding the adoption and use of digital technologies by farmers. According to TAM, individuals' intention to use a technology is influenced by their perceived usefulness and perceived ease of use. In the context of digital marketplaces, farmers' decisions to adopt these platforms are likely to be influenced by their perceptions of the benefits they offer in terms of improving market access, increasing efficiency, and reducing transaction costs [7].

Consider a case where farmers are living in a rural based community have access to mobile based market information application providing them with real-time updates on market prices, weather forecasts and modern agriculture practices. According to this theory, the farmers in this rural area, who perceive this app as useful are more likely to adopt it as they recognise its impact on decision making process. Furthermore, if this app has been designed with right customer journey map (CJM) and farmers as main users, it will be easier for them to navigate, further increasing the adoption rate.

2.3.2 Value Chain Analysis

Agriculture value chain analysis is another useful theoretical framework for analysing farmer’s livelihoods. It provides a very structured framework for examining various stages and interactions happening at various stages of production and distribution of agriculture goods. By now, we know the fundamental utility of digital marketplaces in providing greater market access, improving information transparency, and minimising transactional cost structures [8], [9]. With the lens of value chain analysis, researchers try to understand how income distribution and overall functioning of agriculture value chains impact the lives of farmers and the overall impact on the market structures.

Let's consider a traditional value chain where farmers sell their products to intermediaries, such as wholesalers or brokers because either farmer do not have access to proper information of prices they can retail at urban centres or do not have logistical cost-bearing capabilities to transport it for better gains. With the high uncertainty on whether they will be able to sell it off if they take it to urban centres, they prefer to averse the risk and sell it off to brokers. The broker will buy in bulk and then act as a distributor to retailers or even direct to customers at a higher price while keeping his margin. This model is called arbitrage. In the case of digital marketplaces, farmers can bypass intermediaries and sell directly to customers or retailers either with B2B or B2C business model which means they would be able to retain the high fraction of cost being transferred to intermediaries in this value chain. It will help farmers to gain higher return of investments for their yields which will greatly impact the livelihoods and their incomes.

2.4 Impact of Third-Party Logistics (3PLs) on Digital Marketplaces

2.4.1 Contributions of 3 PLs:

Third-party logistics (3PL) providers play an extremely effective role in shaping efficiency of digital marketplaces. One of the major contributions of 3PL's is enhanced distribution and fulfilment capabilities for warehousing, inventory management and order fulfilment. This enables to streamline logistical operations and ensure orders are delivered to customers in timely manner [10]. It is very important for digital marketplaces to leverage out 3PL's expertise to overcome logistical problems as most of agricultural products are perishable items requiring shorter farm to customer timeframe. As the season cultivation comes to an end, a farmer uses 3PL service to transport the produce to 3PL provider's fulfilment centre and as customer places an order, it pick, pack, and ship the products efficiently.

This system integration in digital marketplaces allows farmers to have a broader market reach, even reaching out for remote and underserved areas [11]. Furthermore, it allows digital marketplace operators to scale up their operations, bring greater visibility to the supply chain, and allow platform to serve multiple regions which means having more customer acquisition due to 3PLs [12]. Instead of investing in reinventing the wheel itself, digital marketplaces can avoid massive, fixed costs for infrastructure set up and other arbitrary costs.

Amazon, a prominent digital marketplace, exemplifies the impact of third-party logistics (3PL) services on market expansion and operational efficiency. Through its comprehensive suite of 3PL offerings, Amazon empowers brands and individual sellers to streamline their logistics operations and scale their businesses more effectively [13]. Amazon's 3PL services not only relieve sellers of the burdensome logistics tasks but also provide access to a vast infrastructure network. This infrastructure includes pre-determined route lanes and middle-mile network management, which optimize delivery routes for cost efficiency while meeting delivery estimate targets (DEA).

Moreover, Amazon's sophisticated logistics infrastructure, including pre-determined route lanes and middle-mile network management, ensures timely and cost-effective delivery of products to customers. By tapping into Amazon's vast distribution network, sellers can reach customers across diverse geographical locations, expanding their market reach and driving sales growth.

2.4.2 Challenges and Considerations:

While partnering out with 3PLs offer a unique set of benefits, digital marketplaces should remain fully aware of the risks associated with complete dependency on external service providers [14]. Outsourcing this critical function can cause quality control issues and lack of customisation for example packaging in a specific logo-printed bag for agriculture goods. Another significant challenge is

service quality consistency and cost transparency. Maintaining consistent service quality with 3PL partners can be challenging as industry 4.0 is transitioning towards decentralised logistics networks. There is need to establish performance metrics and robust service level agreements (SLAs) between both parties to develop an effective mechanism for operations [15].

Lack of transparency for determining costing structures for deliveries remain to be another significant challenge. Therefore, effective cost management through digital marketplaces that needs to be strategized to maximise profits and to be competitive as an alternative solution for farmers in this vertical. To deal with these challenges, some 3PL service providers are offering fixed cost per region per package for delivery time which is a enhances customer experience.

2.4.3 Future Centric Approach: 4PL and 5PL Integration

While 3PL provides a great lever for digital marketplaces, 4 PL and 5 PLs have erupted as a complete solution with more customer centric approach. 4 PL providers excel at integrating various service providers altogether on behalf of the customers enabling further optimisation of entire logistical part of supply chain while allowing centralised management [10]. It allows digital marketplace operators to focus on other core business activities for example marketing, sales, and farmer literacy for customer acquisition. The significant challenge faced is supply chain dependency on 4PL service provider and any disruptions can lead to poor customer experience. Moreover, in comparison to 3PLs, 4PLs are comparatively expensive as a service provider which can reduce profitability for digital marketplaces and farmers altogether [16].

On the other hand, 5 PL service providers have also erupted in this vertical. They offer consulting services, leveraging advanced data analytics and machine learning modelling to optimise supply chain management. It allows competing digital marketplaces to have more strategic insights to anticipate future trends

while identifying growth opportunities for more informed business decision making [17]. This process improvement through data driven approach, allows digital marketplaces to pass on these insights to farmers which can impact their harvest decisions greatly. Furthermore, it all adds up into better customer trust and loyalty which can allow digital marketplaces in agriculture to be more competitive. The significant with dealing with 5 PL is lack of digital literacy for farmers and higher incurred cost for farmer education programs for adapting to new technologies and processes.

Moreover, both 4 PL and 5 PL offer unique set of opportunities to take advantage of by digital marketplaces, but proper research and cost benefit analysis should be conducted before taking investment decisions to integrate one of these services.

2.5 Business Models for Agro-Based Digital Marketplaces

2.5.1 Business to Business (B2B)

In B2B model, a digital marketplace allows multiple stakeholders like farmers, distributors, wholesalers, investors, importers, exporters, and other stakeholders who are usually part of traditional value chain to interact and procure not only the produce but also agricultural inputs like seeds and fertilisers and machinery.

2.5.2 Direct-to-Consumer (D2C):

Under D2C, agro-based digital marketplaces act as intermediaries, enabling farmers to sell directly to end customers without the hassle of middlemen. The main benefit of this model is gaining higher price realisation for their produce which gets distributed among many stakeholders in the traditional supply chain of wholesalers and distributors. From customer's perspective, it provides them

with fresher produce at more fair prices. The significant challenge in implementing this business model for digital marketplaces is that it requires robust logistical operations especially effective last mile delivery network operations and capacity management. It is a great potential enabler for smallholder farmers by increasing their bargaining power and reducing dependency on intermediaries. However, challenges in respect to logistic optimisation and technology adoption remain areas of concern [3].

This business model allows digital marketplaces to perform consumer behaviour analysis by incorporating analytical tools to do customer segmentation and predictive modelling for obtaining insights related to purchasing patterns and specific product demand. This information is critical in developing effective marketing strategies and automated pricing mechanisms [18], [19].

2.5.3 Subscription-Based:

In subscription-based model, consumers can subscribe to regular deliveries of fresh market produce from farmers through enabler such as digital marketplace itself to be delivered on daily, weekly, or monthly basis. The primary benefit to farmers is steady source of income stream and predictable demand. It also allows farmers in building build long term relationships with customer's fostering brand loyalty. From a digital marketplace perspective, this model can often be challenging to offer consistent product quality checks along with the challenges faced in establishing minimum order value to be profitable. Amidst these certain challenges, subscription-based models for agro-based digital markets are gaining significant popularity mainly driven by changing consumer preferences towards organic and fresh produce and rising sustainability concerns [20].

2.6 Digital Disruption: Fintech Solutions

2.6.1 Role of Fintech

Fintech solutions have emerged as a key enabler for success of digital marketplaces by facilitating digital transactions offering quick and secure payment solutions, reducing the risks associated with carrying large sums of cash [17]. Not only this greatly contribute to financial inclusion of farmers in the ecosystem but also leads to more transparency as this sector largely falls in informal channel of economy in many developing countries. These solutions allow farmers to build credit history which paves the way for future financial opportunities and investments for farmers.

Along with credit, many fintech service providers for this vertical are offering insurance products to farmers. These insurance products include index-based crop insurance, to mitigate risks associated with unpredictable weather patterns and crop failures [5]. It greatly serves subsistence farmers whose main livelihoods are dependant on their crop yields every year and use it to barter against other goods of life. Therefore, these fintech providers allow farmers to mitigate crop production risks and improves productivity.

2.6.2 Benefits of Fintech Integration

Many Fintech solution providers are using credit scoring models to assess credit worthiness of farmers based on geographical crop yields, previous transaction history and general market trends. It allows farmers to have access to working capital needs that can be employed in purchasing inputs to farming operations like seeds, fertilizers, and equipment. Another key benefit is fintech-enabled marketplaces provide predictive analytics tools which allows farmers in making more informed decision making. It allows farmers to predict demand and forecasted price of a particular agricultural commodity and optimal planting and

harvesting cycle times based on historical data. It allows farmers to reduce waste and optimise waste and increase in profitability.

2.6.3 Challenges and Considerations

Despite fintech being advantageous, it has a slower adoption curve especially in underdeveloped and developing countries where digital literacy is lower than global average. Moreover, many smallholder farmers lack the skills and knowledge to use these fintech solutions to their advantage. Initiatives such as providing effective digital literacy and internet access especially in far-fetched rural areas can help mitigate these barriers.

Another skeptism usually raised by digital platforms is data privacy and security concerns. Sensitive data like financial records and personal data of farmers are at risk of cyber threats. There is need to measure these risks of such attacks proactively and develop automated firewalls to mitigate these risks.

3. Cross-Case Analysis

3.1 Introduction:

The purpose of this cross-case analysis is to cross-examine the role and impact of digital marketplaces in two distinct regions: Africa and European Union. The central objective is to understand the similarities, differences and factors that greatly influence the interactions between the farmers and the digital marketplaces.

3.2 Case One: Digital Marketplaces in Africa

In Africa, digital marketplaces present unique set of opportunities and challenges. The main challenges include inadequate infrastructure, varying levels of digital literacy, and a predominant informal economy. Though with these challenges in place, digital agriculture is on rise in Africa mainly driven by innovative

platforms and rising acceptability to technology. For example, many startups have erupted like Agrikore which have incorporated blockchain technology to provide smart contracts, access to digital payments, and other marketplace services benefitting 15 million farmers and creating 21,400 jobs by incorporating customer feedback and building trust and loyalty. These platforms have also led to 32 % increase the incomes of the farmers [21]. Majority of farmers and thus farming activities happen in rural areas and startups like Agrocenta are connecting rural farmers with buyers which is a key enabler for the farmers helping them to secure 25 % higher prices for their produce by simply cutting off the middleman aiding them to retain their profits.

South Africa's digital transformation journey in agriculture journey is noteworthy due to it strong infrastructure and ease of doing business policies. It identifies promising technologies such as low-energy devices, mobile applications and AI which are greatly fostering advancements in agrifood systems.

3.3 Case Two: Digital Marketplaces in EU

On the contrary, the European Union has been a melting pot of innovation, regulatory frameworks, and robust market dynamics that supports digital agriculture marketplaces to coexist. This region has been exposed to a massive venture capital and seed founding opportunities along with evolving consumer preferences towards more eco-friendly and organic food. Major tech houses like Microsoft and IBM are on the forefront of innovation providing AI-driven solutions for precision farming technologies and cloud-based solutions for leading digital marketplaces in the region [22].

Furthermore, the EU regulatory framework and awareness towards consumer rights ensures that the these platforms adhere to highest standards ensuring safety, quality and traceability of supply chain. The framework creates an environment

that is more conducive towards investment and innovation for agriculture technologies.

3.4 Comparative Lens

From technological adoption point of view, both regions have leveraged out modern technologies to their advantage, but EU's far more developed infrastructure alongside with tighter regulatory framework is a key enabler for higher rate of adoption and integration of these technologies inside digital marketplaces.

In terms of market dynamics, African markets are more characterised by grassroot innovation which is mainly driven by the necessity and mobile-based technologies while in EU, the main market driving force is consumer demand driven alongside regulatory framework.

Furthermore, digital agriculture in Africa is significantly boosting farmer's incomes and hence their livelihoods which is aiding in reducing the significant economic disparities. In contrast, EU's is more focused towards optimising supply chain efficiency and incorporating sustainability measures in established markets.

Africa faces the challenges of digital literacy which usually leads to higher customer acquisition associated costs while the challenges in EU are saturation risks for growth for digital marketplaces in agriculture.

4. Proposed Model for Digital Agriculture Marketplaces

To enhance the efficiency and efficacy of agricultural markets, a comprehensive model is proposed which can easily be integrated inside digital marketplaces to offer the most innovative features. It can not only aid farmers in gaining access to financial products like decentralised finance (DeFi) but will also help in achieving operational excellence for farming practises that can yield better

returns. The model aims to incorporate advanced fintech solutions, a mix of B2B and B2C platforms, automated pricing mechanisms, and other useful features which will create a robust ecosystem for digital agriculture of the future.

4.1 Asset Liquidation and Financial Intermediary Service

Farmers should be given the opportunity inside digital marketplaces to liquidate their agricultural assets in exchange for capital gains. This feature is beneficial during off-season periods and when farmers face lack of capital inputs for next cropping season. Moreover, fintech innovations like micro loans and insurance should be incorporated for the farmers. In this model, the digital marketplace would act as a liquidity pool provider between the other financial institutions such as banks and farmers.

4.2 Integrated B2B and B2C

Most platforms prefer to either to work on with B2B or B2C model, but to be fully customer centric for the future, the proposed model for the platform is offer both services together. The B2B marketplace would be an auctioning instrument where businesses can bid on bulk quantities of agriculture produce, ensuring farmers more competitive prices. The auctioning will be divided into two forms: pre-harvest and post-harvest. In pre-harvest bidding, businesses can purchase the output of a particular farm at a more competitive price than post-harvest while also serving as a risk-aversion strategy for farmers. Businesses will have access to market trends and models to make these decisions.

For the B2C part of the marketplace, farmers would be able to sell directly to consumers and local marketplace owners, expanding market reach to local and regional markets while maximising their profits.

4.3 Selling Priorities

Farmers should be able to select areas and regions to prioritize for selling based on demand, proximity and other preferences which will give them greater control over their sales strategy. For example, crop X brings better profits in Market X as compared to Market Y, farmers should be able to prioritise sale in Market X over Y to profit maximisation.

4.4 Sixth-Party Logistics (6 PL)

Our comprehensive model benefits the farmers by providing a complete logistical solution combining consulting services stemming from 5 PLs and multiple logistical providers to provide the most cost-efficient capacity management and transportation of agriculture goods.

4.5 Farmer-Customer Matching

Our model incorporates algorithm matching using data analytics and AI to match farmers with potential buyers based on customer profiles, quality metrics, and other critical factors to optimise market reach.

4.6 Automated Prices

In ever-changing market conditions, farmers should be not at any kind of disadvantage. Therefore, we are proposing automated pricing mechanism which will mainly be AI-driven to adjust prices based on several market factors such as demand, supply, and macroeconomic indicators. For farmer protection, floor price of any agriculture commodity can be set.

4.7 Marketing Campaigns

Farmers can create and manage digital marketing campaigns targeting specific areas and demographics. It will help them build a brand recognition and increase sales [6], [23].

4.8 Unitary Selling and Product Grading

Farmers can also participate in unitary selling program. For example, there are there are 14 sellers selling the same agriculture product as wheat with the same quality grade label A. Instead of finding the buyer, they can enrich themselves with third party selling services by pooling into the unitary selling program. The digital marketplace platform will be responsible for marketing and sale of goods in optimal markets at optimal prices to improve supply chain management especially for middle mile capacity management.

4.9 Decentralised Finance (DeFi)

Our model integrates DeFI platforms to offer decentralised lending, borrowing and crowd-funded insurance pools. Farmers can access these solutions to obtain cheaper as compared to traditional financial institutions like banks with quicker processing cycles [24].

5. Discussion and Conclusion

The integration of digital marketplaces in agriculture sector presents an opportunity to transform lives of millions of smallholder farmers. Through this study, several levers affecting smallholder farmers were examined. Digital marketplaces offer tremendous economic benefits by helping them reduce their dependency on intermediaries while also giving access to broader customer base for expansion leading to better price realisation and enhanced profitability for farmers. Though, in success of such digital marketplaces is inherently dependant on contingent efforts to be made to improve digital literacy among farmers. Through this research, it was discovered that younger farmers and those in more developed countries are more prone to adapt towards these digital tools while smallholder farmers in developing countries still face significant challenges and barrier to entry. More proactive government policies towards digital education and more user-friendly designed technology are crucial for a broader adoption.

Since most of the agricultural products are perishable items, which leads to logistical challenges leading to poor delivery estimate accuracies for cross-border and rural area deliveries. To streamline transportation, warehousing, and end to end delivery process, utilising 6PLs is critical to overcome supply chain challenges.

The role of fintech solutions is key enabler for underserved smallholder farmers. More digital payment gateways, microloan facility, and insurance products services like asset liquidation and pre-harvest sale are very beneficial for subsistence farmers enabling to invest in better farming inputs and technologies to improve crop yields.

To further understand the potential and challenges of digital marketplaces, SWOT analysis was conducted. The key strengths are enhanced market access, increased transparency, financial inclusion, and better price realisation. The major weaknesses are digital app literacy gaps especially in underdeveloped countries, dependency on external careers for logistics and supply chain management. The key opportunities remain to be integrating upcoming advancements in tech like AI and IoT to further improve farming activities and expansion to underserved markets. The major threats include data privacy issues along with rise to increase market volatility.

Conclusively, digital marketplaces hold a great transformative potential for agriculture sector, especially for smallholder farmers. By successfully adopting the proposed model and integrating advanced technological solutions, these platforms can significantly impact farmer’s livelihoods. However, it is important to address the challenges of digital literacy and external logistical constraints to maximise the impact.

The future of digital agriculture lies in creating more inclusive and sustainable models that can leverage the technological advancements taking place to drive

economic growth and contribute significantly towards improving the quality of livelihoods of farmers.

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