

Effects of Technological Innovations on Small-Scale Farming in Rural Areas: A South African Perspective

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Abstract:

The aim of the paper is to examine the effects of technological innovations on small-scale farming in rural areas in South Africa. It argues that small-scale farming farmers face challenges related to arable land and water supplies. Technological innovations in South Africa have been an issue of contention in businesses, governments and the society at large. The paper investigates the factors behind the types and state of technological innovations in rural areas, the characteristics and challenges of small-scale farming in rural areas and the effects of technological innovations on small-scale farming in rural areas. The problem of great concern is that certain technological innovations potentially harm the environment if not carefully handled. Small-scale farmers around the world faced a variety of barriers such as labor costs, a lack of education, and inadequate infrastructure. The paper used a literature-based research methodology that demonstrated the effects of technological innovations on small-scale farming in rural areas and used literature review as part of data collection. The paper finds that economic obstacles that small-scale farmers faced included high crop input costs, poor income and labor costs. These obstacles made it difficult for farmers to launch a small-scale farming business. Additionally, low agricultural production and food security had frequently been caused by irregular rainfall patterns, and small-scale farmers are at risk from the growing frequency of meteorological disasters like droughts and excessive rainfall. As a result, it is not shocking that many small-scale farming businesses cannot reach the high market demands. Hence, the paper recommends measures for optimizing the integration of technological innovations on small-scale farming practices in rural areas.

Keywords:

Food Security, Environment, Small-Scale Farming, South Africa, Technological Innovations.

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Introduction

In the ever-evolving landscape of agriculture, technological innovation has emerged as a powerful force, shaping the future of small-scale farming (Alston and Pardey, 2020). As the world grapples with pressing challenges such as food security, sustainability, and rural livelihoods, understanding the impact of these innovations becomes crucial (Shen, Ru, Wang, Li, Yu, Chen, Han and Guo, 2024). The technological innovation on small-scale farming means the creation of new technologies, tools, processes, and systems on agricultural land (Jain, 2023). Two-wheeled tractors, power tillers, direct seed and fertiliser drills, single-row planters, and small-scale sprayer carts are only a few examples of the technological innovations made in Zimbabwe, Bangladesh, and Mexico (Van Loon, Woltering, Krupnik, Baudron, Boa and Govaerts, 2020).

There has been a predominance argument held about the impact of technological innovations on small-scale farming and barriers faced by small-scale farmers (Matlou, 2018). For instance, Food and Agriculture Organization (2020) argues that technological innovation has become increasingly significant in the agricultural sector, promising to revolutionize traditional farming practices. To be precise, technological innovation can empower small-scale farmers and promote inclusivity. Internationally, digital financial services and e-commerce platforms empower farmers, particularly women and marginalized groups, by improving market access and enhancing control over their produce (Duncombe and Boateng, 2019). According to Mbuli, Fonjong and Fletcher (2021), small-scale farmers in Cameroon have an economy based mostly on resources, but they are also susceptible to climate change. Furthermore, the rise in global temperatures, precipitation, and storm intensity are all contributing factors to climate change's danger to food security. Moreover, Chen, Ellet, Phillips and Feng (2021) state that one of the main obstacles to small-scale growers' capacity to run a profitable farming operation is the state of the economy in the United States of America (USA). Research has indicated that labor costs can be a barrier to entry for small-scale farmers as well as to their ability to grow their operations. The general research question that the paper seeks to address is: How does technological innovations affects small-scale farming in rural areas in South Africa? This question is answered in a literature review section which provides details and answers to the general research question.

According to Thibane, Soni, Phali, and Mdoda (2023), smallholder sugarcane farming is an important industry in several nations, including South Africa. Regrettably, several factors have led to the decrease in smallholder sugarcane production. The results indicated that the drop in sugarcane production is caused by labour expenses, drought stress, and financial constraints. According to Ncoyini (2022), small-scale sugar cane growers in South Africa have been facing considerable difficulties. He deduced that this is because these farmers do not have access to climatic data. In the South African context, the adoption of agro-ecological practices and conservation agriculture, facilitated by technological

innovations, has led to improved soil health and sustainability (Berg, Marais, De Klerk, and Boshoff, 2020). Therefore, to comprehend the local dynamics, opportunities and restrictions, it is imperative to investigate how technological innovations affect small-scale farming in particular contexts, such as Wegdraai Village. The paper aims to investigate the effects of technological innovations on small-scale farming in rural areas.

Research Problem

Although small-scale farming has numerous advantages, there are also many obstacles that must be overcome for it to be successful and sustainable (Ncoyini, 2022). Small-scale farmers around the world face a variety of challenges, some of which are related to labor costs, a lack of resources and technology, marketing, economics, climate change, a lack of education, and inadequate infrastructure (Feng, 2021). In South Africa, small-scale farmers face challenges related to the scarcity of arable land and water supplies (Dhillon and Moncur, 2023). Meanwhile, Quayson, Bai and Osei (2020) report that lockdowns have interfered with the customary market exchanges between buyers and sellers in the cocoa and other supply chains, making it difficult for smallholders in South Africa to sell their produce. This circumstance forces smallholders in agricultural supply networks to accept prices that are significantly lower than those of customary market times. They receive an exceedingly small portion of the final value of the commodity product, even within normal time intervals.

Certain technological innovations could harm the environment if they are not overseen carefully (Food and Agriculture Organization, 2020). For example, overuse of chemical inputs or ineffective water management systems can lead to soil erosion, water pollution, and disturbance of ecosystems. The assumption of this problem to sustain is that small-scale farming does not have advanced mechanization such large scale commercial farming to operate within, thus leading to issues of less market penetration and that technology is not always good considering the long-term effects on the environment. Therefore, there is still no concord on whether technological innovations on small-scale farming can improve the potential of these farmers considering the environmental impact (Food and Agriculture Organisation, 2020). Therefore, this study aims to investigate the effects of technological innovations on small-scale farming in rural areas.

Methodology

This study employed a literature-based methodology to scrutinize the principles and characteristics of the impact of technological innovations on small-scale farming in rural regions. This kind of methodology is predicated on knowledge gleaned from books as well as individual experiences and conceptual critiques (Raphiri, Khwela and Selelo, 2024). According to Selelo and Khwela (2024), this kind of technique aims to describe, explain and give meaning to various phenomena. Thus, by using this

method, the researcher provided an overview and clarified the study's background. A review of the literature was done for this study to gather data. This technique is at times referred to as secondary data. Authors gathered data from a variety of sources, including books, publications, journals, and websites. As a result, the author examined the literature about the connection between small-scale farming and technological innovations. Owing to the nature of the research, document analysis was used to analyze the data. One analytical approach that helps researchers provide meaning, explanations and justifications for the themes is document analysis (Raphiri, Khwela and Selelo, 2024). The approach enables the researchers to formulate themes related to the topic of study. As a result, the themes were critically developed and provided context for the topics being discussed.

Literature Review

This section identifies the research gap and tries to fill it by talking about the findings of other academics' investigations. This forms the study's framework and driving force. Jain (2023) is aware that technological innovations entail the development and use of novel tools, methods, systems, and technologies that result in important breakthroughs across a range of industries. In addition to examining the effects of technological innovations, Dhillon's (2023) study looked at the difficulties faced by small-scale farmers and the collapse of organic farming in Africa. The growing use of conventional farming techniques, which mostly rely on synthetic fertilizers, pesticides, and genetically modified organisms (GMOs), is another important reason. It is evident that technological innovations are effective in the context of small-scale farming according to the principles of the innovation theory of entrepreneurship. This paper will commence by discussing different scenarios of types and state technological innovations rural areas, the anticipated characteristics and challenges of small-scale farming in rural areas, and the effects of technological innovations on small-scale farming in rural areas.

Types and State of Technological Innovations in Rural Areas

Green process innovation is no different from other forms of innovation in that its fundamental goal is to optimize the production function (Shen, Ru, Li, Yu. Chen, Han, Wang and Guo, 2024). There are various categories into which technological innovations can be divided, including green innovation technology. Green technology innovation refers to any process, technology or product that aims to lower energy and raw material consumption as well as environmental degradation and, it is crucial for enhancing the quality of the environment (Shen, Ru, Li, Yu. Chen, Han, Wang and Guo, 2021). To achieve sustainable development goals, traditional technology innovation must shift course to become green technology innovation. This is because green technology innovation is more environmentally friendly and concerned with resource conservation. Additionally, there are other categories of technical breakthroughs that will be included in this, including disruptive, product, incremental, and open innovations. Technological

innovations are subject to various conditions, including market demand. Technological innovations in this study looks at machinery, genetically modified seeds and other innovative ideas that could be discovered during this paper.

Characteristics and Challenges of Small-Scale Farming in Rural Areas

It has been suggested that one way to promote local economic development is through small-scale farming. But there is not enough information to pinpoint these farmers' identities, which makes managerial processes difficult (Zuwarimwe, 2022). A farmer in Asia is small-scale if they work small areas of land and rely heavily on traditional methods (Muzenkenyi, 2022). Food and Agriculture Organization United Nations (2018), however, feels that this is not the farming methods employed and that the primary way to characterize small-scale commercial farmers in Africa is through land size. Small-scale farming is conducted on tiny portions of traditional land in Africa and is a component of most rural agricultural operations (Muzenkenyi, 2022). According to the Food and Agriculture Organization (FAO) (2020), small-scale farming is distinguished by labor-intensive operations, the use of animals for traction, restricted application of agrochemicals, technology, and distribution to regional markets. Small-scale farming, in contrast to large-scale commercial agriculture, serves as a source of both income from the sale of surplus farm produce and domestic food security. In the African setting, the term small-scale farming refers to a variety of attributes, including land ownership and size, farming type, farming techniques, and agricultural motivation (Mbuli, 2023).

According to a Kilonzo's (2022) study conducted in South Africa, since 2014, there has been a rise in the number of smallholder farmers transitioning to commercial farming. Government support is provided to small-scale farming firms in Mpumalanga, Kwa-Zulu, and Limpopo. This is due to the growing number of small-scale commercial farmers who are turning into agribusinesses. Economic obstacles that small-scale farmers must overcome include high crop input costs, poor income, and labor costs. These obstacles make it difficult for farmers to launch a small-scale enterprise and to grow it (Dhillon, 2023). Low agricultural production and food security have frequently been caused by irregular rainfall patterns, and small-scale farmers are at risk from the growing frequency of meteorological disasters like droughts and excessive rainfall (Zerssa, Feyssa, Kim and Eichler-Lobermann, 2021).

Technological Innovations and Small-Scale Farming in Rural Areas

Technological innovation can enhance productivity and efficiency in small-scale farming practices. Internationally, studies have shown that the adoption of technologies like precision agriculture and farm management software improves resource management and yields, leading to increased productivity (Mignouna, Abang, and Alene, 2018). Moreover, Masere and Worth (2022) find that small-scale farmers in Zimbabwe face obstacles due to Indigenous knowledge as a barrier to technology adoption as farmers

are slow and resistant to change. Small-scale farmers in Tanzania have access to mobile technology, but they lack experience using it for farming purposes. To be precise, such barriers continue to place smallholder farmers at a disadvantage. In South Africa, technological innovations such as drip irrigation systems and improved seed varieties have been found to enhance crop yields and water use efficiency (Kazmierczak, Wlokas, and Savenije, 2019). Technological innovation plays a role in promoting sustainable farming practices. Innovations in precision agriculture and organic farming methods contribute to reduced chemical inputs and environmental impact (Sharma and Ramasamy, 2019).

The advancement of agriculture in small-scale farming depends on the use of new agricultural technologies. This is consistent with Rogers' (2003) claim that early adopters are more likely to spread the word about adoption to other groups, such as the early majority and the late majority, because of the positions they have within the social system. Researchers like Atsriku (2020) thought that innovations in irrigation, fertilizer application, pesticide use, and the motor tricycle, or "Aboboya," may help small-scale farmers become more successful. Technological innovations can function as a deterrent to barriers faced by small-scale farmers, but they cannot defend and protect farmers on their own without assistance. According to Berg, Marais, De Klerk and Boshoff (2020), technological innovations have had an enormous impact on small-scale farming in rural areas, posing both opportunities and difficulties. Increased production and efficiency have resulted from the transformation of traditional farming operations using digital technologies, sophisticated machinery, and smart farming techniques. Research has indicated a favorable relationship between higher crop yields and the use of digital agriculture technologies. For example, the use of contemporary technologies resulted in notable production increases for smallholder maize farmers in South Africa (Boakye, 2023). Even with the benefits, there are still a lot of obstacles to overcome, like expensive costs, a lack of technological knowledge, and inadequate infrastructure.

Conclusion

The above literature research only shows that there is a major need to pay attention to the issues of rural small-scale farming and technology advancements. During erratic rainfall patterns that increase the likelihood of meteorological disasters like droughts and heavy rainfall, endangering small-scale farmers. The study recommends that, considering the numerous difficulties and barriers that small-scale farmers in rural areas have, they incorporate creative ideas into their operations to help reduce their bad luck. Even if these technological innovations have had detrimental consequences on the environment, farmers will receive support and understanding through environmental stewardship. As a result, the paper made recommendations for how to best incorporate technical advancements into rural small-scale farming techniques.

The practical effects of technological advancements on small-scale agriculture in rural South Africa are significant, especially in tackling productivity issues and improving market access. Advancements like Artificial Intelligence (AI) for pest control, precision agriculture and Internet of Things (IoT) connected sensors can greatly enhance yields and minimize losses. These technologies enable small-scale farmers to better monitor their crops, make decisions based on data, and respond to environmental changes, thus enhancing food security and income reliability. Additionally, platforms such as virtual marketplaces and equipment-sharing applications offer small farmers direct connections to buyers and resources, minimizing dependence on intermediaries and decreasing operational expenses. These tools enhance profitability while also promoting inclusivity by allowing smallholders to compete in larger markets.

Nevertheless, the implementation of these technologies comes with obstacles. Numerous rural farmers encounter obstacles including restricted access to funding, insufficient training, and infrastructure issues like inconsistent electricity or internet access. Tackling these challenges demands focused actions, such as government grants for technology purchases, educational initiatives to improve digital skills, and funding for infrastructure in rural areas. Furthermore, eco-friendly agricultural methods such as hydroponics or solar energy-driven irrigation systems can aid in alleviating climate-related challenges while lowering operational expenses. By connecting these innovations to supportive policies and community-oriented strategies, small-scale farming can evolve from subsistence-level practices to catalysts for economic growth and rural advancement.

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