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Assessment of Reproductive Dynamics and Production Efficiency among Communal Sheep Flocks in the Free State Province, South Africa: A Comparative Study

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ABSTRACT

Sheep farming plays a significant role in generating economic opportunities and employment on a global scale. It is a vital support system for rural economies, mainly where agricultural alternatives are scarce, like farmers living in arid and semiarid areas. This article aims to investigate and promote sustainable communal sheep farming practices and examine the significance of the weaning percentage and how it determines the communal wool industry's success, economic viability, and sustainability. Additionally, the article will address the challenges these farmers face in sweet-, sour- and mixed grass veld types. Furthermore, the article will explore the impact of lambing seasons and flock structures on ewe productivity and identify strategies to mitigate adverse effects in communal sheep flocks. Lastly, the article will discuss management practices in sheep production systems, considering their economic and environmental sustainability. The mean weaning percentage, a critical indicator of reproductive success and productivity, was 48.78%, reflecting substantial dispersion within a sample population of 9 603 sheep across 351 farmers' interviews. Pure breeding exhibits a 5.6% higher weaning percentage than crossbreeding. In cases where there was inbreeding, the weaning percentage was 11.3% lower than that of flocks using unrelated rams. Statistical analysis further underscores the substantial influence ($p<0.001$) of consistent dissemination of production and reproduction technical information, facilitated through governmental initiatives and stakeholder engagements, in driving these improvements. Best sheep and health management practices are

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paramount for enhancing the weaning percentage of sheep flocks. The quality of grazing and the utilisation of well-adapted breeding stock are pivotal factors. Statistical analysis reveals a significant impact ($p<0.05$) of rotational grazing with a herding effect (extensive grazing) compared to free grazing (continuous grazing) with minimal management. Integrating labourers into communal sheep enterprises profoundly influences various operations, notably sheep herding, where they safeguard animals, identify health issues, and guide flock movements to optimal grazing areas, enhancing nutrition and weaning percentages.

Keywords: Continuous Grazing, Management Practices, Weaning Percentage, Wool Sheep

1. INTRODUCTION

Sheep farming plays a significant role in generating economic opportunities and employment on a global scale (Paraskevopoulou *et al*., 2020). It is a vital support system for rural economies, mainly where agricultural alternatives are scarce, like farmers living in arid and semiarid areas (Halimani *et al*., 2021; Taruvinga *et al*., 2022). The livelihoods of farmers and numerous individuals engaged in the sheep farming supply chain, including farm workers (stockmen), wool brokers and processors, mutton processors and various stakeholders within the industry, such as animal health and feed companies, heavily rely on its presence. By fostering these economic avenues, sheep farming contributes to the overall socioeconomic development of communities and sustains the well-being of those involved in the industry (Hajdu, Neves & Granlund, 2020).

The vast grass field of the Free State province, consisting of 87 000 km^2 and its favourable climate, makes it ideal for the 4 486 000 sheep, 2 130 000 cattle and 215 000 goats, contributing to 30% of the gross agricultural income. Although the cultivated land consists of only 32 000 km^2, it contributes almost 60% of the gross agricultural income, with horticulture generating the balance (South African Yearbook, 2022).

Households engaged in agricultural activities, especially livestock farming, can reduce food insecurity in communal households. Sadly, these households decreased by 19.1% in only two years during the drought of 2014/2015. During 2011 – 2016, the number of households engaged in agricultural activities decreased by 600 000 (2.9 million to 2.3 million) (Statistics South Africa, 2019). When the frequency of droughts increases due to climate change (food scarcity for livestock), the risk increases to have a devastating effect on the livelihoods of communal households (Samuels *et al*., 2022).

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The weaning percentage determines the key to success (economic viability and sustainability) in sheep farming. Where various stakeholders, government initiatives and industry organisations, like the National Wool Growers Association (NWGA), were actively involved in the training, research and technical assistance to improve best management practices, infrastructure assistance, the introduction of superior rams and the selling of their wool through formal auctions (earning foreign currency), their income increased markedly with 18% in only five years—enhancing the overall competitiveness of the communal wool farmers in the wool industry (Henderson, 2015). Merino sheep's adaptability to South African conditions and high wool production and quality make it one of the various sheep breeds suitable for the Free State Province (Sankatane, 2018).

Enhanced management practices in sheep production systems (such as feedlot, intensive, and semi-intensive systems) have the potential to generate greater economic profitability. However, these systems often rely heavily on external resources, particularly non-renewable resources derived from fossil energy. This dependence significantly burdens the natural environment and contributes to an unsustainable biophysical state in the long run (Rojas-Moreno *et al*., 2022). By promoting biodiversity, farms can reduce their ecological footprint, enhance their resilience to climate-related challenges, and establish transparent and trustworthy consumer relationships (Dominati *et al*., 2019).

Sustainable agriculture, specifically livestock production, refers to a purposeful and conscious approach by livestock farmers to produce agricultural products like mutton and fibre while implementing best management practices to safeguard the natural resources utilised in farming. This approach is that food production is sustainable, enabling future generations to survive and thrive. Aspiring farmers must effectively manage the natural resources available (such as grassland or meadow) to support the biological activities involved in animal breeding. This, in turn, allows for profitable outcomes both economically, benefiting the farm and loan providers, and environmentally, by maintaining a harmonious farm ecology. These practices should align with best management practices (Nkamisa, 2020).

This article aims to investigate and promote sustainable communal sheep farming practices and examine the significance of the weaning percentage and how it determines the success, economic viability and sustainability of the communal wool sheep industry. Additionally, the article will address the challenges these farmers face in sweet-, sour- and mixed grass veld types. Furthermore, the article will explore the impact of genetic-, socioeconomic-, and infrastructure factors on ewe productivity and identify strategies to mitigate adverse effects in communal sheep flocks. Lastly, the

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article will discuss management practices in sheep production systems, considering their economic profitability and environmental sustainability.

2. MATERIALS AND METHODS

Ethical clearance was obtained from the University of the Free State Research Ethics Committee for this project (UFS-HSD2021/0422/21).

2.1. Study Area

The study was conducted in the Thaba Nchu-Botshabelo area of the Mangaung district in the Free State Province, South Africa. This region has flat, rolling grasslands, crop fields, isolated sandstone kopjes and mountains. The province is a crop and livestock production area divided into five districts: Mangaung, Xhariep, Lejweleputswa, Fezile Dabi, and Thabo Mofutsanyana. However, focus groups for personal communication and training were canvassed in the Thaba Nchu and Botshabelo areas in the Mangaung district, where most communal farmers are situated (Figure 1). The Thaba Nchu and Botshabelo area has 40 communities (59 957 ha grazing area). Of these communities, 21 (53%) (30 182 ha grazing) obtain an even location distribution through the Thaba Nchu and Botshabelo area, with different vegetation types, namely sweet grass veld, sour grass veld and mixed sour grass veld (Van der Westhuizen, Snyman & Fouché, 2018). The climate is characterised by cold winters with a daily minimum average of -0.6 °C with frost and hot summers with a daily maximum average of 33.6 °C) (ARC-NRE, 2023). The long-term annual rainfall (06 June 2012 – 29 January 2022) for the Botshabelo and Thaba Nchu area is 546 mm. Most of the yearly rain (>70%) is received in the summer from November to March (Fouché, De Jager & Opperman, 1985). The Free State Department of Agriculture and Rural Development (FSDARD) (DAFF, 2018) recommends a long-term grazing capacity of 6 ha per Large Stock Unit (LSU) for the Botshabelo and Thaba Nchu area (Meissner *et al*., 1983).

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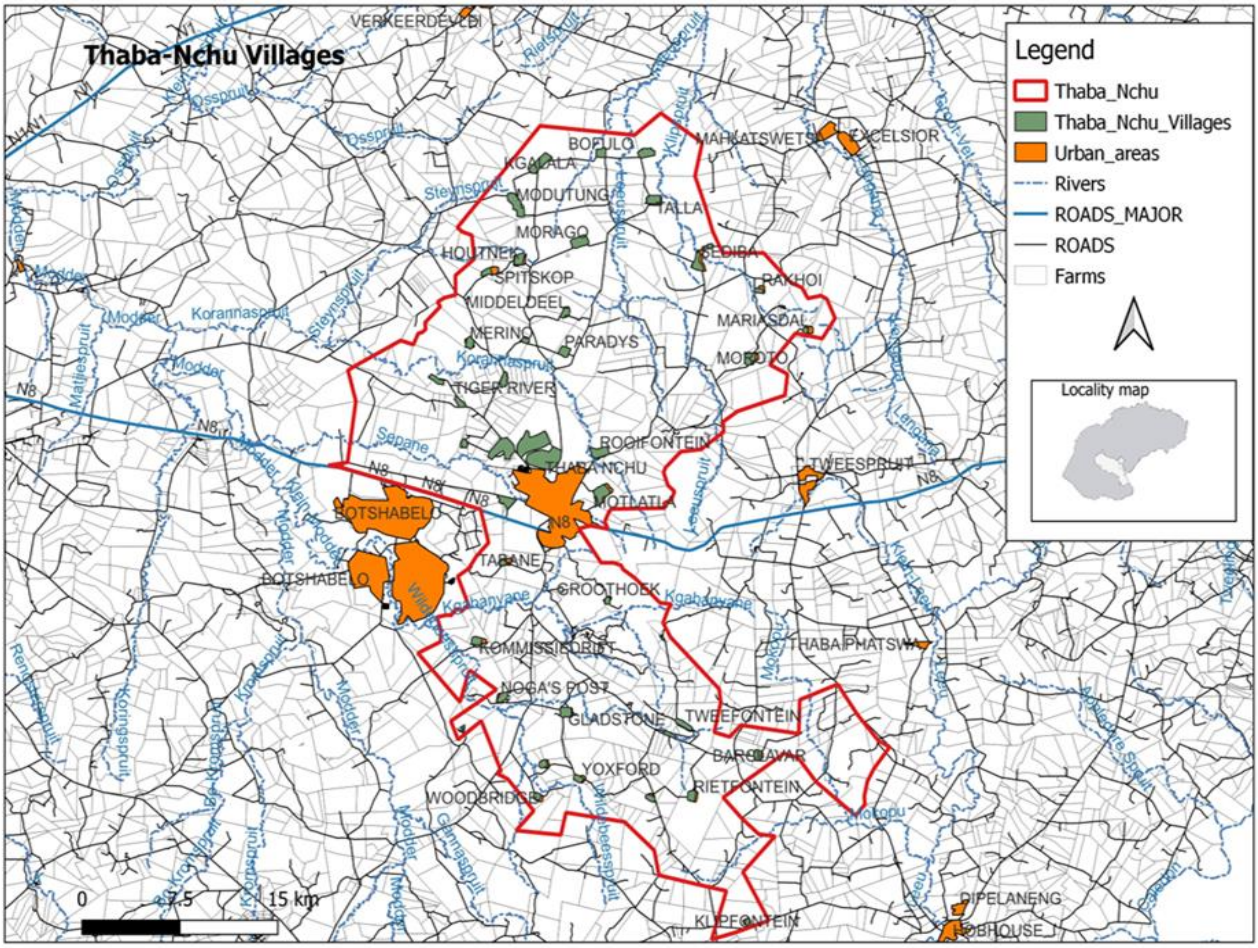

***DARD, GIS section, 2023**

FIGURE 1: Information from Communities in the Thaba Nchu and Botshabelo Areas in the Mangaung District in the Southeastern Part of the Free State Province, South Africa.

2.2. Sampling Procedure

The participants were selected via a non-random, purposive, convenience sampling method to reach the communal wool farmers in the Mangaung district. Approximately 1255 small-stock communal farmers are in the Mangaung district (Mocwiri, 2022). A sample size calculator (Rao, 1991) was used to determine the sample size to generalise the population. For this study, 295 or more observations have a confidence level of 95%, with the actual value within ±5% of the observation value.

2.3. Data Collection Procedure

A structured closed-ended questionnaire, created using the EvaSys software, was used in one-on-one interviews to obtain quantitative data on weaning percentages. The questionnaire captures different aspects of sheep management such as reproduction, record keeping, grazing systems, education and

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technical information obtained, genetic factors and infrastructure. While the survey was in English, all interviews took place in the participants' native languages following the interpretation of the English version. Throughout the data collection phase, supervisors systematically observed enumerators to maintain uniformity, detect outliers, and ensure the precision of the gathered data. The researcher disseminated the questionnaire to respondents and assured them their data would be confidential.

Extension officers recruited participants (David, 2022; Khwidzhili & Worth, 2016) using an inclusion criteria list. Small stock includes wool sheep, dual-purpose sheep, mutton sheep and goats. Although there are approximately 1255 small-stock farmers, only participants farming with wool-type sheep were included. Data was collected from November 2021 until February 2022, when most of the ewes would have lambed and the lambs weaned (Strauss, Avenant & De Waal., 2021). The data collected (e.g., farmer demographics, livestock numbers, reproduction, management) included one year's data (2021/2022).

The weaning percentage over 12 months was the questionnaire's dependent variable affecting livestock owners and agricultural reproduction in general. The following independent (explanatory) variables explain or predict changes in a dependent variable, namely the weaning percentage:

- Genetic factors (breeding methods and origin of breeding animals, flock structure).
- Socioeconomic factors (level of education, labourers, funding, land tenure security, technical information).
- Farm infrastructure (absence or condition of fences and kraals, water reticulation, woolshed, agricultural equipment, own transport, generator).
- Management (belongs to an organisation, including lambing seasons, record keeping, and grazing systems).

2.4. Data Management and Analysis

The SPSS (Version 29) program processed and analysed the data. Scanned completed questionnaires identify outliers and potential errors. The mean values for missing observations are added to calculate the sum in each category. ANOVAs were done on averages to determine significant differences. R-squared analysis was done for descriptive statistics to assess how well the independent variables included in the regression model explain the variability observed in the dependent variable, namely the weaning percentage. The analysed data will follow in the form of tables, graphs, and text.

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3. RESULTS AND DISCUSSION

3.1. Structure of the Sheep Flocks in the Study Area

In the Thaba Nchu region, communal sheep farming constitutes a significant agricultural activity characterised by notable variability in production metrics. The mean weaning percentage, a critical indicator of reproductive success and productivity, was 48.78 ± 46.88, reflecting substantial dispersion within a sample population of 9603 sheep across 351 farmers' interviews. The average flock size per farmer, standing at 27.36 ± 32.11 sheep, underscores the modest scale of operations, where the impact of individual events, such as the loss or gain of a single lamb, can disproportionately affect the overall weaning percentage.

3.2. Reproductive Management Factors Impacted Communal Sheep Flocks

Pure breeding exhibits a 5.6% higher weaning percentage than crossbreeding. In cases where there was inbreeding, the weaning percentage was 11.3% lower than in flocks using unrelated rams. However, if not appropriately managed for genetic relationships, the skewed ram-to-ewe ratio (17.03%) in communal flocks can elevate the risk of inbreeding. Inbreeding poses significant threats, leading to increased genetic disorders and undesirable traits, ultimately impeding the flock's long-term health and productivity, such as the weaning percentage. Implementing a well-structured breeding program with clear objectives mitigates these risks. Such a program should prioritise long-term goals, as genetic enhancement of breeding traits is a time-intensive process (David, 2022; Khwidzhili & Worth, 2016).

TABLE 1: Reproductive Management Factors Impacted Communal Sheep Flock Weaning Percentages

		Weaning % (mean)	**ANOVA results**	
			***F*-statistic**	***p*-value**
Breeding method	Pure breeding	53,32		
	Inbreeding	41,98	1,55	0,21
	Crossbreeding	48,06		
Origin of breeding animals	Acknowledged breeder	39,13		
	Self-bred	55,63		
	Acknowledged breeder and self-bred	51,53	2,44	0,06
	None of the above	41,54		

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Moreover, the origin of breeding animals emerged as a significant factor. While procuring sheep from acknowledged breeders is commonly presumed to enhance flock quality, this study revealed nuanced outcomes. Self-bred flocks demonstrated a remarkable 16.5% higher weaning percentage (Table 1), suggesting potential challenges in adapting acknowledged breeder stock to local conditions or fertility issues. Notably, the full impact of acknowledged breeder stock might not have manifested within the scope of this one-year data, underscoring the need for longitudinal analysis to comprehensively assess breeding practices' efficacy.

3.3. Socioeconomic Factors Impacted Communal Sheep Flocks

Introducing labourers into sheep management practices can lead to tangible benefits, as evidenced by the observed significant difference in weaning percentage ($p<0.05$) compared to enterprises without labourers, with a notable 17.1% increase in weaning percentage (Table 2). This underscores labourers' pivotal role in optimising sheep enterprises' performance and profitability.

Education among farmers markedly contributes to enhancing the sustainability of their agricultural enterprises. Weaning percentages reveal a noteworthy increase from the segment of farmers who have never received formal schooling to those with the highest educational qualifications, despite a decline observed within the certificate/diploma/degree group. This highlights the profound impact of educational attainment on farm performance metrics, particularly concerning livestock productivity. Statistical analysis further underscores the substantial influence ($p<0.001$) of consistent dissemination of production and reproduction technical information, facilitated through governmental initiatives and stakeholder engagements, in driving these improvements.

TABLE 2: Socioeconomic Factors Impacted Communal Sheep Flock Weaning Percentages

		Weaning % (mean)	**ANOVA results**	
			***F*-statistic**	***p*-value**
Level of education	Never been to school	37,50		
	Completed some primary school	43,93		
	Completed some high school	50,19		
	Completed matric	57,69	0,94	0,45
	Completed a certificate/ diploma/ degree	41,31		
	Completed a postgraduate degree	58,34		

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Total number of workers	No workers 1-2 workers More than two workers	47,23 44,72 64,32	**3,21**	**0,04**
Funding	None External funding Self-funding Both	49,66 38,35 55,87 39,72	0,92	0,43
Security of land tenure	Not secure Secure to an extent	46,62 49,68	0,48	0,63
Technical information	Never received technical information Sometimes/ regularly receive technical information	39,35 58,81	**3,83**	**<0,001**

3.4. Infrastructure that Impacted Communal Sheep Flocks

The condition of a wool shed and chaff cutter influenced the weaning percentage, with those having this infrastructure working to an extent having a statistically significant higher weaning percentage than those who did not have the necessary infrastructure ($p < 0,05$), accordingly intervention in this sector is of critical importance (Figure 2). Enhancing the productivity and sustainability of small-scale farmers necessitates significant improvements in infrastructure and extension services' capabilities, as Myeni *et al.* (2019) emphasised. This assertion underscores the critical role of governmental intervention in fostering these enhancements. For the rural and under-resourced areas in South Africa, the infrastructure section has been allocated R600 million for project development (Ramaphosa, 2023).

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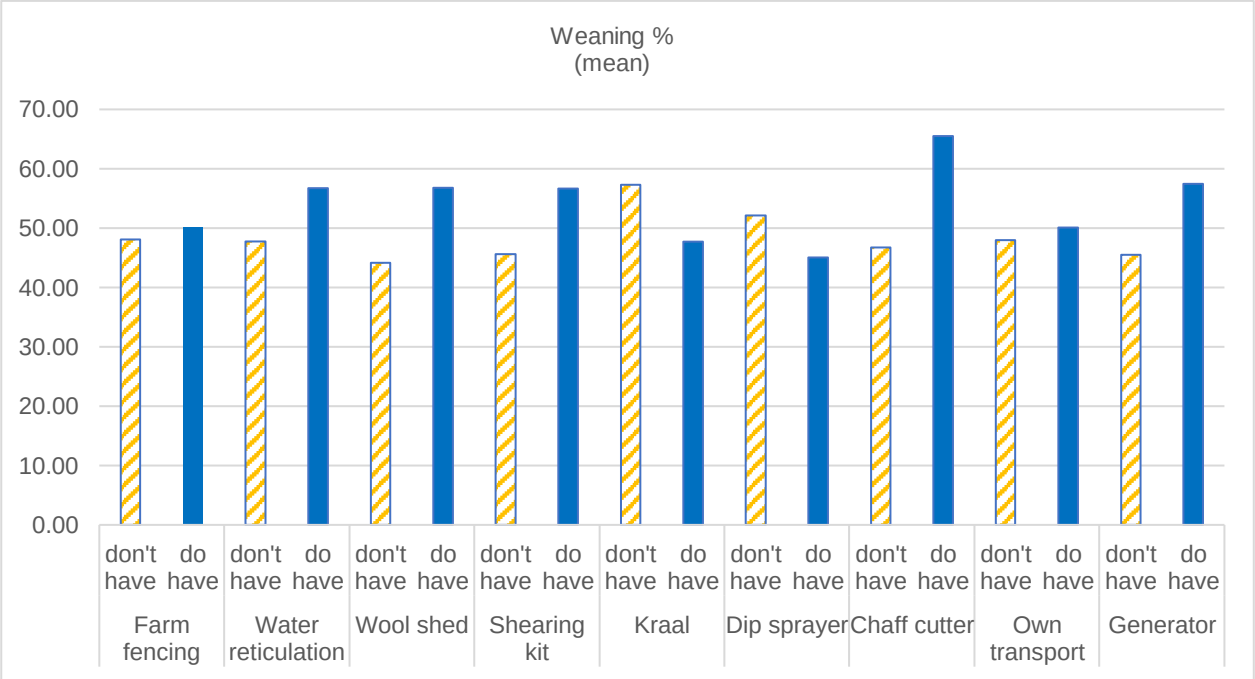

FIGURE 2: Infrastructure That Impacted Communal Sheep Flock Weaning Percentages

3.5. Management Practices That Impacted Communal Sheep Flocks

Best sheep and health management practices are paramount for enhancing the weaning percentage of sheep flocks. The quality of grazing and the utilisation of well-adapted breeding stock are pivotal factors. Statistical analysis reveals a significant impact ($p<0.05$) of rotational grazing with a herding effect (extensive grazing) compared to free grazing (continuous grazing) with minimal management. With herding practices, rotational grazing offers a promising solution to enhance production and reproduction in sheep flocks within communal grazing areas like Thaba Nchu and Botshabelo. Despite challenges such as fragmented land ownership and inadequate infrastructure, this approach utilises large land areas efficiently, promoting natural flock behaviours and optimising resource utilisation. By facilitating efficient flock management and movement, extensive grazing with herding effect addresses these challenges while improving overall productivity and reproductive outcomes in communal grazing contexts (Van der Westhuizen *et al*., 2018).

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TABLE 3: Management Practices That Impacted Communal Sheep Flock Weaning Percentages

		Weaning % (mean)	t-test results	
			t-value	*p*-value
Belong to an organisation	Do not belong to an organisation	48,30	0,12	0,91
	Do you belong to an organisation	48,91		
Lambing seasons	No	56,45	**2,47**	**0,01**
	Yes	43,44		
Record keeping	Do not keep records	48,90	0,14	0,89
	Keep records	48,19		
Grazing system	Intensive (Rotational grazing augmented with planted oats and maise)	47,09	**5,29**	**0,01**
	Extensive (Rotational grazing with herding effect)	57,24		
	Continuous grazing	40,37		

Rotational grazing, facilitated by more than two labourers (Table 2), enables better identification of sick sheep and flock issues. While no specific lambing season significantly influenced ($p<0.05$) weaning percentage, most ewes are typically mated in autumn, aligning with the natural breeding season (Table 3). Nonetheless, farmers adhering to a strict 36-day breeding season potentially disadvantage ewes not in optimal condition due to food shortage during this limited period compared to continuous mating practices. The impact of the lambing season on ewe productivity reveals that year-round lambing treatment resulted in the lowest conception rates (58.4%) and weaning percentage (65.7%), along with a relatively high lamb mortality rate (34.7%), which peaked during the summer months. These combined factors can detrimentally affect the productivity of communal flocks engaged in year-round lambing. Mapiliyao *et al*. (2012) indicated conception (49%) and mortality (22%) rates in the sourveld (Sompondo) regions of the Eastern Cape. Msuntsha & van Zyl (2019) also reported high mortalities (42.4%) in the sandy sourveld of Northern KwaZulu-Natal. The negative impact of the year-round lambing season on ewe productivity (weaning %, 65.3%) would

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be exacerbated by higher stocking rates commonly observed in communal grazing systems (Magawana *et al*., 2021).

4. CONCLUSION

Integrating labourers into communal sheep enterprises profoundly influences various operations, notably sheep herding, where they safeguard animals, identify health issues, and guide flock movements to optimal grazing areas, enhancing nutrition and weaning percentages. Elevating farmers' and labourers' expertise in animal care, grazing, and herding techniques is pivotal for achieving higher weaning percentages. Knowledge transfer mechanisms, including educational programs and dissemination strategies, empower farmers with essential skills and insights for adopting more sustainable practices, crucial for fostering agricultural sustainability and productivity within communal farming communities, emphasising the critical role of continuous learning and knowledge exchange in optimising weaning percentages in communal sheep flocks. Extension services play a significant role in enhancing the weaning percentage by providing technical advice on sheep management.

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6. AUTHORS CONTRIBUTION

AJ. Strauss collected the data for this study, interpreted the results, and wrote the initial draft manuscript. M. de Bruin conducted the statistical analysis. JW. Swanepoel and JJE. Cloete assisted with the final manuscript. All authors have read and approved the finalised manuscript.

7. CONFLICT OF INTEREST DECLARATION

FSDARD employs AJ. Strauss, who did the research with the University of the Free State. RUFORUM was responsible for the funding.

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Reimagining Agricultural Advisors and Educators as Agricultural Bricoleurs Towards Enhanced Skills Transfer: An Adult Learning Perspective

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ABSTRACT

Bricolage's approach describes how post-colonial, post-positivist, post-modernist, or post-structuralist paradigms have driven intellectuals to develop mixed multi-theoretical and multi-methodological methods. Bricoleurs must contextualise the approaches using the metaphor and articulate its meaning and inferences for advisory services in attempting to do so, as agricultural advisors as bricoleurs and emerging farmers view themselves as co-advisors, guided by bricolage principles. The bricoleurs, equipped with adult education approaches and emerging farmers, will engage in a skills transfer exercise in an agricultural environment. In contrast, a bricoleur plays the role of a facilitator, not a teacher or an expert. Emerging farmers are knowledgeable, and many have years of experience working in the farming environment and have massive knowledge and experience that they can circulate amongst themselves. Bricolage highlights the relationship between agricultural advisors' ways of seeing and the social location of their personal history. The agricultural advisor-as-bricoleur abandons the quest for the naive concept of realism. It focuses instead on clarification of their position in the web of reality, the social locations of other co-advisors and the ways they shape the production and interpretation of knowledge. Bricolage tracks significant ruptures in epistemological, ontological, ethical, and political underpinnings that influence agricultural advisors. The record shows that, while traditional agricultural extension services were based on positivist rationalities, successive generations must adopt more interpretive, post-positivist, post-colonial, post-modern, constructivist, and post-structuralist approaches. As a guiding theory for agricultural extension advisors, Bricolage

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can improve skills transfer amongst emerging farmers by using limited resources to complete specific tasks.

Keywords: Bricoleur, Agricultural Advisors, Skills Transfer, Adult Education, Constructivism, Agricultural Educators

1. INTRODUCTION

Bricolage critically examines disciplinary discourses and practices that can give valuable insight into agricultural advisors' cultural, historical, and political positions and works (Pratt *et al*., 2022). In working with emerging farmers, I believe Bricolage as a guiding theory will allow agricultural advisors to create an environment that enables them to express themselves more openly without fear of being wrong. In so doing, the emerging farmers will enjoy a balanced share of power. The word is derived from the French verb *bricoler* ("to tinker"), with the English term DIY ("Do-it-yourself") being the closest equivalent of the contemporary French usage (Kincheloe, 2004; Ben-Ashe, 2022). Bricolage mirrors the spirit of "doing with what is available" when resolving difficulties and discovering possibilities and has been used in areas as diverse as education, art, business, and law (Preece, 2014; Phillimore *et al*., 2019).

Due to its complexity, Bricolage has been used in many other disciplines, including philosophy, critical theory, education, computer software, and business (Ciambotti *et al.,* 2023). When used in multiple disciplines, the accommodative nature of Bricolage can provide agricultural advisors confidence in its relevance as the guiding theory of choice when dealing with training or teaching and learning of emerging farmers. Over the centuries, using Bricolage has been effective in various disciplines as a suitable theoretical basis for emancipatory research (Bansal et al., 2018). The bricolage approach in agricultural sociology is a logical foundation on which the qualitative study takes form and links among the applied constituents and theoretical characteristics of the executed research (Reay *et al*., 2019). The accommodative nature of Bricolage to apply to various fields gives an agricultural advisor or educator confidence as the appropriate theoretical framework of choice within agricultural sociology studies that deal with agricultural society's social, cultural, political, educational and religious problems (Busch & Barkema, 2021). This term, drawn from Bricolage, permits

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the agricultural community to have confidence in what they have and make the best of it. Bricolage mirrors the essence of "complete task with what is available" while resolving difficulties and revealing possibilities in the agriculture community. It has been modified to suit various social sciences, humanities and education (Preece, 2014).

Agricultural advisors in the Departments of Agricultures throughout the country are charged with the responsibility of transferring technological skills to emerging farmers (Buso, 2003; Mabaya, Tihanyi, Karaan & Rooyen, 2011; Makhura, Mda, Marais & Jacobs, 2011; Barlow & Van Dijk, 2013; Claassen, Mukwada, Naidoo & Mahasa, 2014). Little effort is made to understand how emerging farmers learn in the agricultural space. Current training and extension approaches subject emerging farmers to conventional or teacher-centred teaching approaches (Mahini, Forushan & Haghani, 2012; Laleye, 2015). These approaches are not in line with the principles of adult education. The emerging farmers are reported to lose interest in these training sessions because they sound inadequate and practical to their farming situations (Riise, Permin, Larsen & Idi, 2002; Anandajayasekeram, Sindu & Kristin, 2007; Lacy, 2011). This calls for reviewing our modes of teaching to align them with technological advancements that subscribe to adult education approaches. The agricultural advisors must follow the adult education, wearing the bricolage lens when executing their duties. Bricolage theories must inform the conduct or methods that guide the approach of the agricultural advisors or extension services.

Agricultural extension approaches such as farmers' field schools, study groups, commodity groups, and others have been used to deal with the issue of technological skills transfer for emerging farmers (Riise *et al*., 2002; Anandajayasekeram *et al*., 2007; Vermeulen, Kirsten & Sartorius, 2008; Mabaya *et al*., 2011). The agricultural advisors have conducted site visits for visual assessments (Mashamba, 2012). Multidisciplinary teams have been conducted to aid the farmers' challenges, consisting of the agricultural advisors and the support staff, such as animal health technicians, soil conservation technicians, and agricultural economists. These agricultural services methods must be reviewed and aligned with adult learning principles. Bricolage has provided a philosophical framework or lens for agricultural advisors and educators to enable an environment in which they can realise their ability to generate, deliver, and circulate information amongst themselves. The agricultural advisors or educators, along with emerging farmers, will display and circulate their knowledge amongst themselves

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without worrying about any professional methods in their respective fields of practice. Agricural Bricolage (AB) creates an environment where agricultural advisors or educators with emerging farmers can realise their power (Li, Naughton & Nehme, 2015; Mahlomaholo, 2013). This paper aims to borrow from the philosophical framing of Bricolage as a guiding approach for agricultural advisors and educators to improve skills transfer amongst emerging farmers.

2. ROLES OF AGRICULTURAL BRICOLAGE THEORY

The AB is the inculcation of agricultural sociology focus within the bricolage theory. Bricolage refers to the production or formation from a varied collection of obtainable equipment or a task formed by such a procedure (Li *et al*., 2015). Solutions to the accomplishment of AB are cognisant of the features of the available substances and being cognisant of a technique to use, thereby attaining more out of agricultural advisor or educator with emerging farmers while in the construction process of completing a task. AB puts an agricultural advisor or educator in a multi-method style to draw on the power of difference and multi-logicality. In doing so, it is possible to be anxious about matters concerning various cultures and their multiplicities, particularly in systems of multiculturalism that focus on issues of race, social standards, sex and sexual justice vis-à-vis the complex reflection of power (Kincheloe, 2004). *Agricultural Bricoleurs* (ABs), as agricultural advisors, work to set up post-formal dialogues where alterations are recognised and used to seek correct personal desires and universal discriminations (Sehring, 2009).

Agricultural bricoleurs must participate in the post-formal dialogue, assume critical humility that hints at fairness and express confidence to use what they have "Do it yourself" for effective practice in the agriculture community (Stenholm & Renko, 2016). This kind of temperament permits bricoleurs the chance to instigate the formidable mission of transparency and democracy in dealings between the numerous traditions of the world (Muthivhi & Broom, 2008; Ciambotti *et al*., 2023). Developing research submits that Bricolage signifies a supplementary realistic depiction of educational procedure as it occurs in repetition, allowing interested parties everywhere in the academic world to obtain an improved grasp of the authenticities of start-up procedures and behaviours (Stenholm & Renko, 2016; Sharp, 2019; Ciambotti *et al*., 2023). When using agricultural Bricolage within

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practical presentations, they are openly grounded on concepts of diversity, evolving design, flexibility, and plurality. In addition, it implies methodologies that examine processes from various, and sometimes opposing, theoretical and methodological perceptions (Rogers, 2012; Sharp, 2019). Cakula, Jakobsone and Florea (2015) suggest that "the more perspectives one can bring to one's analysis and critique, the better the grasp of the phenomena one will have and the better one was at developing alternative readings and oppositional practices". From my perspective as an agricultural advisor or educator, I present the favourable case for Bricolage to enhance skills transfer.

3. CONTEXTUALISATION OF THE TYPES OF AGRICULTURAL BRICOLAGE

The Agricultural Bricolage defines how post-colonial, post-positivist, post-modernist, or post-structuralist methods will advance agricultural scholars to establish heterogeneous, multi-theoretical and multi-methodological perspectives in knowledge production (Sehring, 2009; Li *et al*., 2015; Gehman *et al*., 2018). AB theory contextualises the approach procedure while articulating its implications and interpretations. In attempting to do so as an *agricultural bricoleur*, executing their functions is guided by bricolage principles. In this context, the bricoleur identifies fellow participants as equals and term them as co-advisors. Using the AB approach, the co-advisor will engage in agricultural activities where an agricultural advisor or educator, known as principal *bricoleur*, takes the role of a facilitator of discourse, not a teacher or an expert. Agricultural advisors or educators (principal bricoleurs) with emerging farmers (co-advisors along with principal bricoleurs) are treated as knowledgeable, and many of them have several years of working in the farming environment and possess immense knowledge and experience that they can circulate amongst themselves. AB concerns troubling epistemological, ontological, moral, and political reinforcements that sway intellectuals at specific periods (Dascalu *et al.,* 2014; Gehman *et al*., 2018).

While the old-fashioned qualitative style was grounded in positivist judgements, the literature indicates that consecutive cohorts accepted mostly explanatory, post-positivist, post-colonial, post-modern, constructivist, and post-structuralist perspectives (Taylor & Maor, 2000; Sejzi & Aris, 2012; Bansal *et al*., 2018). Roger (2012) indicated that *bricoleurs* have five approaches that venerate this meticulous complexity: the narrative *bricoleur*, the political *bricoleur*, the theoretical *bricoleur*, the methodological *bricoleur*, and the interpretive

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bricoleur. An interpretive bricolage perspective, as mentioned by Denzin and Lincoln (2000), defines upholding the conviction that "there is no one correct telling [of an] … event. Each telling, "like light hitting a crystal", reflects a different perspective on [an]… incident". An interpretive *bricoleur* is, therefore, a scholar who "understands that inquiry is an interactive process, shaped by his or her personal history, biography, gender, social class, race and ethnicity and by those of the people in the setting" (Leow & Neo, 2015).

Interpretive *bricoleurs*, assuming post-positivist epistemologies, acknowledge that understanding is never permitted from a personal standpoint or political explanations (Ultanir, 2012; Sharp, 2019). *Agricultural bricoleurs* (agricultural advisors) will be guided by this format, cognisant that each co-advisor has its own experiences. Their experiences will define their attitudes and how they interpret or define concepts. The known issue of the dominance of specific individuals over others is highlighted in the saying that "there is no one correct telling of an event". Theoretical *bricoleurs* toil over and among various theoretical models: "The theoretical *bricoleur* reads widely and is knowledgeable about the many interpretive paradigms (e.g., feminism, Marxism, cultural studies, constructivism, queer theory) that can be brought to any particular problem" (Lundell & Higbee, 2001; Kitchel & Ball, 2014). Political *bricoleurs* are scholars cognisant of the way knowing and power are conjoined. These scholars clarify that the political *bricoleur* is cognisant that science is power, for all inquiry findings have political implications (Sharp, 2019). No value-free science exists (Bansal *et al.,* 2018; Sharp, 2019). Political *bricoleurs* accepting such knowledge, similar to educators familiar with critical pedagogies, create counter-hegemonic types of inquiry which trouble oppressive social concepts and inequalities.

Political *bricoleurs* create understanding for the advantage of marginalised persons through daily, not-considered activities of neoliberal, industrialist, white, masculine, and heterosexist social constructions (Owusu & Janssen, 2013; Sharp, 2019). The concept of the political *bricoleur* swayed Kincheloe's pronouncement of the critical *bricoleur*; thus, Kincheloe's essential ventures of Bricolage into the idea of *bricoleurs*. Narrative *bricoleurs* consider that an inquiry is a description (i.e., a narrative), the reason being that focused existence cannot be "captured"; literature will embody detailed explanations of an occurrence (Vanevenhoven *et al.,* 2011). As such, texts are permanently placed directly from specific contextual perspectives. Narrative *bricoleurs* consider how ideas and talk shape how to make meaning

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(Sharp, 2019). Besides ignoring ideas, texts and talk, narrative bricoleurs attempt to appreciate their effect on the inquiry processes and their writings (Bansal *et al.*, 2018). Narrative *bricoleurs* consequently try to disturb and deter others from univocal inquiry depictions. They ensure that narrative *bricoleurs* define their methods from numerous approaches, such as spoken words and sources (Sharp, 2019).

4. EPISTEMOLOGY OF BRICOLAGE

Scholars of Bricolage (Kincheloe, 2004; Mahlomaholo, 2013) mention the two kinds of *bricoleurs*: ones that are dedicated to investigative eclecticism, providing current situations to structure the approaches used and the ones who seek to participate in the genealogy/archaeology of the arenas with some outstanding proposals in mind. *Agricultural bricoleurs*, as agricultural advisors, lean towards the notion that theory is not an explanation of the world but a justification for relating to the world (Thompson-Hardy, 2018). As epistemology evolved, it was understood that knowledge comes from relationships between objects and subjects and how they interact in the world (Phillimore *et al.*, 2019). Bricolage includes the epistemological approach that allows different people to construct different meanings in various ways (Ciambotti *et al*., 2023). The features of Bricolage include deflection, play, means of a non-professional, limited means, and unlimited tasks (Stenholm & Renko, 2016). Epistemology helps to answer questions about what makes true knowledge different from false knowledge or knowledge based on inadequate information (Thompson-Hardy, 2018). The epistemological underpinning of Bricolage emanates from an old-fashioned French manifestation that symbolises crafts-persons who artistically use ingredients remaining from extra tasks to build new artefacts (Ultanir, 2012; Ciambotti *et al*., 2023).

In light of Bricolage, there is a key difference between constructivism and constructionism. Constructivism must be used only for epistemological considerations that seek to find meaning from an individual perspective, and it is used in creating and transmitting knowledge (Pratt *et al*., 2022). Constructivism focuses on each individual's way of making sense of the world as valid, standing in the way of a critical stance (Ben-Asher, 2022). In contrast, social constructionism considers the culture surrounding the individual and how that culture shapes how the individual views the world. In light of this perspective, constructivism resists a critical approach while constructionism fosters it (Thompson-Hardy, 2018). Bricolage signals

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the relations between an investigator's viewing methods and the societal locality. The inquirer-as-*agricultural bricoleur* (agricultural advisor) deserts the search for certain ingenuous perceptions of pragmatism, the societal positions of other investigators and the methods with which they structure the explanation and creation of the meaning of knowledge, concentrating their place on the articulation of their location in the matrix of actuality. AB admires the complexity of the existing world. Indeed, it is based on an epistemology of complexity (Tshabalala Ndeya-Ndereya & Merwe, 2014; Ciambotti et al., 2023).

5. THE RHETORIC AND ROLES OF THE AGRICULTURAL BRICOLEUR (AGRICULTURAL ADVISOR)

Qualitative inquiry is embedded in a phenomenological model, which enshrines that actuality is a social construct amongst individuals or mutual definitions of the circumstances (Busch & Barkema, 2021). The theory underpinning AB focuses on the principles of social constructivism (Nyika & Murray-Orr, 2017; Cole, 2022). AB assigns the ways of constructivists that separate it from the naive realism of the positivists, the critical realism of the post-positivists, and the historical realism of the critical theorists in favour of relativism based on multiple psychological constructions conveyed by collectives and individuals (Mahlomaholo, 2013; Baliņa, Baumgarte & Salna, 2015). Rhetoric is the art of spoken or written words, which are essential and effective. It generally refers to how language is employed, but it means the insincere or even deceptive use of words (Hota *et al*., 2019; Cole, 2022). Within AB, the intellectual refers to fellow inquiry 'participants' as co-advisors, not objects (Owusu & Janssen, 2013). *Agricultural bricoleur* considers that agricultural advisors or educators with emerging farmers as co-advisors are human beings with emotions and feelings and have massive knowledge to contribute.

Agricultural bricoleurs become "immersed" in the phenomenon of interest, reflecting a neutral view and cognisant of their own bias and attempting to be fair in representing the views of others in the agricultural environment (Rogers, 2012; Stenholm & Renko, 2016). The role of an agricultural bricoleur is to create a learning and teaching environment in which emerging farmers as fellow co-advisors or co-educators (co-advisors) will realise their power to sort out solutions to their challenges. *Agricultural bricoleur* believes that emerging farmers (co-advisors) are humans with past experiences and feelings relating to the study and should

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be treated as partners rather than objects (Stenholm & Renko, 2016). The agricultural bricoleur with emerging farmers (co-advisors) work together to construct their reality rather than a purely objective perception of lived experience, and no such construction can claim absolute facts (Cardno *et al*., 2017). *Agricultural bricoleur* recognises that what people perceive and believe is shaped by their assumptions, prior experiences, and the reality with which they engage (Pratt *et al*., 2022). From this perspective, every theory, model, or conclusion is necessarily a simplified and incomplete attempt to grasp something about a complex reality (Ciambotti *et al*., 2023).

The epistemological stance and the methodological and theoretical approaches applicable to the social and agricultural environment are not grounded in experimental or quasi-experimental design and are not selected randomly (Busch & Barkema, 2021). Instead, agricultural bricoleurs and co-advisors present themselves based on their relevance to the agricultural environment. For example, McTaggart indicates that Moreno had used collective engagement and the idea of similar to co-advisors as early as 1913 in community development initiatives while working with sex workers in the Vienna suburb of Spittelberg (McTaggart, 2016). The idea is to build and deepen the involvement and voice of those affected by what is being engaged and, over time, to develop more radically engaged and well-founded understandings (Crane, 2011). The post-formalism of Kincheloe (2001), who has operated to advance new systems of gathering intelligence and describing intellect, is a very productive concept for collaborative guidelines amongst co-advisors, together with doing work for social justice and democratic re-allocations of power. In addition, helping by understanding race, social standards, sex, and sexual dimensions of all intellectual deeds is an advantage (Kincheloe, 2004). Post-formalism is associated with interrogations of knowledge liberation via ideological dis-embedding and a key focus on the course of self-production escalations above the formalist rationale (Mahlomaholo, 2013). Its commitment to formalising techniques constantly proposes more queries for resolution by concentrating on the demands of human self-respect, independence, power, and social duty (Ana, 2015; Avni, 2015).

6. THE TEACHING PARADIGM FOR SKILLS TRANSFER FOR THE EMERGING FARMERS (CO-ADVISORS)

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Several methods can be explored to facilitate agricultural courses. With the emergence of the new world order, agricultural advisors and educators' exposure to meaningful subject matter phased in agriculture yields content mastery (Omoto & Nyongesa, 2013). *Conventional* or *teacher-centred learning* is a non-participatory approach where students are rarely expected to ask questions or challenge academic theories (Mahini *et al.,* 2012). This approach considers students as passive receptors of information without considering the need to actively participate in the learning process (Attard, De Loio Geven & Santa, 2010). Teacher-centred learning is a teaching method whereby the teacher is primarily the giver of knowledge and wisdom to the learners (Msila & Setlhako, 2012). Observing this approach, the agricultural advisor or educator operates as the centre of knowledge and directs the knowledge process by controlling the students' access to information (Msonde, 2011).

The practicality of this approach has proven to fail with emerging farmers as adult students. Adult students prefer to learn autonomously and are in charge of their learning. They are known to dislike being treated as children without knowledge or skills. The emerging farmers have been subjected to this learning method since the democratic dispensation, and it has not yielded satisfactory agricultural knowledge utilisation amongst themselves. The approaches used by agricultural advisors have to align with the prerequisites of the adult learning principles. The adult learning principles consider the emerging farmers' lifelong skills and prior knowledge. It allows them to express themselves and circulate their knowledge amongst themselves as they learn. Therefore, it has become a powerful learning and teaching tool that agricultural advisors and educators use for emerging farmers to use their lifelong skills to address their challenges.

Learner-centred learning does not have one universally agreed definition despite being a term often used by several higher education policy-makers (Taylor & Mulhall, 2001; Tshabalala *et al*., 2014). This method will allow emerging farmers to shape their learning paths and place their responsibility to make their educational process meaningful (Hirumi, 2002; Mahini *et al.,* 2012). The term suggests an educational method that puts emerging farmers as learners at the centre, focusing on agricultural advisors or educators to the emerging farmers or learners (Attard *et al.,* 2010). Learner-centred or farmer-centred learning suggests reflecting a learning approach based on the philosophy that the student, "otherwise referred to below as the learner or farmer," is at the heart of the learning process. Van

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Eekelen *et al.* (2006), cited by Attard *et al.*, state that learner-centred learning allows emerging farmers to shape their learning paths and places their responsibility to actively make their educational process a meaningful one. The farmer-centred learning approach can create an environment where emerging farmers will share their experiences with each other, circulating their lifelong skills and experiences amongst themselves to use them to solve their problems.

The skills transfer in the agricultural context can be defined as a flow of skills between skills holders or knowledge 'generators' such as inquiry laboratories and universities and skills users such as emerging farmers (Chingware, 2014). The skills signify knowledge of agricultural enterprises' type and physical potential and include the physical and biological factors that can be modified through technology development. Therefore, technological skills refer to the flow of skills that include educational training and teaching-learning through information passage from the trainer to the trainee (Laleye, 2015). The application of skills depends on how farmers perceive technology; perception is how an individual receives information or stimuli from the environment and transforms it into psychological awareness (Vygotsky, 1996). Farmers assess expected outcomes, and their choice of action (decision) will depend on farmers' evaluation of the individual skill and other outcomes in terms of their perspectives (Tshabalala, Ndeya-Ndereya, & Merwe, 2014; Babintsev, Sapryka & Serkina, 2015).

Emerging farmers need skills that will ensure they have low input but high benefits and high economic productivity (Cankaya, Kutlu, & Cebeci, 2015). The real value of transformation depends on the knowledge base, ideas, and insights that reside in the heads or are accessible to emerging farmers when needed (Roberts & Roberts, 2006; Hunt, Birch, Vanclay & Coutts, 2014). Adults' educational learning and teaching need to be problem-focused and goal-orientated to achieve favourable improvements (Idowu, 2005; Christidou, Hatzinikita & Gravani, 2012; Jakobsone & Cakula, 2015). These skills will play a crucial role in the quality and quantity of agricultural production and, most importantly, food security (Claassen *et al*., 2014; Blignaut, 2015). Lack of post-settlement educational support to beneficiaries of land reform (Claassen *et al*. 2014) and low engagement levels of South African agribusiness and retailers with emerging farmers (Karaan & Kirsten, 2008) amount to failure in agricultural production. Technical assistance for quality and standards for the small-scale developing

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sector without access to the necessary resources, as Mashroofa and Senevirathne (2014) highlighted, could lead to failure. This solidifies the need for agricultural extension services to rethink how they disseminate information and conduct daily teaching and learning sessions for emerging farmers. To align the approach used with the adult learning principles.

7. ADULT EDUCATION FOR EMERGING FARMERS

Adult education is defined by Laleye (2015) as a process of teaching and learning that subscribe to autonomous principles that are goal and problem-orientated, bring knowledge and experience, and apply what they learned amongst others (Smarrella, 2015). Adult education uses learning and teaching techniques to display their expertise while learning from fellow emerging farmers (Havlin, Beaton, Tisdale & Nelson, 1999; Crookes, Crookes & Walsh, 2013). Adult education perspectives allow emerging farmers to invest in adult learning to achieve economic efficiency and address equity deficiencies (Eady, Herrington & Jones, 2010; Hava & Erturgut, 2010). This trend is driven by advances in information and communication technologies and reduced trade barriers (Lacy, 2011; Bernard, Msungu, & Sanare, 2013; Cankaya *et al*., 2015). The role of adult learning in productivity, innovation, and employment chances of individuals has only recently come to the fore (Rubenson, 2007).

Farmer-centred learning is a teaching approach that inspires emerging farmers to become active in the learning process; such an approach will show value in their problem-solving skills and critical thinking. The ethos behind this approach to learning changed during the second half of the twentieth century when theories of constructivism and constructionism gained popularity (Hannafin & Hannafin, 2010; Li, 2015; Awases, 2015). Changes to the pedagogical methods and educational processes should be more flexible for students and encourage them to participate as much as possible. Adult education is a proven, trialled and tested approach that guides the adult learning process and fosters emerging farmers' participation. This approach denotes that emerging farmers come to a learning centre or classroom with a wealth of knowledge that can be circulated, and each learns from it. This is because emerging farmers work daily in their working environment and are well-grounded in their farming expertise to use lifelong skills to solve their problems.

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8. CONCLUSION

The concept of Agricultural Bricolage is suggested as the most suitable since it is a flexible method appropriate to studying a structural kind, the study of social, cultural, political and religious importance operating within agricultural society. AB has toured cognitive science, technological information, innovation, and organisation theory (Owusu & Janssen, 2013). It embraces a sympathetic inquiry setting composed of field-based and interpretative contexts as a procedure and for working in a multidisciplinary situation (Kincheloe, 2001). AB conceptualises a far more robust process for structuring evidence, generating information, and telling the stories that embody it (Kincheloe, 2004). Bricolage would manifest as inefficient, trial-and-error actions based on a superficial model (Ben-Ari, 1998; Le Loarne, 2005). The bricolage approach can provide a philosophical lens for agricultural advisors to enable a sustainable learning environment for emerging farmers. Where the emerging farmers will display and circulate their knowledge amongst themselves without worrying about any professional methods used by professionals in their respective fields of practice, therefore creating an environment where they will realise their power (Wright, Knight & Pomerleau, 1999; Mahlomaholo, 2013; Li, Naughton & Nehme, 2015). In forming the Bricolage, different theoretical traditions are engaged in a wider critical theoretical/critical pedagogical context to form a baseline for a transformative model of a multi-methodological approach. Bricolage is recycled to symbolise concrete instead of an intellectual learning style (Ben-Ari, 1998). The mode of teaching, learning, and disseminating information to emerging farmers has to be goal-focused and problem-orientated, which requires a multi-methodological approach. The bricolage approach allows various available pieces to solve existing problems simply by using the knowledge freely available in the context of emerging farmers. I think emerging farmers will learn best in a fun and open learning environment with a shared balance of power between the agricultural advisors and emerging farmers and everyone engaging as equals. The adult education approach by agricultural advisors and educators taking a posture of the bricoleur as a guiding theory will empower agricultural advisors and educators to create a sustainable learning environment for emerging farmers, making them realise their power.

9. CONFLICT OF INTEREST

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The authors declare that there is no conflict of interest in this manuscript.

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Validating Small-Scale Sugarcane Farmers' Climate Perceptions Through Scientific Climate Data to Enhance Awareness of Climate Change: The Case of Swayimana Area in KZN Midlands, South Africa

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ABSTRACT

Climate change is a serious challenge that poses an additional problem to the many existing difficulties in the agricultural sector. It will likely exacerbate an already dire situation by making current production methods less sustainable. Previous studies concluded that most people in developing countries perceive climate change as a spatially and temporally distant threat. However, recent studies have raised a new narrative, suggesting that rural communities are becoming more aware of climate change and variability. The study, therefore, aimed to compare the perceptions of climate change among small-scale sugarcane farmers with scientifically observed climate trends in the study area. The study mainly analysed rainfall and air temperature trends over twenty years and compared these with climate change, as farmers in the study area perceived. Additionally, it assessed whether the participants had implemented adaptation plans to minimise the adverse effects of the observed climate variations, both scientifically and perceptually. The study findings indicate that small-scale sugarcane farmers perceive climate change fairly accurately. Less than half of the small-scale sugarcane farmers (nearly 40%) observed increased temperatures, rainfall, drought frequency, and frost occurrence. Their perceptions aligned with the findings from the scientific data, which indicated that maximum temperature has been increasing at 0.049 ^{o}C per annum^{-1} from 1997 to 2017 while the rainfall showed an increase of 15.475 mm per annum^{-1} over the same period. These findings confirm that these farmers are becoming more aware of climate change occurring in their communities. However, the study results also show that despite the accurate

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perception of climate change, farmers struggle to adapt to this accurately perceived climate change. This highlights their vulnerability to climate change due to a lack of adaptive capacity. The study recommends government intervention to facilitate improved collaboration between academics and farmers for information sharing to identify possible adaptation strategies for small-scale farmers.

Keywords: Climate Change Perception, Climate Change Awareness, Adaptive Capacity, Small-Scale Farming

1. INTRODUCTION

Climate change remains a significant challenge restricting sustainable development progress in many African countries. Climate change will likely aggravate the difficult situation by making the current livelihoods unsustainable, leading to deeper poverty. Climate change studies show that most parts of Africa are already experiencing significant climatic changes, which are expected to intensify in the future (Abiodun *et al.*, 2019; Karypidou *et al.*, 2021). High surface temperatures, dry conditions and intense rainfall patterns have become prevalent in southern Africa and are anticipated to intensify (Ujeneza & Abioudun, 2015; Abiodun *et al.*, 2019). Developing countries with most of their population depend on agriculture for food and income (Mabhaudhi et al., 2018) and, therefore, must improve their resilience. Specifically, rural small-scale farmers whose livelihoods depend on natural resources will probably bear the brunt of adverse effects. Recurring droughts and other extreme weather events threaten the sustainability of small-scale agriculture, particularly in rural areas where farmers already face other challenges (Mabhaudi *et al.*, 2018). As a result, small-scale farmers are considered one of the most vulnerable groups to climate change and climate variability (Harvey *et al.*, 2018). This necessitates a better understanding of climate change and variability to design relevant adaptation strategies that deal with how climate change impacts small-scale agriculture. This understanding is predominantly needed by smallholder farmers who often suffer the consequences of local and global environmental changes (Mkonda *et al.*, 2018). The literature highlights smallholder farmers' lack of climate change knowledge, resulting in a low adaptive capacity (Ncoyini *et al.*, 2022; Popoola *et al.*, 2020; Lazo, 2015). As such, a lack of knowledge among small-scale farmers exacerbates their vulnerability to the adverse effects of climate change and extremes.

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There is a consensus that without scientific information, farmers can use their climate observations and experiences to make necessary agricultural production changes. Farmers who perceive climate change are more likely to pay attention to adaptative actions. Madison (2007) suggests that climate change adaptation requires farmers to first notice that the climate has changed. It is argued that people who are already proactive in climate change adaptation started by perceiving and understanding that the local climate was changing (Hasan & Kumar, 2019; Tesfuhuney & Mbeletshie, 2019). People's perception of climate change is a collective awareness of how climatic parameters have changed over the past years. It is defined as an awareness of the trend in climatic factors such as rainfall, temperature, extreme weather events, and the onset and end of the wet season (Tesfuhuney & Mbeletshie, 2019). Numerous studies have been conducted to understand climate change perception amongst the public (Acquah & Onumah, 2011; Maponya & Mphandeli, 2013; Kibue *et al.*, 2015; Elum *et al.*, 2016; Mkonda *et al.*, 2018; Tesfuhuney & Mbeletshie, 2019; Diniso *et al.*, 2022). Some studies revealed that the public perceives and understands climate change (Kibue *et al.*, 2015; Elum *et al.*, 2016; Tesfuhuney & Mbeletshie, 2019), while others reported a lack of climate change awareness, particularly among small-scale farmers (Maponya & Mphandeli, 2013; Diniso *et al.*, 2022). However, although some studies claim that the public perceives that the climate is changing, the assertion often associates a high level of climate change awareness with simply hearing about it (Kibue *et al.*, 2015). It is important to differentiate between hearing about the climate change concept and perceiving climate change. People often dismiss any subject if its influence is not evident on their livelihood (Diniso *et al.*, 2022). Previous studies have shown a poor understanding and perception of climate change among Africans. For example, Tederera (2010) indicated that South Africans often refer to climate change as "changing weather". Also, Diniso *et al.* (2022) reported that most of the study participants could not comprehend the influence of global warming on climate change. This misunderstanding is of great concern, given that it may adversely influence the extent of adaptation.

In addition, the fact that sub-populations within a specific region may experience climate changes differently needs to be considered. Everyone must first notice that the climate is changing so that everyone can respond to it. Thus, local knowledge is essential for determining how individuals respond to climate change. Kruger & Nxumalo (2017) have indicated that meteorological stations within proximity can show different trends. Thus, they cannot be completely associated with climate change; they can also be associated with other influential

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local factors. The observed difference in climatic trends may indicate diverse climate conditions experienced by communities within the same region. Kruger (2006) highlighted the low density of weather stations in KwaZulu-Natal (KZN), and MacKellar *et al.* (2014) argued that stations within the same hydroclimatic area may fail to represent the heterogeneity of the area. Kruger & Nxumalo (2017) emphasise that rainfall amounts across districts lack homogeneity, particularly in areas with complex topography. This highlights that those farmers within the same district can experience and observe different climate variations.

Previously, climate change studies focused more on climate change and its impacts based on climate change scenarios, using solely measured climatic data and models (James & Washington, 2012; Engelbrecht *et al.*, 2015; Dosio, 2017). Similar studies in the study area analysed climate change based only on measured climate data (Strydom & Savage, 2018; Ndlovu *et al.*, 2021). The differences observed in different weather stations indicate that a successful understanding of climate change is not only limited to the values of climate parameters but also includes climate variability and associated extreme weather events, as well as the understanding of these by local people experiencing these changes. Therefore, an in-depth study was needed to determine small-scale farmers' climate change experience against measured climate data. Hence, this study compares small-scale sugarcane farmers' climate change perceptions with scientifically observed climate trends. The study also assessed whether the participants had adaptation plans to minimise the adverse effects of the climate variation observed scientifically and perceptually.

2. MATERIALS AND METHODS

2.1. Study Site

The Wartburg area is situated in KwaZulu-Natal, southeast South Africa. It is located at 29.4332 ^{o} S and 30.5812 ^{o} E at 1000 m above sea level. The study site is characterised by a subtropical climate with warm, wet summers and cool, dry winters with a long-term annual average rainfall of 881 mm and an average air temperature of 18^{o}C. The study area is amongst the regions with high-quality farming in the province and specialises in sugarcane production under dryland conditions. The survey data was collected from a rural farming community called Swayimana. This community is situated to the East of Pietermaritzburg. Farming serves as a primary source of livelihood in the area. The area is characterised by good rainfall and arable soils; hence, it is predominantly used for agricultural production.

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2.2. Survey Data Collection Method

The study used a random sampling technique to select the prospective participants. Face-to-face interviews were conducted following a questionnaire guide for data collection. The questionnaire consisted of both open- and closed-ended questions. The inclusion of open-ended questions was intended to allow respondents to provide insight into their personal experiences. Despite having access to meteorological data for analysis and guidance in compiling options for them to select from, it was felt that the results would likely be biased and fail to reflect their true observations and experiences. The interviews were conducted over two months (from 13 December 2018 to 05 February 2019). These were carried out individually and in a native language (isiZulu) to ensure the prospective respondents understood the questions well. A total of 66 questionnaires were completed through the interviews. This represents 30% of the sugarcane farmers in the study area.

2.3. Meteorological Data and Methodology

The meteorological data used in this study were accessed from the South African Sugarcane Research Institute (SASRI) through the SASRI website. The study analysed data from Bruny's Hill weather station located 29^{o} 25' 0" South and 30^{o} 41' 0" East and at an altitude of 990 m. The study analysed annual and monthly data over 20 years (1998 – 2018). The weather station was selected based on its vicinity to the Swayimana community in Wartburg, where the survey was conducted. The datasets included daily, monthly and yearly data on maximum and minimum air temperature and rainfall. The study analysed average annual air temperature and rainfall trends. The daily data were used for the calculation of drought indices. The data was collected from an automatic weather station and was of good quality with no missing values.

2.4. Drought Indices Used in the Study

The Standardised Precipitation Evapotranspiration Index (SPEI) was used to analyse historical drought trends at the study site. The SPEI has been extensively used for defining and monitoring drought in many parts of the world (Khan *et al.*, 2017; Lee *et al.*, 2017; Jang, 2018), including southern Africa (Edossa *et al.*, 2014; Botai *et al.*, 2016; Botai *et al.*, 2019). The SPEI is preferred for drought characterisation over the Standardised Precipitation Index (SPI) because its calculations consider the effects of air temperature on drought occurrences. It is computed as the difference between precipitation (P) and potential evapotranspiration (PET). This study employed the SPEI script embedded in R software (R Core Team, 2013) to calculate the drought

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index. The potential evapotranspiration used for drought index calculations was computed using the Hargreaves air temperature-based method (Hargreaves & Samani, 1985). This is calculated based on the daily maximum and minimum air temperature range and the latitude of the study site. The Hargreaves air temperature-based method is believed to produce sensible results because it is linked to solar radiation through the daily air temperature range and the mean extraterrestrial radiation (Yates & Strzepe, 1994). A detailed description of the SPEI calculation can be found in Beguería *et al.* (2014).

3. RESULTS AND DISCUSSION

3.1. Demographic Information of the Participants

According to Table 1, sugarcane small-scale farmers are evenly distributed in gender, with the percentage of male farmers (51%) slightly higher than female farmers (49%). The participants' age distribution ranged from the late 20s to over 60. The results of this study reflect the reality of farmers' ages in the agricultural sector. In South Africa, the average age of farmers is 62 years (Sihlobo, 2015), partly due to a continuous decrease in youth participation in agriculture since early 2000, particularly in rural areas (Cheteni, 2016). The literacy level of the participants reflects their age. Most elderly people in South Africa are uneducated (Khuluvhe, 2021), and this study confirms that the majority of the participants only had primary education. Over 77% of the participants produced sugarcane in a piece of land less than 2 ha in size. Twenty percent of the participants have been farming for five consecutive years or less after taking a long break from production due to substantial losses occurring in the past.

TABLE 1: Demographic Results of the Respondents (n = 66)

Variables	Description	Responses (%)
Gender	Male	51
	Female	49
Age (years)	<40	24
	41-50	20
	51-60	25
	>60	31
	Primary	52

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Literacy level		
	Secondary	46
	Bachelor degree	2
Farm size (ha)	<1	30
	1-2	47
	>2	23
Farming experience	<1	3
	1-5	17
	5-10	40
	>10	40

3.2. Scientifically Measured Climate Data Trends Versus Trends in People's Perceptions of Climate

The controversy in climate change perception studies has been clear enough to stimulate interest in local studies to better understand climate change perception amongst the public in rural farming communities. Initially, it was concluded that most people in developing countries perceive climate change as a spatially and temporally distant threat (Maiella *et al.*, 2020). However, recent studies (Elum *et al.*, 2016; Tesfuhuney & Mbeletshie, 2019) raised a new narrative, indicating that rural communities have started observing and experiencing climate variations in their respective communities. This implies that rural communities are becoming more aware of climate change and variability (Elum *et al.*, 2016; Tesfuhuney & Mbeletshie, 2019). This study utilised meteorological data from a nearby weather station to study local climate trends, particularly rainfall and air temperature, over twenty years. The study results are presented in Figures 1 and 2 and Table 2. The results of the study suggest a significant ($p < 0.05$) decrease in minimum air temperature (Tmn) and a negligible reduction in maximum air temperature (Tmx) over the 20 years under study. The rainfall trends also suggest a significant ($p < 0.05$) increase for the study site.

Minimum temperatures have been reported to increase faster than Tmax in various parts of the world (He *et al.*, 2020); however, the study results suggest a decreasing trend of Tmn throughout 1998-2018, indicating that the study area is becoming cooler. The Tmn significantly

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decreased at 0.05 ºC per annum^{-1} for 1998-2018. This decrease has also been observed at a nearby station in Cedara (Kruger *et al.*, 2019). Given global warming, it is difficult to explain the possible reason behind the decreasing minimum air temperature at the study site. However, it is fair to highlight that the 2014 frost event might have contributed to the decreasing Tmn trend (Ramburan *et al.*, 2015). The decreasing Tmn trend might also confirm the influence of other factors rather than climate change (Kruger & Nxumalo, 2017)**.** For instance, factors that affect microclimate also tend to significantly influence atmospheric variations at a local level. These factors encompass elements such as land use, topographical aspects, land cover, and proximity to the ocean. Drought also influences the decrease in Tmn due to the absence of clouds and insufficient water vapour to enhance downward longwave radiation. Because clouds act as insulators for nighttime temperatures, their absence causes efficient heat loss from the surface (Lopez-Diaz *et al.*, 2013). Therefore, this suggests that dry conditions increase maximum temperatures but decrease minimum temperatures, increasing the diurnal temperature range.

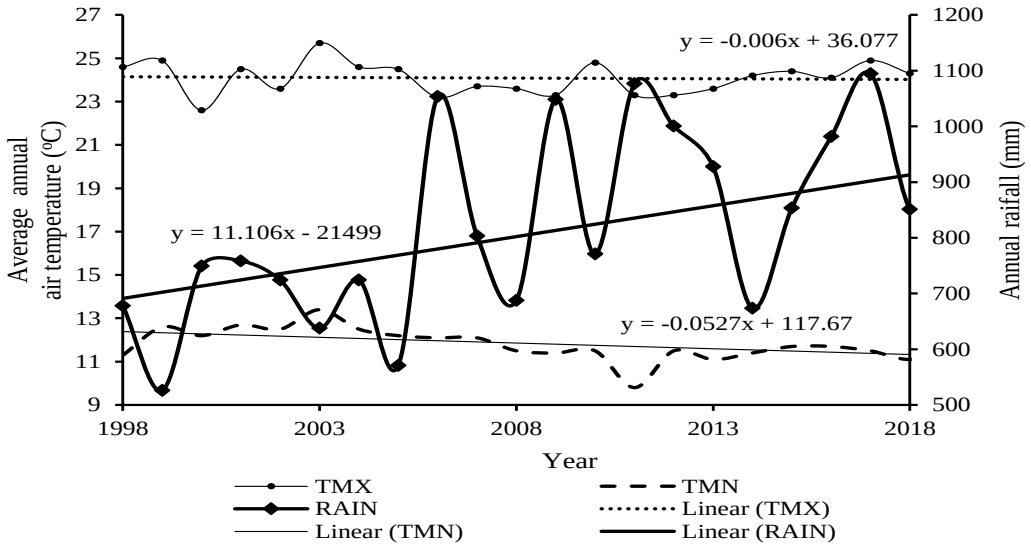

FIGURE 1: Average Annual Air Temperature and Total Rainfall Variation for Bruny's Hill Station From 1998 to 2018

The negligible decrease in Tmx is not aligned with the widely acknowledged Tmx increase worldwide (Halimatou *et al.*, 2017; Aguilar *et al.*, 2005; Larbi *et al.*, 2018). However, these results partly concur with Kruger & Nxumalo (2017) and Kruger *et al.* (2019), who found no

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change in maximum air temperature trends in a nearby weather station from 1931-2015 and 1951- 2005, respectively. The study results suggest that local factors might influence local climate trends more than a global phenomenon. Figure 2 shows the trend over a decade (2007 to 2017), and Figure 3 indicates small-scale farmers' perception of climate variability in the study site over the same period (2007 to 2017). Over a decade, there has been an insignificant increasing Tmx and rainfall and an insignificant decrease in Tmn.

Based on their experience and observations, small-scale farmers indicated that they noticed some climate change from 2007 to 2017. Figure 3 shows that over 35% of the participants observed increased rainfall and air temperatures. Their observations are aligned with the measured climatic data from Bruny's weather station. According to the results, over the 2007 to 2017 period, the study site experienced a maximum air temperature increase of 0.049 ^{o}C annum $^{-1}$ and a rainfall increase of 15.475 mm per annum^{-1}. Although an increase in annual rainfall has been observed, it does not automatically translate to good rains for agricultural production. Ncoyini-Manciya (2021) reported an increase in the yearly maximum one-day precipitation (RX1day) and annual total rainfall from daily precipitation greater than the 95th percentile (R95p) indices, which indicates that high amounts of rainfall are received over a relatively short period.

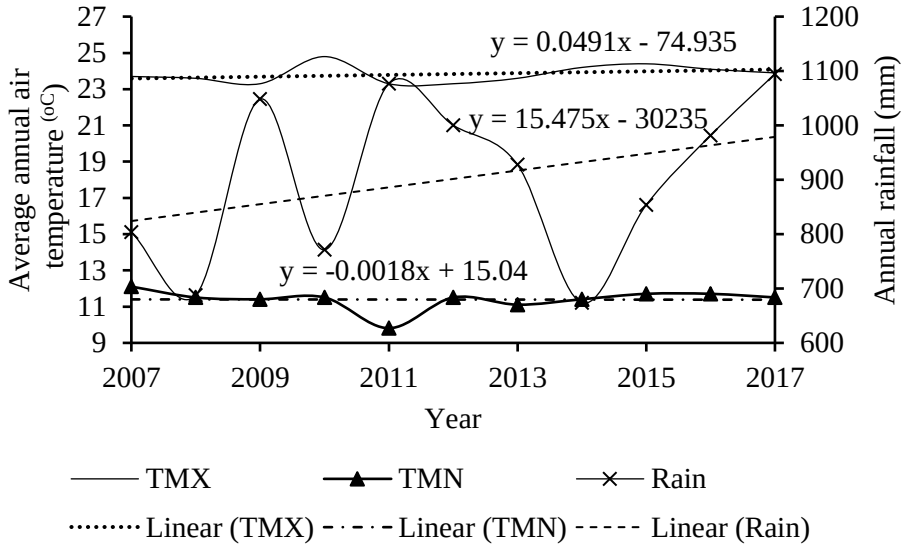

FIGURE 2: Average Annual Air Temperature and Total Rainfall Variation for Bruny's Hill Station From 2007 to 2017.

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Secondly, some small-scale farmers have also observed frequent extreme weather events and drought occurrences at the study site. The rainfall trends found in the study site are consistent with Trenberth's (2011) statement, which states that as air temperature continues to increase due to high greenhouse gas concentration in the atmosphere, the water-holding capacity of air will also increase, leading to the greater moisture content in the atmosphere. Consequently, precipitation will increase due to high atmospheric content and warmer air temperatures (Fowler & Hennessy, 1995).

TABLE 2: Regression Results for Annual Rainfall and Average Annual Air Temperature From 1998 to 2018

Variable (1998- 2018)	**Slope**	**p-value**
Tmax	-0.006	0.512
Tmin	-0.070	0.006
Rain	16.640	0.003
Variable (2007- 2017)	**Slope**	**p-value**
Tmax	0.049	0.322
Tmin	-0.002	0.311
Rain	15.475	0.975

The perceived frost occurrence aligns with the observed decreasing Tmn in the study site. The perceived prevalence of frost events may be partly attributed to the topography. Areas with high altitudes (>800 m) tend to experience cooler climate conditions. Some farmers observed delays in rainfall season start (7%) or storms and wind (17 %), while others perceived no change (5%). High rainfall, high temperatures, and drought occurrences were among the most perceived climate changes at the study site. The measured data from the weather stations correspond with the farmers' observation, showing increased rainfall and maximum temperatures.

According to Nhamo *et al.* (2019), the Southern African region has been experiencing an increase in the frequency and intensity of drought. Climate change perception results (Figure 3) indicate that some farmers, although only 10%, have observed an increase in the frequency of extreme weather events. Based on the findings, the prevalence of high rainfall, high temperatures, and drought were amongst the area's most common climate/weather extremes. To validate the drought trend perception, the study employed the SPEI to compute drought

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indices for the period under study. Figure 4 shows the drought index results calculated using measured meteorological data.

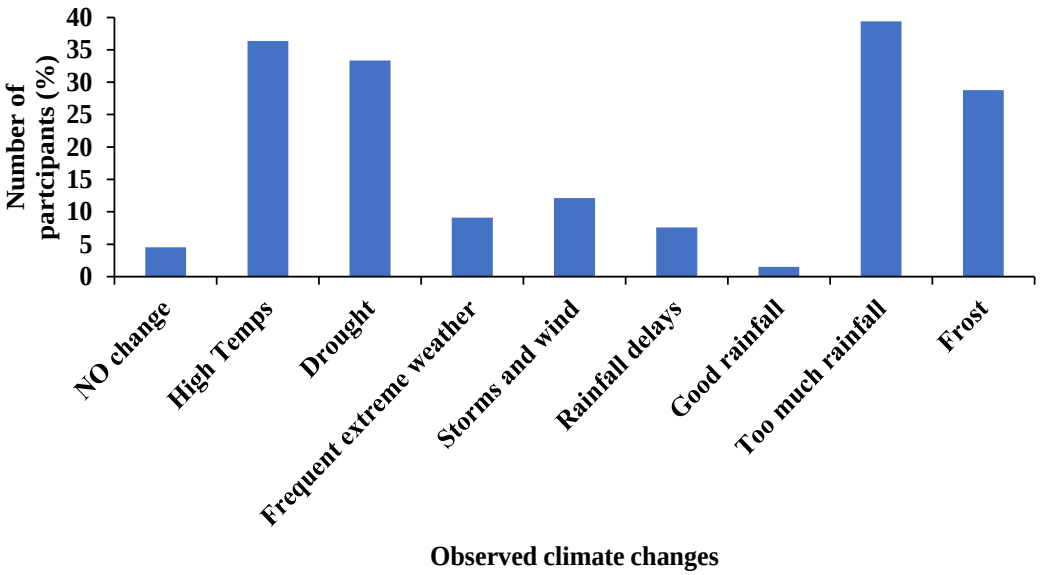

FIGURE 3: Perceived Climate Change in the Wartburg Area From 2007 to 2017. *(participants selected more than one option)*

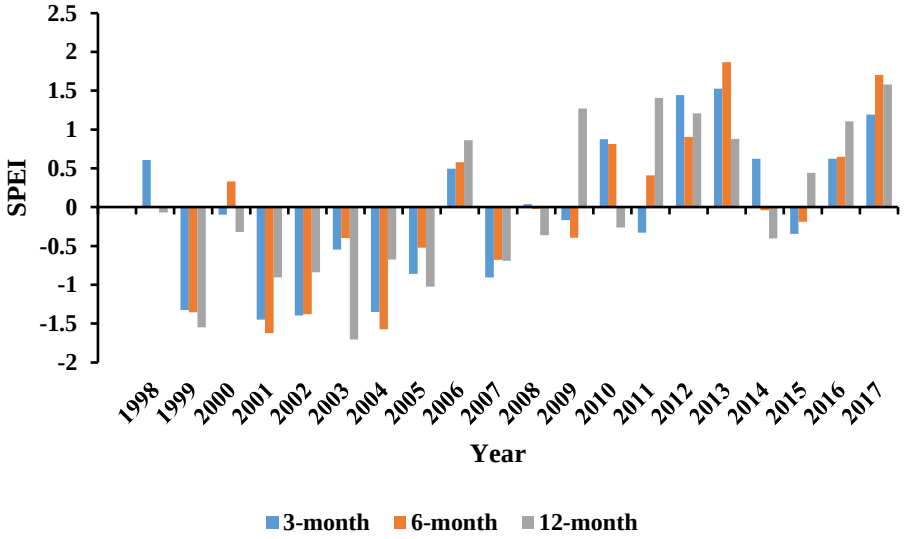

FIGURE 4: Drought Events Characterised by SPEI From 1998 to 2018.

The SPEI results indicate that the study site has experienced both dry and wet conditions over the 2007 to 2017 period. The SPEI results concur with the wet and dry patterns the farmers

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have been observing, with extreme wetting trends more frequent than extreme drying. The prevalence of wet and dry conditions in the study site confirms the increased frequency of extreme weather events as perceived by the study participants. However, severe drought events occurred before 2007. The study findings concur with Kibue *et al.* (2015), Elum *et al.* (2016), and Tesfuhuney & Mbeletshie (2019) that small-scale farmers perceive and understand climate change occurring in their respective areas.

3.3. Adaptation Strategies Employed by Sugarcane Small-Scale Farmers in KZN Midlands

Figure 5 indicates sugarcane small-scale farmers' adaptation strategies to deal with the perceived climate changes in the study site. Fifty-five percent of the participants indicated that they did not have any strategies in place for minimising the adverse effects of perceived climate change. At the same time, about 40% of them relied solely on mulching. They reasoned that mulching was adopted based on what they observed from the nearby commercial farmers. They did not understand the reason for the application of mulch, but they decided to apply it. That aside, the results confirm that despite the observed increase in drought frequency and projected prevalence of drought events in southern Africa, sugarcane small-scale farmers have no plans to adapt to climate change. The study findings are aligned with the lack of adaptative capacity among small-scale farmers, which has been extensively discussed in the literature (Dasgupta *et al.*, 2014; Ofoegbu *et al.*, 2016; Karienye & Macharia, 2020). Subsequently, a decline in small-scale farmers' production has been noted (Mnisi & Dlamini, 2012), and this decline is partly attributed to extreme weather events (Dubb, 2013). The minimal adaptive capacity that is evident emanates from restricted funds and limited knowledge of the possible adaptation strategies. Furthermore, illiteracy has been reported to cause poor crop husbandry practices among sugarcane small-scale farmers in South Africa (Eweg *et al.*, 2009; Zulu *et al.*, 2011).

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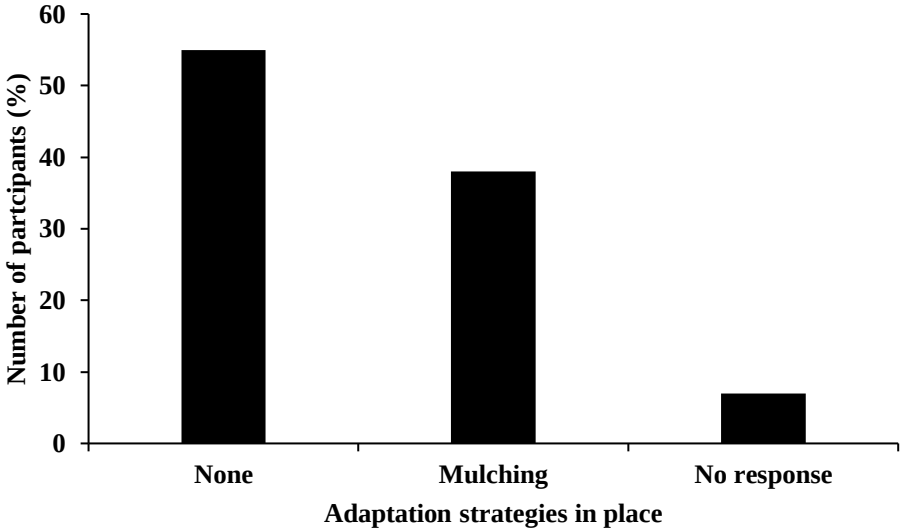

FIGURE 5: Strategies Adopted by Sugarcane Small-Scale Farmers in the Study Site.

4. CONCLUSION

The study intended to compare the meteorological data available with the climate change perceptions of small-scale farmers in the study area from 2007 to 2017. The meteorological data results indicated the exact climate change that farmers perceived. The study findings suggest that farmers are becoming more aware of the climate changes in their respective areas. This implies that farmers no longer perceive climate change as a distant threat but rather as a serious issue that needs to be dealt with. However, farmers struggle to adapt to climate change successfully and sustainably due to a lack of knowledge, funding, and high illiteracy levels. Therefore, the study findings encourage improved collaboration between farmers and academics or researchers for better information sharing that would capacitate them on possible adaptation strategies. Farmers would benefit from further training on climate change. Thus, it is recommended that the government intervene to facilitate the necessary collaboration for this purpose. This study only focused on small-scale sugarcane farmers in a specified study site. Future research could broaden the study area and/or include small-scale farmers in general from regions near a weather station to study their perceptions of climate change versus measured climate data from a weather station.

5. AVAILABILITY OF DATA AND MATERIALS

The datasets used in this study are available from the provided website. The data from the survey is available on request.

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6. CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The Influence of Capacity Building on Small-Scale Agro-Processors in South Africa: Lessons for Agricultural Extension Advisory Services

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ABSTRACT

This paper examines capacity building from the perspective of business growth and success in small-scale agro-processing enterprises. Our analytical approach was underpinned by the inability of small-scale agri-enterprises to grow and succeed despite the South African government's support for capacity building through the economic empowerment programme initiative in the past three decades. The study was conducted in five of nine selected South African provinces (Gauteng, Limpopo, North-West, Free State, and Mpumalanga). This study was essential for developing an effective strategy for enhancing agri-business growth and success in South Africa. A concurrent mixed-methods research design was used, and data from 503 small-scale agro-processors was analysed using descriptive and multiple regression analysis techniques. The results revealed that capacity building ($\beta = 0.274$, $p = 0.000$) significantly influences the economic empowerment of small-scale agro-processors. Furthermore, the study showed that mentorship and technical and financial skills are critical types of capacity building that influence the economic empowerment of small-scale agro-processors in South Africa. It is recommended that all government or private stakeholders, including agricultural extension advisory services, invest in capacity-building programmes for

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small-scale agro-processors to achieve economic empowerment. Economically empowered small-scale agro-processors will significantly contribute to employment creation and better income distribution.

Keywords: Capacity Building, Human Capital Theory, Small-Scale Agro-Processors, Agricultural Extension Advisory Services

1. INTRODUCTION

Numerous studies have shown that capacity building plays a vital role in the growth and development of small-scale agro-processors (Owoo & Lambon-Quayeflo, 2018; Mkuna, Walaila & Isaga, 2021; Bittar, Raphel & Rawago-Odoyo, 2022; Mthombeni, Antwi & Oduniti, 2022). Human capital theory insinuates that an educated population is productive (Olaniyan & Okemakinde, 2008; Aladejebi, 2018). Furthermore, Schultz (1971), Sakamota and Powers (1995), Psacharopolous and Woodhall (1997), and Aladejebi (2018) argued that the human capital theory is centred on the assumption that formal education can lead to and is vital to improving the production capacity of a population. Human capital theorists' postulate that there is a direct positive relationship between formal education and the productive capacity of a population (Aladejebi, 2018).

The agro-processing sector plays a considerable role in South African society's socioeconomic development (Manasoe, Mmbengwa & Lekunze, 2021a). For example, the South African food industry employs 46 percent semi- and unskilled labour, 40.3 percent mid-level skills and only 7.1 percent high-level skills (Gebrehiwet, 2012). Hence, due to the forward and backward linkages, it is identified and prioritised in various development policies such as the National Development Plan, Industrial Policy Action Plan, and New Growth Plan. Multiple studies demonstrate the significance of small-scale agro-processing enterprises (Sinek, 1995; Mohamed & Mnguu, 2014; Daninga, 2020; Manasoe *et al.*, 2021a). Agro-processing comprises manufacturing activities that transform raw materials and intermediate products from agriculture, forestry, and fisheries (FAO, 1997; Mazungunye, 2020). In developing and transitioning countries, agro-processing activities dominate the manufacturing sector. These activities contribute 52 percent, 36 percent and 32 percent of the total value-added of manufacturing in low-, middle-, and upper-middle-income countries, respectively. Their contribution can be even higher in agro-based countries. In addition, about 4-5 percent of the

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total value-added in the low and middle-income countries is from agro-processing. Thus, agro-processing is vital in contributing to the economy's output. Agro-processed products comprise a significant part of these countries' exports (Mazungunye, 2020).

Small-scale food enterprises have played a vital economic role in employment creation and better income distribution. According to Hlatshwayo et al. (2021), small-scale agro-processors provide about 70% of employment in rural households. Furthermore, the small-scale agro-processors serve as a training ground for entrepreneurs before they invest in larger enterprises. Small-scale food enterprises also have essential linkages to related industries, such as manufacturing machinery, food packaging materials, and suppliers of food ingredients (Sinek, 1995). Furthermore, Daninga (2020) and Manasoe *et al*. (2021a) assert that small-scale agro-processing industries in sub-Saharan Africa are potential sources of livelihood for most disadvantaged people. The small-scale agro-processors have a functional role in employing workers at low capital cost, generating higher production volumes, introducing innovation and entrepreneurship skills, increasing exports, and distributing income across the country due to increased profit accrued from increased investment (Mohamed *et al*., 2014; Chichaybelu *et al*., 2021). However, the contrary can be assumed in South Africa, where agro-processing and agriculture are premised on a dualistic system.

In South Africa, commercial agriculture is the leading player in the agro-processing industry, supplying major retailers and export agencies. Large-scale commercial farmers are typically considered the main drivers of national food security, producing about 80% of the country's food (Giller, 2020). In contrast, small-scale agro-processing plays a limited role in supplying agro-processed products commercially despite receiving the government's perpetual financial and non-financial support (Mmbengwa, Rambau & Qin, 2020), which includes, amongst others, entrepreneurial assistance, access to capital, business and incubation, industry research and technology transfer, and infrastructure investment (Department of Agriculture, Forestry and Fisheries, 2016). Although small-scale agro-processors receive the government's support, their growth and expansion do not resonate with the corresponding support, leading to policymakers questioning the rationale for supporting these entrepreneurs. A systematic under-investment characterises South Africa's human capital (Thwala& Phaladi, 2009). Studies show that most small-scale agro-processing enterprises in most African countries are operating below capacity (inefficiently) due to the absence of capacity building (Shitu, Sakia, Meti, & Maraddi,

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2013; Rambe & Agbotame, 2018). In addition, they lack sustainability due to a lack of technical and managerial skills (Shitu *et al*., 2013; Rambe *et al*., 2018).

Various studies have shown that capacity building contributes to economic growth but also the social development of local people (Cheers, Cock, Kruges & Trigg, 2005; Madu, 2019). Furthermore, capacity building can be considered essential and related to rural development and, simultaneously, the sustainability of rural development projects (Flora et al., 1999; Madu, 2019). Capacity building of farmers towards equipping them with crucial information about markets is of paramount necessity (Shitu *et al*., 2013). Furthermore, capacity building is defined as the development of skills and capacities, enhanced knowledge, and information exchange between the actors involved in innovation, including farmers and their organisations, agricultural research, education and training institutions, extension and advisory services institutions, and the researchers and professionals working in the agricultural sector. Proper training, capacity building and investment in relevant physical and scientific infrastructure are necessary to ensure that the country has the requisite absorptive capacity to benefit from the numerous technology initiatives and efforts going on within and outside its frontiers (Banji & Sampath, 2007; Kinyanjui, Kabare & Waititu, 2018). Capacity building for agro-processing firms is critical to their growth and success. Government interventions must be refocused to provide training incentives for firms willing to relocate. It concluded that capacity building based on technical skills might be required to ensure that these entrepreneurs effectively carry out their entrepreneurial duties (Nyame & Caesar, 2022). According to Aladejebi (2018), some researchers consider capacity building an antidote to hunger, poverty, diseases, crises, and the stimulation of economic activity. Furthermore, capacity building involves equipping people with the knowledge, skills, information, and training to carry out their functions effectively in a nation.

However, the lack of capacity building in South Africa's small-scale agro-processing enterprise sector is dire. The study's objectives were to outline the socioeconomic characteristics of South Africa's small-scale agro-processing enterprises regarding gender, age, and educational background and to analyse the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa. The capacity of small-scale agro-processors is extremely weak. Henceforth, the study aims to analyse the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa.

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2. PROBLEM STATEMENT

Since the dawn of democracy in 1994, the South African government adopted a transformation policy that included the economic empowerment of small businesses. In addition, the agricultural and agro-processing sector was prioritised for support due to its backward and forward linkages in the economy. Various initiatives were developed to support small-scale agro-processors, including capacity-building programmes. Despite the commitment from the government and the huge investments made to assist small-scale agro-processors in being integrated into commercial agrifood chains, actual success stories of emerging farmers successfully operating in commercial agrifood chains are scarce. A study by Mthombeni et al. (2022) shows that despite the government's investment capacity-building programmes, most small-scale agro-processors have no formal training on good processing practices.

The study's main objective was to examine the impact of capacity building on the economic empowerment of small-scale agro-processors in South Africa. This study is significant to SME owners and managers in capacity building and benefits. Also, this study is vital to policymakers, academics, potential investors, and government agencies. Concerning the roles they can play in improving the human capacity building of small-scale agro-processors.

3. THEORETICAL FRAMEWORK

This article is premised on human capital theory, which posits a reciprocal relationship between human capital, productivity, and income (Fix, 2018). According to Fix (2018), the human capital theory originated in the mid-20th century work of Mincer (1958), Schultz (1961), and Becker (1962). The human capital theory assumes that education determines labour's marginal productivity and earnings (Marginson, 2017). Furthermore, Marginson (2017) indicates that the lifetime earnings of educated labour define the value of an investment in education. Education, work, productivity, and earnings are seen in the linear continuum. Graduate earnings follow when educated students acquire the embodied productivity (the portable human capital) employers use.

According to Namasivayam and Denizci (2006), human capital refers to education, knowledge, work competence, and psychometric evaluations. In addition, Aliu and Aigbavboa (2019) define human capital as an individual's skill, knowledge, health, and creativity. According to Aliu *et al.* (2019), Adam Smith argues that education and training are the bedrock of human capital in any society. Furthermore, Aliu *et al.* (2019) indicated that centuries later, Marshall

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(1965) supported Smith's postulations, described education as a national investment, and highlighted that the most valuable capital is invested in humans. Like most theories, the human capital theory is not exempted from criticism. Over time, various researchers have criticised the theory for being too basic in its assumption. They have reasoned that education alone cannot influence organisational productivity but must complement other constructs (Aliu *et al.*, 2019).

Aliu *et al.* (2019) have identified the key features of human capital: knowledge and skill, creativity and innovation, competitive advantage, and increased customer satisfaction with the organisation. The knowledge and skills feature proposed that training is a considerable investment in workers that fosters their skills and abilities in handling workplace problems. While the competitive advantage feature alludes, organisations must seek to encourage creativity and innovations to align themselves with the present complexities and convolutions characterising the world of work (Namasivayam & Denizci, 2006). On the third feature, Namasivayam *et al.* (2006) indicate that in establishing a competitive edge, organisations must seek to create a distinction from their competitors by acquiring the services of more knowledgeable and skilled employees. Lastly, the increased customer satisfaction from the organisation opines that employees who display a high quality of service delivery tend to create a positive vibe among customers that positively influences their loyalty to the organisation, which can lead to increased financial benefit for the firm. The human capital theory affects economic growth and can help develop the economy by expanding its people's knowledge and skills, including small-scale agro-processors.

The agricultural extension and advisory services or agricultural extension officers are defined as systems that should facilitate the access of farmers, their organisations, and other market actors to knowledge, information, and technologies (Ali, Hamad, Abdallh, & Elagab, 2020). The agricultural extension officers play a critical role in the capacity building in the agricultural sector. However, various authors differ in terms of the role the agricultural extension officers have to play. According to an article by Mkuki and Msuya (2020), agricultural extension officers are grouped into two broad categories: process and technical skills (Suvedi & Kaplowitz, 2016). However, Agricultural for Impact (2015) states that AEOs' roles are categorised as technology transfer, advisory, and facilitation. Also, Moris (1987), as cited by Mattee (1994), grouped AEOs' roles into two categories: educational and advisory. Based on the literature reviewed and the author's experience in the extension field, the seven categories of roles were formulated to help understand the AEO's perception of their roles. These include

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facilitation, organisational, intermediation, educational, technical, advisory, and administrative roles. According to Takemura, Uchida, and Yoshikawa (2014), agricultural extension officers assist small-scale agro-processors with technical and social matters.

Furthermore, within the agricultural extension and advisory services, extension isn't merely occupying a bridge position. Still, it facilitates improving the efficiency and effectiveness of both the farmer and the research to facilitate the transfer of agricultural technologies among the farmers (Rivera et al., 1997). The extension starts with knowledge management and ends with human enrichment. By its nature, agricultural extension has an important role in promoting the adoption of new technologies and innovations (Jamilah et al., 2010). Through education and communication, agricultural extension changes farmers' attitudes, knowledge, and skills. The role of agricultural extension involves disseminating information, building farmers' capacity through various communication methods, and helping farmers make informed decisions (Sinkaiye, 2005). Extension services can be crucial in providing information on sustainable agricultural education. Thus, the role of extension is very important in supporting sustainable agriculture, which is moving from production to a wider set of sustainability (Salem, 1994; Rahman, Mardiningsih & Dalmiyatun, 2018).

4. METHODOLOGY

4.1. Study Area and Research Design

The study was conducted in five provinces of the Republic of South Africa: Gauteng, Limpopo, North West, Free State, and Mpumalanga (see Figure 1). The focus of the study was on the small-scale agro-processors located in these provinces. These provinces combined account for 55% of South Africa's population and 64% of its agri-business economy (StatsSA, 2018; Mthombeni *et al*., 2021). Lastly, the study area accounts for 60.5% of South Africa's economy. The World Bank (2020) data shows that South Africa had an 87% adult literacy rate in 2020, ranking below countries such as Mexico (95%), Brazil (93%), and Azerbaijan (99.8%). At the same time, South Africa's Human Development Index value for 2019 is 0.709, which places the country in the low human development category, positioning it at 114 out of 189 countries.

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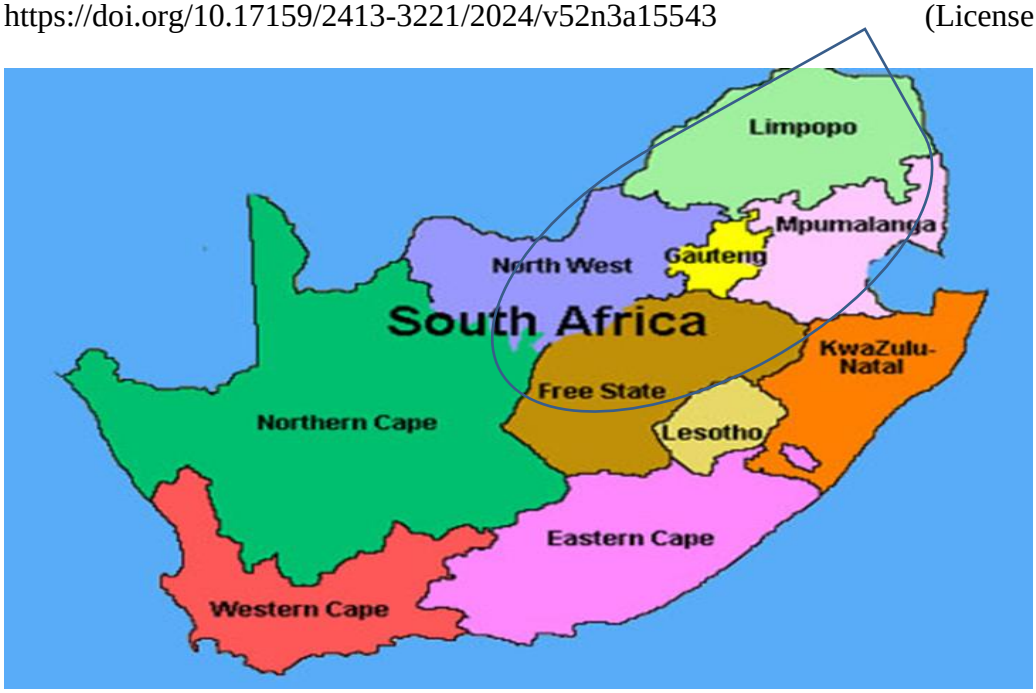

FIGURE 1: Map of South Africa showing Provinces (Source: Google Maps, 2019).

The study employed a concurrent mixed methods design to collect qualitative and quantitative primary data.

4.2. Sampling Procedure and Sample Size

The population in this study comprised small-scale agro-processors chosen from the study area. Due to the informal nature of the enterprises and their traditional background and meagre economic contributions, South Africa's government institutions do not have a formal database to derive their accurate population. The study population was estimated to be 1150 small-scale agro-processors, based on their concentration in various centres of the study areas. The target population was owners and managers of small-scale agro-processing enterprises located within the study area. According to the province, a stratified random sampling technique was used to select 503 respondents. When randomly selecting people from a population, these characteristics may or may not be present in the sample in the same proportions; stratification ensures their representation (Creswell *et al*., 2017). Identifying whether the sample contains individuals in the same proportion as the character appears in the entire population within each stratum is appropriate. Stratified sampling was appropriate for this study since the number of agro-processing firms differed from province to province. The provinces were selected due to the value of the agricultural activities in each province. A sample calculator was used to calculate the sample size per province. Table 1 depicts that Limpopo and North West Province

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received a higher response rate than anticipated, while Mpumalanga and Free State's response rate was below expectation.

TABLE 1: Estimated Population, Sample, and Response Rate Per Province

Province	Population (N)	Sample Size (n)	Percentage of sample size per province	Number of questionnaires completed	Response rate %
Gauteng	300	100	33.3%	100	100%
Limpopo	200	100	50%	103	102%
North West	150	100	66.7%	143	143%
Mpumalanga	300	100	33.3%	98	98%
Free State	200	100	50%	60	60%
Total	1,150	500	43.5%	503	100.6%

4.3. Data Collection

The study used primary data, which was collected through a survey. The data was collected over two months (July – August) in 2019 via face-to-face interviews using semi-structured questionnaires. The questionnaire was designed and divided into two sections (descriptive and inferential) informed by the study's objectives. The questionnaire was pre-tested to check whether it was suitable for the study and to check for some errors. It is also assisted by training the data collectors to familiarise them with the questionnaire. The people's interviews were conducted in local languages (Setswana, Sesotho, Siswati, Sepedi, Isizulu, and Isixhosa) to reduce misinterpretations and gain the interviewees' confidence. In business management research, an acceptable range for response rates could be 50%–80% (Ali, Ciftci, Nanu, Cobanoglu & Ryu, 2021). Through the assistance of two data collectors, the researcher distributed 503 questionnaires to owners and managers of small-scale agro-processing enterprises in North West (143), Limpopo (102), Free State (60), Mpumalanga (98), and Gauteng (100) Provinces, all of which were completed. Therefore, this study's response rate was 100%, well beyond the acceptable range of 50% and 80% in business management research.

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4.4. Data Analysis

The study adopted descriptive and empirical analytical techniques to analyse the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa. Mondal, Swain, and Mondal (2022) assert that descriptive statistics is the first step to gaining insight into the research data. They further indicate that when researchers know the central tendency and distribution of the data, they decide on the inferential statistical plan. The analyses were obtained using descriptive analytics and multiple regression analysis. The descriptive statistics include percentages and mean scores. Standard deviation analyses the socio-demographic characteristics of small-scale agro-processors, such as age, gender, educational status, employment status, marital status, agro-processing speciality, and years of experience in the agro-processing industry (Chikaire, Ajaero & Atoma, 2022; Mahasha, Hlongwa & Gidi, 2022; Manasoe, Mmbengwa & Lekunze, 2022).

According to More *et al*. (2006), multiple regression analysis is a statistical technique that can be used to analyse the relationship between a single dependent and several independent variables. Regression analysis aims to project the character of interconnection among the various input and output variables (Bharati, Ray, Khandelwala, Rai & Jaiswal, 2021). The multiple regression analysis applies to more than one input variable. It provides the most appropriate equation showing the relationship between independent and criterion variables (Teymen & Mengin, 2020). Multiple regression analysis aims to use the independent variable whose values are known to predict a single dependent value. The multiple regression analysis was used to identify the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa. The aim is to estimate and model the relationship between the set of hypothesised causal variables to understand their influence on the economic empowerment of small-scale agro-processors.

4.4.1. Hypothesis Testing

The multiple regression analysis may be used when you want to determine the following:

- **Null hypothesis:** There are no determinants that influence the economic empowerment of the small-scale agro-processors and
- **Alternative hypothesis:** At least one determinant influences the economic empowerment of the small-scale agro-processors.

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4.4.2. Model Specification

The analysis of this study was conducted through multiple linear regression modelling. The assumption was that X_1, X_2 and X_3 are the predictors of economic empowerment variables as informed by the human capacity-building theory (Munyigi et al., 2024). Table 2 provides the measurement. Gujarati (1992) suggested that the multiple linear regression model should be specified as depicted by the following:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + E_{ij}$$

Where:

Y = economic empowerment (continuous),

β_0 = constants,

β_i = coefficients of variation,

X_1 = infrastructural resources,

X_2 = transformation,

X_3 = capacity-building of small-scale agro-processors, and

E_{ij} = error term.

TABLE 2: Description and the Measurements of the Dependent and Independent Variables.

Variables	Description	Measurements	Expected sign
Dependent			
Y	Economic empowerment	5-point Likert scale	±
Independent			
X_1	Infrastructural resources	5-point Likert scale	+
X_2	Transformation,	5-point Likert scale	+
X_3	capacity-building	5-point Likert scale	+

5. RESULTS AND DISCUSSIONS

This section discusses study results from the two analytical frameworks used to examine the socioeconomic factors of the small-scale agro-processors in South Africa. The socioeconomic characteristics of the small-scale agro-processors were analysed using descriptive statistics. In

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contrast, the influence of capacity building on the small-scale agro-processors was analysed using multiple regression analysis. The descriptive and inferential results are presented as tables in section 5 below.

5.1. The Socioeconomic Characteristics of the Participants in the Small-Scale Agro-Processing Activities

The participants' descriptive analysis was presented to provide a picture of the representativeness of the study sample (Khoza *et al.,* 2019). The descriptive results analyse the characteristic demographic profile in an empirical study and establish the biographical parameters of the sampled participant group (Mazibuko, Smith & Tshuma, 2018). Table 3 exhibits the socioeconomic characteristics of small-scale agro-processors in South Africa. Researchers have shown that the respondents' demographic profiles are central to determining their capacity.

The results revealed that most of the respondents were females [365 (72.6%)] as compared to males [138 (27.4%)]. This corroborates the findings of various studies (Ampadu-Ameyaw & Omari, 2015; Quartey & Darkwah, 2015; Williams, Akuffobea, Onumah & Essegbey, 2016; Owoo & Lambon-Quayefio, 2017; Mangubhai & Lawless, 2021; Mthombeni *et al*., 2021; Manasoe, Mmbengwa & Lekunze, 2021b) which indicate that; 95% of actors involved in agro-processing are women as compared with the male counterparts. The dominance of females might result from the unique situation of South Africa, where black women were not allowed to participate in the formal economy during the apartheid period. This was also ventilated during the focus group discussion sessions. In these sessions, some participants strongly felt that government interventions have been very biased toward male-owned enterprises. Furthermore, these results contrast the findings presented by Akpan, Offor, and Archibong (2020); Adduali, Bahadur, and Fraser (2022); Kena, Golicha, Jemal, and Gayo (2022), who found fewer female participants in their survey. On the other hand, Olive *et al*. (2020) reported a slightly similar gender representation in their sample, where females were 61% compared to 39% of males. The current study results contradict three other South African studies, which found that males play a dominant role in the agro-processing sector compared to women (Khoza *et al.,* 2019; Mazibuko *et al*., 2018; Mmbengwa *et al.,* 2019). The findings by Khoza *et al.* (2019), Mazibuko *et al.* (2018), Mmbengwa *et al*. (2019) and Thindisa and Urban (2022) corroborate the findings by Kuwornu and Dunayiri (2014) and Gumbochuma (2017). They

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found that male farmers constitute a majority in the agro-processing industry compared to female farmers. The main finding of the descriptive analysis is that the current study disagrees with most of the studies on the composition of small-scale agro-processors in South Africa. The current study found that most small-scale agro-processors are women, while most studies found that males were the majority. These findings show that South Africa's transformation and women's economic empowerment efforts yield positive results. This might further mean that most males are often more prone to primarily farming crops or livestock, while women take the processing duties.

In the same results, the marital status analysis showed varying proportions. It showed that the number of small-scale agro-processors who were never married was the highest [214 (42.5%)]. It has also shown that married small-scale agro-processors formed the second highest [181 (36.0%)] participants in the sample. These findings contrast the findings of Ampadu-Ameyaw *et al*. (2015) and Mazibuko *et al*. (2018), who found that the majority (65% and 61%, respectively) of women small-scale agro-processors were married. Findings by Ampadu-Ameyaw *et al.* (2015) and Mazibuko *et al*. (2018) corroborate findings by Mkuna, Nalaila, and Isagama (2021). This implies that married women are more active in agro-processing business than other non-agro-processing businesses. Household responsibility may allow married women to dive more into agro-processing. These observations show that married women and those who never married comprise the small-scale agro-processors. The higher participation by unmarried males might imply that more young males are participating in the sector owing to the successful implementation of the country's youth development programs. Akpan *et al.* (2020) confirm that most of the participants in the sector are married entrepreneurs. However, this study seems to have some differences when it comes to those who are unmarried. Overall, it may be reasonable to assume that marriage resource availability positively influences male and female entrepreneurs in this sector.

Furthermore, the study found that over 70% of female and male small-scale agro-processors possess an educational level up to the secondary level (Ekerete & Ekanem,2015; Ampadu-Ameyaw *et al*., 2015; Swai, 2017; Githinji, 2017; Akpan *et al.*, 2020; Akpan *et al*., 2020 and Mthombeni *et al.*,2021). At the same time, Ampadu-Ameyaw *et al.* (2015) found that most small-scale agro-processors had less than six years of formal education. They attributed the low education to poverty and some parents' disinterest in school for their girls. The low education of these women is consistent with a study by Mazibuko *et al.* (2018) and Quartey *et*

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al. (2015), which suggests that most micro and small business entrepreneurs in Africa have no or little education. On the contrary, the current study found that 11.2% of female and 3.6% of small-scale male agro-processors in South Africa do not have formal education, while the majority acquired secondary education. This also implies that most higher education graduates have not embraced entrepreneurship despite more education skills related to good business management (Githinji, 2017). Mthombeni *et al.* (2021) and Adom (2019) discovered results contradicting the current study. They found that 30% and 22% of their respondents had completed post-secondary education, compared to 55.7% in the current research. The results demonstrate that most respondents are highly educated, implying that the respondent's level of education has no positive impact on the economic empowerment of small-scale agro-processors.

The study further found that females and males have 5.6 years and 4.6 years of experience in business, respectively. At the same time, females have 5.3 years of experience in the agro-processing business compared to 4.3 years of males, an average of 4.8 years for both genders. In contrast, Morris *et al.* (2019) found that most small-scale agro-processors had 11.89 years of experience in the agro-processing business. A study by Williams *et al.* (2016) found that about half (50%) of the agro-processors in Ghana had engaged in agro-processing activities for more than 10 years, whereas 36% had been in operation between four and 10 years. About 14% of the agro-processors had been in business operation for three years or less. In addition, a study by Githinji (2017) found that small-scale agro-processors have been in the industry for over five years. Long years of business engagement provide an experience that is an important asset that may contribute to improved performance if best practices have been learned over the years.

Furthermore, Williams *et al.* (2016) indicate that education and training play a key role in developing the abilities of existing entrepreneurs to grow their businesses to tremendous success, hence an essential factor to consider for improved productivity. It is argued that the limited years of experience in the business and the agro-processing industry are the primary reasons for the failure of small-scale agro-processors in South Africa. Therefore, investing in capacity building for small-scale agro-processors is essential to achieve sustained growth in these enterprises.

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The descriptive analysis from this study has also shown that more females, compared to males, are small-scale agro-processors. The mean value of their years of experience in the agro-processing sector was five years for females and four years for males. The short(er) duration displayed by the mean years of experience by agro-processors indicates the necessity for capacity building for small-scale agro-processing enterprises to achieve strategic economic empowerment.

TABLE 3: Socioeconomic Characteristics of the Respondents

Gender	**Female**		**Male**	
Socio-economic variables	**Frequency**	**Percent**	**Frequency**	**Percent**
Gender	365	72.6	138	27.4
Marital status				
Married	134	36.7	47	34.0
Widowed	36	9.8	2	1.4
Divorced	27	7.4	3	2.2
Separated	29	8.0	11	8.0
Never married	139	38.1	35	25.4
No response	0	0.0	40	29.0
Employment status				
Employed	27	7,4	12	8,7
Self-employed	284	77,8	114	82,6
Pensioner	32	8,8	3	2,2
Entrepreneur	20	5,5	9	6,5
Unemployed	2	0,5	0	0
Highest qualifications				
No schooling	41	11.2	5	3.6
Primary and secondary	226	61.9	93	67.4
Certificate	89	24.4	33	23.9
Diploma	7	1.9	6	4.3
Degree	2	0.6	1	0.8
Agro-processing specialty				
Drying	156	42.7	62	44.9

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Canning	32	8.8	6	4.3
Bottling	48	13.2	24	17.4
Juicing	23	6.3	11	8.0
Powdering	72	19.7	18	13.0
Paste/puree	14	3.8	4	2.9
Cleaning	20	5.5	13	9.4
Entrepreneurial Position				
Director	1	0.3	2	1.4
Owner	334	91.5	126	91.3
Managing Director	6	1.6	3	2.2
Manager	24	6.6	7	5.1
Educational Background				
Agriculture	132	36.2	51	37.0
Science	95	26.0	40	29.0
Commerce	94	25.8	27	19.6
Engineering	17	4.7	16	11.6
Humanities	25	6.8	3	2.2
Medicine	2	0.5	1	0.7
Employment and Experience				
	Mean	SD	Mean	SD
Experience in the business	5,6466	3,21287	4,6594	2,64022
Experience in the agro-processing	5,3753	3,29484	4,3551	2,71734

5.2. Analysis of the Influence of Capacity Building on the Economic Empowerment of Small-Scale Agro-Processors in South Africa.

This section discusses the results from the multiple regression analysis on the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa. Table 4 shows the determinants of economic empowerment of small-scale agro-processors, namely infrastructure, resources, transformation, and capacity building. According to the results, infrastructure and resources, transformation, and capacity building account for 16.5% of these enterprises' economic empowerment variance (R2 = 0.165, adjusted R2 = 0.160,

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F (3, 499) = 32.876). Additionally, Table 2 reports the unstandardised (β), Standardised (Beta) regression coefficients and semi-partial correlation (Sr2) for each predictor in the regression model. The results reveal that capacity-building (Beta = 0.274, p = 0.000), transformation (Beta = 0.152, p = 0.000), infrastructure, and resources (Beta = 0.075, p = 0.050) were significant and influenced economic empowerment of small-scale agro-processors.

TABLE 4: Determinants of the Economic Empowerment of the Small-Scale Agro-Processors.

	Collinearity Statistics						
Variables	**β**	**Beta**	**Lower**	**Upper**	**Sr^2**	**Tolerance**	**V.I.F.**
(Constant)	1,514***		0,890	2,138			
	(0.318)						
Infrastructural	0,026*	0,075	-0,004	0,056	0.005	0,849	1,178
resources	(0.015)						
Transformation	0,056***	0,152	0,021	0,091	0.017	0,728	1,374
	(0.018)						
Capacity building	0,073***	0,274	0,048	0,098	0.056	0,744	1,343
	(0.013)						

Notes: *R^2 = 0.165, Adjusted R^2= 0.160, F (3, 499) = 32.876. *** = P< 0.000, * = P< 0.10, F^2 = 0.198 (small effect size)*

The results also revealed that the influence of these factors was low (F2 = 0.198). Among these factors, capacity-building had a significant impact, followed by transformation, infrastructure, and resources. This finding is consistent with the findings of Coppock et al. (2011) and Daninga (2020), whose studies revealed that human capacity building significantly impacted Ethiopia's impoverished and Chinese communities, respectively. Nwankwo and Ezeokafor (2020) and Palmioli et al. (2020) have also found that capacity-building is essential in improving farmers' lives using local cassava varieties and food systems. Similarly, Geet al. (2020) have found that agricultural transformation significantly improves small peasants' livelihood systems. Ombaka *et al.* (2020) have found that technical skills, entrepreneurship infrastructure network, and transformation are essential in enhancing small-scale agro-processors's capacity building. The study findings concur with other findings, which reveal that agricultural transformation is

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critical for small-scale agro-processors in South Africa. Findings from the study's conclusions also reveal the role of capacity building in enhancing the strategic economic empowerment of small-scale agro-processors.

Table 4 below depicts the types of capacity building: mentorship, technical skills, leadership skills, access to information, and financial skills. All these types have a mean score of above 18, which indicates that each variable is significant for the capacity building of small-scale agro-processors. However, mentorship and technical and financial skills have a considerable influence. Furthermore, the overall Cronbach Alpha for capacity building is 0.780, and the Cronbach Alpha for each variable is above 0.70, with mentorship (0.754), financial skills (0.780), and technical skills (0.735). Various studies concur with the current study's findings that mentorships are critical for the capacity building of small businesses and assist the businesses to be more productive (Muchau, 2013; Bjursell & Sadbom, 2018; Kuratko, Neubert & Marvel, 2021). Their findings concur with the current study but differ from the findings by Muchau, who noted that mentorship does not positively influence the capacity building of small-scale agro-processors. In another study on mentorship's influence on business performance, Kuratko *et al.* (2021) found that more coachable entrepreneurs are ultimately more successful during their time in these programs and are more satisfied with their mentorship experience. The general and overall observation is that mentorship is a critical capacity-building type for the economic empowerment of small-scale agro-processors.

Table 5 below depicts that technical skills have an overall Cronbach Alpha of 0.735. These results demonstrate that technical skills significantly influence the capacity building of small-scale agro-processors. In terms of technical skills, the current study concurs with various studies that technical skills are critical for the capacity building of small businesses (Almahry, Sarea & Hamdan, 2018; McKenzie, 2021; Ahmad *et al*., 2018; Akpan, Udoh & Adebisi, 2022). Technical skills include written and oral communication, technical implementation, and organising skills (Almahry *et al.*, 2018). Their study found that the technical skills of small-scale agro-processors are improved by the level of entrepreneurial education and vice-versa. A study by McKenzie (2021) found that access to technical skills increases profit and sales on average by 5 – 10 percent. Therefore, small-scale agro-processors' access to technical skills will improve their capacity-building abilities and business success.

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Dahlstrom and Talmage (2018), Hussain, Salia, and Karim (2018), and Umar, Sasongko, and Aguzman (2018) show that financial skills are critical for the success of small businesses. Hussain *et al.* (2018) examined the relationship between financial literacy, access to finance, and growth among small- and medium-sized enterprises (SMEs) within the Midlands region of the United Kingdom. It assesses whether financial literacy assists SMEs in overcoming information asymmetry, mitigates the need for collateral, optimises capital structure, and improves access to finance. The study found that financial literacy is an interconnecting resource that mitigates information asymmetry and collateral deficit when evaluating loan applications; therefore, financial literacy should be part of the school curriculum. The analysis suggests enhanced financial literacy, reduced monitoring costs, and optimises firms' capital structure, positively impacting SMEs' growth. Financial management knowledge is recognised as the core resource that aids effective decision-making by owners of SMEs. These studies concur with the current study's findings that financial skills are a crucial variable for the capacity building of small-scale agro-processors.

Table 5 below shows that mentorship, technical, and leadership skills have the highest Cronbach's Alpha of 0.754, 0,735, and 0,728, respectively. This shows that the South African government should invest in mentorship programmes and technical and financial skills to achieve increased capacity building for small-scale agro-processors, significantly influencing the economic empowerment of small-scale agro-processors. Since the agricultural extension officers are responsible for the capacity building of small-scale agro-processors, they should dedicate their resources towards mentorship and technical and leadership skills to achieve the economic empowerment of small-scale agro-processors in South Africa.

TABLE 5: Types of Capacity Building in the Economic Empowerment of Small-Scale Agro-Processors.

Variables	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Capacity building					
Mentorship	18,5984	19,181	0,507	0,304	0,754
Technical skills	18,4254	18,098	0,565	0,358	0,735

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Leadership skills	18,3380	17,575	0,588	0,364	0,728
Access to information	18,3479	17,403	0,609	0,417	0,720
Financial skills	18,4175	19,108	0,502	0,298	0,756
Overall Cronbach's Alpha					0.780

6. CONCLUSIONS AND RECOMMENDATIONS

The study aimed to analyse the influence of capacity building on the economic empowerment of small-scale agro-processors in South Africa, focusing on its implications for industrial development. The study revealed that capacity building significantly influences the economic empowerment of small-scale agro-processors in South Africa compared to infrastructure, resources, and transformation. The study revealed that capacity building's influence on economic empowerment of small-scale agro-processors is Beta = 0.274 and p=0.000. Since most small-scale agro-processors in South Africa are women-owned businesses, the government should target support for the agro-processing enterprises owned by women.

The study further discussed the types of capacity-building programmes. It was revealed that mentorship, financial, and technical skills are critical for capacity building, influencing the economic empowerment of small-scale agro-processors. It is recommended that the South African government should prioritise and invest in mentorship and financial and technical skills programmes to achieve the economic empowerment of small-scale agro-processors. The capacity-building initiatives should, amongst others, include these parameters. Therefore, the South African government should prioritise these parameters to enhance the economic empowerment of small-scale agro-processors. Future research could investigate the impact of identified parameters along with the commodity classifications in various regions of South Africa.

In addition, it is recommended that governments develop policies and programmes to support the capacity building of small-scale agro-processors and invest in capacity building to achieve the economic empowerment agenda of South Africa. Furthermore, the agricultural extension officers should dedicate their resources towards mentorship and technical and leadership skills to achieve the economic empowerment of small-scale agro-processors in South Africa. Lastly, the economic empowerment of small-scale agro-processors through capacity-building

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programmes will contribute towards South Africa's industrialisation and structural transformation agenda. Since most small-scale agro-processors are women, it is further recommended that agricultural extension officers develop capacity-building programmes geared to them. Lastly, to achieve increased industrialisation and structural transformation, capacity-building programmes should include training small-scale agro-processors in technical skills such as using advanced manufacturing tools and machinery since most small-scale agro-processors process their products manually or through old production technologies.

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Small-Scale Pig Farming as a Tool for Unemployment Alleviation in Buffalo City, Eastern Cape of South Africa

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ABSTRACT

The study examines the effect of small-scale pig farming on unemployment alleviation in Buffalo City, Eastern Cape of South Africa. This is against the backdrop of the extreme youth unemployment and increasing poverty rate being witnessed in South Africa (SA) due to the unstable global economic environment that has impacted most economies of the world. On its part, the government made an appreciable number of investments, especially in the agricultural sector, to address the unemployment challenges, which has yielded varied levels of success. The unemployment situation in SA was compounded by the COVID-19 pandemic, which resulted in approximately 33% of the labour resources that were productive before the pandemic to idle. This necessitated a government injection of R100 billion as a stimulus package into the economy to support small businesses and the agricultural sector, especially small-scale farmers. Mixed methods were adopted to gather primary data from 164 pig farmers, which were randomly selected. XLSTAT and SPSS 28 were used to analyse the quantitative data, and NVivo was used for the qualitative data. The results revealed that farming activities provided a source of income for most pig farmers, with several households depending on it for their livelihood. The collective advantage among pig farmers was the availability of space for farming activities, and most of them engaged in pig farming as a necessity. The government plays a crucial role in the sustainability of pig farming activities in the area through the various interventions that create the needed enabling environment for the farmers to thrive.

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Keywords: Small Scale, Unemployment, Poverty, Pig Farming

1. INTRODUCTION

This study examines the effects and viability of small-scale pig farming on unemployment and poverty alleviation in Buffalo City, Eastern Cape of South Africa. This is against the backdrop of the extreme youth unemployment and the increasing poverty rate being witnessed in South Africa (SA) due to the unstable global economic environment that has impacted most economies of the world with the resulting increase in the cost of living (Gourinchas, 2022). Joyce and Pholoho (2014) analysed the South African government's policy in agriculture for the development and support of new smallholder farmers. Support for smallholder farmers is an important area for development that could positively impact poverty alleviation and household food security. South Africa, to a large extent, has achieved food security at the national level, but more still needs to be done at the rural level due to the level of unemployment and poverty rate (Altman et al., 2009).

In recent times, South Africa has been experiencing a high level of unemployment and poverty while facing food security challenges (Gourinchas, 2022). The published poverty levels and trends indicate a significant rise in poverty levels (Stats SA, 2017). This level fluctuates continuously. The World Bank suggests that "approximately 55.5% (30.3 million) of the population are living in poverty at the national upper poverty line (ZAR 992) while a total number of 13.8 million people (25%) are experiencing food shortage" (World Bank, 2022:1). The World Bank (2016) indicates that economic growth is required to improve income-generating potentials and opportunities of the underprivileged through agriculture and industrialisation.

It should be noted that at the onset of the pandemic, which subsequently led to the country's lockdown to reduce the pandemic's adverse effects on human lives, the South African fiscal position was weak, as indicated by the 2020 budget review. During and after the lockdown, enormous job losses were witnessed in the country owing to the COVID-19 pandemic that necessitated several months of lockdown. Additionally, implementing lockdown regulations negatively affected most businesses in the country. To kickstart the economy after the lockdown, the government introduced several intervening measures to boost economic activities to help create jobs and reduce unemployment (Geza et al., 2022). Some of the measures include tightening financial conditions, discretionary policies to support incomes and

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ease financial conditions of households, injection of R100 billion for SMEs and an informal business stimulus package to support small businesses and the agricultural sector, among others (PMG, 2022). Despite all these efforts, the country's youth unemployment level remains a critical economic issue for the government (Geza et al., 2022).

Unemployment has been an ongoing challenge for the government for years. In the second quarter of 2022, according to Stats SA (2022), the unemployment rate stood at 33.9%. Steenkamp (2015) asserts that the unemployment rate remains high, with several populations still lacking necessities such as food and shelter. Ferreira (2016) suggests diverse reasons for South Africa's high unemployment rate. Some areas of the country, such as the Eastern Cape (EC), are surrounded by under-used land, which can be used for crop or animal farming, including pig farming. Despite the large expanse of unused land, the region still suffers from extreme poverty and high unemployment rates. In the second quarter of 2022, the unemployment rate in the area was about 33.9%, while the highest unemployment rate during the period recorded in the EC was 42.8% (Stats SA, 2022).

The extreme unemployment and poverty rates also contribute negatively to revenue generation. Fewer people are in the income bracket able to pay personal income tax and are more dependent on social grants (De Vos, Obokoh & Abiola, 2020). Given the lean tax base and revenue generation, which the government depends on to fund social and economic spending programmes, it fell short of projections by R48.2 billion in the 2017/18 financial year (Stats SA, 2018). Considering the recent crime statistics, unemployment is a challenge. It was reported that "Housebreaking, theft of motor vehicles, murder and consumer fraud increased between 2017/18 and 2018/19" (Stats SA, 2019).

Because of the vast available agricultural land in most provinces and the economic opportunities created by government incentives for small businesses and, by extension, small-scale pig farmers, how can we understand the relative effect of small-scale pig farming towards the alleviation of unemployment and poverty in Buffalo City and South Africa in general? Hence, the reason for the study.

2. LITERATURE REVIEW

The global economy faces an increasingly gloomy and uncertain outlook revolving around the COVID-19 pandemic. Additionally, Russia’s invasion of Ukraine, the higher-than-expected

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inflation in the United States and major European economies, the tightening of global financial conditions and the slowdown in China's economy resulted in the contraction of global output in the second quarter of 2022 (Gourinchas, 2022). The contraction in global output has implications for developing countries' poverty levels and unemployment rates, as evidenced by the high cost of living index. Sekhampu (2013) asserts widespread poverty is among the most challenging global concerns. The fundamental causes and issues need to be identified to overcome poverty.

Prior studies have highlighted the causes of poverty and factors that exacerbate poverty in Africa, such as structural inequality and lack of access to resources, poor infrastructure and government corruption. Included are low income and unemployment, less development, climate change, conflict, and civil wars (Mayekoo, 2023; Addae-Korankye, 2014; Francis, 2006; Hulme & Shepherd, 2003). However, Chumika et al. (2010) conducted a study on 500 emerging farmers across the nine provinces of South Africa. They applied factor analysis on fifteen infrastructure indicators to determine the accessibility and use of infrastructure. The results indicate that services infrastructure was generally more accessible to emerging farmers than before. The study implications are that government policy should be formulated to address farmers' access to services. Furthermore, locating services in areas near farmers is critical because nearness to amenities stimulates agricultural and rural development towards reducing unemployment and poverty.

On the other hand, Ramukumba (2014) remarks that inadequate employment is one of the most significant challenges to overcoming poverty. According to Buerger (2012), employment remains one of the most effective ways to combat poverty as it provides resources for the poor to meet their basic and welfare needs. Employment opportunities in small or underdeveloped regions are scarce due to a lack of development and investment opportunities that would have provided employment. This indicates that regions are often neglected (Teschner, 2012). It has been argued that only a few living in extreme poverty regions find local employment or can establish small businesses due to a lack of access to resources (Mayekoo, 2023). The most observed occupations among such people in those resource-scare regions are farming, managing cattle and livestock, and other small labour-intensive occupations due to the availability of farmland. In some cases, the land is restricted by ownership. However, government asset redistribution has, to some extent, been set to reduce land-restricted access

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to favour small-scale African farmers who were previously deprived of land due to the apartheid past (Francis, 2006; Hall, 2004).

2.1. The Effects of Pig Farming on Poverty Alleviation in South Africa

The Food and Agriculture Organisation (FAO, 2015) remarks that poverty rates remain high in several countries, especially in rural areas. Reports show that 77% of the deprived rural communities globally rely on farming for their livelihood (FAO, 2015). An increasing number of studies established that agriculture significantly reduces poverty, considering that most poor people live in rural areas and depend mainly on agriculture. Katagame, Fanani and Nugroho (2017) argue that most small-scale farmers have increased their educational levels and financial authority attributable to pig farming. Today, pig farming has created jobs for people engaged in pork production, pig farming education, pig feed production businesses, transport companies, and markets.

Ryan (2018) contends that pig farming is a viable system of livestock production that provides pork meat for a balanced household diet, sale, consumption, and poverty reduction. Access to formal and external markets is influential in predominant pig farming. Pig farming is no longer a source of income but a form of investment while reducing socio-financial risks, providing protein to household members and manure to crop fertiliser (Russo & Von Blottnitz, 2017). Matabane et al. (2015) remark that pig production is vital for improving the uncertainty of household food and for poverty reduction in poor countryside areas. Pig farming is particularly appealing due to the ease of rearing and the availability of materials and feed for the pigs. With the continuous government incentives for small-scale farmers, it will be safe to assume that more people will go into pig farming due to the high rate and ease of production.

2.2. The Constraints Of Pig Farming

Mokoele et al. (2014) assert that nutrition and feeding are vital in animal production and health. Pigs, therefore, require a healthy and balanced feed with nutrients. This is important for their production and reproduction. According to Lapar and Staal (2010), feed amounts to 64-96% of production costs in small-scale pig farming. Due to financial constraints, Mokoele et al. (2014) claim that emerging small-scale pig farmers are prone to poverty and exposed to low-quality feeds with a potential outcome of disease spread. Krüger, Van Marle-Köster, and Theron (2017) remark that the other constraint hindering pig farming engagement is the shortage of

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breeding pigs (boars). An adverse perception prevails among pig farmers in South Africa about the small-scale breeding of boars since boars are used only for breeding. This discourages farmers from keeping their pigs (Gouws, 2019). The high maintenance costs for a boar are another constraint hindering pig farming despite abundant farmland.

Matabane et al. (2018) remarked that pre-weaning mortality remains a leading constraint to pig farming and production. Numerous factors can influence deaths in pigs, "mainly during the first 48 hours after farrowing, crushing by the sow being the first cause" (Mainau, Temple, & Mantec, 2015:1). Wabacha et al. (2004) attribute 69% of pig death to overlay. Pre-weaning mortality decreases pig farming profitability. Feeding the pig energy feeds throughout farrowing lessens the time of farrowing and rates of pre-weaning mortality (Roy, Mondal, & Moktan, 2018). Disease outbreaks are pig production's biggest threat, causing economic losses. Mokoele et al. (2015) remark that the frequent outbreak of diseases is a constraint or threat to pig farming to small-scale pig farmers in view of their limited resources. Diseases affect not only the production output but also the quality of pork meat and the safety of consumers who may consume infected pork meat. Antwi and Seahlodi (2017) identified the lack of finance, poor marketing information access, lack of access to the existing high-value markets, inadequate market infrastructure and smaller herd sizes as some of the major constraints facing small-scale pig farmers in South Africa.

2.3. Theoretical Base of the Study

This study is underpinned by two theoretical frameworks, the conflict theory and resource-based view theory (RBV). Firstly, conflict theory is a sociological theory that considers the apartheid past of South Africa. It looks at the societal power struggle between groups within the society over limited resources under a post-industrialised capitalist environment in which resources are the modes of production (Hayes, 2022). The conflict theory contends that society is always in conflict because of the endless competition for finite resources. This theory implies that those who own wealth and resources protect and store them, while those who do not do what they can to protect the resources. Hegde (2020) suggests that Karl Marx's social theory focused on social class conflicts. Marx explained the conflicts between the lower class and the upper class. Both theories relate to this study as unemployment and poverty are social concerns, where government and citizens are a function because the means of production still reside in the hands of a few influential people.

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Secondly, the resource-based view theory propounded by Birger Wernerfelt underscores how small-scale pig farming has become a tool for unemployment alleviation in Buffalo City, Eastern Cape of South Africa (Wernerfelt, 1984). The RBV theory focuses on how firms or individuals leverage their unique resources and capabilities to achieve sustainable competitive advantage. In the context of small-scale pig farming, the RBV theory analyses how the resources available in Buffalo City, such as land, water, and community support, contribute to the success of pig farming ventures and their role in alleviating unemployment.

According to the RBV theory, sustainable competitive advantage stems from possessing valuable, rare, inimitable, and non-substitutable (VRIN) resources. In this case, the abundant land space, availability of water, and community support serve as valuable resources that enable individuals to engage in pig farming for income generation. These resources may be rare or scarce in other areas, giving pig farmers in Buffalo City a competitive advantage in the agricultural sector.

The RBV theory also emphasises the importance of organisational capabilities in effectively leveraging resources. Pig farmers in Buffalo City possess unique skills, knowledge, and networks that enable them to manage their farming operations efficiently despite constraints such as limited access to financial services or marketing barriers. By leveraging their capabilities, pig farmers in Buffalo City have overcome challenges and created sustainable livelihoods for themselves and their communities.

Similarly, the RBV theory suggests that the sustainability of competitive advantage depends on the ability of individuals or firms to renew and continuously develop their resources and capabilities over time. In the context of small-scale pig farming in Buffalo City, this involves initiatives to improve farming practices, access new markets, or adapt to changing environmental or economic conditions. Government interventions and policies that support the development of pig farming infrastructure provide access to financial resources or facilitate market access, which has also contributed to the long-term sustainability of pig farming as a tool for unemployment alleviation in Buffalo City.

Overall, the RBV theory provides a theoretical framework for understanding how the resources and capabilities available in Buffalo City contribute to the success of small-scale pig farming ventures and their role in addressing unemployment challenges. Applying the RBV lens makes

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it crystal clear that specific resources, capabilities, and strategic actions of the pig farmers in Buffalo City drive the success of pig farming initiatives.

3. RESEARCH METHODOLOGY

According to the 2016 community survey, Buffalo City in the EC has an area density of 2 750km² and a total population of 834 997. The target population was those between the ages of 15 and 64 in Buffalo City, estimated at 510 000 in the fourth quarter of 2017 by Stats SA. Unemployed individuals and existing farmers were randomly selected to better understand the relative effect of unemployment in South Africa and to provide more insight into the phenomena.

FIGURE 1: Study Area Presenting Buffalo City (Source: Municipalities.co.za)

This was considered because it was believed that discussing pig farming could create employment opportunities for the unemployed. Officials of the Department of Rural Development and Agrarian Reform were interviewed to obtain a complete representation of the problem while observing the policymakers' opinions. According to Turner (2020), sampling is a subset selection of the population of research interest. The study employed a simple random sampling technique, "in the simplest case of random sampling, each member of the population has the same chance of being included in the sample, and each sample of a particular size has the same probability of being chosen" (Welman, Kruger & Mitchellet, 2005). The total sample size for this study was 164 respondents with an 80% confidence level, 50% expected frequency and 5% acceptable margin of error. Participants were randomly selected from Mdingi, Tolofiyeni, and Masingatha. Some participants assisted in directing data collectors to other pig farmers in their respective communities.

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The study used semi-structured telephonic interviews and open-ended questions to collect data. Interviews were recorded with the participant's permission and transcribed after that. The questionnaires used for primary data collection consist of open and closed-ended questions. Before administering the questionnaire, a pilot study was conducted at Langa Township, a few kilometres outside Cape Town, to test the reliability and validity of the instruments. The data collection period was from 6 January 2020 to August 2022, which was prolonged by the COVID-19 pandemic lockdown. The pandemic greatly influenced telephonic data collection due to social distance regulations and the compulsory use of face masks.

The quantitative data was analysed and verified using Excel and other data analysis software. The qualitative data was analysed through a thematic approach using NVivo software.

4. PRESENTATION AND DISCUSSION OF RESULTS

This section presents the findings and discusses the results on the effects of small-scale pig farming on unemployment and poverty reduction. Additionally, it covers the constraints that may hinder people from engaging in pig farming in Buffalo City in the Eastern Cape of South Africa. The city has abundant unused farmland with many unemployed youths given government efforts at securing food sufficiency at the rural level. All the tables displayed in this section contain analyses of the results of the questionnaire unless otherwise stated.

4.1. The Effects of Pig Farming on Poverty Alleviation in Buffalo City, Eastern Cape

The analysis indicates that 80% of the respondents have a secondary school certificate, which means that most are literate. To some extent, this tends to reflect the unemployment level in South Africa and impacts the poverty rate. It follows the recent rating, presenting South Africa as the most unequal nation globally, as revealed by the Gini coefficient 0.6 (STAT SA, 2019; De Vos, Obokoh, & Abiola, 2020). Given the impact of poverty on the standard of living, the respondents resorted to pig farming as a way out to change this endemic situation.

Respondents were asked how pig farming affected them. As recorded in Table 1 below, 70% responded that it provided food for their families, while 19% indicated that pig farming is their only source of income. Another 31.7% said they embarked on pig farming to get additional income to their existing jobs. This is because some pig farmers are employed full-time or part-time in other jobs but have to farm as additional work to boost their income. From the table,

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11.6% indicated that they received their pigs as gifts to start pig farming, while 25.0% received funding for their pig farm.

TABLE 1: Effects of Pig Farming on Poverty Alleviation

Purpose of farming	**%**
To feed your family with the pigs you raise	70.1%
It is your only income	18.1%
To add to your other incomes	31.7%
The pigs were provided to you, or you already had pigs	11.6%
Funding was provided to farm with pigs	25.0%

The first significant response during the interviews confirms the inimical high unemployment rate in the community. Several respondents affirmed the high rate of unemployment in the community. In this regard, a respondent remarked:

"The community is impoverished, and there is a lack of job opportunities".

According to this respondent, the poverty state of the community is appalling, and this is attained by the exhilarating rate of joblessness in the community. From their responses, it could be deduced that employment at a certain age will be difficult. A respondent remarked that, for those above 35, employment is dismal. Many pursued and considered several resources in their attempts to overcome this disheartening, impoverished state. According to the respondents, many community residents are jobless while having sufficient space around them. It was suggested that they could explore the resources for their survival. Considering their responses, several factors lead to involvement in pig farming in the communities, such as:

4.1.1. Availability of Land and Other Resources

More than 80% of the respondents revealed that abundant land space in the community is a sufficient push and a sure instrument supporting pig farming. The availability of land space and adequate water further contributes to the success of pig farming. This was corroborated by the respondents' remarks that pig farming is feasible on land with enough space and water.

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According to one of the respondents, besides the land space spurring pig farming in the community, there is abundant water and stability of power supply. This means that factors like water and power supply are major considerations in piggery and pig farming. This view contradicts Mayekoo's (2023) and Addae-Korankye's (2014) assertion that the lack of resources is part of the cause of poverty. Although the lack of farmland and power supply might hold true in some geographic locations, it might differ for other areas. This depends on the ability of the inhabitants to put the resources to proper use to combat unemployment and poverty.

Additionally, it points to similar conditions in most developing countries with abundant resources controlled by a few. This has led to significant conflicts and armed struggles in different parts of the world. It points directly to the theoretical underpinning of this study (Hayes, 2022; Hegde, 2020).

4.1.2. Affordability of Pig Farming

Another factor that stirs people up to pursue pig farming is that pig farming is inexpensive and easy to manage and sustain. In the words of the respondents:

> "It's easy to look after them; all we have to do is to feed them and ensure they have enough water".
> "Pig farming is viable in my community because we are hardly affected by drought and even by animal diseases such as swine flu. We have been only hit once or twice".
> "It is easy to farm pigs because they can almost eat anything even when you don't have feed; you can go to your neighbours and ask for leftover food and even supermarkets to ask for expired food to feed them".

Respondents indicated they could only have pigs in their gardens and backyards, even if they could not afford larger land for large-scale pig farming. Many found it inexpensive to manage because they have farms producing mielies (maize) to feed the animals. Furthermore, they would not always need to bear extra costs to maintain their farms. This is because pigs can comfortably be fed rice, bran, broken rice, maize, soya beans, cassava, vegetables, restaurant leftovers, food waste products and distillers' residues, which are considerably inexpensive. The respondents further said they worked one hour per day for every 120 farrowings per week.

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4.1.3. Community Business

Respondents confirmed that pig farming is viable in their area because it is a community business. They practised it over the years, obtaining sufficient experience in pig farming. The interest of the upcoming adults is also intensely aroused by their sight of this agelong venture in their land. A respondent remarked:

> "Pig farming is valuable because people from my community love pigs, and all my life I grew up knowing people in the community farming pigs".

This demonstrates that pig farming has been widely practised in their land as the sole source of economic sustenance. The community sometimes offer pigs and piglets as gifts instead of money. This stimulates the receiver into embarking on pig farming on a small scale. A youth knowing the benefits of pig farming, being offered pigs will cherish and nurture it. They could sell it for an income or could slaughter it for food. The economy of the land will receive a boost, as stated by the respondent.

> "Because most people from my community enjoy pork meat. I don't see anything that can stop us from farming pigs as we are not from the Muslim community whereby, we might not have been allowed to farm them".

The above statement is consistent with Matabane et al. (2015), who remark that pig production is vital for improving household food uncertainty and poverty reduction in poor countryside areas. Pig farming is chiefly workable and achievable in the community because no religious bias exists. The community are non-Islamic. Therefore, they could proceed with raising pigs with no religious constraints. It can be concluded that the involvement of people in pig farming helps the community alleviate poverty. Therefore, pig farming has a statistically significant and positive effect on poverty alleviation in Buffalo City in the EC. This is consistent with Ryan's (2018) assertion that pig farming is a viable system of livestock production that provides pork meat for a balanced household diet, sale, consumption, and poverty reduction.

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4.2 Constraints to Pig Farming Despite the Abundant Farmland in Buffalo City

TABLE 2: Constraints That May Hinder Pig Farming Engagement

Items	Disagree	Neutral	Agree
Lack of access to new knowledge in pig farming technologies in Buffalo City	17 (10.4%)	42 (25.6%)	105 (64%)
Buffalo City Municipality lacks disease control programmes for pigs	13 (8.0%)	13 (7.9%)	138(84.1%)
Many farmers in BC lack access to financial services	11 (6.7%)	15 (9.1%)	138 (84.2%)
Many pig farmers encounter marketing barriers, insufficient market amenities	37(22.6%)	20 (12.2%)	107 (65.2%)
The government lacks a proper policy on pig production in the national livestock development programme	18 (11%)	33 (20.1%)	113 (68.9%)

The results in Table 2 observe that 64% of respondents had inadequate access to knowledge of new pig farming technologies. This constitutes a significant barrier on the path of the farmers in raising their pigs. This is consistent with Antwi and Seahlodi (2017), who identified constraints that small-scale farmers face in pig production. It was observed that 84.1% of the respondents indicated the absence of disease control programmes in the municipality. This could lead to losses should there be an outbreak of diseases in the area. Furthermore, 84.2% of the respondents believe that several Buffalo City farmers lack access to financial services to engage in commercial pig farming. This confirms the assertion that structural inequality and lack of access to resources, poor infrastructure, low income and unemployment, and less development, amongst others, compound poverty (Mayekoo, 2023; Addae-Korankye, 2014; Francis, 2006; Hulme & Shepherd, 2003).

Most respondents (65.2%) observed that several pig farmers encounter marketing barriers, such as insufficient market amenities, loading ramps and scale pens, scarce market data, low prices, and high costs of transactions. These barriers present a great threat to marketing their products. Most (68.9%) stated that the government lacks a proper policy on pig production in the national livestock development programme. This is contrary to the study by Joyce and Pholoho (2014), which revealed prioritised policy development and support for smallholder farmers. Various

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respondents strongly expressed that support from the government is the lubricant for their enthusiastic participation in pig farming. The equipment and medicine pig farmers need could sometimes be too expensive for these impoverished farmers to survive. This view is consistent with Chumika et al. (2010), who assert that proximity to facilities diminishes the impact of government support, especially for farmers. Investment in the farmers' area indirectly expands the government's revenue opportunities and development.

5. CONCLUSION AND RECOMMENDATION

This study has examined the viability of small-scale pig farming in Buffalo City in the EC and its effects on reducing unemployment. The results revealed that pig farming impacts the unemployment situation and standard of living in the province. It provides a source of income to several households who depend on pig farming for their livelihood. The collective advantage among pig farmers was the availability of space for farming activities. It was revealed that farmers engaged in pig farming as a necessity. The government plays a crucial role through its interventions for the province's sustainability of pig farming activities. Since pig farming does not need a high level of expertise for success, pigs can be reared in backyards. However, the findings did not indicate whether Buffalo City in the EC is developing and upgrading its infrastructure, such as roads, communication lines, and farming facilities. This can be a basis for guiding government departments in planning, monitoring, and service delivery in rural areas.

The government has implemented farming programmes that are not specific to pig farming. The findings can set the foundation for policy development that targets small-scale farmers, especially pig farming. The environment is highly conducive to pig farming. However, adequate support is required for it to succeed. The young or new pig farmers need financial support to set up farms. The government should provide funding for other farming activities. A future study should investigate why more residents are not involved in farming despite ample land and funding. The government should continue to play a crucial role in providing the needed environment for job creation through policy intervention. This will assist in continually addressing the province's unemployment rate and ultimately impact the national youth unemployment rate.

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Sustainability of New Generation Commercial Farmers in South Africa: A North-West Province Case Study

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ABSTRACT

In this study, factors hindering emerging farmers in South Africa from farming sustainably were explored from the perspectives of emerging farmers, commercial farmers, and industry experts. In addition, industry experts gave actionable recommendations on what can be done to counteract the problems faced. A mixed-methods research approach was followed, with data obtained via questionnaires and Logistical Framework Analysis. The farmers and industry experts identified several factors hampering emerging farmers' economic, environmental and social sustainability. Among these factors were difficulty accessing finance, lack of extension officer support, low profitability, not implementing sustainable agricultural practices, not supporting local communities, and a lack of social entrepreneurship. Industry experts put forth numerous actionable recommendations to improve emerging farmers' social, environmental and economic sustainability. Recommendations included, among other things, acquiring crop insurance, sharing machinery, owning title deeds, using subject-specific advice, mentoring and succession planning, and government policies to enhance female participation in agriculture.

Keywords: Economic Sustainability, Emerging Farmers, Environmental Sustainability, Rural Development, Social Sustainability

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1. INTRODUCTION

Engaging in environmentally, economically and socially sustainable agricultural practices means growing crops and livestock in ways that simultaneously meet three objectives: economic profitability, social benefits to the farming community, and conservation of the environment (Sullivan, 2003).

Environmentally sustainable agriculture aims to minimise environmental damage and use resources more efficiently (Leigh & Wentworth, 2017). The ability of the environment to maintain its functioning within natural parameters and cycles over time is a key issue in South Africa due to a strong reliance on renewable and non-renewable resources (South Africa Department of Environmental Affairs, 2016). The main driver of economically sustainable agriculture is profitability. Therefore, where farmers have low profitability, the farming enterprise cannot reward the farmer with returns on his investment, resulting in the farm not being economically sustainable (Hofstrand & Johanns, 2019).

Social sustainability, in turn, is seen as a conceptually elusive concept. However, food security and rural development are essential for social sustainability because of their role in economic development and improving people's livelihoods (Sabyasachi & Satpati, 2013. Emerging farmers form an integrated part of the commercial agricultural sector, which aims to increase South Africa's food production, help alleviate hunger and aid economic development by improving food availability for the poor through lower prices and higher incomes (British Standards Institution, 2013; Prosperi *et al.*, 2014). In addition, farming contributes to the overall state of rural regions in terms of employment, business opportunities, and infrastructure (European Commission, 2000).

An environmentally, economically and socially sustainable agriculture system is essential to enhance farmers' and society's quality of life (Krall, 2015; United Nations, 2018) and to sustain the growing need for food production to combat food insecurities for an ever-growing population (National Research Council, 2010).

1.1. Challenges to Sustainable Farming Faced By South African Farmers

Farmers, especially emerging farmers in South Africa, face numerous challenges that hamper them from farming sustainably. Farmers need support in decision-making by providing

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information on effective farming methods and practices based on the latest research (Department of Environmental Affairs, n.d.). In addition, better support systems on the ground are needed for agricultural progress, including more professional extension systems (The Thematic Group on Sustainable Agriculture and Food Systems, 2015).

Consumer demands for quality standards, food safety, and safe handling involve specialised production, packing techniques, and refrigerated transport, all of which require large capital investments that small and medium-sized enterprises cannot easily afford. The consumers' and corporation's requirements and rules can act as effective barriers to participation in high-value chains for emerging farmers (Dorward, Kydd, & Poulton, 2008; Kirsten & Sartorius, 2002).

A lack of capital for investment is a prevalent problem among small-scale farmers in South Africa (Qwabe, 2014). The funding framework in South Africa does not appear to be geared toward emerging farmers; instead, it caters to existing commercial farmers (Mtombeni, Bove, & Thibane, 2019). Emerging farmers in South Africa also have low collateral value, restricting their access to finance (Kislat, Menkhoff, & Neuberger, 2013). Access to a comprehensive range of financial services is a significant challenge for emerging farmers, hindering economic development (De Klerk *et al.*, 2013). A lack of capital, in turn, results in farmers not owning the necessary machinery for their farming operations. Not owning machinery makes it difficult to do farming activities at the ideal time leading to potential yield losses and lowering profitability (Dane, 2020).

Smallholder farmers' incomes and livelihoods are increasingly affected by natural forces beyond their control. Yet, less than 20% of smallholder farmers globally have insurance against the impact of unexpected events (Rishi & Priebe, 2020). Climate change presents a threat to all farmers in South Africa. Due to global climate change, the climatic variability and occurrence of extreme weather events will likely lead to a substantial increase in agricultural risk, destabilising farm income (Gobin, Tarquis, & Dalezios, 2013).

A lack of succession planning also hinders the social sustainability of South African farmers. Since the future of food and agriculture lies in the hands of the next generation of family farmers, urgent actions are needed to support young people's engagement in agriculture and promote their active contribution to rural development (Food and Agriculture Organisation & IFAD, 2019).

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Social sustainability is further hampered by emerging farmers not investing in local community businesses. Investment in locally owned businesses leads to the sustainable use of local resources and the employment of local workers at decent wages, primarily serving local consumers (Shuman, 2021). In addition, a lack of specialised sustainable farming education threatens the sustainability of South Africa's emerging farmers. Therefore, education is essential for achieving a sustainable future (Skrefsrud, 2022).

Finally, a lack of female farmers is another challenge, risking the sustainability of emerging South African farmers (Acord, Oxfam & ActionAid, 2011). A study by El Neel (2018) showed that having women involved in farming significantly increased household food security and wealth. Women have important roles as food producers, managers of natural resources, caretakers of household food and nutrition security and contributors to household income (Olumakaiye & Ajayi, 2006). Furthermore, if women were given equal access to resources and human capital, they could achieve higher yields than men (Quisumbing *et al.*, 1996).

1.2. Sustainable Farming Practices

Emerging farmers in South Africa can mitigate the above challenges by engaging in sustainable farming practices that lead to greater economic, environmental, and social sustainability. Conventional farming (CF) practices contribute to numerous forms of environmental degradation, including air and water pollution, soil depletion, soil erosion, and diminished biodiversity (Bradley, 2002; Horrigan, Lawrence, & Walker, 2002; Lal, Reicosky, & Hanson, 2007; Gauker, 2010). In addition, CF practices aimed at higher yields per hectare strain the ability of the soil to maintain enough replenishment of essential natural minerals, leading to less nutrient-dense food (Montgomery, 2007; Benbrook *et al.*, 2008; Balmford *et al.*, 2018).

Environmental degradation is further exacerbated by careless farming practices, such as the irresponsible disposal of crop protection containers (CropLife International, 2019). In contrast, engaging in farming practices, such as conservation agriculture, organic agriculture, integrated crop management, climate-smart agriculture, and precision agriculture, can help farmers to farm more sustainably.

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1.2.1. Conservation Agriculture

Conservation agriculture tillage involves tillage practices ranging from zero tillage (No-till), reduced (minimum) tillage, mulch tillage, ridge tillage, and contour tillage. The aim is to minimise soil disturbance for a better soil environment and minimal environmental impact (Bradley, 2002; Palm *et al.*, 2014; Busari *et al.*, 2015). For example, farmers using no-till farming systems can reduce energy use by up to 70% (Gomiero, 2016). In addition, by not ploughing the soil and increasing the levels of crop residues that help conserve soil moisture (Ding, Schoengold, & Tadesse, 2009), they can minimise topsoil losses due to erosion *(*Claassen *et al.*, 2018).

Increased levels of crop residue lead to higher soil carbon, which positively affects the activities of soil macrofauna (Liu *et al*., 2006; Lal, 2004; Kargas, Kerkides, & Poulovassilis, 2012).

1.2.2. Organic Agriculture

Organic agriculture can be defined as a farming system where farmers work with nature rather than against nature, using environmentally friendly methods of weed, pest, and disease control aimed at producing food with minimal harm to ecosystems, animals, and humans (Šrůtek & Urban, 2008; Seufert, Ramankutty, & Foley, 2012; Pimentel & Burgess, 2013). Studies have found that organic agriculture farming systems are more environmentally friendly than conventional farming systems, resulting in greater soil carbon levels, better soil quality, and less soil erosion and groundwater pollution (Bengtsson, Ahnström, & Weibull, 2005; Tuomisto *et al.*, 2012; Muller *et al.*, 2017).

1.2.3. Integrated Crop Management

Integrated crop management concentrates on the whole farm operation. It links best management practices into an integrated plan while broadening integrated pest management by incorporating all aspects of crop production (Padgitt *et al.*, 2001). The system requires a high investment in infrastructure. The increased complexity of this system results in a higher risk and demands better-qualified farmers, managers, technicians, and workers to manage the system (Balbino *et al.*, 2014).

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According to Rana and Chopra (2013), the integrated crop management system provides synergy among different agricultural divisions and an opportunity to increase economic yield and profitability, resulting in greater sustainability.

1.2.4. Precision Agriculture and Digitalisation

Precision agriculture is made possible by digitalising agriculture (Comninos, 2020). According to the African Development Bank (2021), there are several opportunities for digital agricultural solutions to substantially increase resource use efficiency, profitability, transparency, market participation, and environmental sustainability. Digital solutions also have the potential to create more efficient agricultural value chains by decreasing costs, increasing decision support, reducing loss, and improving sustainable resource use efficiency (Kenney, Serhan, & Trystram, 2020).

1.2.5. Crop Diversity, Cover Crops and Crop Rotation

Increasing crop diversity on a farm can contribute to soil conservation, wildlife habitat, and increased populations of beneficial insects. Cover crops in the off-season after harvesting can provide several benefits, including improved soil quality and fertility, weed suppression, and erosion control (Legg & Viatte, 2001). In addition, crop rotation with different crops plays an important role in the development and distribution of bio pores and the dynamics of microbial communities through the recycling of crop residues, thus contributing to the development of soil structure and helping prevent soil degradation (Ball *et al.*, 2005).

3. AIMS OF THE STUDY

This study aimed to explore problems emerging farmers face in the South African context from the perspectives of emerging farmers, commercial farmers, and industry experts. Furthermore, the study aimed to give actionable recommendations to emerging farmers on increasing their farms' economic, environmental, and social sustainability by obtaining inputs from industry experts.

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4. METHODS

4.1. Research Design

A mixed-methods research design was used for this study. Closed-ended questionnaires measuring economic, environmental and social sustainability were distributed to emerging and commercial farmers growing dry beans for the Zamukele and HSB projects in the North-West Province of South Africa.

An adapted Logical Framework Analysis (LFA) tool was used to collect qualitative data from industry experts to determine what they believe is needed to improve emerging farmers' sustainability.

4.2. Sample and Data Collection

The sample consisted of 14 emerging farmers from the Zamukele dry bean growers group and nine commercial farmers growing dry beans for HSB.

4.3. Data Analysis

Quantitative data was analysed by running descriptive statistics for all questions using the Statistical Package for the Social Sciences (SPSS) version 26. In addition, Logical Framework Analysis was used to analyse the qualitative data from industry experts.

5. RESULTS AND DISCUSSION

5.1. Economic Sustainability of Emerging Farmers

Emerging farmers highlighted the difficulty in accessing finance as hampering their economic sustainability. In addition, the lack of extension officer support and the availability of land on the market were also seen as problematic. However, a lack of farming experience was seen as less problematic (Figure 1).

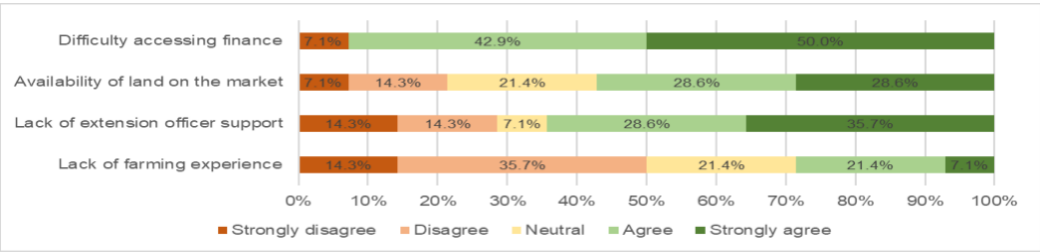

FIGURE 1: Factors Hampering Farm Economic Sustainability According to Emerging Farmers

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These findings align with previous studies showing that lack of capital for investment is a prevalent problem for small-scale farmers in South Africa (Qwabe, 2014) and that better support on the ground in the form of more professional agricultural extension systems is needed (The Thematic Group on Sustainable Agriculture and Food Systems, 2015).

Emerging farmers also found not owning the necessary machinery problematic. All emerging farmers indicated that they do not own a harvester and use contractors to harvest for them. Most emerging farmers (77.7%) then noted that they had to wait for contractors, resulting in them not harvesting at the ideal time. This corresponds with the findings by Dane (2020) that farmers not owning the necessary machinery resulted in yield losses and lowered profitability.

Cost factors that hampered emerging farmers from farming sustainably, as highlighted by the farmers, included the cost of labour, direct input costs, and farm instalments. In addition, contractor fees and leases of agricultural farmland were seen as particularly problematic (Figure 2).

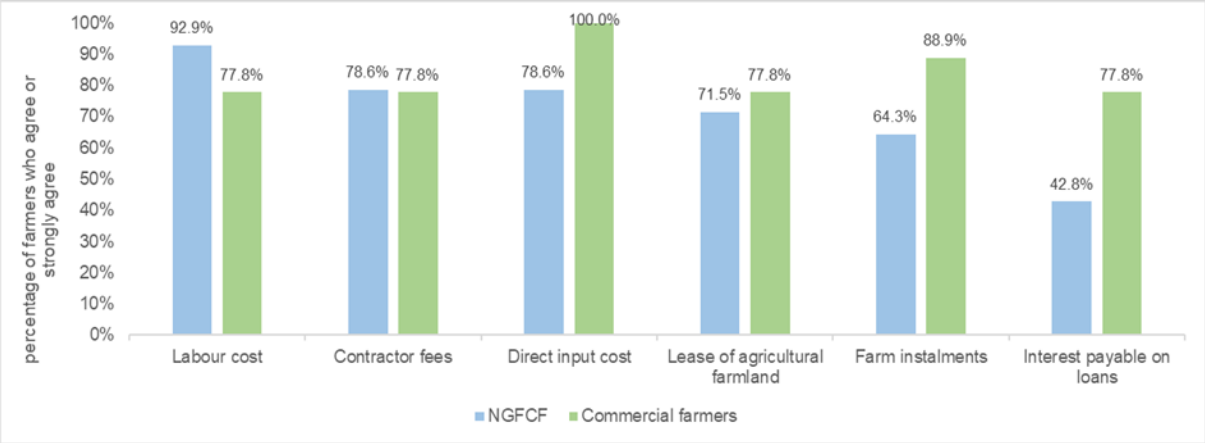

FIGURE 2: Cost Factors That Hamper Emerging Farmers From Farming Sustainably

These findings are not surprising, given that the literature shows that emerging farmers in South Africa experience financial constraints due to factors such as barriers to participation in high-value chains (Dorward, Kydd, & Poulton, 2008; Kirsten & Sartorius, 2002), the funding framework in South Africa favouring commercial farmers (Mtombeni, Bove, & Thibane, 2019), and emerging farmers' lack of knowledge around the importance of taking out insurance policies (Rishi & Priebe, 2020). Financial constraints hamper emerging farmers from buying machinery and from being able to afford all the abovementioned costs.

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5.2. Industry Experts' Views On Emerging Farmers' Economic Sustainability

The views of industry experts on the economic sustainability of emerging farmers were captured by a Log Frame Analysis (Figure 3).

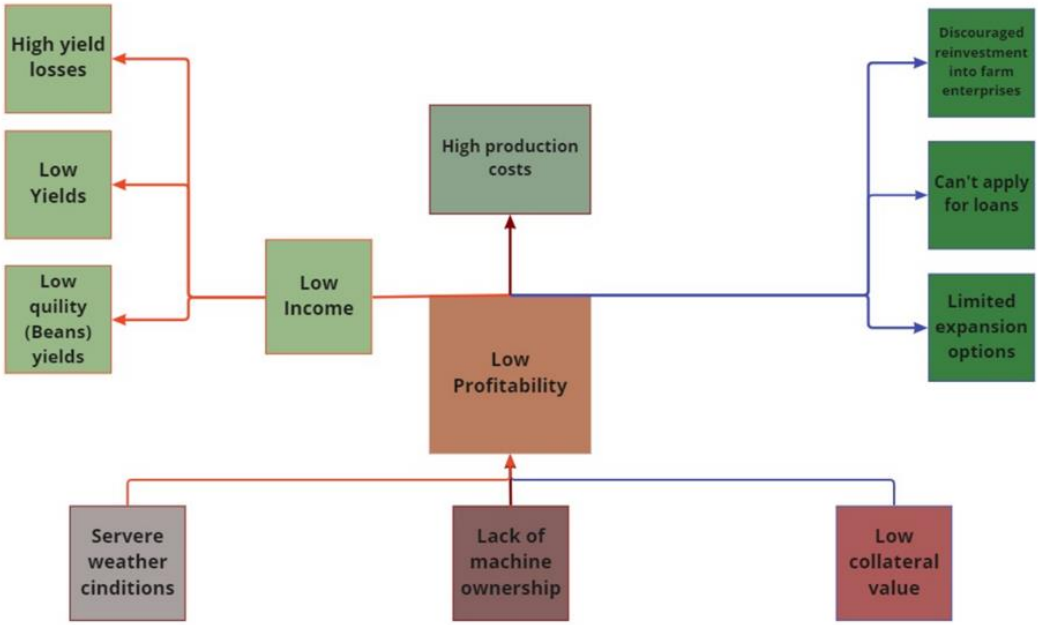

FIGURE 3: Problem Tree By Industry Experts For Emerging Farmers' Economic Sustainability

The core problem focus was low profitability, which forms the tree trunk in the middle of Figure 3. As mentioned, profitability is crucial for economic sustainability. Low profitability results in the farming enterprise being unable to reward the farmer with returns on his investment (Hofstrand & Johanns, 2019). The problems related to economic sustainability identified by industry experts were divided into causes and effects. The causes are the roots of the Problem Tree, and the effects are the branches.

The first cause identified was severe weather conditions. Severe weather conditions damage crops, resulting in lower yields and income, low return on investment and cash flow restrictions. This aligns with the literature on global climate change, which leads to extreme weather events that increase agricultural risk and destabilise farm income (Gobin, Tarquis, & Dalezios, 2013).

The second cause was not owning machinery. In this case, participants not owning harvesting machinery led to late harvesting. This resulted in beans becoming too dry for canners to use and shattering and splitting during harvesting and at the processing plants, leading to income

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losses for emerging farmers (Liebenberg, 2002). Not owning the necessary machinery results in emerging farmers using more labour and being unable to perform farming activities at the ideal time. The result is additional production costs, potential yield losses, and lowered profitability (Dane, 2020).

The third cause identified by experts was low collateral value. According to Kislat, Menkhoff, and Neuberger (2013), the lack of collateral contributes to restricted access to finance. Access to financial services is a significant challenge for emerging farmers that hinders economic development (De Klerk *et al*., 2013). According to industry experts, low collateral value results in emerging farmers being unable to expand their farming enterprise and access finance. Access to financial services is critical for providing funds for farm investments to improve productivity and postharvest practices, for improving household cash flow, and for enabling farmers to have better access to markets and to manage risks associated with farming (Gaamaa *et al.*, 2014).

The next phase in the LFA process is to turn the Problem Tree into an Objective Tree. The Objective Tree describes the future situation once the identified problems have been solved. This involves reformulating the negative statements of Figure 3 into positive statements to achieve in the future. The logical cause-and-effect relationship is converted into a logical activity-ends relationship that forms the Objective (Van Niekerk, 2012). The Objective Tree is displayed in Figure 4.

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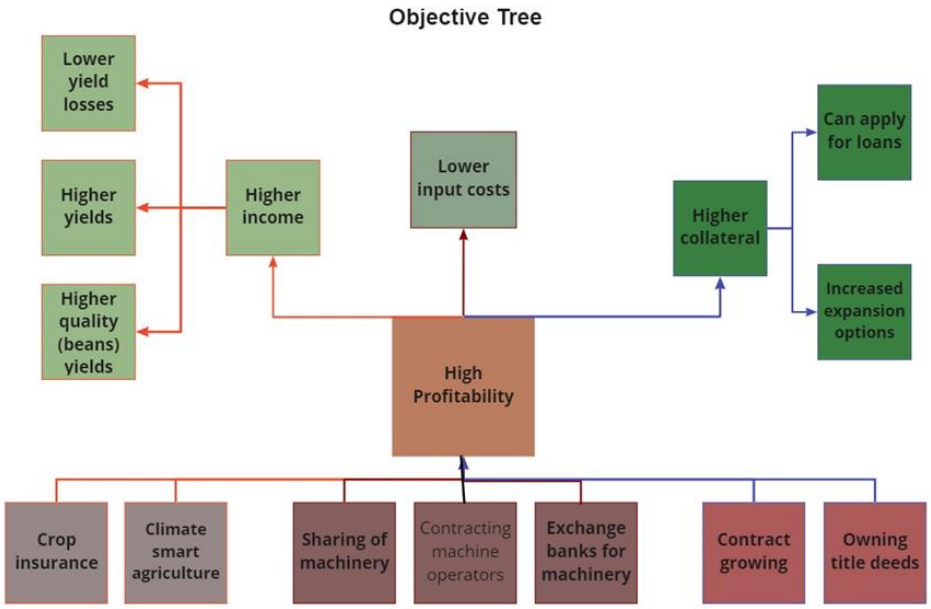

FIGURE 4: Objective Tree By Industry Experts For Emerging Farmers' Economic Sustainability

In the Objective Tree, the trunk represents the core objective statement for emerging farmers to achieve economic sustainability. The roots represent the activities to reach the objectives, and the branches represent the end goals.

The industry experts identified several desirable ends for emerging farmers to achieve economic sustainability. These ends included higher income due to higher yields, higher quality beans, lower yield losses, lower input costs, and higher collateral, improving emerging farmers' ability to apply for loans and expand.

The industry experts identified seven activities that would enable emerging farmers to become economically sustainable. The seven activities are:

1. Crop insurance
2. Climate-smart agriculture
3. Sharing of machinery
4. Contracting machine operators
5. Exchange banks for machinery
6. Contract growing
7. Owning title deeds

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5.3. Environmental Sustainability of Emerging Farmers

A crucial factor in improving emerging farmers' environmental sustainability is using qualified people for advice on best management practices for preventing soil erosion, improving soil health and fertility, using the correct crop protection products, and correctly using guidelines to store products and discard empty containers safely. In this regard, it is problematic that only 35.7% of the participants received regular visits from government extension officers, and only 42.9% reported receiving sound advice from these officers.

This finding is in line with the literature showing that better support systems on the ground are needed for emerging farmers, including more professional extension services that can help farmers with decision-making by providing information on more effective farming methods and practices based on the latest research (The Thematic Group on Sustainable Agriculture and Food Systems, 2015).

Several techniques and strategies have been proven to promote environmental sustainability, including doing soil surveys, conservation cultivation practices like no-till or minimum-till (Karayel & Sarauskis, 2019), organic farming (Šrůtek & Urban, 2008; Seufert, Ramankutty, & Foley, 2012; Pimentel & Burgess, 2013), crop rotation (Ball *et al*., 2005), the use of cover crops (Legg & Viatte, 2001), and the correct use of crop protection products.

Most emerging farmers strongly agreed that a soil survey is important to determine the best soil for crop production (71.4%) and that taking the necessary steps to prevent soil erosion is recommended (64.3%).

It is concerning that a substantial proportion of participants (42.9%) indicated that they make use of conventional cultivation tillage, while only a third of the emerging farmers applied organic amendments (35.7%). As noted, conventional farming practices contribute to numerous forms of environmental degradation, including air and water pollution, soil depletion, soil erosion, and diminished biodiversity (Bradley, 2002; Horrigan, Lawrence & Walker, 2002; Lal, Reicosky & Hanson, 2007; Gauker, 2010; Palm *et al*., 2014). In contrast, conservation tillage methods use less time and fuel, lead to less soil erosion, and require fewer labourers. At the same time, it stimulates higher agricultural productivity, increases the moisture retention capacity of the soil, reduces soil compaction and crust formation, lessens carbon emissions and air pollution, and improves surface water quality (Karayel & Sarauskis, 2019). Furthermore,

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organic farming and conservation tillage improve soil health by increasing microorganisms' abundance, diversity, and activity (Tahat *et al.*, 2020).

Most emerging farmers rotated crops (92.9%) to improve soil health. However, only 21.4% made use of cover crops. As noted, planting cover crops in the off-season enhances soil quality and fertility, suppresses weeds, and controls erosion (Legg & Viatte, 2001). Crop rotation, in turn, is important for the development and distribution of bio pores and the dynamics of microbial communities by recycling crop residues (Ball *et al.*, 2005).

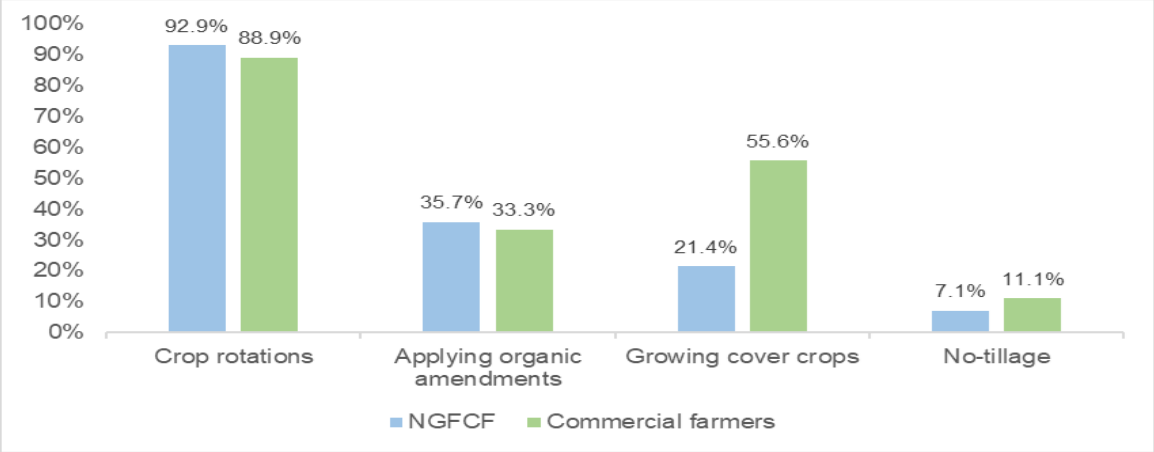

FIGURE 5: Steps to Improve Soil Health (Comparison of Emerging and Commercial Farmers)

Commercial farmers emphasised crop rotations to improve soil health, with 88.9% indicating this as an important factor. Growing cover crops was seen as important by 55.6% of commercial farmers. Commercial farmers viewed organic amendments and no-tillage as less critical for improving soil health.

Most emerging farmers (77.8%) use soil testing to improve soil fertility. At the same time, almost two-thirds noted that balancing soil nutrients and using a balanced fertiliser program is important for improving soil fertility. These findings are encouraging, given that integrated soil fertility management approaches that combine organic fertiliser resources with optimal chemical fertilisers effectively improve soil health and productivity (Ghorbani *et al.*, 2008; Vanlauwe *et al.*, 2010).

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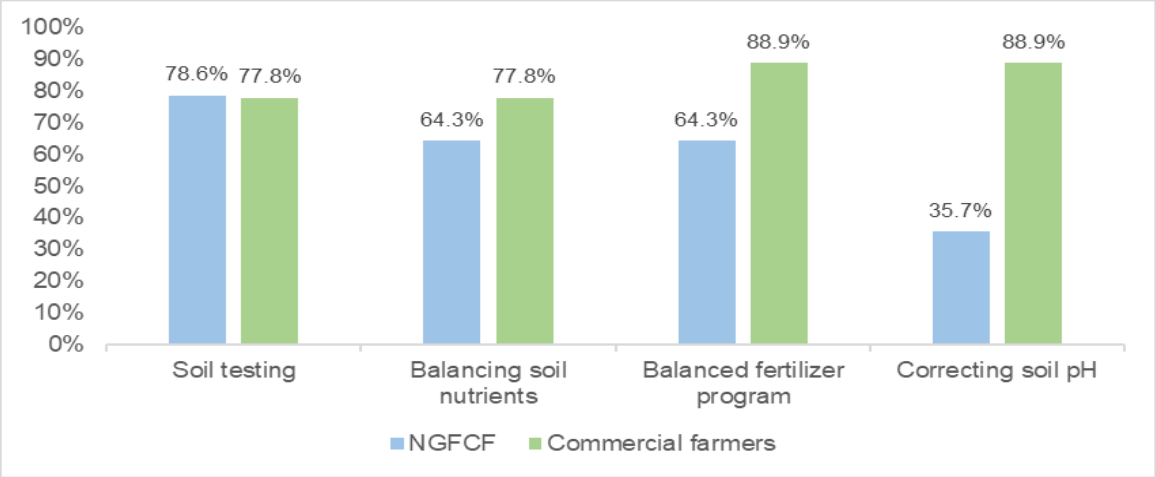

FIGURE 6: Steps to Improve Soil Fertility (Comparison of Emerging and Commercial Farmers)

More than three-quarters of commercial farmers rated soil testing, balancing soil nutrients, using a balanced fertiliser program and correcting soil pH as necessary for improving soil fertility.

Regarding factors that impact environmental protection, all emerging farmers were made up of qualified individuals to advise them on crop protection products, and 92% followed the instructions on the label for the use and application. Most emerging farmers (57.1%) used chemical products, while 42.9% used a combination of chemical and biological products. Most emerging farmers strongly agreed (57.1%) that following guidelines to safely store crop protection products and discard empty crop protection containers is important. Concerning environmental sustainability, 14.2% of participants disagreed or had a neutral view on discarding empty crop protection containers, and 7.1% did not follow the instructions on the label when using and applying crop protection products. The appropriate disposal or recycling of empty crop protection containers is essential for protecting the health of farmers, their communities, and the environment (CropLife International, 2019).

5.4. Industry Experts' Views On Emerging Farmers' Environmental Sustainability

The core problem was not implementing sustainable agricultural practices, forming the tree trunk in the middle of Figure 7. The industry experts identified various problems that were divided into causes and effects. The roots of the problem tree represent the causes, and the branches represent the effects.

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The first cause identified was not utilising advice, directly impacting how emerging farmers go about sustainable environmental practices. The effect of not using advice on agricultural production negatively influences their ability to solve problems and obtain information, skills, and technologies to improve sustainability (Davis, 2009). However, given the earlier findings, the problem is probably a lack of extension support rather than farmers, not heeding advice.

The second cause identified was a lack of education on soil erosion, negatively impacting soil degradation and erosion management and prevention. Educational campaigns focused on farmers' sense of social responsibility and their profit motives positively impacted the adoption of new, environmentally sound technologies (Wang, 2009).

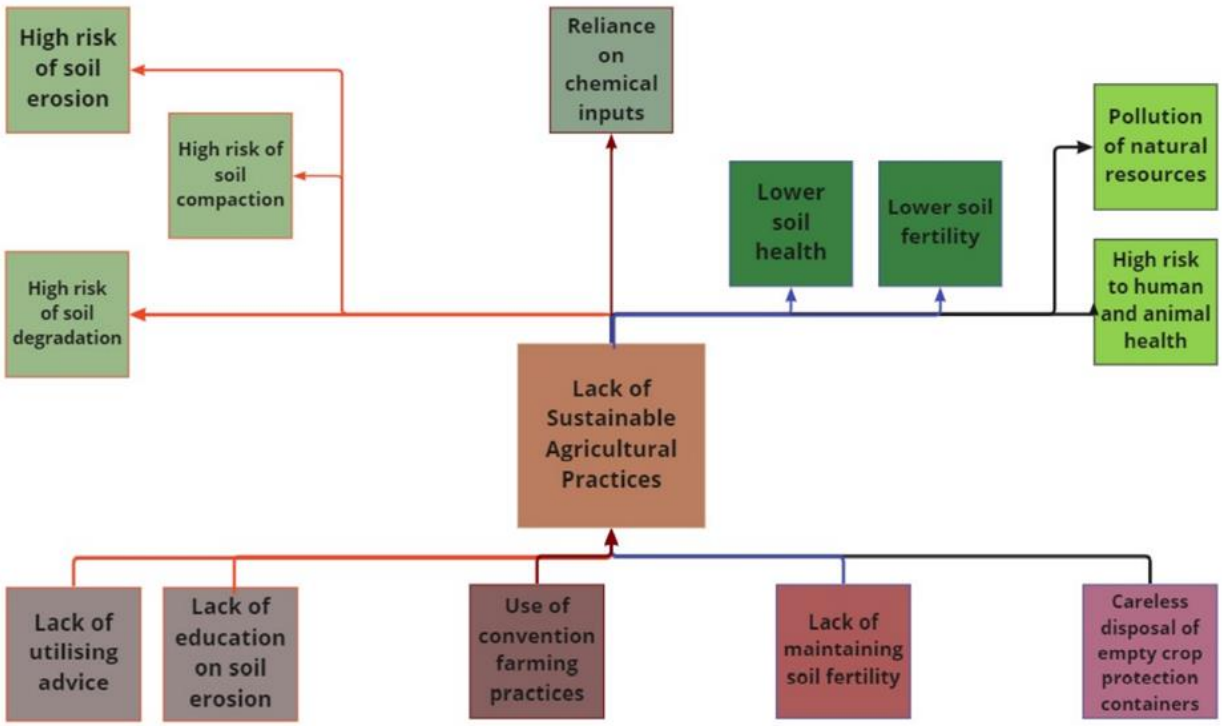

FIGURE 7: Industry Experts' Problem Tree for Emerging Farmers' Environmental Sustainability

The third cause identified was the use of CF practices. CF-based agriculture increases erosion rates enough to make farming unsustainable (Montgomery, 2007). CF contributes to air and water pollution, soil depletion, soil erosion and diminishing biodiversity (Bradley, 2002; Horrigan, Lawrence & Walker, 2002; Lal, Reicosky & Hanson, 2007; Gauker, 2010; Palm *et al.*, 2014).

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The fourth cause identified was not maintaining soil fertility, negatively impacting soil health and fertility. Providing plants with balanced essential nutrients through organic matter and minerals is the basis of healthy soils. This is the foundation of the food system that produces healthy crops that nourish people (Ghorbani *et al*., 2008).

The fifth cause identified was the careless disposal of empty crop protection containers, leading to adverse effects on the health of humans and animals and the pollution of natural resources. Farmers must dispose of crop protection containers responsibly and ethically to maintain a healthy ecosystem. Appropriately disposing of or recycling empty crop protection containers is essential to protect the health of farmers, their communities and the environment (CropLife International, 2019).

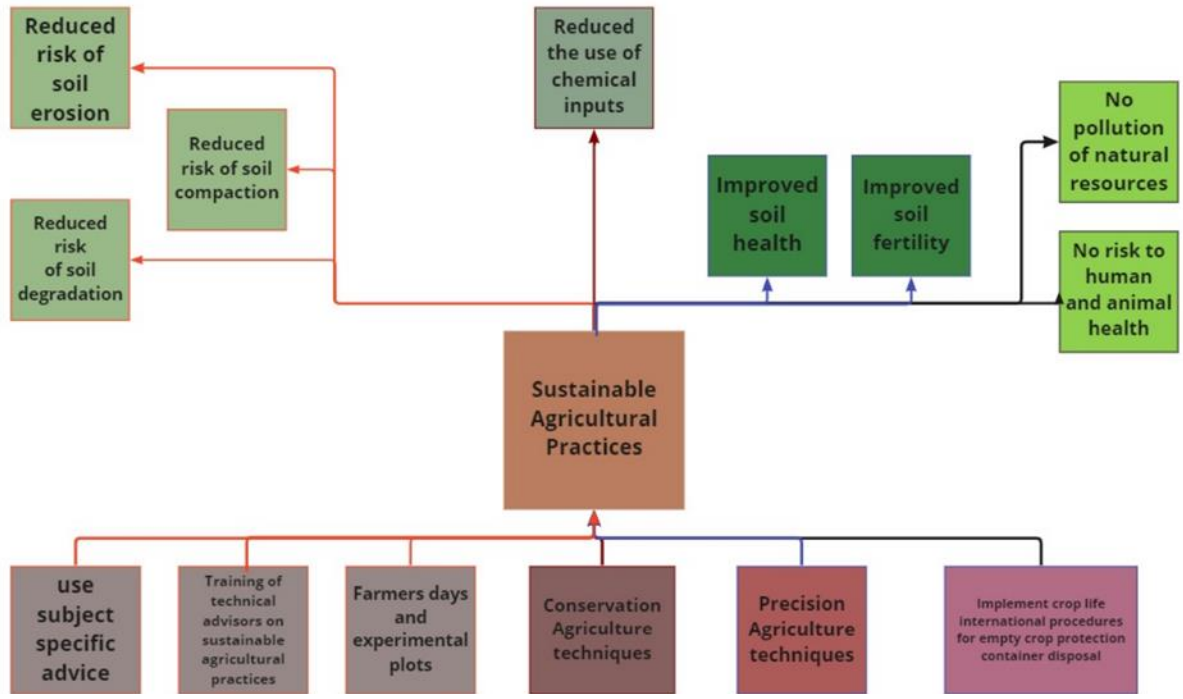

FIGURE 8: Industry Experts' Objective Tree For Emerging Farmers' Environmental Sustainability.

The industry experts identified seven central activities that they believed would enable emerging farmers to become environmentally sustainable, including:

1. Use of subject-specific advice.
2. Training of technical advisors on sustainable agricultural practices.
3. Farmer's days and experimental plots.
4. Conservation agriculture (CA) techniques.

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5. Precision agriculture (PA) techniques.
6. Implement crop life international procedures for empty container disposal.

5.5. Social Sustainability of Emerging Farmers

Rural development is vital for promoting social sustainability through poverty reduction and improving rural livelihoods (Sarris, 2001). The support and involvement of farms in communities can aid rural development in different ways. Farming contributes significantly to the overall state of rural regions in terms of employment, business opportunities, and infrastructure (European Commission, 2000).

Emerging and commercial farmers were asked what support they felt was important and how emerging farmers support local families to promote rural development and social sustainability (Figure 9).

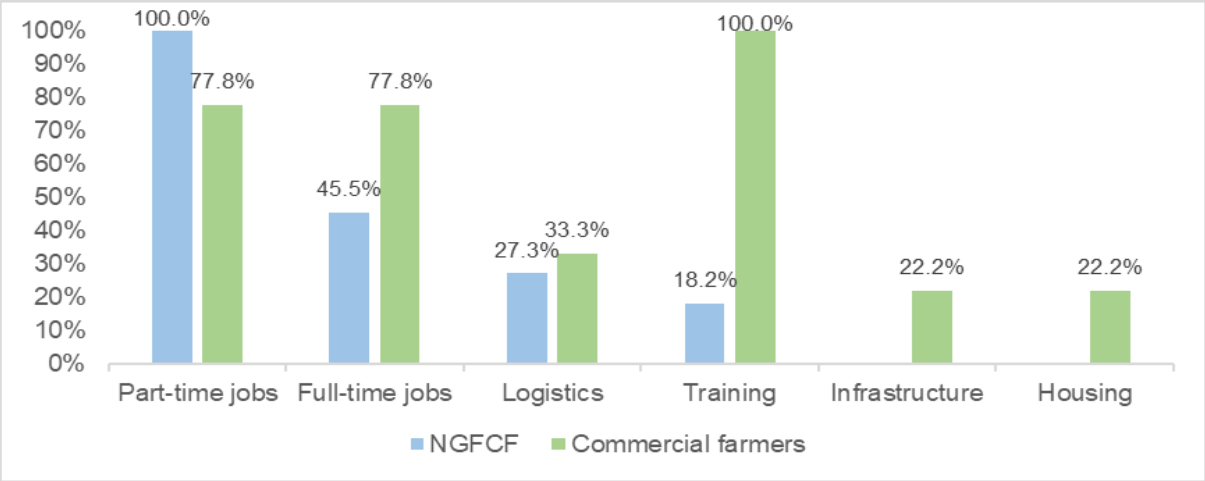

FIGURE 9: Support Provided to Local Families

Commercial farmers emphasised the importance of training local families to promote social sustainability. In addition, commercial farmers highlighted providing part-time and full-time jobs to local families as crucial for social sustainability. In line with the views of the commercial farmers, all emerging farmers indicated that they provide part-time jobs to local families, while 45.5% provide full-time jobs. However, in contrast to commercial farmers' views on the importance of training, less than a fifth of emerging farmers indicated that they provide training to local families.

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5.6. Industry Experts' Views On Emerging Farmers' Social Sustainability

The core problem identified was the lack of social entrepreneurship initiatives, forming the tree trunk in the middle of Figure 10. The industry experts identified various problems that were divided into causes and effects. The roots of the problem tree represent the causes, and the branches represent the effects.

The lack of succession planning was the first cause identified, with its primary effects a high risk of food insecurity (Ntshangase *et al.*, 2016), an increased risk of unemployment (Aladejebi, 2021), and low rural development. As noted, the generational renewal of family farming is a precondition for keeping agriculture viable and sustainable. Retaining young people on farms and in rural communities is crucial for the future of food and agriculture (Food and Agriculture Organisation & IFAD, 2019).

The second cause identified was a lack of local business investment. Investment in locally owned businesses leads to the sustainable use of local resources and employment of local workers at decent wages (Gaamaa *et al.*, 2014).

A lack of specialised agricultural education was the third identified cause. With education essential for achieving a sustainable future (Skrefsrud, 2022), a lack thereof is a serious risk factor for South Africa's emerging farmers' sustainability.

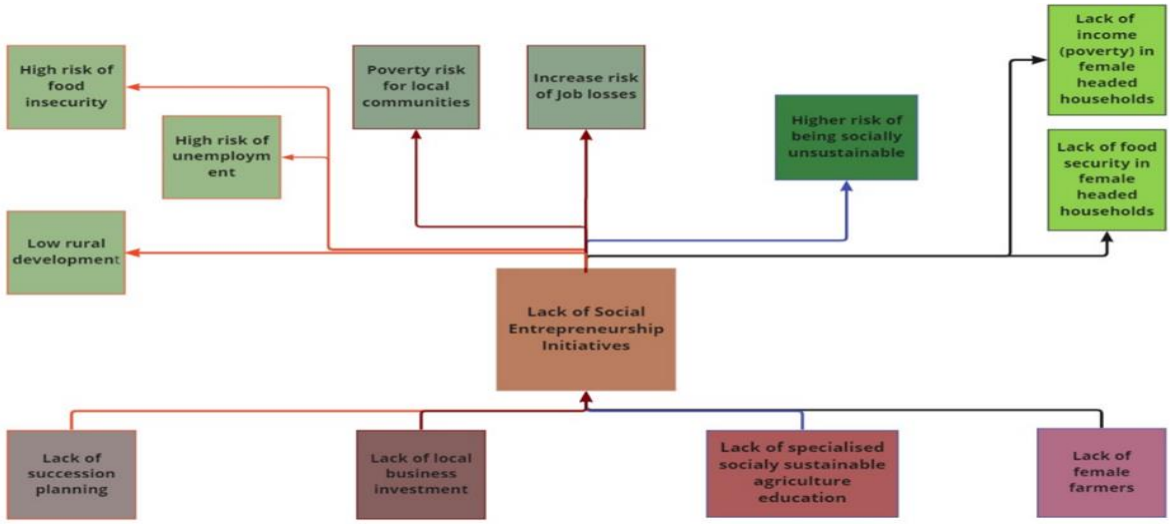

FIGURE 10: Industry Experts' Problem Tree For Emerging Farmers' Social Sustainability

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The fourth cause identified is the lack of female farmers. The effects expected are a lack of female-driven value-adding initiatives and low food security in female-headed households. As noted, female farmers are important as food producers, natural resource managers, caretakers of household food and nutrition security, and contributors to household income (El Neel, 2018; Olumakaiye & Ajayi, 2006). It has also been shown that women farmers can achieve higher yields than men, given equal access to resources and human capital (Quisumbing *et al.*, 1996).

In the Objective Tree, the trunk represents the core objective statement: improved social entrepreneurship initiatives for emerging farmers. The roots represent the activities to reach the objectives, and the branches represent the end goals.

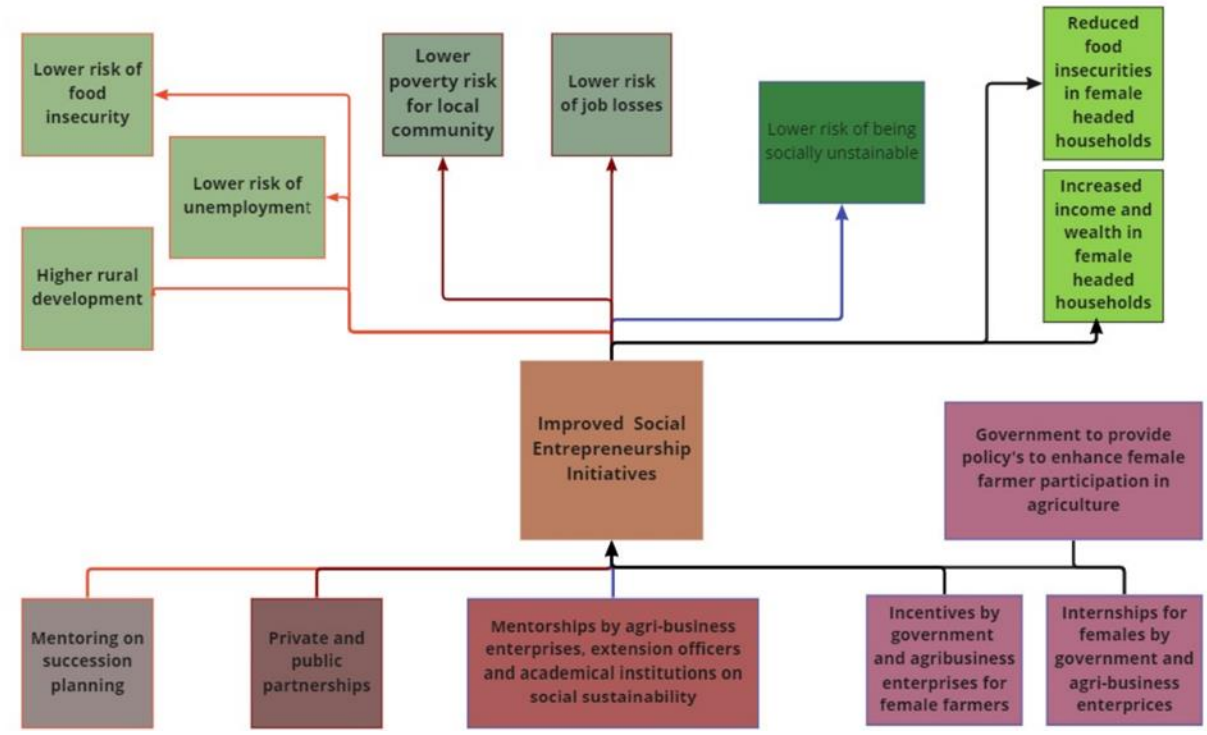

FIGURE 11: Industry Experts' Objective Tree For Emerging Farmers' Social Sustainability

The industry experts identified several desirable ends for emerging farmers to achieve social sustainability, including (i) lowering the risk of food insecurity, unemployment, and poverty for local communities, (ii) reducing job losses, (iii) increasing income and wealth in female-headed households, and (iv) increasing rural development.

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The industry experts identified eight central activities that they believed would enable emerging farmers to become socially sustainable. These six central activities are:

1. Mentoring on succession planning.
2. Private and public partnerships.
3. Mentorships by agribusiness enterprises, extension officers and academic institutions on social sustainability.
4. Conservation agriculture (CA) techniques.
5. Internships for females by government and agri-business enterprises.
6. Incentives by the government and agri-business enterprises for female farmers.
7. Government-provided policies to enhance female farmer participation in agriculture.

6. CONCLUSION

This study aimed to explore problems emerging farmers face in the South African context from the perspectives of emerging farmers, commercial farmers, and industry experts. Furthermore, the study aimed to give actionable recommendations to emerging farmers on increasing their farming practices' economic, environmental, and social sustainability by obtaining inputs from industry experts.

From the emerging and commercial farmers' perspective, difficulty accessing finance, lack of extension officer support, lack of land on the market, labour costs, contractor fees, not owning machinery, leasing costs, farm instalments, and direct input costs hindered economic sustainability. Industry experts identified low profitability as hindering emerging farmers' economic sustainability.

The industry experts put forth seven actionable solutions to enable emerging farmers to become economically sustainable, including emerging farmers (i) acquiring crop insurance, (ii) engaging in climate-smart agriculture, (iii) sharing machinery, (iv) using contract machine operators, (v) exchanging banks for machinery, (vi) using contract growing, and (vii) owning title deeds.

The problems hindering environmental sustainability identified by emerging and commercial farmers included a lack of guidance from extension officers on implementing sustainable

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agricultural practices and the consequent lack of implementation of methods such as rotating crops, testing soils and balancing soil nutrients.

Aligned with the farmers' views, the industry experts identified not implementing sustainable agricultural practices as the core problem affecting emerging farmers' environmental sustainability.

The actionable solutions proposed by the industry experts centred around educational interventions. The solutions included using subject-specific advice, training technical advisors on sustainable agricultural practices, farmer's days and experimental plots, using conservation- and precision agricultural techniques, and implementing crop life international procedures for empty container disposal.

Finally, rural development has been recognised as critical in promoting social sustainability. Farmers can influence rural development by supporting and becoming involved with the local communities. However, the results show that local families lacked support from the emerging farmers participating in the study. Although all the emerging farmers indicated that they provide part-time jobs to local families, less than half provided full-time jobs, and even fewer helped with logistics or provided training to these families. Industry experts identified a lack of social entrepreneurship initiatives as the core problem hindering social sustainability.

After identifying the problems, the industry experts identified eight activities they believed would enable emerging farmers to become socially sustainable commercial farmers. These include mentoring and succession planning, private and public partnerships, social sustainability mentorship by agribusiness enterprises, extension officers and academic institutions, internships and incentives for female farmers by government and agri-business enterprises, and government policies to enhance female farmer participation in agriculture.

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Analysis of Climate Change Knowledge and Capacity Needs of Rural Women Farmers in Southern Nigeria

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ABSTRACT

The study analysed climate change knowledge and capacity needs of rural women crop farmers in Southern Nigeria. Data was collected from 420 women farmers selected through a multi-stage sampling procedure using a questionnaire, interview schedule and key informant interviews. Descriptive statistics, Analysis of Variance and Ordered Probit Regression analysis were used to analyse the data collected. Knowledge of the management of resistant crop varieties ($\bar{X}$ = 3.48), use of improved farming technologies ($\bar{X}$ = 3.48) and access to credit facilities for adaptation purposes ($\bar{X}$ = 3.46) were the major areas of knowledge and capacity needs of the rural women farmers. Marital status, educational level, and access to credit influenced rural women farmers' knowledge and capacity needs. Results further showed a significant difference in the knowledge and capacity needs of rural women farmers across the six states of southern Nigeria used for the study. Climate change intervention programmes and policies in Nigeria need to take cognisance of some socioeconomic characteristics of rural women farmers that influenced their knowledge and capacity needs, as these could provide deeper insight into developing a more impactful intervention programme and policy.

Keywords: Rural Women, Information Needs, Crop Farmers, Capacity Needs, Climate Change Adaptation

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1. INTRODUCTION

Climate change is already having a global impact on smallholder farming systems in the tropics, their livelihoods, and ecosystems, as well as poor rural households in middle and low-income countries who bear the brunt of the burden due to their heavy dependence on rain-fed agriculture (Omerkhil *et al*., 2020; Das *et al*., 2020; Notre Dame Global Adaptation Initiative [ND-GAIN], 2021). Climate change affects humans, the environment, agriculture and other sectors, though it has more effects on agriculture than any other economic sector (Intergovernmental Panel for Climate Change [IPCC], 2014). Nigeria is an agrarian country with about 6% of its land area estimated to be exposed to extreme weather events, as evident in extreme variations in rainfall patterns, droughts, relative humidity and varying temperature fluctuations (Sokoto *et al*., 2016; Adhvaryu *et al*., 2019). Climate change leads to losses in agricultural productivity, threatening the sustainability of food production among small-scale rural communities, food security, income and welfare of farm families (Food and Agriculture Organisation, 2018; Henri-Ukoha, 2020; Atube *et al*., 2021; Ifeanyi-obi *et al*., 2022). The recent increase in rural-urban migration in Nigeria and reduced streamflow have also been attributed to the changing climate (Cattaneo & Massetti, 2019; Akinwumi *et al*., 2020). The issue of climate change and its impacts remains a worldwide concern in the next century and beyond.

Climate information and knowledge are required to equip farmers to adopt proactive measures and decisions that reduce their vulnerability to climate risks. The relevance of timely climate information delivery and knowledge building in agriculture in minimising the negative impacts of climate disasters cannot be over-emphasised (Carr *et al*., 2016; Apgar *et al*., 2017; Ketiem *et al*., 2017; Ozor & Nyambane, 2018; Ketiem *et al*., 2017; Soares *et al*., 2018; Naab *et al*., 2019; Paparrizos *et al*., 2020; Ifeanyi-obi & Ekere, 2021). For instance, timely climate information can help farmers to achieve favourable weather and climate conditions, which translates to social and economic opportunities, enhanced farm income, reduction in costs of inputs as well as economic loss from climate risks and uncertainties (Nyadzi, 2019; Rahaman, 2020). However, farmers in Southern Nigeria depend on their experience and traditional information base for their farm practices while making farm decisions. The Nigerian Meteorological Agency is the government arm responsible for generating weather information

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in Nigeria. It has been observed that the form of this climate information delivery does not support understanding on the farmers' side as most of the information is delivered in a highly technical scientific manner. Onyango *et al.* (2014) complained that even when weather and climate information is provided to farmers, the current form of delivery does not support their operational decisions. These decisions include timing of land preparation, planting time, type of seed or likelihood of severe weather. This is worsened by their inadequate access to considerable location and time-specific climate information services (Rashid *et al*., 2014; Kumar *et al*., 2020), consequently making them vulnerable to climate change impacts. The Agricultural Development Programme (ADP) is the government arm primarily responsible for agricultural advisory services in Nigeria. This unit faces the challenge of manpower shortage and inadequate resources for service delivery. This has affected her ability to deliver timely advisory services, particularly in climate change.

Vulnerability is exacerbated by a lack of reliable weather and climate information necessary to support adaptation to more resilient farming practices (Onyango *et al*., 2014). However, access to information and capacity building for farmers on climate change knowledge is germane in improving their resilience to climate risks and impact (Zuma-Netshiukhwi *et al*., 2016). This, therefore, calls for measures to enhance the farmer's capacity to access timely climate information given the concerns raised. Several works have been conducted on climate information and knowledge needs of farmers (Onyango *et al*., 2013; Feleke, 2015; Kruk *et al*., 2017; Mareverwa, 2018; Muita *et al*., 2021), but a few addressed the climate knowledge and capacity needs of farmers in Southern Nigeria. The preceding left a knowledge gap, which this study intends to fill. To address this issue, the study will empirically assess the climate change knowledge and capacity needs of rural women crop farmers in Southern Nigeria the capacity of farmers in terms of their timely and reliable climate.

2. OBJECTIVES OF THE STUDY

The broad objective of the study was to analyse climate change knowledge and capacity needs of rural women crop farmers in Southern Nigeria. The specific objectives were to:

1. Describe the socioeconomic characteristics of rural women farmers in the study area.

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2. Determine climate change adaptation knowledge and capacity needs of rural women farmers in the study area.
3. Determine the relationship between rural women farmer's knowledge and capacity needs and their socioeconomic characteristics.
4. Assess differences in the climate change adaptation knowledge and capacity needs of rural women farmers in southern Nigeria.

3. THEORETICAL AND CONCEPTUAL FRAMEWORK

The quality of life one lives, and one's existence in totality, depends hugely on the healthiness of their environment. Even though one's environment is a key determinant of one's existence, knowingly and unknowingly, in their quest to earn a living and meet their daily needs, has continued to exert undue pressure on their environment, resulting in mainly negative consequences. Many of today's environmental issues are increasingly the result of human actions, personal consumer decisions, and small and large business activities (Akintunde, 2017). One of such many problems is the issue of climate change, which has been established to be mainly induced by human activities that encourage the emission of greenhouse gases (GHGs). Climate change has exerted adverse negative effects on all sectors of the economy, particularly the agricultural sector of developing countries (like Nigeria), which depends mainly on weather signals.

Most earlier adaptation efforts focused on identifying adaptation strategies and developing technologies to facilitate adaptation. It is important to note that knowledge predisposes an individual to adapt. Knowledge influences attitude, and a positive attitude stimulates positive environmental behaviour. Earlier and later researchers' findings show a correlation between knowledge and behaviour (Bagozzi & Burnkrant, 1979; Fazio & Zanna, 1978, 2006; Ajzen, 2005).

Recent trends on climate change issues have shown that the vulnerability of an individual to climate change is not dependent solely on the extent of climate change events but also on some key socioeconomic factors, including the individual's level of knowledge as well as the traditional belief system and practices existing in an individual's local setting. These factors influence an individual/system's ability to respond effectively to climate change, hence the

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need to build farmer climate change knowledge. As the effects of climate change continue to intensify and the need for increasing adaptation action grows, it becomes pertinent to strengthen farmer's knowledge of climate change to stimulate responsible behavioural change. Mann *et al*. (2020) stated that it is no longer enough to help individuals understand ecosystems; there is a need to go beyond awareness and knowledge and into the realm of behaviour change. This research aims to support rural women in developing environmentally responsible behaviour (ERB) through increasing their knowledge of climate change and factors influencing effective adaptation. Effective knowledge building can only happen when the knowledge gap is identified, and the knowledge building is structured to address their knowledge needs adequately. Akintode (2017) suggested three theories to aid the examination and understanding of the Environmentally Responsible Behavior (ERB) concept. They are the Primitive Model, Hines's Model of Environmentally Responsible Behaviour (Hines *et al*., 1987), and Ajzen and Fishbein's reasoned/responsible action theory. The study is based on Hines, Hungerford, and Tomera's (1987) theory of Environmentally Responsible Behaviour (ERB) in Akintunde (2017). The model stated that there must be an intention to act environmentally friendly. It proposes five major factors influencing environmentally responsible behaviour: intention to act, locus of control, attitudes, sense of personal responsibility, and knowledge.

This research recognises that women crop farmers already intend to act due to the numerous threats and risks posed to their farming activities by climate change. Still, they cannot act effectively due to poor knowledge of climate change and other numerous socioeconomic factors militating against successful adaptation, particularly social exclusion. The study proposes that equipping women with climate change knowledge will strengthen them to embrace environmentally responsible behaviour and develop control over climate risks and threats. Furthermore, it noted that holistic knowledge of climate change and influencing factors to adaptation will help create a sense of personal responsibility to contribute to climate change adaptation discourse among rural women. The research intends to contribute not just to building the knowledge of rural women crop farmers on the concepts of climate change but also to understanding other factors that may influence their attitude and adaptive behaviours, hence stimulating responsible action.

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The conceptual framework proposes that rural women crop farmer's response to climate change is not influenced by only their level of exposure to and intensity of climate change effects; the knowledge of climate change and other key socioeconomic factors play a vital role in their willingness and choice of response to climate change effects. It conceptualised that some socioeconomic factors may affect women crop farmers' capacity to adapt in response to climate change effects. It assumes that knowledge of these socioeconomic factors could facilitate finding commensurate strategies to alleviate climate change effects. The framework assumes a strong relationship between the dependent variable, rural women's climate change knowledge and capacity needs and the independent variables, socioeconomic characteristics.

4. METHODOLOGY

This study was conducted in Southern Nigeria. The country has a total area of 923,768 square kilometres, which falls within Latitude: 9° 03' 60.00" N and Longitude: 7° 28' 59.99" E. Rainfall is the crucial climatic variable in the country with a marked alternation of wet and dry seasons in most areas. Rainfall is experienced almost throughout the year in the country, with the most significant occurring between April and October. The Mean annual temperature for Nigeria is 26.9^{o}C, with average monthly temperatures ranging between 24^{O}C and 30^{O}C.

The southern part of Nigeria experiences strong rainfall events during the rainy season, usually between March and October. Rainfall amount in the region rises above 2,000mm and can reach 4,000mm in the Niger Delta zone of the region during such time (Nigeria, 2020). The central livelihood patterns of the people of rural areas range from farming to petty trading, as well as artisans and civil servants.

A multi-stage sampling procedure was used to select the sample for this study. The first stage comprises the random selection of two states from each of the three geopolitical zones that make up Southern Nigeria. The States are Abia and Enugu (southeast zone), Rivers and Akwa Ibom (SouthSouth zone) and Oyo and Osun (SouthWest zone). The second stage comprises the purposive selection of two agricultural zones from each state selected. This was based on the dominance of rural areas in the zone. In the third stage, one agricultural block was chosen from each of the selected twelve agricultural zones, giving a total of twelve agricultural blocks for the study. The final stage comprised the selection of one agricultural circle from each block. The circles selected were Ovom, Amakama, Umunaa, Umuoke, Abua odua, Olakwo 1, Ikot

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Ekpan, Ikot Esikan, Oluyole, Kajola, Agbora and Akola. The study was targeted at only rural women farmers in crop production; hence, the list of all registered women crop farmers in these circles was accessed from the agricultural extension agents, and 35 female crop farmers were selected, giving a total of 420 women crop farmers for the study.

Data was collected with a questionnaire and interview schedule where the farmer was illiterate. In addition, key informant interviews were conducted with key women leaders to help get in-depth knowledge of the subject matter and triangulate information collected during questionnaire administration.

Socioeconomic characteristics of the rural women crop farmers were analysed using mean, frequency counts and percentages. The rural women's climate change adaptation and capacity needs were captured using a 4-point Likert scale of Very High, High, Low and Very Low, which was assigned weights of 4, 3, 2 and 1, respectively. A midpoint of 2.5 was obtained, implying that rural women's climate change information and capacity needs are low in statements with a mean value of below 2.5 and high in those with a mean value of 2.5 and above. The relationship between the rural women crop farmer's information, capacity needs, and socioeconomic characteristics was determined using the Ordered Probit Regression model. In contrast, Analysis of Variance (ANOVA) was used to assess differences in the climate change adaptation information and capacity needs among rural women in southern Nigeria. The model specification for the OLS and ANOVA are stated below:

4.1. Model Specification

4.1.1. Relationship Between Rural Women Crop Farmers' Knowledge and Capacity Needs and Their Socioeconomic Characteristics

The relationship between rural crop women farmers' knowledge and socioeconomic characteristics was assessed using an ordered probit regression model. The error term in the ordered probit model is assumed to be normally distributed with zero mean and constant variance (variance = 1) (Edriss, 2019). The ordered probit model is therefore stated as follows:

$$Y_i^* = \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_{10} X_{10i} + \varepsilon_i$$

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$$Y_i = \begin{cases} 1 = Very\ low \\ 2 = Low \\ 3 = High \\ 4 = Very\ high \end{cases}$$

Where Y represents the ordered or ranked response of climate change knowledge and capacity need of rural crop farmers measured with a four point-Likert scale of Very High (4), High (3), Low (2) and Very Low (1), X_1 represents age (measured in years), X_2 represents marital status (Single = 1, Separated = 2, Married = 3), X_3 represents educational level (1 = no formal education, 2 = primary, 3 = Secondary, 4 = tertiary), X_4 represents farming experience (measured in number of years), X_5 represents access to credit (No = 0, Yes = 1), X_6 represents membership of cooperative association (No = 0, Yes = 1), X_7 represents extension agent visit (No = 0, Yes = 1), X_8 represents farm size (in numbers), X_9 represents monthly income from farming activities (in Naira), X_{10} represents amount of credit accessed (in Naira), and e = Error term.

Furthermore, the marginal effect of the model is estimated and used for result discussions, given the non-linearity and non-probabilistic nature of the coefficients. Hence, marginal effect estimates the probability of each outcome change as each explanatory variable changes (Edriss, 2019). Therefore, each dependent outcome variable (Y = 1, 2, 3, 4) would have its probability of occurrence as the independent variable changes.

4.1.2. Difference in Climate Change Adaptation Knowledge and Capacity Needs of Rural Women in Southern Nigeria

Analysis of Variance was employed to assess the difference in climate change adaptation knowledge and capacity needs among rural women in southern Nigeria. The result was subjected to the Turkey HSD Comparison test to identify where the variance in information and capacity needs among rural women crop farmers in southern Nigeria lies.

5. RESULTS AND DISCUSSION

5.1. Socioeconomic Characteristics of Rural Women Crop Farmers

Results in Table 1 show the socioeconomic characteristics of the rural women crop farmers in the zone. It shows that 91% of the rural women are married with a mean age and household size of 48 years and five persons, respectively. Most of them had secondary education (51%).

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They were majorly full-time farmers (95%) with average farm size and farming experience of 0.64 Ha and 13 years. Both inheritance and lease (65%) were the major sources of farmland, while farm labour was accessed mainly through hired and family supply (86%). The average monthly income is N33,130. Only 33% have access to credit facilities, while 43% are cooperative association members. Extension visits are relatively existing in the area as 48% indicated being visited by an extension agent. Cassava (96%), Maize (93%) and Vegetables (93%) were the major crops cultivated in the zone.

The result above indicates that most rural women could read and write, and 58% had at least a secondary school certificate. When farmers are educated, accessing information through written channels (Ninh, 2021; Yongshan & Yonghe, 2020; Akanni, 2019) and mobile phones could be easier. This holds a lot of potential for their overall productivity as access to information is vital in making rational farm decisions and timely responses to extreme weather events.

Also, membership in a cooperative society could be a veritable factor in promoting information dissemination among farmers (Oluwaseun & Trudy, 2014), as many access farm information through fellow cooperative members. Membership in a cooperative society among rural women is relatively low, which is a militating factor in effective information dissemination among them.

Furthermore, the result shows that a good percentage of rural women have yet to be visited by agricultural extension agents. This is disturbing, bearing in mind that the agricultural extension agents are the primary personnel mandated by agricultural advisory services in the country. The grossly inadequate extension visits may be attributed to the country's low number of agricultural extension agents. The extension agent-to-farmer ratio remains below the expected level (1:200) for effective training and visit extension, which is the extension approach used in Nigeria. Currently, the country has an agricultural extension agent-to-farmer ratio of 1:3000 (Sennuga *et al*., 2020), making it extremely difficult for the extension agents to disseminate information to the farm population in the country effectively. This is a pointer to the cogent need to harness other means/channels of agricultural information dissemination that could complement the few available extension agents. Leveraging mobile phones for e-extension services holds excellent potential in this regard.

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TABLE 1: Socioeconomic Characteristics of Rural Women Crop Farmers in Southern Nigeria

S/N	Variable	Frequency	Percentage (%)	Mean
1	Age (Years)			48
	≥ 30	45	11.0	
	31 - 50	195	47.0	
	51 – 70	180	42.0	
2	Marital status			
	Single	15	3.0	
	Separated	24	6.0	
	Married	381	91.0	
3	Educational Status			
	No formal education	54	13	
	Primary education	122	29.0	
	Secondary education	212	51.0	
	Tertiary education	32	7.0	
4	Farming Status			
	Part time farmers	21	5.0	
	Full time farmers	399	95.0	
5	Household size			5
	≤ 5 Persons	218	52.0	
	6 - 10	45	45.0	
	< 10 Persons	16	3.0	
6	Farming experience (years)			13
	1 - 10	42	10.0	
	11 - 20	80	18.0	
	21 – 30	95	23.0	
	31 – 40	98	24.0	
	> 40	105	25.0	

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7	Farm Size (Ha)			
	<1	352	84.3	0.64
	1 - 2	55	12.6	
	Above 2	13	3.1	
8	Source of Farmland			
	Lease	89	21.0	
	Purchase	15	4.0	
	Inheritance	42	10.0	
	Both Inheritance and Lease	274	65	
9	Source of Farm Labour			
	Hired	49	12.0	
	Family supplied	9	2.0	
	Both Hired and Family Supplied	362	86.0	
10	Monthly income from Farming activities (Naira)			33,130
	≤ 20,000	122	29.0	
	21,000 – 40,000	226	54.0	
	41,000 – 60,000	49	11.0	
	61,000 – 80,000	12	3.0	
	81,000 – 100,000	3	1.0	
	> 100,000	8	2.0	
11	Access to credit facilities in the past	138	33.0	
12	Membership of Cooperative society	180	43.0	
13	Visited by Extension Agent	202	48	
14	*Major crops cultivated			
	Cassava	408	96	
	Maize	393	93	
	Vegetables	393	93	
	Yam	340	81	
	Cocoyam	313	74	
	Plantain	313	74	

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Pineapple	167	40
Rice	80	19

***Multiple response**

5.2. Climate Change Adaptation Knowledge and Capacity Needs of Rural Women Crop Farmers

The level of knowledge and capacity in climate change adaptation among rural women crop farmers was found to be generally low ($\bar{X}$ = 1.78). This indicates the compelling need to build their knowledge and capacity in climate change adaptation. Almost all (97.4%) women indicated they needed to develop their knowledge and capacity in climate change adaptation. Table 2 shows the different areas of knowledge and capacity needs indicated by the rural women crop farmers. The significant areas of information and capacity need indicated by the rural women were knowledge on resistant crops ($\bar{X}$ = 3.48), use of improved technologies ($\bar{X}$ = 3.48), easy access to credit facilities for adaptation purposes ($\bar{X}$ = 3.46), capacity on adopting Climate Smart Agriculture (CSA) practices ($\bar{X}$ = 3.46), knowledge and skill in pest control practices ($\bar{X}$ = 3.44), knowledge on crop vulnerability to climate change ($\bar{X}$ = 3.44), knowledge and capacity on group dynamism for better adaptation to climate change ($\bar{X}$ = 3.40) and knowledge on existing government climate change adaptation initiatives and policies ($\bar{X}$ = 3.40).

A similar result was found by Okoro, Agwu and Anugwa (2016), who identified the use of improved varieties, occupational diversification, and change in timing of farm operations, among others, as the climate change knowledge needs of farmers in Enugu state. Egbule and Agwu (2014) in same line found that men and women farmers require knowledge on how bush burning (80.9% and 81.5%) and deforestation (72.6% and 76.4%) activities bring about climate change, further indicating that climate change information needs of men and women differ.

TABLE 2: Climate Change Adaptation Knowledge and Capacity Needs of Rural Women Crop Farmers in Southern Nigeria

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Climate Change Adaptation in Knowledge and Capacity Needs of Rural Women Farmers	**Very High**	**High**	**Low**	**Very Low**	**Mean**
I need to acquire more knowledge of existing government climate change adaptation initiatives and policies	171(41.8)	230(56.2)	8(2.0)		3.40**
I need to develop my capacity in crop management practices for climate change adaptation	173(42.3)	224(54.8)	12(2.9)		3.29**
My capacity to upscale available Indigenous adaptation practices needs to be improved	164(40.1)	224(54.8)	21(5.1)		3.35**
Knowledge of accessing adaptation information using social media needs to be improved	159(38.9)	231(56.5)	17(4.2)	2(0.5)	3.34**
Knowledge of crop vulnerability to climate change	196(47.9)	197(48.2)	16(3.9)		3.44**
Need to develop my knowledge and capacity in alternative livelihood means	159(38.9)	236(57.7)	14(3.4)		3.35**
Need to develop my capacity in soil management practices	170(41.6)	223(54.5)	15(3.7)	1(2)	3.37**
My knowledge and skill in the use of Agro-chemicals need to be developed	183(44.7)	219(53.5)	7(1.7)		3.34**
Need more knowledge and skill in Pest control practices	188(46.0)	212(51.8)	9(2.2)		3.44**
More knowledge of non-environmentally friendly farming practices	172(42.1)	223(54.5)	14(3.4)		3.39**
Knowledge of the vulnerability of different livelihoods to climate change	173(42.3)	217(53.1)	19(4.6)		3.38**

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Knowledge of better understanding of weather information	162(39.6)	236(57.7)	11(2.7)		3.37**
Need more knowledge and capacity in water management practices	1148(36.2)	223(54.5)	38(9.3)		3.27**
Knowledge and capacity on the use of improved technologies need to be developed	207(50.6)	193(47.2)	9(2.2)		3.48**
More capacity for adopting Climate Smart Agriculture (CSA) practices	198(48.4)	204(49.9)	5(1.2)	2(0.5)	3.46**
More knowledge on how to access credit facilities to facilitate adaptation	197(48.2)	203(49.6)	8(2.0)	1(0.2)	3.46**
More knowledge and capacity on group dynamism for better adaptation to climate change	171(41.8)	230(56.2)	8(2.0)		3.40**
More knowledge of operational land use Acts and degrees	146(35.7)	241(58.9)	22(5.4)		3.30**
Knowledge of resistant crops	210(51.3)	187(45.7)	12(2.9)		3.48**

*Low **High

5.3. Relationship Between Rural Women's Crop Farmers' Knowledge and Capacity Needs and Their Socioeconomic Characteristics

Table 3 shows the descriptive statistics of women concerning their knowledge and capacity needs. The result suggests that the percentage of women with very high knowledge and capacity needs is 41.73%. In addition, the percentage of women with high knowledge and capacity needs is 57.54%, while 0.73% of women have low knowledge and capacity needs, and 0% have very low knowledge and capacity needs. This implies that the number of women who require knowledge and capacity building was 171 women (very high need) and 235 women (high need). In comparison, only about three women require minimal to no capacity development (low need).

TABLE 3: Descriptive Statistics of the Dependent Variables

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Variable	Mean	Std. Dev.	Min	Max
Very high	0.4172782	0.1134467	0.0727063	0.9227671
High	0.5753811	0.1136599	0.0744328	0.924543
Low	0.0073407	0.0006679	0.0027506	0.0078258
Very low	0	0	0	0

In addition, the ordered probit model is used to determine the relationship between rural women crop farmers' knowledge and capacity needs and their socioeconomic characteristics. To justify the choice of model adopted, Akaike's Information Criterion (AIC) was used to select the model that provides the best fit based on the smallest AIC value. The AIC values between ordered probit regression (AIC = 595.3143) and ordered logit regression (AIC = 595.5641) were compared for best fit. Therefore, the ordered probit model was adopted for the analysis because it fits the model better. The result of the ordered probit regression is shown in Table 4. Given that the model is not linear and the coefficients are not probabilities, the marginal effect is estimated and presented in Table 5. The marginal effect was conducted to ascertain the probabilities of each outcome.

TABLE 4: Result for the Ordered Probit Regression

Variables (n=409)	Coefficient	Standard error	p-value
Age	-0.004	0.010	0.686
Marital status: Separated	-1. 093	0.492	0.026
Married	-0.747	0.388	0.054
Primary education	-0.254	0.218	0.243
Secondary education	-0.423	0.212	0.045
Tertiary education	-0.959	0.329	0.004
Farming experience	0.002	0.009	0.831

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Credit	-0.548	0.274	0.046
Membership in a Cooperative society	0.056	0.177	0.750
Visited by Extension Agent	0.219	0.135	0.140
Farm size	0.008	0.005	0.122
Monthly income from Farming activities (Naira)	4.85e-07	2.04e-06	0.812
Access to credit facilities in the past	3.02e-06	1.49e-06	0.042
Cut 1	-0.8599	0.4936	
Cut 2	-0.8403	0.4935	
Log-likelihood	-282.657		
LR	22.86		
p-value	0.04		

The result in Table 5 suggests that marital status plays a role in accessing crop farmers' knowledge and capacity needs. This agrees with the findings of Diouf *et al*. (2019). Hence, the probability of women requiring very high knowledge and capacity needs decreases with marital status. In contrast, it had the opposite effect on women requiring high knowledge and capacity needs ($p<0.05$). The result also shows that having a secondary and tertiary education reduced the probability of women having very high knowledge and capacity needs ($p=0.044<0.05$; $p=0.001<0.01$, respectively) by 16.7% and 35%, respectively. This implies that literate farmers may not require a lot of knowledge and capacity building.

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TABLE 5: Socioeconomic Factors Influencing Rural Women Crop Farmers' Knowledge and Capacity Needs

Variables	Very high		High		Low	
***DV= Knowledge and capacity need**	Marginal effects (Standard Error)	p-value	Marginal effects (Standard Error)	p-value	Marginal effects (Standard Error)	p-value
Age	-0.002 (0.003)	0.686	0.002 (0.004)	0.686	-6.26e-06 (0.000)	0.696
Separated	-0.415 (0.169)	0.014**	0.415 (0.169)	0.014	-0.000 (0.002)	0.961
Married	-0.288 (0.135)	0.033**	0.288 (0.134)	0.032**	0.001(0.002)	0.554
Primary education	-0.101 (0.086)	0.240	0.101 (0.086)	0.239	0.000(0.000)	0.806
Secondary education	-0.167 (0.083)	0.044**	0.167 (0.083)	0.043**	-0.000(0.000)	0.566
Tertiary education	-0.350 (0.108)	0.001***	0.352 (0.108)	0.001***	-0.002(0.002)	0.228
Farming experience	0.001 (0.003)	0.831	-0.001 (0.003)	0.831	0.000(0.000)	0.832
Credit access	-0.206 (0.098)	0.035**	0.208 (0.099)	0.036**	-0.001(0.001)	0.246
Membership of Cooperative society	0.022 (0.069)	0.750	-0.022 (0.069)	0.750	0.000 (0.000)	0.751
Visited by Extension Agent	0.085 (0.052)	0.103	-0.086 (0.052)	0.103	0.000 (0.000)	0.262
Farm size	0.003 (0.002)	0.122	-0.003 (0.002)	0.122	0.000 (0.000)	0.275

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Monthly income from Farming activities (Naira)	1.89e-07 (7.94e-07)	0.812	-1.90e-07 (7.97e-07)	0.812	7.51e-10 (3.20e-09)	0.814
Amount of credit accessed in the past	1.18e-06 (5.80e-07)	0.042**	-1.18e-06 (5.82e-07)	0.042**	4.67e-09 (3.83e-09)	0.222

DV= Dependent variable *** represent 1% significance level, ** represent 5% significance level

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On the other hand, having a secondary and tertiary education increased the probability of women having high knowledge and capacity needs ($p=0.043<0.05$; $p=0.001<0.01$, respectively) by 16.7% and 35%, respectively (Table 3). This aligns with the findings of Chen and Lu (2019) and Diouf *et al*. (2019). Chen and Lu (2019) reported that the higher the farmers' educational attainment, the higher their information needs are. In contrast, Diouf *et al*. (2019) reported that literate farmers were more likely to access climate information services. Lastly, Table 3 indicates that having access to credit reduced the probability of women having very high knowledge and capacity needs by 20.6% ($p=0.035<0.05$). However, for women with high-capacity needs, access to credit increased their probabilities by 20.8% ($p=0.036<0.05$). Therefore, farmers' ability to access credit is important to determine their capacity and knowledge needs.

5.4. Difference in the Climate Change Adaptation Knowledge and Capacity Needs of Rural Women in Southern Nigeria

A one-way between-groups analysis of variance was conducted to check differences in the climate change knowledge and capacity needs among rural women in the six states used for the study. As shown in Table 6, the result shows a statistically significant difference in the climate change adaptation knowledge and capacity needs of rural women crop farmers at $p < .05$ level: $f (5, 414) = 2.865$, $p = 0.015$.

TABLE 6: Analysis of Variance in the Climate Change Knowledge and Capacity Needs of Rural Women Crop Farmers in Southern Nigeria

Sources of variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2143.755	5	428.751	2.865	.015
Within Groups	61951.129	414	149.640		
Total	64094.883	419			

Despite reaching statistical significance, the difference in mean scores between the groups was quite small. The effect size (the strength of the difference between groups) was calculated to find out the relative magnitude of the difference between means or the amount of total variance in the dependent variable that is predictable from the knowledge of the levels of the independent variable.

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The effect size calculated using the eta-squared method was 0.03, which, according to Cohen (1988), is classified as a small effect size. It could be said that despite reaching statistical significance, the actual difference in mean scores between the groups (states) was quite small.

A post-hoc comparison test was conducted to identify precisely where the difference lies. Post-hoc comparisons using the Turkey HSD test indicated that the mean score for Abia state (M= 58.4286, SD= 17.68) differ significantly from Enugu state (M= 64.7429, SD= 7.23655) and Oyo State (M= 65.300, SD= 4.71307). This shows that the climate change information and capacity needs of rural women crop farmers in Abia State vary from those in Enugu State and Oyo State. This may be due to the peculiar effects and challenges the rural women crop farmers face in these zones. In addition, looking at the ecological zones of the states, Abia state lies in the Humid forest zone of the country, while Enugu and Oyo states lie in the Derived savannah. This could also contribute to how climate change affects them, hence different knowledge and capacity needs.

6. CONCLUSION AND RECOMMENDATIONS

The study concludes that the rural women farmers were primarily middle-aged, literate, married, and had adequate farming experience. In addition, the rural women farmers were small-scale full-time farmers with low access to extension services and cooperative society membership. As a result, farmers are deprived of benefits such as effective information dissemination regarding climate change adaptation. Hence, rural women farmers in the study area are encouraged to be members of a cooperative society and adequately receive extension services to effectively adapt to the negative effects of climate change through appropriate knowledge and capacity building. Furthermore, rural women farmers' knowledge and capacity in climate change adaptation was generally low. Therefore, farmers need to build knowledge and capacity in climate change adaptation.

Thus, marital status, level of education, and the number of credits obtained by rural women crop farmers greatly determine the farmers' need for knowledge and capacity building. Therefore, depending on the level of interest (whether for farmers requiring 'very high' knowledge and capacity building or for farmers requiring 'high' knowledge and capacity building), the unique relationships and interactions between the socioeconomic characteristics of women crop farmers

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and their knowledge and capacity need should be considered for any meaningful policies and solutions to be made.

The study further concludes that rural women crop farmers' climate change knowledge and capacity needs in Abia, Enugu, and Oyo states differ. Hence, climate change knowledge and capacity building should be based on their relative needs, given the peculiarities of each state. Therefore, researchers should consider this in future studies.

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Can Agroecology Close the Health Disparities Gap for Urban Vulnerable Communities in South Africa?

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ABSTRACT

Approximately 34% of households in Johannesburg grapple with food insecurity, with 60% allocating R1000 (roughly $57) or less per month for food. The advent of COVID-19 exacerbated the situation, particularly for socially disadvantaged low-income populations, limiting their access to optimal health options. The pandemic underscored the importance of a balanced diet and consuming various vegetables and herbs rich in vitamins and other essential minerals to boost the immune system. The pandemic further highlighted the disparities in South Africa's food and health systems. This article delves into the core challenges, including food insecurity, the lasting impact of COVID-19, and poor public health facilities and interventions in South Africa. It explores the potential of agroecology in addressing health disparities in South Africa's urban communities. A transdisciplinary literature review was conducted, primarily utilising secondary data from two key sites: the Research, Teaching and Food Systems Hub at the Auckland Park Bunting campus of the University of Johannesburg and research reports from the Siyakhana Growth and Development team. This study posits that the agroecological approach can effectively address the high prevalence of food and nutrition insecurity. Promoting localised food production is essential for the successful implementation of agroecology. This should be complemented by appropriate and personalised training and capacity-building initiatives through consolidated stakeholder mobilisation. A supportive policy framework advocating for urban farming and agroecology is also crucial.

Keywords: Urban Agriculture, Capacity Building Community Health, Nutrition, Environmental Stewardship

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1. INTRODUCTION

There are significant disparities in community health in South Africa, across the African continent, and globally. These disparities, although challenging, are manageable and can be addressed through concerted efforts at the global, national, and local levels (Morris *et al*., 2021). The challenges of health and food insecurity are unprecedented and have been further intensified by the lasting impact of the COVID-19 pandemic and the ongoing economic recession in South Africa (Plamondon *et al*., 2020). The pandemic has amplified the social, economic, and environmental issues, contributing to numerous health complications. Despite some progress since 1994, South Africa is marked by stark inequalities in health and wealth, with poverty and unemployment pervasive (Hlongwane *et al*., 2022). According to Erokhin *et al*. (2020), the economic impact of COVID-19 and the economic downturn, evident in rising prices, especially food, and an unemployment rate nearing 35%, amplifies the devastating impact on health (Gumata *et al*., 2021).

South Africa is grappling with a wide array of health issues, including low birth weight, stunting, Tuberculosis (TB), cardiovascular disease, hypertension, diabetes, and cancer (Singer *et al*., 2021). Numerous studies underscore the importance of plant-based foods such as vegetables, fruits, whole grains, legumes, nuts, and seeds in preventing many diseases. These foods provide essential vitamins, minerals, and other plant compounds (Mullins *et al*., 2021; Rock *et al*., 2020; Kaparapu *et al*., 2020). Agroecology, an essential agricultural and developmental intervention, is pivotal in enhancing the availability of diverse foods, addressing health disparities, and raising awareness about ecological health. In addition to being a source of a balanced and appropriate organic diet rich in safe and nutritious food, it is a crucial component of environmental health (Rudolph *et al*., 2020).

1.1. Purpose of the Paper

This paper aims to study and assess agroecology as a potential strategy for enhancing nutrition, augmenting food accessibility and availability, promoting environmental stewardship, and reducing household food expenditure.

2. METHODOLOGY

A comprehensive, transdisciplinary literature review was undertaken, utilising secondary data sources predominantly from two key sites: the Centre for Ecological Intelligence's (CEI)

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Research, Teaching and Food Systems Hub at the Auckland Park Bunting campus of the University of Johannesburg and reports by the Siyakhana Growth and Development NPO. The collected data was meticulously synthesised, establishing several thematic topics, including agroecology, health disparities, organic produce promotion, dietary diversity, and sustainable community development. These themes provided a structured framework for the analysis and interpretation of the data.

Several secondary reports linked to the sites were scrutinised. These included the Conservation Agriculture Report (GDARD, 2017), which offered insights into conservation practices in agriculture; the Gauteng City-Region Observatory Food Systems Review Paper (Working Paper Series, 2017), which provided a comprehensive overview of the food systems in the Gauteng City-Region; The City of Johannesburg Prevalence of Food Security Report (2017), which shed light on the state of food security in the greater Johannesburg Metropole; and the GDARD Mid-Term Evaluation of the Siyazondla Homestead Food Gardens Programme (2014). These reports were supplemented by data collected and interventions conducted at the CEI hub, including initiatives related to food justice and innovative agroecological elements. These innovative elements encompassed food production systems, the circular economy and waste management. A rigorous and methodical approach to data collection and analysis ensured a thorough understanding of the subject matter, providing comprehensive data and a strong argument for discussion and the recommendations made in this paper.

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FIGURE 1: Siyakhana Organic Garden

FIGURE 2: Centre for Ecological Intelligence's (CEI) Research, Teaching and Food Systems Hub at the Auckland Park Bunting campus

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3. INTERVENTIONS

3.1. Small-Scale Farming and Urban Agriculture

According to Rudolph *et al*. (2023), the agroecological farming system presents a viable alternative to enhance food production, particularly for the most vulnerable communities and households. This system, backed by substantial evidence, is instrumental in augmenting dietary diversity locally and mitigating the numerous health and environmental risks associated with industrial agriculture. Agroecology not only has the potential to feed the poorest segments of the population but also offers a source of income and access to high-quality food at a low cost. For middle-income families, it presents an opportunity for savings and a return on their investment in urban property. Furthermore, it can be profitable for small and large entrepreneurs. A report by the European Union (EU) (2023) confirmed that investing in agroecology can yield a return on investment of between 7 to 30 US dollars for every dollar invested.

However, implementing agroecological methods must be contextualised within the broader framework of the rapid urbanisation of peri-urban arable land. This urbanisation could lead to declining agricultural production (Sumbo *et al*., 2023). Compounding factors such as limited and erratic access to water and energy could further inhibit affordable food supply (Altieri *et al*., 2020; Abdulai *et al*., 2023). While agroecology offers numerous benefits, its application must be carefully considered within urbanisation and resource availability to ensure sustainable and equitable food production (Mondal *et al*., 2021).

Despite these challenges, Chandia (2020) argues that small-scale and alternative farming, such as rooftop and vertical gardens, and the effective use of small spaces using innovative methods, systems, and materials in public open spaces such as parks, schools, and clinics, can generate substantial food in urban and peri-urban environments. Thus, executing an urban agriculture strategy could provide a solution to producing a wide range and diversity of food, thereby addressing food shortages and waste management while also impacting health, education, and economic benefits (Rudolph *et al*., 2023).

Nino *et al*. (2020) showed that a 100 m^2 plot can sustain a family for a year with fruits and vegetables, providing a nutritional intake of vitamins A, C, and B and iron. Furthermore, gardening has been identified as a form of exercise that can promote health and reduce the incidence of heart disease, obesity, and diabetes, offering a generally therapeutic environment.

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The potential of small-scale farming as a solution for food insecurity must be considered (Dasa *et al*., 2018). With sufficient entrepreneurship skills and support, small-scale agriculture can hugely contribute to the country's economic development and well-being by providing employment services and raw materials for agriculture and other industries. Small-scale farms also tend to be more natural and organic than commercial farms, as small-scale farmers cannot afford agrochemicals, fertilisers and genetically modified seeds. Hence, the food produced from small-scale farms is healthier and contains fewer chemicals. Small-scale agriculture can break the cycle of poverty, but only if it is productive, profitable, sustainable, resilient, and, very importantly, linked to markets (Rudolph *et al*., 2020). To ensure that beneficiaries can achieve optimal health, agricultural projects should be nutrition-oriented, promoting adequate, healthy food and creating local markets while protecting and contributing towards environmental sustainability (Mwadzingeni *et al*., 2021).

Agroecology promotion enables people to increase control over and improve their health. This approach recognises that the urban environment can significantly impact public health. Health benefits to the broader population can be achieved by facilitating the development of urban environments that promote health, equity, and economic development (Pereira *et al*., 2018).

Given the high prevalence of food and nutritional insecurity among South Africans, one of the strategies used to improve food availability and access in urban centres is the establishment of community food gardens. Indeed, it has been demonstrated that community food gardens can significantly transform poor communities by subsidising household supplies, supplying households with an income, and increasing food diversity (Alessandro *et al*., 2021).
Chetty-Mhlanga *et al*. (2021) posited that establishing gardens in schools can increase awareness of the importance of good nutrition and spread it to communities. Growing food in schools could enhance learning, skills, health, and well-being outcomes for children and young people, particularly in diet and nutrition. Integrating health and nutrition education into the curriculum promotes healthy habits such as improved hygiene and sanitation, dietary diversity, nutrient preservation, and informed food choices. Furthermore, ensuring that girls remain in school can prevent the intergenerational transmission of malnutrition, low birth weight, and child malnutrition (Rudolph *et al*., 2023; Adidja *et al*., 2019). Despite all the positive aspects of agroecology, it is important to understand and appreciate that simultaneously addressing all factors related to health disparities may be challenging. Nevertheless, breaking the cycle at

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various critical points in the systemic feedback loop, which links disparities with public, environmental and socio-economic challenges, is essential (Wezel *et al*., 2020).

4. FINDINGS AND DISCUSSION

4.1. City of Johannesburg (CoJ) Food Resilience Report

Rudolph *et al*. (2021), drawing from the CoJ Food Resilience Report (2017), showed that 34% of households in the greater Johannesburg Metropole experience food insecurity. Furthermore, 60% of these households spend R1000 (approximately $57) or less on food per month. Households employ various coping strategies to manage their limited resources, including purchasing and consuming less preferred but inexpensive foods, buying only essential items, adhering to a strict budget, reducing portions, or borrowing food or money from friends or relatives (Nkosi, 2017). However, these strategies often compromise the quality and quantity of the diet. This is evidenced by the fact that one in five households reported limited nutritional diversity. Most households consume foods and drinks high in starch and sugar, while consuming fruits, vegetables, and pulses is less frequent. This dietary pattern could potentially increase the risk of non-communicable diseases and weaken immunity, leading to significant health and financial implications (Jamshidi-Naeini *et al*., 2021).

A focus group discussion held at the Siyakhana Organic Garden in Bezuidenhout Park, Johannesburg, revealed that certain demographic groups, including the elderly, women, the unemployed, and individuals with low levels of education, are particularly susceptible to food insecurity. This underscores the need for systemic and economic interventions that can address social determinants related to food and nutritional disadvantages. Mazenda *et al*. (2021) further emphasised the crucial role of municipalities in enhancing food security by implementing appropriate policies and support programs. These findings highlight the urgent need for broad, targeted interventions to improve food security and nutrition in the greater Johannesburg Metropole.

4.2. Gauteng Department of Agriculture and Rural Development (GDARD) Conservation Agriculture

The GDARD report (2017) evaluation of local and provincial initiatives provided an insightful analysis of the state of urban agriculture and food gardens. The data revealed that only a small fraction of households are engaged in urban agriculture and food gardens. Many households

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refrained from participating in agricultural activities, which could be attributed to many factors. One of the primary deterrents is the stringent city by-laws that govern agricultural practices within urban settings. These regulations pose significant barriers for households interested in urban agriculture or setting up food gardens. Another major obstacle is limited access to land. Open spaces suitable for agriculture are often scarce in densely populated urban areas, restricting households' opportunities to engage in agricultural activities. These findings were confirmed by a recent study by Mkhize *et al*. (2023).

Furthermore, there is a noticeable lack of knowledge regarding innovative or alternative farming practices among households. This knowledge gap further hinders their ability to invest time and effort in urban agriculture effectively and efficiently and sustain these interventions. An observation from the feedback was a general disinterest in agriculture amongst most households, which could be attributed to the perceived labour intensity of agricultural activities, lack of immediate economic returns, or simply a preference for other forms of livelihood. The above findings demonstrate substantial barriers to adopting urban agriculture and food gardens. Policy, systems thinking, short-, medium- and longer-term strategic and targeted interventions addressing these challenges could increase household participation in these practices (Fantini, 2023).

In addition, the development of small-scale food gardens and farms in diverse environments is hindered by limited resources such as water and energy and a deficiency in capacity building and training (Rudolph *et al*., 2023). Despite these obstacles, the agroecology systems approach is perceived as a feasible and sustainable resolution to these challenges (GDARD Report, 2017).

The two projects under scrutiny implemented agroecological methods, and the results validated numerous advantageous assertions expressed above. These advantages include the revitalisation and augmentation of agriculture through enhanced soil quality, heightened soil resistivity, and the soil's increased ability to retain essential nutrients. Furthermore, it promoted a circular economy through the valorisation of waste and the creation of multiple revenue streams, improved governance of the agroecology project, and environmental sensitivity (Shrestha *et al*., 2020; Fantini, 2023). In summary, despite the considerable impediments to adopting urban agriculture, the agroecological approach presents promising solutions for enhancing agricultural practices and outcomes (Mkhize *et al*., 2023).

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Mabapa *et al*. (2017) and Steglich *et al*. (2023) posit that agroecology enhances the resilience of livelihoods by fostering the development and implementation of multiple agricultural enterprises. This, in turn, offers solutions for mitigating and adapting to climate change while providing a consistent income source. The CEI hub's multi and cross-disciplinary work related to food systems further highlighted the effectiveness of various elements of agroecology. These include diversity, co-creation of knowledge, synergies, efficiency, recycling, resilience, human and social values, culture and food traditions, responsible governance, and circular and solidarity economy. These elements have proven successful and could be replicated in other community sites, yielding numerous benefits, particularly in water and energy conservation. However, despite the myriad advantages of agroecology, certain challenges were identified. These challenges encompass human error, poor farm management and maintenance, and inefficient use of resources. There are also difficulties in accurately measuring farm inputs and outputs, which can lead to inaccuracies and inefficiencies. It is important to note that, on the one hand, agroecology is vulnerable to the climate conditions of the surrounding environment (Pereira, 2018). On the other hand, agroecology farming best practices are efficient for ensuring resilient, sustainable farming systems even under climate change and variability (Akanmu *et al*., 2023).

In essence, while agroecology offers many benefits and has the potential to enhance the resilience of livelihoods, it has its challenges. This complexity must be clearly understood to harness agroecology's potential fully (Khalid *et al*., 2023).

4.3. Siyazondla Household Food Security Programme

The Gauteng Department of Agriculture and Rural Development (GDARD), through its Siyazondla household food security programme, invested R45 million, distributed 26,032 garden starter packs, offered training, and evaluated 380 of the recipients (GDARD, 2014; Mcata, 2019). Ninety percent of the participants interviewed received food garden training, but it was primarily focused on basic information rather than practical application. Although 87% of the households were still trying to maintain their gardens after one year, they faced barriers such as accessing seedlings, water problems, and soil health issues. Additionally, 96% of households consumed limited produce from their gardens. Fewer than 20% of households reported selling homegrown produce and saving money from their gardens. The programme evaluation identified key limitations, such as the need for improved food security and

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household incomes. Babalola (2021) noted that about 6.6 million South Africans faced severe hunger due to the COVID-19 lockdown restrictions, and it's unlikely that this worrying statistic has changed two years later. The negative influence of this public health pandemic on food security in South Africa was massive, and the impact is still being felt with severe disruptions in the agricultural production and food supply chain. Babalola (2021) further asserts that families and communities should be encouraged to grow their produce to be food secure and even create a source of income. These recommendations are supported by Kazungu *et al.* (2023).

4.4. Sustainable Social Entrepreneurship Models for Urban Agribusiness Initiatives in Johannesburg

A comprehensive case study focusing on farming initiatives within the Johannesburg City Metropole collected data through in-depth interviews with eight experts in the field. The findings indicated that the concept of social entrepreneurship in the context of urban farming initiatives remains somewhat nebulous and ill-defined, resulting in varying interpretations and understandings. Despite this lack of clarity, certain farm-level interventions have been identified as essential for the success of these initiatives. These interventions include applying innovative precision farming technologies, allowing for more efficient and effective farming practices, and using the agroecological approach. This combination of precision agriculture and agroecology seems to be a suitable blend of current practice (Mafuwane *et al.*, 2023).

Furthermore, establishing a supportive policy environment within local government that actively promotes urban farming was deemed necessary. Such a policy framework can provide legal and regulatory support for urban farming initiatives. In addition, the importance of multi-stakeholder collaboration is emphasised. This involves stakeholders' active participation and cooperation, including farmers, local communities, government agencies, non-governmental organisations, and businesses. In essence, while the concept of social entrepreneurship in urban farming is still evolving, certain key interventions and approaches have been identified as essential for the success of these initiatives (Mello, 2019; Rudolph *et al.*, 2021).

5. CONCLUSIONS

Agroecology has received much attention as a sustainable production strategy capable of leveraging the agricultural-nutrition linkages to positively impact community health. The

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agroecological food production approach and methods improve nutrient adequacy through higher production diversity, environmental sensitivity and sustainable solutions. The various local and provincial government and other reports mentioned above all emphasise the need for government to play a more decisive role and support broader systemic and economic drivers to address food and nutritional insecurity. Universities can contribute by adding value through research and training, developing replicable models, and providing institutional support. Social entrepreneurship in urban farming initiatives confirms and reinforces the importance of leveraging technology and dedicated management solutions for urban farming, thereby increasing production and generating income.

Investment in agroecology is an important strategy to boost food production and economic development. South Africa can exploit and build on its extensive public and agricultural extension systems network to address health and nutrition issues by using agroecology in combination with precision farming. Farmers can learn how to grow various nutritious crops within available budgets and apply biodiversity methods. There is a need for consolidated efforts from local, provincial, and national governments to promote and ensure healthier urban and inner-city environments. This should include allocating funding towards research interventions addressing water, air, and soil pollution, as well as the nutritional status of urban populations. Additionally, zoning specific land for agroecology and providing appropriate and accredited training at all levels are essential components of this comprehensive approach.

South Africa faces challenges, including epidemics of chronic illness such as diabetes and hypertensive cardiac disease, as well as high maternal, neonatal, and childhood mortality rates, compounded by the aftermath of COVID-19. These challenges highlight the urgency of prioritising health promotion and primary prevention through school-based and public health initiatives, including nutrition interventions. Learning opportunities for schools and communities, where agroecology promotion is a health promotion and disease prevention tool, should include small-scale agriculture nutrition courses, workshops, growing food, greening initiatives, environmental awareness, and entrepreneurship. Key issues for successful implementation involve community ownership, a clear vision, and decisive action. Addressing extreme malnutrition levels lays the foundation for promoting the health and well-being of current and future generations. This approach should be at the core of public extension efforts. Embedded in broader systemic shifts towards food security, policies supporting food gardens and organic foods can contribute to sound and sustainable nutrition practices essential for

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poverty reduction. The partnership between Siyakhana Growth and Development and CEI has made impressive progress in raising a broader awareness of the challenges of food security and nutrition and their connections to health and sustainable development.

To successfully implement agroecology, it is imperative to motivate families and communities to cultivate their own produce. This not only ensures food security but, more importantly, creates a potential source of income. Challenges like human error, poor farm management, and maintenance, which lead to inefficient use of resources, can be effectively addressed through precision farming and targeted training and capacity-building initiatives.

Creating a supportive policy environment that actively advocates for urban farming can offer the necessary legal and regulatory backing for urban farming initiatives. Furthermore, the significance of multi-stakeholder collaboration, aligned with Goal 17 of the Sustainable Development Goals (SDGs), cannot be overstated. Through the collective efforts of all stakeholders, we can truly harness the full potential of agroecology.

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Agricultural Extension Practitioners' Use of Information Communication Tools in the Capricorn District, Limpopo, South Africa: A Perception Study

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ABSTRACT

Perception is a critical concept in innovation adoption. Reports from the Limpopo Department of Agriculture and Rural Development indicate that agricultural extension practitioners (AEPs) do not use the full complement of Information, Communication and Technologies (ICTs) made available for their extension work. This can compromise the effectiveness of extension service delivery to farmers. This study applied the Düvel adoption behaviour analysis framework to help understand the AEPs' perceptions and use of ICTs made available to them for their work. Using a self-administered questionnaire and adopting a census approach, data was collected from the AEPs in two local municipalities of the Capricorn district. Data was analysed by descriptive statistics. The findings indicate that most AEPs have a favourable perception of the ICTs made available to them for their work. Furthermore, the study found factors that are incompatible with the present situation of AEPs that constrain the use of all the ICTs. These findings have important implications for delivering effective extension services to farmers. The study results also show that the Düvel behaviour analysis framework consistently yields results congruent with theoretical expectations. This enriches the extension theory. To solve incompatibility challenges, recommendations are made based on the findings.

Keywords: Agricultural Extension Practitioner, Communication, Information, Perception, Technology, Tools, Adoption Behaviour

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1. INTRODUCTION

Communication is necessary in any human endeavour and sine qua non for effective agricultural extension work and agricultural development in general. Agricultural extension involves the conscious use of information communication to help people, such as farmers, form sound opinions and make good decisions towards achieving productive and successful farming businesses. It is said that the process of communicating about farm practices can be traced back to the early development of agrarian societies (Telg & Irani, 2012). It can be argued that traditionally, such communities looked for information on techniques and technologies to improve their agricultural production practices. Extension educators delivered much of this information to cater to their audience's needs by using traditional channels, such as face-to-face interaction, newsletters, magazines, pamphlets, and radio broadcasts (Telg & Irani, 2012). As the world moved towards an information-based economy, audiences for farm information, their needs, and the channels used to meet those needs have also changed.

Free government extension services to small-scale/smallholder and subsistence farmers have been and continue to be the dominant extension service model in many countries, especially developing ones (Sala, Ross & David, 2016). However, since the 1980s, budget constraints have plagued public extension services worldwide, which has resulted in fewer field-level public extension practitioners being employed and a lack of other resources, such as transport, being made available to deliver services (Gershon, Willett, & Zijp, 1999). These challenges have made it increasingly difficult for field-level extension workers worldwide to reach the thousands or even millions of small-scale/smallholder and subsistence farmers who often live in widely dispersed communities. Furthermore, the global population is expected to reach 9 billion by 2050, and all these people will need food (McNamara, Belden, Kelly, Pehu & Donovan, 2011). The increased demand for food due to the expected growth in the world population requires urgency from institutions such as agricultural extension organisations to find new ways to reach farmers with relevant and up-to-date agricultural information, technology, and advice that will empower them to be productive and successful. To meet these challenges, innovative extension approaches that have emerged in the last 15-20 years globally include information, communication and technology-based agricultural extension and advisory services (ICTs) (Davis & Asenso-Okyere, 2010).

Many papers have been written on ICTs, agricultural development, and extension service delivery. Most of these studies focus on areas such as the use of ICTs in the delivery of

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extension services to farmers (Rohila, Yadav & Ghanghas, 2017; Mabe & Oladele, 2012); the use and accessibility of mobile phones by farmers (Matto, 2018; Kante, Oboko & Chepke, 2016); and the awareness level of the use of ICT tools among agricultural extension practitioners (AEPs) (Mabe & Oladele, 2012). Other dominant research areas have examined ICT's importance and impact on agricultural development (Trendov, Varas & Zeng, 2019; Derso & Ejiro, 2015; Asenso-Okyere & Mekonnen, 2012).

Since 1994, agricultural extension in South Africa has become the vehicle to deliver government agricultural agenda in the face of food security concerns, concerns about low agricultural productivity among smallholder producers, the campaign for poverty alleviation, and the consideration of the devastating impacts of climate change on agricultural production, especially, on smallholder and subsistence agriculture. To navigate these challenges, the South African government has taken various policy initiatives to effectively and efficiently improve the extension delivery system to support smallholder and subsistence agriculture. These initiatives include, among others, the publication of the Norms and Standards in 2005 (Department of Agriculture, 2005) and the launch of the Extension Revitalization Plan(ERP) in 2008 (Department of Agriculture, Forestry and Fisheries [DAFF], 2011). Some of the objectives of the ERP initiatives include enhancing communication with farmers and farmer organisations through the use of new communication tools such as ICTs, adopting effective/efficient communication methods, and providing ICT infrastructure and other resources to extension practitioners.

Our study focuses on the field-level agricultural extension practitioners' (AEPs) perceptions of the ICT infrastructure provided to them by the Limpopo Department of Agriculture and Rural Development (LDARD) in the extension services delivery system under the Extension Revitalization Plan (ERP) (DAFF, 2011). Three ICT tools were introduced to be used with the personal computers which AEPs already had. Therefore, the four ICT tools investigated in this study are the smart pen technology (SPT), the smartphone, the laptop/desktop computer, and the Extension Suite Online (ESO) system.

The ESO version 1 is an internet-based (online) information system and an integrated agricultural production and extension support knowledge base developed to provide agricultural advisors with information on every possible aspect of agriculture. It was introduced into the extension service delivery system in South Africa in 2007 (De Villiers, 2012). As an

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agricultural knowledge centre, the information needs of farmers are translated into research activities, and the research results are translated into practical farming solutions. The system is available to the AEPs for their extension work anytime and anywhere, and it has internet connectivity to provide information to farmers. As an ICT tool, ESO embodies information that AEPs can access because it comprises soft- and hardware information and communication technology that facilitates communication between researchers and AEPs.

The smart pen technology (SPT), also called digital pen, was introduced to the LDARD in November 2010 (Lane, n.d). This followed a pilot study of the technology and its acceptance in the Western Cape Department of Agriculture in 2009, after which the DAFF embarked on a national roll-out of the technology in the other eight provinces of South Africa (Lane, n.d.). The smart pen is an efficient communication technology tool with GPS and a camera-enabled mobile phone. The solution allows the department's extension practitioners to register projects, do real-time monitoring, write and send reports, reduce paperwork, and provide support at regular site visits while also attaching GPS coordinates and photographs to reports. Extension managers can also use it to monitor information on agricultural projects and farm visits by AEPs.

A smartphone is an information and communication technology tool with enhanced applications and is generally used for information storage and communication purposes. The phone can connect to the personal computer to store the AEPs' field information for processing. The laptop is an information and communication technology tool used to store, retrieve, process, and communicate information related to extension work.

Even though the DAFF had adopted these ICTs for extension delivery work, their use depends on the AEPs' perceptions of these ICTs. The importance of perception as a powerful means of determining the psychological field forces in behaviour, and therefore, adoption or use of behaviour has been acknowledged long ago (Thomas & Znaniecki, 1927; Düvel, 1975). Studies on the perceptions of agricultural extension practitioners towards ICTs have been conducted by Oladele (2015) in South Africa, Ajayi, Alabi and Akinsola (2013) in Nigeria and Kopecky (2016) in Uganda. The Ajayi *et al*. (2013) and Oladele's (2015) studies were based on extension practitioners' perceptions of ICT in general. Kopecky (2016) investigated extension practitioners' perceptions of an ICT tool (smartphones) adopted by an extension organisation to be used by field-level extension practitioners for extension work. In this regard, our study

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comes close to this latter topic, but the difference is that our study investigated four ICTs. All the studies mentioned here analysed perception differently, either based on the use of a Likert scale (Oladele, 2015; Ajayi *et al*., 2013) or personal interviews to elicit extension workers' perceptions toward smartphones for their work (Kopecky, 2016). Furthermore, none of the studies previously mentioned used a widely tested conceptual framework to analyse the concept perception. This could have provided a basis for questionnaire construction to elicit respondents' perceptions, as we have done in our study.

Various definitions have been provided to explain the concept of 'perception' (McDonald, 2011; Hatfield, 2001). The operational definition of the perception of an innovation used in our study is based on Düvel's (1991) framework, which conceptualises perception in terms of the relative advantages of the innovation, the prominence of the innovation, and the compatibility of the innovation with the adopter's or user's situation. Düvel (1991) put forward the concept 'relative advantages' to replace Rogers' (1983) innovation attribute "relative advantage". The relative advantages relate to the attractiveness of the innovation; this is operationally defined as the advantages (or positive forces) and disadvantages (or negative forces) associated with the use or adoption of the innovation. The innovation attribute' prominence' is synonymous with the "relative advantage" of Rogers (1983). Düvel (1991) refers to the concept of 'prominence' as the overall comparison of the new idea (in this study, the four ICTs used together) with the old idea (use of laptop and smartphone together) about the achievement of one's goal.

The incompatibility of an innovation with an individual's present situation looks at whether the innovation is relevant in a respondent's specific, present situation. The situational incompatibility aspects represent the barriers to implementing an idea or one's goal achievement and are potentially negative. Therefore, these barriers become irrelevant once the new idea is implemented (Düvel, 1991). The incompatibility aspects relate to the social, physical, cultural, communication, and economic factors of the respondent's life that can prevent the use or adoption of an innovation. However, these factors can make the use or adoption of innovation possible when addressed rather than stimulated (Düvel, 1991). Most factors that make an individual unable or incapable of using or adopting an innovation, such as personal/environmental factors, fall into this category of variables and are more independent. Due to the wide variations in the literature concerning the influence of the independent variables on the use or adoption of innovations (Afful, 1995; Sulaiman & Sadamate, 2000;

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Israel & Wilson, 2006; Ajayi, 2006), the researchers in this present study carefully considered some independent variables to assess their incompatibility with the AEPs situation regarding their use of the ICTs provided to them by the LDARD for their work.

The Düvel (1991) framework for adoption behaviour analysis has been widely tested, and the mediating variables (needs, perception, and knowledge) have been found to consistently remain more important determinants of innovation use or adoption behaviour (Msuya, 2016; Annor-Frempong, 2013) than the independent variables. A meta-analysis of innovation characteristics and adoption (Tornatzky & Klein, 1982) found that the relative advantage of the innovation has a more substantial positive effect on adoption behaviour. Furthermore, Leeuwis and van den Ban (2004) also commented on the positive relationship between farmers' evaluation of the advantages and disadvantages of innovation and adoption. All these findings are consistent with the mediating variable categorisation of Düvel (1991) as a more important precursor of adoption or use behaviour than the independent variables. For this reason, the Düvel (1991) framework was adopted as a conceptual framework for a more focused analysis of AEPs' perceptions and use of the ICT tools provided to them for their extension work. The perception variables in the framework for ICT use analysis in our study were the prominence of the ICT tools in helping respondents to achieve their goals, the relative advantages of the ICT tools and the incompatibility of the ICT tools with the AEPs present social and economic situation. The Düvel (1991) framework guided the construction of the questionnaire for this study, and therefore, the validity and reliability of the data collection instrument were verified. Given the lack of extant literature based on empirical work on the use of the Düvel (1991) framework to address this topic, this study becomes even more necessary to inform extension managers and policymakers on AEPs perceptions of ICTs as well as relevant reasons for the non-use among AEPs of the four ICTs (smart pen, smartphone, laptop/desktop computer and the Extension Suite Online (ESO) system) provided to them for their work.

The purpose of the study was to investigate how field-level AEPs perceptions of the ICTs provided to them for their work can assist in gaining an understanding of the incompatibility of the ICTs with their situation and why they do not always use all four ICTs, how the relative advantages of the ICTs affect their use and how the prominence of the ICTs help AEPs to achieve their extension goals. The central research question for this study was as follows: How do AEPs' perceptions of the ICT tools provided to them for their work help to understand why

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AEPs do not always use all the ICTs for their Extension work? The specific research questions of the study were:

i. How incompatible are the ICTs with AEPs in the present situation? How many ICTs do AEPs use together? What is the frequency of ICT usage among AEPs? What are the AEPs' reasons for not using all the ICTs for their work?
ii. How aware or unaware are AEPs of the disadvantages and advantages of the ICTs provided to them for their work?
iii. What do AEPs think of the prominence of the ICTs provided for their work to achieve their extension goals?

2. METHODOLOGY

The data for this paper was based on a master's degree study conducted at the Tshebela and Mankweng Service Centres in the Capricorn district in the Limpopo Province in 2017. The Centres provide agricultural extension services to farmers. The population of this study comprised the agricultural extension practitioners (AEPs) at the Mankweng and Tshebela Service Centres. The study used a survey research design and a self-administered, semi-structured questionnaire. Data was collected in 2017 from 40 of the 45 AEPs available to participate in the study at the two service centres. This number of respondents is still adequate for statistical analysis based on the Central Limit theorem, which states that if sample sizes are large enough, $n \geq 30$, the distribution of the mean will be approximately normal (Glen, 2013).

2.1. Generation of Index for Awareness of Disadvantages of ICTs

Respondents were asked to indicate whether they agree, coded as 1 or undecided or disagree, coded as 0, with statements on nine variables regarding awareness of disadvantages associated with using the four ICT tools. Individual respondent's mean scores on all nine variables were compared with the total mean score of all 40 respondents and the associated standard deviation. A respondent whose mean score was less than the total mean score was given a code 0; this means the respondent is unaware of the disadvantages of using ICTs for his or her work. The opposite was the case when the individual mean score was equal to or higher than the total mean score; such a respondent was given a code of 1; this means the respondent is aware of the disadvantages of using the ICTs in their work.

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2.2. Generation of Index for Unawareness of Advantages of ICTs

A similar procedure as in the index generation for awareness of disadvantages was used to generate an index for a respondent's unawareness of the advantages of ICTs (based on 15 variables) for their work. An individual whose mean score was equal to, or more than, the total mean score was judged as unaware of the advantages of using the ICT tools for their work and coded 1; an individual was coded 0 in the opposite case.

2.3. Assessment of ICT Prominence

The prominence of the ICTs was assessed by requesting respondents to indicate their agreement with the study question that the use of the four ICT tools (laptop, smartphone, smart pen and ESO) together helps one to achieve one's career goal compared to the use of only the smartphone and laptop together. The responses were coded as 1 (helps to achieve one's goal) and 0 (does not help to achieve one's goal).

2.4. Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS). Data was subjected to descriptive analysis, which included the use of means, percentages, and standard deviation of selected variables to provide information about the state of the situation regarding AEPs' perceptions and the use of the ICT tools provided for their extension work.

3. RESULTS AND DISCUSSION

3.1. Incompatibility of ICT with Respondents' Situation

AEPs' use of the ICT tools presupposes that they have been supplied with the tools or that these tools have been made available to them and have the necessary infrastructure to use them. This section summarises the results of the first research question related to the incompatibility of ICTs with the AEPs' present situation.

3.1.1. Sex of Respondents

The findings in this study show that an equal number of females and males (50%, N= 40) took part in the survey. However, other studies on AEPs, such as that of Ajayi *et al.* (2013) and Mustapha *et al*. (2022) in Nigeria, Antwi-Agyei and Stringer (2021) in Ghana and Mabe and Oladele (2012) in the North West province of South Africa, revealed that the majority of AEPs were males. Compared to the findings in other places such as Nigeria, our finding shows that

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the LDARD was doing well in achieving gender equity in its recruitment of workers in compliance with the Employment Equity Act, 55 of 1998 (South African Government, 1998). On the other hand, the difference in numbers between our study and that of Mabe and Oladele (2012) in the North West province of South Africa indicates that some provincial Departments of Agriculture are doing better in terms of improving female representation.

Regarding the potential of gender of the AEP being a constraint to the use of ICT, the findings reveal that generally, most males and females (75%, N= 40) used ICTs daily for their extension work. This finding is consistent with the finding by Maleka (2011) in five provinces of South Africa, including Limpopo, that gender differences do not exist in the adoption and usage of ICTs. Even though gender was not a constraint about the use of ICTs, our finding indicates that more males (60%) (N= 40) compared to females (40%) (N= 40**)** used all four ICT tools provided to them.

3.1.2. Age

The findings in Table 1 indicate that 27.50% of the AEPs were youth, as defined by Statistics SA's (2016) age categories, whereby youth are grouped as people who fall in the age bracket 15 to 34 years. The majority of the AEPs (70%) were in the middle age group (36-57), and very few (2.5%) respondents were considered old (58 and over). Similar findings were made by Agwu *et al*. (2008) in a study in Nigeria where there was only a small percentage (5%) of AEPs in the older age group; the dominant group was the middle-aged group, and the remaining percentage was youth. Our finding on the age of AEPs, however, contradicts that of Samansiri and Wanigasundera (2014), who conducted research in Sri Lanka, where they found that the youth was less involved in the field of agricultural extension than the older age group.

TABLE 1: Age Distribution of Respondents (N= 40)

Age group	**Frequency**	**%**
25-35	11	27.5
36-46	16	40.0
47-57	12	30.0
58+	01	2.5
Total	**40**	**100**

Min: 29; Max. 60; Median: 39; Skewness: .378

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The AEP's responses to the question about age and how often they used the ICTs indicated that 75% (N= 40) use their ICT tools daily compared to weekly or monthly. Ignoring the one individual (60 years of age) in the 58 years and over age group, most AEPs in all the other age categories used their ICT tools daily, but not all four ICT tools together. However, a closer look at the data indicates that mostly the age group 25-35 (73%, N= 11) used all four ICT tools daily. This finding concurs with the results of Maleka (2011), who indicated that age played a significant role in ICT adoption and usage and that younger individuals were more likely to adopt and use ICTs, irrespective of gender. The dominance of the youth and middle-aged group in agricultural extension is thus good because these groups are more familiar with new technologies and, therefore, more likely to embrace them for their work than the older respondents.

3.1.3. Income of Respondents

The rationale behind enquiring about the AEP's annual income was to indicate their ability to pay for smartphone airtime or data since the practice is that AEPs should buy the airtime or data when needed. They will be reimbursed later by the employer. According to the responses (N= 40), only a minority of the respondents (5%) earned less than R250, 000 per annum. The rest of the AEPs in the study earned R250,000-300,000 (55%) and over R300,000 (40%). Interestingly, the results on income and the use of all four ICT tools together (smart pen, smartphone, laptop/desktop computer and the Extension Suite online system) show that 41% of the AEPs who earned between R250,000 and R300,000 would make use of all four ICT tools compared to only 25% of those who earned more than R300,000. A possible explanation for this is that the middle-income earners are those aged 25-35, while those earning more than R300,000 belong to the older age group. Section 3.1.2 of this article has shown that most AEPs in the age group 25-35 use all four ICT tools compared to a smaller percentage in the older age group. Age, more than income earned, appears to be a deciding factor in using all ICT tools together. Ajayi *et al.* (2013) and Gilwald, Stork, and Milek (2010) found that income increases the probability of owning ICTs. However, these studies findings were based on a different context. The AEPs in our study must spend their own money on data to use an ICT tool (smartphone) to perform their job, though they will be reimbursed later. These differences in findings might also be because a minimum income threshold is needed. Once this is met, income is no longer a deciding factor in the use of ICT, which in our study appears to be the

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money AEPs must spend on data for their smartphones and the reimbursement they must apply for later.

3.1.4. Level of Education

The level of education of respondents (N= 40) indicates that slightly over half of the respondents (57.50%) had an honours degree, while some had a master's (17.50%) or bachelor's degree (15%) or a diploma (10%). This finding differs from that of Mugwisi (2013) in KwaZulu Natal, South Africa, which indicated that most AEPs had a bachelor's degree (46%) and a few had a master's degree (11%). Our finding that most AEPs had tertiary education (90%), however, concurs with the results of Abdullahi, Garforth, and Orward (2013), which indicated that the majority (50%) of extension agents in Nigeria had tertiary qualifications. The finding by Tata and McNamara (2016) that AEPs with advanced degrees faced fewer technical challenges when using internet-based systems than their less-educated colleagues bodes well for extension work in the LDARD since most AEPs in this office have tertiary education qualifications.

3.1.5. Respondents' Training for ICT Usage

Table 2 provides a summary of responses to the question as to whether AEPs received training in the use of ICT tools. The findings in Table 2 indicate that between 57-60% said they did not receive training in three (ESO, SPT, smartphone) of the four ICT tools they are supposed to use. However, 70% of the respondents mentioned receiving laptop training. Looking at the training received (Table 2) and the frequency of ICT use (Table 3), we see that of the 75% of AEPs who used ICT tools daily, 90% received training on all four ICT tools, while 70% received some or no training at all. Furthermore, of the 35% (N= 40) who reported using all four ICT tools, 80% received training in using all four ICT tools, while only 20% received training on some or no training at all. These differences in ICT training and use may be due to the lack of knowledge of best practices in IT usage and IT-related skill deficiencies in the workforce, which constrain the benefits that can be gained from ICTs, as found by Kaushik and Singh (2004).

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TABLE 2: Distribution of Respondents' Training Received for ICT Usage (N= 40)

	Response	Frequency	Percentage
ESO	Yes	17	42.5
	No	23	57.5
Laptop	Yes	28	70.0
	No	12	30.0
Smart Pen Technology	Yes	17	42.5
	No	23	57.5
Smart phone	Yes	16	40.0
	No	24	60.0

3.1.6. Use of ICTs: Number, Frequency, and Availability of Associated Infrastructure

3.1.6.1. Number of ICT Tools Used Together

Figure 1 summarises the AEPs' responses to the question about the number of ICTs they use for their extension work. The results reveal that only 35% and 25% used all four and three ICT tools respectively together. Sadly, a good number of them, namely 40%, used only one or two tools.

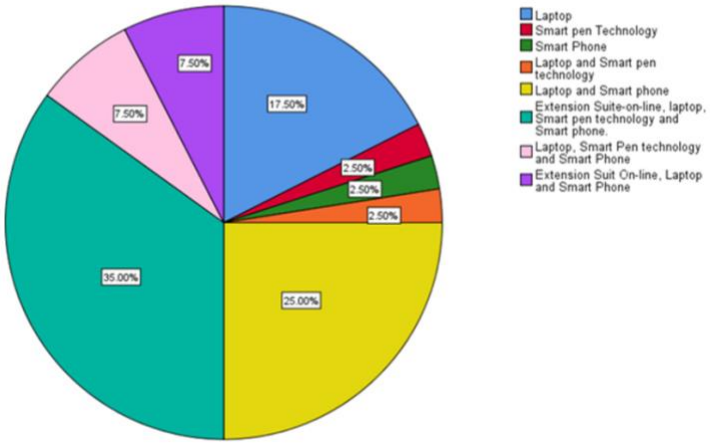

FIGURE 1: Percentage of AEPs Using ICTs (N= 40)

A study by Sebeho (2016) in four municipalities in the Fezile Dabi District in the Free State, South Africa, based on farmers' perceptions of extension practitioners provided with ICT tools such as the smart pen technology, the Extension Suit Online system, smartphone and laptops, showed a poor picture of extension service delivery. For example, 96.5% of the farmers in the four municipalities said they did not experience any positive improvement in the delivery of

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extension services despite the extension practitioner being supplied with laptops, and only 4% of the farmers perceived improvement in service delivery even though extension practitioners had access to the ESO. Regarding the use of smart pen technology, it was reported in the study that only 3.5% of the farmers experienced the impact of this ICT on service delivery, while only 6.5% of farmers said the use of the cell phone improved the accessibility of extension practitioners. A lack of similar studies on the types of ICTs used together makes it difficult to compare our findings.

3.1.6.2. Frequency of Use of ICT Tools

AEPs were asked to indicate how often they used the ICT tools for their extension work. The results (Table 3) show that overall, most AEPs (70%) used their ICT tools daily compared to weekly or monthly.

TABLE 3: Distribution of Respondents According to Frequency Of Use of ICT Tools (N= 40)

Frequency of use of ICT tool	Percentage of respondents
Daily	70.00
Weekly	17.50
Monthly	7.50
Other	5.00

3.1.6.3. Reasons For Not Using All Four ICT Tools

AEPs were further prompted to explain their reasons for not using all four ICT tools (laptop, smartphone, ESO, and smart pen). Their reasons relate to the associated infrastructure necessary to use the ICTs and are summarised in Table 4. The most common reason provided by most respondents (46%) was that the LDARD did not provide them with all of the four ICT tools. The second most popular reason the respondents gave (17%) was that their ICT tool got damaged and had not been replaced or repaired at the time of our survey. The other reasons were a lack of knowledge about the ESO, challenges associated with internet connectivity, the inconvenience of paying for data for the cell phones (to be reimbursed by the employer later), and lack of training in ICT tool usage. Some of these constraints concerning the use of the ICT tools are similar to those mentioned by the respondents in Sebeho's (2016) study, in the Free State in which 47% of the AEPs were dissatisfied with the use of the laptops because they could

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not access the internet as a result of their 3-G cards being disconnected; only 40% of AEPs were satisfied with using their cell phones while the majority of them were not. The Sebeho (2016) study did not provide reasons for their dissatisfaction. Still, one cannot rule out the problem of using one's own money to buy data for the phone and then apply for reimbursement from the department later. Again, only 40% of AEPs were satisfied with using the ESO system, and the majority were not. Sebeho (2016) believed this dissatisfaction was because their 3-G cards were disconnected, so they could not access the internet to use the ESO system. Training in ICTs is critical to its use, as previously indicated (see section 3.1.5) in our study, which found that most of the AEPs who used all ICT tools daily received training in using all four ICTs. The lack of training in the use of ICTs (Table 2) as a barrier to usage is corroborated by the findings of Kaushik and Singh (2004), who determined that a lack of knowledge of best practices in IT usage as well as IT-related skills deficiencies in the workforce constrain the benefits of ICT.

TABLE 4: Respondents' Reasons for Not Using All Four ICTs (N= 40)

Reason	**%**
The department did not supply the other ICTs	45.83
My ICT was damaged	16.67
No internet connection	8.33
I am not a field worker and thus do not have ICT	8.33
No training in the use of ICT	4.17
Reimbursement for data purchased is inconvenient	8.33
I did not know about ESO	8.33

3.2. RELATIVE ADVANTAGES OF ICTs

The findings presented in this section relate to the second research question about the AEPs' awareness of the disadvantages and their unawareness of the advantages of the ICT tools provided for their work.

3.2.1. Respondents' Awareness of the Disadvantages of ICTs

The findings on respondents' awareness of the disadvantages of using ICTs for their work indicate that most AEPs, 60% (N= 40), disagreed with the research question that the ICTs

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provided to them have more disadvantages than advantages. In comparison, 40% agreed that they have more disadvantages than advantages. The findings, therefore, indicate that less than half of respondents agree there are disadvantages to using ICT tools for their extension work. These findings concur with that of Akuku, Makini, Wasilwa, Makelo, and Kamau (2014) in a study conducted in Kenya in which it was indicated that AEPs and farmers agree that the use of ICT tools brings a lot of positive change to agricultural extension work and have the potential of improving rural livelihoods and contributing to poverty eradication. Given the evidence in the literature of a negative relationship between awareness of the disadvantages of innovation and its use or adoption (Afful *et al.*, 2013), the finding in our study bodes well for AEPs' continued use of ICTs for their extension work.

3.2.2. Respondents' Unawareness of the Advantages of ICTs

The findings on respondents' unawareness of the advantages of the use of ICTs for their extension work indicate that 54% (N= 40) of AEPs agreed with the research question that the ICTs have more advantages than disadvantages; 46%, however, disagreed and said ICTs have more disadvantages than advantages. Put differently, less than half of the respondents agree that ICT tools have advantages for their extension work. This is good news because it means most respondents knew of the advantages of using ICTs for their work. A study by Samansiri and Wanigasundera (2014) in Sri Lanka indicated that most (68%) AEPs are familiar with the usefulness of ICT tools to access the information necessary for their extension activities. Again, given the evidence in the literature regarding the negative relationship between unawareness of the advantages of innovation and its use or adoption **(**Afful *et al.,* 2013; Hudson & Hite, 2003), the finding in our study has positive implications for AEPs continued use of ICTs for their work.

3.3. PROMINENCE OF ICTS AND GOAL ACHIEVEMENT

This study's findings on the third research question, about the prominence of the ICTs provided to the AEPs in achieving their extension goals, indicate that most of them (70%; N= 40) think the use of all four of the ICTs is helping them to achieve their extension career goals compared to the use of only the smartphone and laptop. This finding is very important because it means practitioners will continue to use the four tools together to perform their extension work, provided the constraints to using these tools are addressed. The literature on the positive

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relationship between the prominence of an innovation and its adoption (Afful *et al.,* 2013; Msuya, 2016) supports our finding.

4. CONCLUSIONS AND RECOMMENDATIONS

To understand why AEPs do not always use all four ICT tools provided to them for their work and to answer the study research questions, the study investigated AEPs perceptions of ICTs in this regard. The application of the Düvel (1991) framework helped the researchers to analyse the AEPs perceptions of ICTs and to gain an understanding of their incompatibility with AEPs' present situation, as well as to gauge their views on the advantages and disadvantages of using the ICT tools for their work and the prominence of the ICT tools for achieving their extension career goals.

The AEPs' use of the ICTs presupposes that they have been supplied with the ICTs, have the knowledge of how to use them, and have the necessary infrastructure to use them. A principal finding from this study is that the reasons for the AEPs not always using all the ICTs do not relate to the advantages and disadvantages of the ICTs or the prominence of the ICTs. This is because the minority of AEPs are unaware of the advantages or the disadvantages of ICTs. At the same time, most have a positive view of the prominence of ICTs in achieving their extension career goals. The findings on the incompatibility of the ICTs with the AEPs' present situation show that only a few AEPs use all four ICT tools together in their daily work. A minority of the AEPs are using all the ICT tools because of the following issues: the LDARD did not provide some of the ICT tools to the AEPs, such as 3-G cards which facilitate accessing the internet; damaged ICT tools have not been replaced or repaired by the LDARD; a lack of training in the use of the ESO hampers usage; there are challenges regarding internet connection in the workplace; and there is the inconvenience having to pay for data for cell phones and being reimbursed later by the LDARD. These challenges fall on the shoulders of the LDARD.

Furthermore, regarding the incompatibility issues, our findings show that the gender and age of AEPs and training in using ICTs are critical to using all four ICTs. All the preceding findings are consistent with the literature.

The study recommends that the LDARD focuses on the following to overcome the constraints in the AEPs' use of all the ICTs identified in this study and improve AEPs efficiency and

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effectiveness in the delivery of extension services: supply all the AEPs with the necessary ICTs; make AEPs aware of all four ICTs since some AEPs did not know about ESO and train all AEPs in the use of the ICTs; attend to internet connection challenges and speed up the reimbursement of AEPs for the cost incurred to purchase data to use their smartphones.

The implications of the findings of this study for field-level extension practice in the LDARD are that the positive perceptions of AEPs of ICTs for their work bode well for their continued use of modern and advanced technology for their work and reliance on scientific knowledge to guide farmers. The latter invariably leads to effective and efficient service delivery to farmers. For extension theory, our findings indicate that the Düvel (1991) framework has once again withstood the test of time regarding the use or adoption of innovations in that the perception variables continue to consistently yield the expected results corroborated by other findings in the literature.

Other developing countries can take a cue from this study by equipping their field-level extension practitioners with the necessary information and communication technologies. This will help them to keep pace with current, developing scientific knowledge in their field of work and the use of modern technology in their work. The latter will invariably lead to effective and efficient service delivery to farmers, *ceteris paribus.*

5. ACKNOWLEDGEMENT

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6. CONFLICT OF INTEREST

The authors do not have any conflict of interest.

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Reimagining Decoloniality and Extension

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ABSTRACT

The language of change in curricula is increasingly being examined through the lens of decoloniality and Africanisation. This underscores the need to consider Extension education and the practice of extension within the context of contemporary post-colonial debates. This article examined decoloniality and its relevance in the practice of Extension education. To achieve this, the article adopted an interpretative qualitative analysis of relevant literature, documents, and research findings. The findings suggest that successful decolonisation calls for Extension curricula to be attentive to content challenges, the origin and foundation of which may be deeply rooted in the ideologies and logic of the global north. Additionally, the article highlighted the necessity for academics, researchers, and practitioners to prioritise local knowledge and methodologies. This means using a variety of solutions, regardless of their origin (African or Western), and adopting the most effective approach. These measures are essential for fostering effective development within the specific context of Extension Education and developmental needs.

Keywords: Extension, Decoloniality, Extension Education

1. INTRODUCTION

The need for curriculum reform has been a global phenomenon driven by the expansion and massification of higher education. A compelling rationale for re-examining curricular content originates from Freire (1996), who proposed that universities, as agents of societal change, should actively contribute to economic and socio-political freedom through education. This notion resonated strongly within South Africa's education landscape when, in 2016, calls for curriculum change intersected with the #RhodesMustFall and #FeesMustFall movements (Habib, 2021; Hodes, 2017; Maringira & Gukurune, 2017). These events catalysed the discourse on decolonisation and the

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integration of decoloniality into all aspects of education and everyday existence. Considering these events and Freire's (1996) proposition, it is imperative for Extensionists to reflect on what decoloniality means in the field of extension, how it applies, and whether any changes are necessary.

This article's motivation is to evaluate Extension education's effectiveness critically. First, it aims to enhance rural communities' socio-economic conditions within the broader discourse. Second, it underscores the necessity to acknowledge that the discourse of decolonisation and decoloniality raises pivotal questions regarding the epistemology, or theory of knowledge, that underpins the discipline of Extension as both a field of study and a method of practice. This article adopted an interpretative qualitative analysis of relevant literature, documents, and research findings in the field. It is important to note that the literature on decolonisation is extensive, and this article does not aim to provide an exhaustive review of it. Instead, it seeks to pose critical questions for academics, practitioners, and researchers operating within the Extension domain. It is worth noting that the term 'Extension', written with the capital letter 'E', refers to Extension as a discipline of study, while the term 'extension' in the lower case refers to the overall practice of extension.

2. METHODOLOGY

Research methodology frames the logic of inquiry based on ways of thinking or paradigms, shaping the specific methods adopted for an investigation and subsequent analytic processes that help shape conclusions (Rahman, 2017). This article adopted an interpretative qualitative analysis of relevant literature, documents, and research findings to uncover relevant definitions and meanings of Extension education. Data was analysed using content analysis, and critical reflection informed the conclusions.

3. EXTENSION EDUCATION AND ITS ORIGINS

While the concept of extension can be traced back to Mesopotamia (1800 BC) and the Han Dynasty (25-220 A.D.), the earliest documented account relating to the origins of Extension education and curriculum at the tertiary level can be traced back to the late 1850s in the United Kingdom (Jones & Garforth, 1998; Jones, 1989). This period coincided with the peak of colonial expansion, where education was strategically designed to enhance further and solidify colonial rule.

Extension is defined by the Food and Agriculture Organisation (FAO) as systems that are designed to enable farmers, their organisations, and other market actors to access knowledge, information, and technologies. It aims to facilitate their interaction with partners in research, education, agribusiness,

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and other pertinent institutions while assisting them in developing their own technical, organisational, and management skills and practices (FAO, 2022). Expanding on the FAO's definition, Bonye, Alfred and Jasaw (2012) asserted that extension services provide invaluable information on new agricultural technologies with the potential to enhance production in farming communities. Swanson (2008) adds that extension services transcend mere technology transfer, highlighting its broader role in community development. This includes the development of human and social capital, enhancing skills and knowledge for production and processing, facilitating access to markets and trade, organising farmers and producer groups, and collaborating with farmers to achieve sustainable natural resource management. Considering these complementary definitions, it can be concluded that Extension, in its broad scope, includes skills related to agriculture and those that are not, such as health, the home, and community development. Regardless of the specific focus, each form of extension shares the common aim of promoting development and inducing change. Often regarded as an informal transfer of knowledge, extension seeks to reshape the way rural communities perceive and respond to their challenges (FAO, 2022).

From an agricultural perspective, the term 'Agricultural Extension' is frequently used in the literature and is associated with advisory services aimed at boosting production, increasing food security, and improving rural livelihoods as part of pro-poor policy programmes. In this article, the terms 'Extension' and 'Agricultural Extension' are used interchangeably, referring to the support service for rural communities engaged in subsistence and commercial farming. The support provided encompasses the provision of skills, knowledge, and overall assistance to aid individuals in addressing farming and livelihood-related challenges.

It is, however, important to note that extension services are primarily driven by government priorities and influenced by various bureaucratic and governance-related machinery and agendas, even though many NGOs offer extension services. While the relationship between rural communities and extension workers may seem straightforward, the language of decolonisation and decoloniality raises questions about the origin of knowledge and its purpose in shaping communities. This then begs the question: What exactly is decolonisation and decoloniality, and does it imply abandoning everything associated with colonialism and all curricula?

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4. DECOLONISATION AND DECOLONIALITY

4.1. A Movement Away from Colonisation

In its simplest form, decolonisation implies a movement away from colonial rule. The post-World War II (WWII) era witnessed a global dismantling of colonial rule. This movement away from colonial rule primarily resulted in the political liberation of countries and the transfer of power to newly independent states. However, in *Waves of Decolonisation*, Luis-Brown (2008) reveals that decolonisation arose before this. He emphasises that between the 1880s and the 1930s, writer-activists in Cuba, Mexico, and the United States of America (USA) developed narratives and theories of decolonisation, advocating for freedom and equality and a breakaway from the 'empire'. Luis-Brown (2008) underscores that the Harlem Renaissance movement of the USA, the Mexican *indigenismo*, and the Cuban *negrismo* in the 1920s influenced each other regarding ideas for transition and the need to challenge imperialist notions.

Similarly, in the 1920s, Du Bois, a civil rights activist in the United States of America, called for local communities to challenge the ideas, logic, and systems introduced by the colonial rule. Thus, these discussions took place before the waves of decolonisation, which took place post-WWII, meaning that the body of literature on decolonisation is not new. This is highlighted in the work of other authors, including Maldonado-Torres (2007), Mbembe (2015), and Bhambra (2009), to name a few. This literature further shows that decolonisation is much more than a movement away from colonial rule through political liberation.

4.2. Neo-colonialism and Development

The term' development' essentially implies a change or a movement away from a previous condition. Truman used the term 'underdeveloped' in 1949 to suggest that Western conditions and strategies were more desirable, leading to interventions through various programmes in the 'underdeveloped' world. This logic created the impetus for particular socio-economic and political relationships in building the countries of the 'third world' through aid and other means.

The term 'neo-colonialism' gained prominence in the post-WWII era. The term was coined by the first President of independent Ghana, Kwame Nkrumah, in 1965 to describe a situation where political independence coexists with continued influence from former colonisers through entities such as international monetary bodies, multinational corporations, and education and cultural institutions (Ashcroft, Griffiths, & Triffin, 2003).

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The Bandung Conference of 1955, which preceded the adoption of neo-colonialism as a term, brought together recently independent Afro-Asian non-aligned countries. The conference concluded that development entailed overcoming socio-economic and political welfare obstacles, marking a radical departure from Truman's post-World War II ideology. This new perspective called for an unshackling from colonial rule, implying that the movement away from colonisation was much more than a mere transfer of power.

4.3. Decoloniality and Power Over Ideas

Decolonisation and decoloniality have different meanings in many texts, even though some authors, like Maldonado-Torres (2007), use the terms interchangeably. His position is that one should not consider the movement away from colonial rule in a vacuum but instead regard questions of decolonisation as questions about decoloniality. Theorists like Du Bois, Césaire, Fanon, and Cabral were involved in the twentieth-century project for African decolonisation and were engaged in extensive and diverse analyses. These included sociological perspectives (Du Bois), literature (Césaire), psychoanalysis (Fanon), and Agrarian political economy (Cabral). Frantz Fanon emphasised the 'coloniality of knowledge' and the 'coloniality of being' (Mignolo, 2007). His work, often misused during #FeesMustFall, highlighted the denial of African emancipation within European ideas supporting colonialism. This resulted in bodies of knowledge that sought to highlight life's narrative after colonisation and the need for local ideas, thinking, and problem-solving methods to take precedence.

Ngugi wa Thiong'o (1986) underscored the domination of the mind and imagination as a critical aspect of colonialism. Similar positions were expressed by Maldonado-Torres (2007) and Ndlovu-Gatsheni (2013), the latter noting the invisible control lingering beyond colonial rule, impacting minds, problem-solving logic, and prioritising Western ideas.

Maldonado-Torres (2007), in reflecting on the South African experience, avers that apartheid continued beyond 1994 and that the counter-revolution against the entrenched ways of thinking continues far beyond the change in political power. Fanon (1967), who writes from the perspective of African post-independence, pointed out that decolonisation and Africanisation are not synonymous terms. Instead, he states that decolonisation removes that invisible control introduced through colonisation; Africanisation includes African ideas and ways of thinking in problem-solving. His position was that the former needed to take place for the latter to be effective.

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Cabral, the only Agronomist among the well-known decolonial theorists, had a similar view when he called for a "creative destruction" of colonial rule's social and economic effects. This article does not focus on Cabral's position regarding the counter-revolution, although it is valid to argue that his stance on decolonisation is intertwined with his counter-revolutionary position. Instead, this article emphasises Cabral's specific position on decoloniality and agriculture. He challenged the idea that colonialists brought development and introduced the concept of history into Africa (Pedreira, 1973). Instead, he felt that the significance of indigenous knowledge in responding to challenges by farmers needed to be restored and that the only way to do this was to engage in a "creative destruction" of Westernised solutions to local problems. This is echoed in the work of Ndlovu-Gatsheni (2013a), who argues that portraying the global south as inferior to the worldwide north has psychologically undermined how problems are solved in the global south. In other words, the logic and methodologies are biased, disregarding traditional knowledge systems.

These positions about colonialism and power are described by Quijano (2000) in what he called a "colonial matrix of power" with four interlocking domains. These are control of the economy (land appropriation, exploitation of labour, and control of natural resources), control of authority (institutions and the army), control of gender and sexuality (family and education), and control of subjectivity and knowledge (epistemology, education, and identity formation). Using these forms of power keeps people entrenched in a colonised mindset.

Thus, the proponents of decoloniality point to the fact that technology and scientific discoveries were used to justify colonialism. In addition, it was pervasive and invasive as it disregarded indigenous knowledge systems. The decolonisation project thus advances the perspective that there is an urgent need for change in curriculum to move away from Westernised interpretations of problems and their solutions. It is, therefore, essential to demystify how knowledge is constructed in the context of Extension and extension. It qualifies the idea that all people can generate and disseminate useful knowledge, especially in activities like crop cultivation, livestock production, the care and maintenance of the environment, and other rural agricultural practices they and their ancestors have been doing for generations.

4.4. Decoloniality and Curricula

Curriculum transformation, sometimes called curriculum reform and even curriculum renewal, includes changes made to teaching and learning content and a refocus on research objectives (Esakov, 2009; Clark, 2002; Shay, 2015). Within the context of Extension education, it is possible that twenty

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years ago, Extensionists did not necessarily consider the idea of decolonisation and its effects on Extension, when these conversations were already taking place in the Humanities. However, these conversations occurred in Extension in a different language, the language of Indigenous knowledge systems. The language of decoloniality in education, and in particular in epistemology or the theory of knowledge, is more recent, as shown by literature published by Wynter (2003), Gilroy (1995), Spillers (1987), Hartman (1997; 2007), Walcott (2014), Moten (2013), Wilderson (2000), Maart (2014), Nimako (2011), McKittrick (2013), Martina (2014), Kilomba (2008), Vergès (2004), Painter (1995), Brand (2020), Sharpe (2010), Fanon (1976) and Césaire (2001), among others.

The idea of an African-driven epistemology, or theory of knowledge, is strongly supported by Ndlovu-Gatsheni (2013a), who argued that curriculum change was necessary if genuine change was to be achieved. Mbembe (2015) cautions that learning institutions cannot continue providing curricula based upon knowledge premised on Western ideals. Msila and Gumbo (2016) concluded that including Indigenous African epistemologies in curricula can empower educators, researchers, and learners to solve problems more responsive to their environment. The logic is that education and curricula are political tools (Msila, 2007). Hence, if one accepts that within the South African situation, curricula were political and "authority-driven and elitist" (Jansen & Taylor, 2003), then curricula within the post-apartheid period needed to interrogate the nature of knowledge or epistemology propounded in all curricula. This article supports the position that decoloniality requires a shift in epistemology rather than merely including African perspectives.

5. DECOLONIALITY AND EXTENSION

Decoloniality requires a disentanglement from the basic ideas which shape learning, change, and development intervention. Maart (2020) notes that bigger questions need to be asked. These include; "What are we removing the colonial from? Ourselves? Our thinking? Our being? And what does such a process include? A series of acts that involve an untying from colonial practices?". In this regard, Maart's (2020:25) position is that "decolonisation is a series of acts aimed at undoing colonisation". It involves reimagining methodologies, recording embedded community knowledge, and incorporating it into curricula for effective development. In rural development, especially in agriculture, decoloniality demands the inclusion of local models based on Indigenous knowledge systems which challenge neo-colonialism (Wildcat, McDonald, Irlbacher-Fox, & Coulthard, 2014; Zavala, 2013; Chilisa, 2012). Extension education requires removing knowledge that disempowers rural communities and introducing empowering knowledge for effective development.

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Academics, researchers, and practitioners must consider their interventions' impact on the rural poor. This involves revisiting development definitions, advice, logic, and solutions, emphasising the nature of the knowledge selected and its appropriateness for the local context. Fanon (1967) stresses the need to understand the nature of knowledge and the impact of the colonial legacy, encouraging a careful consideration of introduced knowledge during colonial rule.

Understanding the environment, respecting indigenous knowledge systems, and questioning the methodology's appropriateness are crucial for true development and empowerment. Researchers and practitioners must assess whether methodologies align with dominant ideologies or uniquely address community problems, emphasising incorporating Indigenous knowledge into proposed solutions. This process enables questioning issues of power and knowledge and being in Extension education.

6. CONCLUSION

Decolonisation extends beyond the dismantling of colonial rule. It prompts a critical examination of knowledge, challenging the assumptions that what the global north offers is superior and that knowledge from the global south is inferior. The decolonisation discourse questions the nature of curricula and the solutions embedded in curricular materials, often influenced by texts and ideologies from the global north. Engaging in this debate does not entail eradicating all forms of knowledge; instead, it provides an opportunity to question power dynamics and epistemic influences. This allows for demystifying the link between ideology and the nature of Extension education.

The primary goal of development interventions should be the liberation of individuals, not only in physical space but also in their thought processes, valuing local knowledge and shaping the design of solutions in rural communities. The language of decolonisation and decoloniality necessitates that Extension curricula offer insights into the role and relevance of indigenous knowledge and systems as potential solutions. Decolonising the Extension curriculum goes beyond including perspectives of African scholars; it requires embracing reflexive practice, altering the methodologies being taught, and thereby enhancing the skill set of Extension workers. This, in turn, enables more effective engagement with rural communities.

For researchers, it is imperative to actively record Indigenous knowledge solutions and systems. By documenting these practices, they can be incorporated into curricula, contributing to the ongoing process of decolonisation in Extension education. The next stage is to interrogate epistemological trends in Extension and to examine the extent to which a decolonised Extension curriculum has been

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adopted. Key questions to be asked include: Who is the curriculum designed for? What principles guide the selection of knowledge to be included in the curriculum? To what extent do teaching practices recognise Indigenous methodologies for extension practice? Who records research findings, and what methodological approach is used to analyse findings?

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