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TOBACCO PRODUCTION MANAGEMENT SYSTEMS FOR SUSTAINABILITY OF SMALL-SCALE FARMERS IN GOROMONZI

BY

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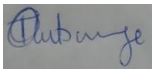
APPROVAL FORM

The undersigned certify that they have read and recommended to Bindura University of Science Education (BUSE) for acceptance a Dissertation entitled **"Tobacco Production Management Systems for Sustainability of Small-Scale Farmers in Goromonzi"** by **Tariro C Chitsunge** in partial fulfilment of the requirements for the degree of Executive Masters of Business Leadership (EMB).

TARIRO C CHITSUNGE  03-12-2024

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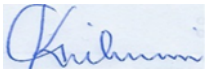
Dr Gilbert Kichini Signature:  Date: 03.12.24

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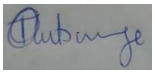
Signature:  Date: 26 November 2024

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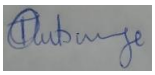
DECLARATION

I, **TARIRO C CHITSUNGE,** do hereby declare that this dissertation is a result of my own investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.



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DEDICATION

I dedicate this dissertation to my Lord and Saviour Jesus Christ who held everything together throughout this journey and to my husband, Tinashe Augustine Mukoko, whose support and love made this program possible.

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ABSTRACT

The tobacco leaf represents 10% of the country's gross domestic product (GDP) and 70% to 80% of the tobacco production in the country is from smallholder farmers – farmers with commonly less than 2 hectares of land of tobacco. Despite the significant role of smallholder tobacco farmers in Zimbabwe, they encounter numerous challenges that include high production costs, low market prices, high debts and environmental impacts among others. The challenges of the tobacco farmers cut across the entire production chain. The current study therefore sought to develop a production information management system that may help smallholder tobacco improve their production stamina and reduce operational challenges. In an effort to address this agenda, the study adopted a mixed method under the post-positivism philosophical stance. Using disproportionate stratified sampling, 265 questionnaires were distributed to 231 farmers and 34 TIMB staff. Furthermore, 10 interviews with relevant farmers and 5 with TIMB staff were held to gain insights into the production system being used by farmers in Goromonzi. A response rate of 56.2% for surveys and 73.3% participation for interviews were recorded. The data was analysed using SPSS version 24 while the qualitative data was analysed thematically. The results showed current tobacco farming practices among the smallholder farmers in Goromonzi are not sustainable and not providing a viable business entity for the households. The methods are manual and highly controlled under the contract farming government policy position. The farmers encounter structural, personal and technology related bottlenecks such as lack of market information, limited power to negotiate inputs and prices, and also increasing harsh economic and weather conditions. Adoption of any technology might be constrained by these factors. It was proposed that external forces and government position might need to intervene to regulate the promotion of adoption of technology-driven production system dependent on viable economic conditions, competent farming community and positive cultural base. This is likely to produce measurable sustainability and viability of the tobacco farming system in Goromonzi. The farming system cannot be isolated from growing global health concerns, carbon emission and child labour laws. Despite these discoveries, the study could not widely validate the effectiveness of the proposed framework. Further researches in this regard might be pertinent.

Keywords: Tobacco Production Management Systems, Small-scale farmers, Tobacco farmers, Goromonzi, Government policy, Sustainability

LIST OF ACRONYMS

Gross domestic product	GDP
HDI	Human development index
MENA	Middle East and North African
TIMB	Tobacco Industry and marketing board
US	United States

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

This study intends to design and develop an information management system for the production of tobacco among marginalized smallholder farmers in less tobacco-arable land in Zimbabwe particularly Goromonzi in Mashonaland East province. Smallholder farmers constitute more than 60% of tobacco growers in the country but also represent the most negatively affected farmers in the country. For instance, from 2012 to 2015, tobacco production dropped sharply from 24.5% to 5.7% due to several factors that include low productivity, high input costs, low output prices, and failure to repay loans. The government has endeavoured to help smallholder farmers through crafting several interventions inclusive of contract farming and government monitoring marketing process. Despite these interventions, smallholder farmers in Goromonzi continue to experience operational challenges. A critical component to these challenges is limited access to proper and accurate production and marketing information. It is thus argued in this study that provision of a production information management system for the farmers may go long way to curtail majority of the existential problems. In this chapter, the challenges of tobacco production among smallholder farmers are discussed leading to historical and conceptual development of the problem. It also presents the research objectives, scope and limitations of the study without demeaning the justification and relevance of conducting the current research. The chapter also presents the key definitions and lays out some assumptions made which guide this research.

1.1 Background to the Study

1.1.1 Global trends of smallholder tobacco production

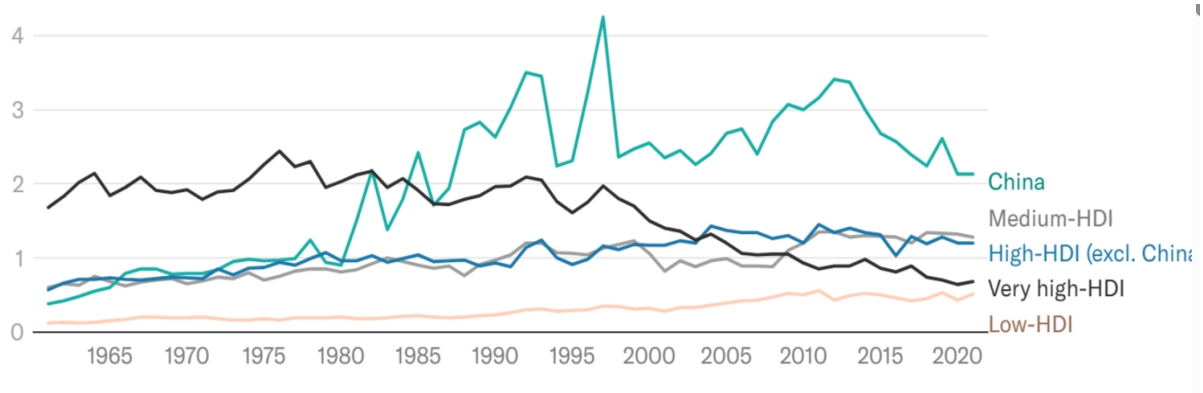
Worldwide, 60% of the tobacco farmers are smallholders with large percentages being drawn from countries such as China, Brazil and India. The global trends indicate that tobacco production in general is declining especially among countries with alternative means of supporting their economies, countries with high public campaigns against tobacco use and countries with high concerns for the climate and health (Rogers, 2020). Smallholder tobacco farmers represent a significant part of the economies of developing countries with respect to revenue generation and

employment creation. According to Chikozho (2022), smallholder tobacco farmer refers to a farmer cultivating a relatively small piece of land commonly 2 hectares and below. Usually, the smallholder framer is less well-resourced as compared to large commercial farmers. Smallholder farming is associated with diverse challenges from limited land preparation and tillage to constrained access to marketing opportunities and price fluctuations among others (Ngwira, 2021).

1.1.2 Regional outlook of tobacco production

Farmers from developing economies such as Malawi, Zambia and Zimbabwe represent a significant portion of the global production (Kassam, 2023; Mazwi et al., 2023). The narration of tobacco farming is thus not evenly distributed across the regions of the world but much pronounced in few countries. Due to many unequivocally negative effects from consumption of tobacco and the high environmental and health concerns, the production of tobacco has started showing signs of decline especially in countries with high human development index (HDI) as depicted in Figure 2.1.

Figure 0.1: Production trends of tobacco among low to high HDI countries (1961-2021)



Source: (Hopkins, 2024, p. 2)

1.1.3 Local trends in the phenomenon studied

Despite decline in tobacco production among the developed economies, production in developing economies continues to rise. For instance, tobacco production in Zimbabwe has risen over the years and represents the largest part of all tobacco grown in Africa (Chingosho et al., 2021b). Flue-cured tobacco represents 95% of all the tobacco produced in Zimbabwe and statistics shows that after the land resettlement of 2000 when majority of black farmers were allocated new commercial farms, the production of tobacco has been soaring with 258 million kilograms being produced in

2019 (Mazwi et al., 2023). The 2019 production represented the highest such figures since 1980. While smallholder farmers represented the bulk of the tobacco produced, they encountered numerous production challenges. Production of tobacco refers to the entire chain of cultivating, harvesting, curing, processing, and marketing of tobacco (Kassam, 2023). The entire chain of processes presents itself with several challenges especially for the smallholder. Smallholder farmers in Zimbabwe have tobacco-related debts and constrained in terms of resources inclusive of limited farming information relevant to the entire production network (Chingosho et al., 2021b). For instance, smallholder tobacco farmers in Zimbabwe have limited financial resources and equipment, uncertain market conditions, limited agricultural management prowess, environmental disasters and competitive environment (Ngwira, 2021). Furthermore, smallholder farmers encounter labour issues as they rely on family labour which includes exploitation of children below 18 years (Shonhe et al., 2022). Zant (2020) argues that one of core instrumental strategy to improve the production among smallholder farmers is to adopt computerised production management information systems to enable the farmers to receive and share information along the entire spectrum of the tobacco production chain. Despite the understanding of the role of timely and proper information to tobacco farmers, there is dearth of literature on the subject matters especially in marginalised farmers in rural settings (Chingosho et al., 2021b). Smallholders farmers in such rural settings have increased tobacco farming related debts, increased production costs and price fluctuations, and market information asymmetry (Zant, 2020).

Goromonzi is in ecological region II that receives between 700 to 1050 mm of average rainfall. Before the fast-track land reform programme of 2000, the region was dominated by large commercial farmers largely characterised by horticultural production (Makate et al., 2022). After the reform programme, the agrarian structure shifted towards more smallholder farmers production of commercial products that included largely tobacco farming estimated to be around 684 formally registered with TIMB. The farmers were largely contract-based. According to Makate et al. (2022), Goromonzi soils are not suitable for tobacco farming and the number of tobacco farmers has been plummeting. For instance from 2012 to 2015, the numbers dropped from 24.5% to 5.7% of the total number of smallholder tobacco farmers in the country (Makate et al., 2022). Goromonzi is Mashonaland East which is characterised by horticultural farming and crop production. According to Makate et al. (2022), many of smallholder tobacco farmers have entered into contract farming in Goromonzi due to several factors inclusive of low productivity, high input costs, low output

prices, and failure to repay loans. Even with contract farming, smallholder tobacco farmers continue to experience inadequate inputs and low productivity raising questions over the relevance of contract farming to resolve smallholder tobacco farmers' production challenges (Makate et al., 2022; Mazwi et al., 2023).

1.2 Statement of the problem.

Zimbabwe is the largest producer of leaf tobacco in Africa the 6th largest across the globe. The tobacco leaf represents 10% of the country's gross domestic product (GDP) and between 70% to 80% of the tobacco production in the country is from smallholder farmers – farmers with commonly less than 2 hectares of land of tobacco (Ruckert et al., 2022; Shonhe et al., 2022). Despite the significant role of smallholder tobacco farmers in Zimbabwe, they encounter numerous challenges that include high production costs, low market prices, high debts and environmental impacts among others. According to Chingosho et al. (2021), 57% of smallholder tobacco farmers are in tobacco-related debts, and 81% of smallholder farmers report of dissatisfaction with tobacco market prices year after year (Shonhe et al., 2022). The problems of smallholder tobacco farmers thus are wide, less studied and even less attended to with current approaches so far adopted including contract farming proving less sustainable and responsive to these challenges (Ruckert et al., 2022). This is particularly underscored in farming zones such as Goromonzi where the bulk of the tobacco farmers are on contracting farming (Mazwi et al., 2023). Goromonzi is peri-urban to Harare making it one of the strategic tobacco growing area in Mashonaland East of Zimbabwe. If the smallholder tobacco farmers' challenges remain studied and explored, the sustainability of tobacco farming in Zimbabwe remain less attainable and a risk to the future of tobacco farming in Zimbabwe especially given increased public concerns over its production and consumption (Ruckert et al., 2022). Thus, study thus seek to explore the production challenges of smallholder tobacco farming in Zimbabwe so as to inform a responsive tobacco production system in the country.

1.3 Main Research Objective

To develop a viable and sustainable technology-based tobacco production management system for smallholder farmers

1.3.1 Main Research Objective

The study is guided by the following objectives:

- To evaluate the current production management system (economic, social and environmental viability parameters) for smallholder tobacco farmers
- To establish the challenges of adopting technology-oriented production systems among smallholder farmers.
- Develop a technology-based tobacco production management system for smallholder farmers.

1.4 Research Questions

1. What is the current production information management system (economic, social and environmental viability parameters) for smallholder tobacco farmers in Goromonzi?

2. What are the challenges of adopting technology-oriented production systems among smallholder farmers?

3. How to develop a technology-based tobacco production management system for smallholder farmers?

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1.5 Significance of the study

1.5.1 Long-term viability of the tobacco industry in Zimbabwe

The research results may be pertinent in helping the smallholder farmer tobacco industry – farmers, regulators and marketers to identify sustainability practices that may help long-term viability of the industry. Smallholder farmers in Goromonzi encounter production information gaps which inherently affect their decision making and production patterns. Findings from the extant study are likely to furnish the farmers and the entire industry with production loopholes and framework to address such gaps through a responsive information management system.

1.5.2 TIMB and government

TIMB being the regulator of the sector may require data from this study to understand the sustainability challenges of the sector and how to create production and regulatory frameworks that may support smallholder farmers sustain their operations.

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1.6 Purpose of the study

The purpose of the design-based research study is to explore factors affecting tobacco production among farmers in Goromonzi so as to develop a technology-based supply chain management system for such farmers

1.7 Justification of the study

There are limited studies exploring the availability and architecture on supply chain or production system for the smallholder farmers of tobacco in marginalising regions such as Goromonzi in Zimbabwe. While it is appreciable that information exchange across the entire production system of tobacco is crucial to enhance quality of the product, productivity of farmers and also marketing efficiency, there is constraint researches in the field (Hopkins, 2024). The current study endeavours to fill such a gap. The output of the research is a practical production information management system that may connect farmers directly to various stakeholders such as input suppliers and buyers of tobacco. In the process this reduces current costs attributable to information asymmetry.

1.8 Scope of the study

The study focused on TIMB registered farmers for the 2023-2024 farming season and existing TIMB staff during the same period.

1.9 Research assumptions

It is assumed that during the study the agricultural policies and the tobacco industry strategy remains stable. The regulatory framework for the production and marketing of tobacco as governed by TIMB remains unchanged during the study period. Policy frameworks may take considerable time beyond the study period of one year to be changed (Mango and Kugedera, 2022)

1.10 Limitations of the study

The use of only 10 farmers and 5 TIMB staff to evaluate the produced system risked the undervaluation of the performance of the system. The researcher adopted purposive sampling to increase validity of responses and quality of the evaluation exercise.

1.11 Operational definition of terms

Tobacco production management system – an integrated information management framework to assist in the generation, distribution and exploitation of tobacco farming information for smallholder farmers (Chikozho, 2022).

Sustainability – situation in which the tobacco farming meets the needs of the smallholder farmers without negatively affecting their long-term survival (Ngwira, 2021)

Small-scale farmers – farmers cultivating a relatively small piece of land commonly 2 hectares and below (Chikozho, 2022).

1.12 Chapter Summary

The chapter presented the background to the growing challenges of tobacco production among smallholder farmers in marginalising tobacco farming zones particularly Goromonzi in Mashonaland East province in Zimbabwe. It also outlined the research objectives hinged on a clearly defined statement of the problem. The surveyed background information and statement of the problem clearly indicated the smallholder tobacco farmers encounter information gaps which aggregately negatively impacts on their production supply chain. Therefore, the chapter stated the key steps to developing the framework which were outlined in research objectives and study questions. It also presented the scope, assumptions and limitations of the research. In the next chapter, a synthesis and summary of past studies are given.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 Introduction

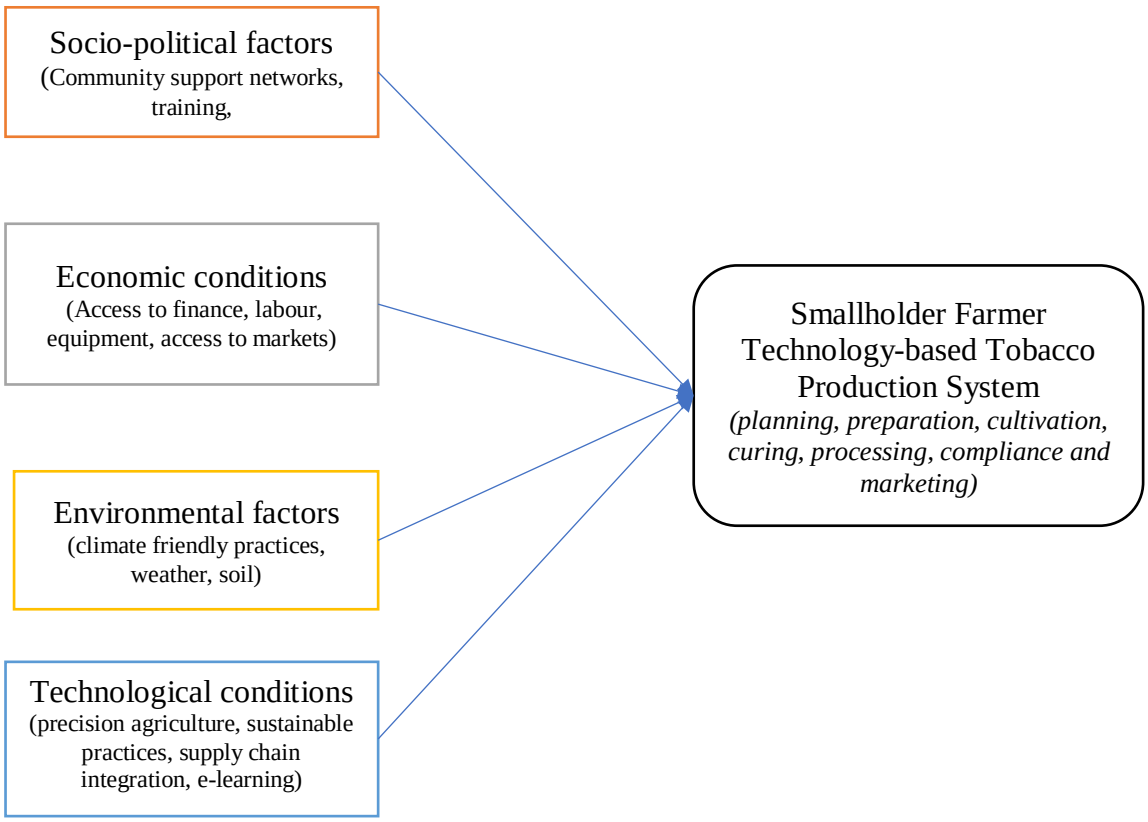
This chapter delves into existing body of relevant research on integrated information management systems for smallholder farmers especially those in tobacco production systems. It serves as the comprehensive foundation for understanding the challenges encountered by smallholder farmers in terms of information gaps and concomitant production challenges. The reviewed literature consisted mainly of journal articles focused on tobacco production among smallholder farmers drawing some lessons on possible integrated information management systems that may stimulate efficient and effective tobacco production among the smallholder farmers. The chapter begin by exploring the key concepts upon which the study is anchored and then delves into the 2.3 Value chain framework which is the main theory informing this research. Production of tobacco is a complex phenomenon whose success largely depends on exploiting the right information at the right time – from seed preparation to marketing. Tobacco may significantly lose value along the supply chain and thus its production depends on a strong value chain framework that is active in effective information sharing. Upon analysis of the theories and concepts informing the current study, the chapter then presents the description of the tobacco production system in general narrowing to analysis of the technology-driven tobacco production systems. The chapter also presents the constraints which smallholder farmers encounter in adopting technology-based production systems. In this chapter the various methodologies adopted in previous researches are also explored.

2.2 Conceptual framework

A technology-driven tobacco production systems targeting smallholder farmers is entire integrated supply chain system for smallholder tobacco farmers which leverage on contemporary agricultural technologies and practices meant to ensure that tobacco farming benefits the current generation without affecting future generations. It is a system that allows smallholder farmers to plan, prepare, cultivate, cure, process, and market their tobacco without affecting future generations nor their future continuity needs. The diagram depicted in Figure 3.1 clearly demonstrates the various key components necessary to establishing a sustainable tobacco production mechanism for smallholder farmers. It is the basis of initiation of this study and envisaged to provide some long-lasting

solutions to addressing current tobacco production challenges among smallholder farmers in Goromonzi District.

Figure 2.1: Technology-oriented tobacco production (supply chain) management system



Source: Adapted from (Maulidah, 2020, p. 152)

Understanding the tobacco supply chain management system helps unpack the underlying socio-political, environmental and technological factors that drive smallholder tobacco farmer's challenges and production matrix. For instance, the ability of farmers to prepare adequately for the farming season depends on their knowledge space and access to resources. Providing the farmers with timely information on how to prepare for the season up to information on distribution and marketing of the product remains critical in tobacco farming. Therefore, the supply chain system requires improvement mainly in form of enhanced technology-oriented production system as depicted in Figure 2.1.

2.3 Theoretical framework

The smallholder farmers for tobacco are affected across the entire production chain. This is quite different from production of other products such as maize and other commercial products. Tobacco can be affected significantly at any weak link of the supply chain. Therefore, the study took on the lens of value chain theory which allows for broader view of the entire supply chain of the tobacco production system.

2.3.1 Value chain framework

The study is premised on the value chain framework theory which analyses the efficiency and profitability of the smallholder farmer's entire chain of activities from seeding to export of the product (Kassam, 2023). It is premised on examining the entire processes of the production of tobacco. The value chain framework examines how value is added on each stage from input, production, processing, marketing and distribution of the tobacco. Critical to the framework is the need to do the value analysis and coordinate stakeholders so as to have an integrate and efficient tobacco production system for the farmers. Core the system is enhance efficiency and competitiveness for the farmers especially the smallholders.

While the value chain framework theory has widely been used to identify bottlenecks in in system, it has been criticised for its complexity and power imbalances. The theory fails to capture the power imbalances in the supply chain and production mechanisms. For instance. Challenges of smallholder farmers hinge on political influences which cannot be fully captured by the framework. In addition, the smallholder farmers face some market access problems inclusive of limited negotiating powers on fair prices. These inherent challenges can hardly be captured by the framework. The frameworks also overlook environmental and social concerns which are increasingly being raised in contemporary societies. For instance, use of firewood to cure tobacco, carbon emission and health implications, are increasing societal challenges that can hardly be explained using the value chain framework theory.

Despite the limitations, the theory has widely been used to enhance efficiency and improve access to market among marginalised farmers. The theory helps to map the value chain and also pinpoint inefficiencies in the production system. Thus, it is pivotal in allowing smallholder farmers adopt practices and technologies aimed at improving efficiency and cut production costs.

2.4 Tobacco production management systems

The tobacco production system is an integration of multiple processes and conditions that can be viewed as socio-economic components, environmental elements and technological features. Smallholder farmers also encounter challenges in poor infrastructure with regard to road, storage facilities and also market information. Underlying majority of the problems of smallholder farmers is information asymmetry. According to Makate et al. (2022), smallholder farmers are significantly crippled due to limited access to reliable information on the market and even production technologies. Information on how to build strong and rewarding relationships with buyers remains a challenge for smallholders farmers – a situation which has spurred the development of costly contract farming and poor price negotiations in the auction floors (Shroff, 2022).

Furthermore, the rising environmental and health campaigns against tobacco consumption hardly informs smallholder tobacco farmer decisions. The situation is increasing the risk of future sustainability of the sector (Shonhe et al., 2022). In addition, limited information on appropriate technology to enhance productivity and efficiency among smallholder farmers remains a significant bottleneck for the sector.

2.4.1 Socio-economic conditions

The management systems of smallholder tobacco producers in emerging and developing economies has been characterised by contract farming arrangements (CFA). According to (Makoka et al., 2017), tobacco farming is generally perceived as profitable and viable farming option especially among smallholder farmers who may require to expand their farming businesses. However, empirical evidence and previous studies suggest significant debate over such assertions. This is particularly evidenced by CFA shortfalls. The production system of tobacco under contract farming arrangements has been popularised in Zimbabwe but evidence indicates that smallholder farmers hardly achieve the 39% productivity as generally perceived. (Pangapanga-Phiri et al., 2024) argue that CFA has not reduced the labour-intensive requirements for smallholder farmers and neither has it been accessible evenly across all the farmers especially the elderly and women. Furthermore, contract farming arrangements (CFA) have also indicated that though CFA has allowed farmers in Malawi to operate at margins just enough to keep the above national poverty thresholds, the arrangement has not guaranteed economic prosperity. The credits and inputs

provided under CFA have only increased debt burdens among smallholder farmers and left them even much poorer than without CFA. (Makoka et al., 2017) demonstrate that CFA has raised losses for smallholder farmers through increased costs with marginal market gains. The authors argue that the narrative that tobacco farming is panacea for smallholder to gain wealth is misleading. The case studies in Malawi and Zimbabwe suggest that CFA is an arrangement that has just gained traction as a means for smallholder farmers to gain inputs on time while leveraging on markets gains. However, such perceptions are slowly being overtaken by the huge losses and debt burdens among the farmers.

Financial challenges continue to define smallholder farmers' challenges. (Chingosho et al., 2021a) report that 57% of surveyed smallholder farmers in Zimbabwe who focus on tobacco farming have huge debts. Indebtedness of smallholder tobacco farmers is an important problem that has limited the production of tobacco among these farmers. Even under CFA, the smallholder farmers encounter unfavourable terms and conditions which often than not leave them in huge debts (Mango and Kugedera, 2022). In addition, (Ndoro-mkombachoto, 2024) clearly report that smallholder farmers have limited market power to negotiate for better prices for their products. Tobacco production commonly favours large companies which tend to practise monopolistic terms. The smallholder farmers have limited bargaining power even under CFA arrangements leading to trapping of many such famers in poverty and cycles of debts. The CFA exposes the farmers to prices set by the contracting companies. The above discourse shows that tobacco farming in developing economies is perceived as source of incomes for farmers.

Several conditions influence the production and supply chain system of smallholder tobacco farmers. Chingosho et al. (2021) report that smallholder tobacco production systems are affecting by limited availability and affordability of high-quality inputs (seeds and fertilisers). Productivity of tobacco highly depends on the quality of the inputs (seeds, fertilisers, pesticides and herbicides) among others. A system that helps smallholder farmers access high quality inputs is pertinent and much needed (Maulidah, 2020). Smallholder farmers need some system that provide timely information on such pertinent data. Furthermore, accessibility to cheap financial resources cannot be underestimated. It has been observed that much of the challenges of smallholder farmers arise from limited information on credit lines and also on cost management to the entire production chain (Chikozho, 2022). This also includes information on availability and costs of labour.

Smallholder farmers tend to rely on family structures to supply labour which has resulted in social concerns over the use of children as tobacco workers (Mazwi et al., 2023).

2.4.2 Environmental viability parameters

Tobacco farming is impacted by the ecological environment. According to Lecours et al. (2012), smallholder tobacco farming suffer from negative environmental impacts. Smallholder tobacco farmers rely on natural resources such as wood for burning tobacco. The use of wood results in deforestation, soil degradation and pollution. These negative environmental effects eventually impact on the farming capability of the farmers by way of disrupting the ecosystems and diminishing biodiversity. Smallholder tobacco farming do not have money to use modern technologies to cure their tobacco. As a result smallholder tobacco farmers depend on use of fuel wood in the curing processes which contribute to natural habitat losses and exacerbates climate change (Lakatos et al., 2024). These use of natural resources in the curing and production of tobacco among smallholder farmers is contributing to unsustainable land management practices. Furthermore, the burning of wood is contributing to huge carbon footprint into the atmosphere. The high dependence on traditional techniques in the production of tobacco among smallholder farmers is leading to high concerns for the unsustainable production management systems. The findings underscore the fact that smallholder tobacco farming is leading to environmental degradation and climate change negative implications. It is apparent that due to poor environmental management information among the smallholder farmers, the existing production systems are negatively affecting biodiversity and disrupting ecosystems.

2.4.3 Technology viability factors

Modern tobacco farming uses less labour but highly depend on technological advancements including use of modern communication systems to convey relevant tobacco production data and information (Makoka et al., 2017). Technology plays a crucial role in shaping modern tobacco production systems that commonly result in improved efficiency, overall tobacco management and sustainability thrust. According to Zant (2020), there are a number of key technological advancements focused on improving safe tobacco production chain which not only improves the chances of smallholder farmers in gaining more revenue but also reduce high dependency on conventional natural resources such as fire wood for curing tobacco. The technologies range from

those that assist in the planning and planting processes to monitoring of the tobacco growing trends. Hopkins (2024) asserts that precise agriculture is one cheap and very effective farming that smallholder tobacco farmers may adopt to transform their production systems. Precision agriculture includes use of modern information collection and analysis tools such as use of global position systems (GPS) and geographical information systems (GIS) to analyse field data that may help farmers optimise their planting, irrigation and fertilisation process. The key to these processes in tobacco farming rests in their ability to help smallholder farmers precisely understanding their crops and their performance. Furthermore, similar technologies that include soil sensors to help farmers monitor soil moisture and nutrient levels are critical modern technologies (Chikozho, 2022). Tobacco is sensitive product that requires farmers to have proper information. The use of modern systems to collect and analyse data on several dimensions of the plant remains critical especially for smallholder farmers. Furthermore, the selection of tobacco seeds and also disease and pest control techniques requires modern biotechnology information and knowledge. Healthier crops will ensure smallholder farmers can harvest better crops and better revenue. In addition the use of drones and online learning systems may go a long way in improving the control of the production of crops by smallholder farmers.

Ndoro-mkombachoto (2024) propounds that the key to improving smallholder tobacco farming yields and productivity is the adoption of an integrated systems. These platforms help farmers to track their production metrics in various dimensions be it soil moisture, nutrient levels, market information and even climate change management strategies. The platforms provide the smallholder farmers with various user interfaces on mobile phones, computers and even on web portals. These systems are relatively cheap and integrated such that the farmers can easily access very relevant production information. The various other technologies such as drones, satellite imagery, sensors and climate data analytics can easily be integrated into a production management systems that may help even the poorest farmers' access relevant data and production strategies. Furthermore, various e-commerce platforms such as direct sales and online global markets can easily be accessed. This way farmers can improve their profit posture and capabilities. Maulidah (2020) suggests that a modernised business model for the farmers which includes clear sustainability metrics and production performance metrics may help smallholder farmers even adopt modern farming techniques that may reduce their losses and high dependency on traditional production systems such as contract farming arrangements.

2.5 Technology-based tobacco production (supply chain system) for smallholder farmers

An important factor in modern tobacco farming value chain system is the inclusion of various technologies such as use of drones, Internet of things (IoT) sensors and robust information management system (Zant, 2020; Chingosho et al., 2021). Access and availability of robust smallholder information management systems helps the farmers with relevant production and marketing information which inadvertently improves the efficiency of the entire tobacco production chain system. For instance, Ngwira (2021) underscores that computerised and digitalised tobacco production systems may help smallholder farmers have direct access to the buyers and even allows them build lasting and rewarding links with buyers. The system also helps farmers make informed decisions with respect to costs control and selection of best quality input architecture (Ruckert et al., 2022). Developing a supply chain information management system that is accessible on mobile and different computing devices may enhance access to critical production information and services among smallholder farmers. For instance, the digital platform might help the farmers explore available credit lines inclusive of global cheap financial services (Hopkins, 2024).

While no single literature seem to cover the entire elements of the technology-driven tobacco production system which is integrative and information driven, the various studies seem to point to potential of integrative information management systems to enhance the efficiency and sustainability of tobacco farming among smallholder farmers in marginalised communities (Maulidah, 2020).

Technology-driven tobacco production systems for smallholder farmers focus on empowering these farmers with tools and resources that enhance productivity, sustainability, and market access. A critical component to the technology-driven systems for tobacco farmers is the adoption on online information management systems that can be accessed through mobile applications and computer portals. These tools may help the farmers plan, monitor and manage all aspects of the tobacco seed selection, cultivation, planting, production, harvesting and marketing (Rogers, 2020). These computer-driven applications also help farmers to localise weather forecasts and thus help them to precisely predict weather patterns for effective decision making about activities such as irrigation and planting (Ruckert et al., 2022).

Furthermore, dedicated technology such as drones, soil sensors and satellite imagery constitute some central platforms upon which farmers may understand more of the tobacco needs such as nutrient levels, moisture levels, aerial crop monitoring and pest infestation control. Integrated with e-learning platforms, the farmers may help access to advanced tobacco production techniques and resources (Shonhe et al., 2022). In Zimbabwe, following the land reform programme of 2000, many smallholder farmers had to depend on government driven extension work. However, due to growing number of smallholder farmers especially for tobacco, such services fall short of the required intensity and diversity. Emergence of online training and education remains a potential candidate to transform tobacco farming among smallholder farmers.

One of the problems among smallholder farmers especially in developing economies is the limited access to financial resources. Access to finance remains a risk for many smallholder tobacco farmers. Tobacco requires significant number of inputs whose costs may be out of reach of many farmers. Integrating the tobacco production supply chain to global sources of funds is one surest way for the smallholder farmers to transform their farming practices (Chingosho et al., 2021). The microfinancing schemes and crowdfunding platforms may raise funding for smallholder famers but such arrangements have proved to be expensive for many. This is one of the underlying cause of huge debt burdens among the smallholder farmers (Pangapanga-Phiri et al., 2024). However, due to online websites and financing options online, smallholder farmers may have access to cheap global sources of funds apart from the expensive local funding vehicles. Online marketplaces that enable farmers to sell their tobacco directly to consumers or distributors, reducing reliance on middlemen.

The integrative information management systems also provide other farming options such as best sustainable practices such as pest control mechanisms, crop diversification and seed variety selection strategies. Farmers can also access performance metrics and even yield prediction models that may help farmers plan ahead (Shonhe et al., 2022). Data analytics and monitoring skills are not easily accessible to many smallholder farmers but such are crucial especially in tobacco farming. These advanced skills are only accessible through integrative information management systems. Furthermore, it is through such technologies that smallholder farmers may be part of functional farm cooperatives on various platforms inclusive of social media work groups.

This holistic approach not only benefits individual farmers but also contributes to the overall health of the tobacco industry. Through the online platforms, the farmers may share experiences, challenge and strategies to solve their daily farming and production challenges. Implementing technology-driven tobacco production systems for smallholder farmers can significantly enhance their productivity and sustainability. By providing access to information, resources, and markets, these systems empower farmers to improve their livelihoods while adopting more sustainable practices.

2.6 Challenges of adopting technology-oriented production systems among smallholder farmers

The adoption of technology-driven production system among smallholder farmers is characterised by several conditions and factors. Smallholder tobacco farmers' decisions are affected by several prevailing conditions and features. These factors include the nature of technology to be adopted, the individual farmer conditions, the socio-economic and political environment including the working environment of the farmers.

2.6.1 Technological characteristics

Every piece of technology has its complexity, ease of use and also functionality which in total contribute to the decision being made by the farmer to adopt or not adopt the technology (Ndhlovu and Mlanga, 2023). Farming technologies such as precision agriculture, drones and even soil sensors inclusive of satellite imagery and GPS require some level of competency on the level of the farmer. Highly complex technologies that require huge effort of learning and application on the part of the smallholder farmer might dissuade them from adopting it. Simple technology that demands minimum effort will always attract interest from many farmers. Several theories have been devised to understand the effect of technology characteristics on adoption pattern. One of the elements of adoption is the functionality of the technology. Smallholder farmers might require technology that addresses their real-life farming challenges such as selection of seed varieties, fertilisers and even climate pattern data. Thus, the adoption of farming technology highly depends on its complexity and usefulness (Bath, 2023). Another factor affecting adoption is the compatibility of the technology with existing knowledge and use of the farmers. The various technologies available and their various characteristics pose some significant opportunities for

smallholder farmers and these may easily be gleaned from an integrative information management system.

2.6.2 Personal characteristics

Excluding the technology-related features, the individual farmer conditions also play an important challenge to the farmer. Smallholder farmers have limited access to modern and emerging technologies such that they are largely predisposed to adapting to new changes. According to Maulidah (2020), smallholder tobacco farmers have unique individual characteristics which includes different attitudes, subjective influences and also background on the use of modern technologies.

Many smallholder farmers have limited capability to adopt new technologies. Smallholder farmers constitute those farmers with limited educational skills and knowledge on the growth of tobacco farming. The limited knowledge does not only limited the farmers' ability to farm but also to adopt new technologies like precision agriculture and biotechnology techniques (Ngwira, 2021). Competency of famers around some given technology cannot be underestimated. The use of emergent technologies such satellite imagery, and even data analytics depends highly on the knowledge of how such technologies are applied. Use of drones and also online learning tools depends on the adeptness of the farmers to modern technologies.

2.6.3 Environmental and cultural features

An important decision factor on adoption of technology-driven tobacco production mechanisms is the conditions of the climate, soil and also farming culture. Tobacco farming highly depends on weather elements and also on the nature of the land (Ngwira, 2021). The nature of technology applicable in given farming environment relies on the nature of the soil and weather conditions. Climatic changes is affecting the type of technology that may be adopted. For instance, in Zimbabwe frequent droughts and dry seasons is increasingly demanding adoption of modern technologies such as precision agriculture and sustainable farming practices (Shonhe et al., 2022).

The worsening environmental conditions that include poor soils and weather hazards in Zimbabwe is persuading tobacco farmers to adopt drought resistant tobacco variety. Farmers in marginalised environments such as Goromonzi encounter poor soils and also cultural limitations. Farming zones

such as Goromonzi were traditionally for crops such as maize and horticulture. This implies that the farmers in those communities relied naturally on farming techniques bound to crops other than tobacco. However, the growing importance of tobacco as gold leaf for the country has persuaded many of such farmers to adopt new farming culture. The type of technology used lacks the modernity appropriate for tobacco farming. The choices of the farmers inclusive of traditional use of combine harvesters and also natural rains, contradicts the requirements for tobacco. The farmers have to adopt new farming techniques that include precision irrigation and other such tobacco farming strategies (Mango and Kugedera, 2022).

2.6.4 Economic conditions

An important adoption to technology-driven farming practices among tobacco smallholder farmers is the economies around the tobacco farming supply chain. Availability of required resources such as availability of the necessary infrastructure and finances to support the new technology. For instance the adoption of e-learning platforms and precision agriculture depends on availability of the foundational infrastructure such as the Internet and mobile communication networks among others (Zant, 2020). Advanced economies have wide set of infrastructure that promotes the adoption of modern farming techniques. However, in countries such as Zimbabwe, there is limited infrastructure such as Internet backbone networks and also limited road network humper the ability of the smallholder farmers adopting modern tobacco production mechanisms. The use of drones requires electricity and also high dependence on communication systems. The limited infrastructure in this regard is forestalling the development of advanced farming technologies.

In addition, the limited availability of financial resources is also constraining the smallholder tobacco farmers from adopting more efficient and sustainable tobacco farming practices (Ruckert et al., 2022). Tobacco farming needs expensive technologies such as health seedlings and also irrigation technologies. The limited availability of finances to procure such advanced technologies is prohibiting a number of smallholder farmers from adopting such technologies. Furthermore, the lack of farming technologies such as modern precision irrigation technologies is on its own a factor that dissuade many farmers from possessing and exploiting such modern and efficient tobacco farming technologies.

2.6.5 Policy and political characteristics

The deliberate policy position taken especially by the government and various lead entities in any farming community has implications on available farming options and nature of technology that the farmers may adopt (Ruckert et al., 2022). Mango and Kugedera (2022) highlight that government policies such as promotion of CFA has resulted in smallholder tobacco farmers adopting technologies defined and promoted by the contractors. Smallholder farmers have limited choices of what they may do and may not do. Therefore, the political decisions made over the farming practices in a country have implications on type and nature of farming technologies. Zimbabwe is one case study in which policies over the years since 2000 when the country embarked on land reform programme have negatively affected smallholder farmers in terms of access to modern farming technologies. The government policy resulted in the country getting economic sanctions. The sanctions negatively affected the farming community especially smallholder tobacco farmers. Zimbabwe's stance on use of contract farming has resulted in most of the affected farmers adopting technologies which in most cases do not positively contribute to the growth of the farming activities. For instance, the monitoring of the planting process is often against the abilities and wishes of the farmers. The smallholder farmers can hardly adopt emerging drones and precision farming due to prescriptive strategies imposed by the contractors. In addition, the government policy that all tobacco in Zimbabwe has to go through the registered auction floors has limited the ability of farmers on adopting latest online marketing platforms for their products.

2.7 Chapter Summary

The surveyed literature clearly indicates that tobacco farming is a gradually technology-intensive farming practice. The chapter discussed the concept of technology-driven tobacco farming which largely depends on an integrative information production system. It links all tobacco production supply chain nodes into a seamless production network. However, such a potential framework is hardly adopted among the smallholder farming communities due to several prohibiting conditions inclusive of lack of finances and infrastructure. Furthermore, the technology-related and individual farmer's conditions are pertinent to the adoption pattern. This is also true for the policy and environmental realities surrounding the farmers. The survey also showed limited understanding of integrative tobacco information production systems among smallholder farmers as majority of tobacco farming among the smallholder farmers is highly prescribed by government such as the

popularisation of contract farming arrangements. Despite limited evidence of the effectiveness of CFA, its continued use and worsening of smallholder farmers problems, CFA seem to preoccupy both practitioners and researchers. However, most farmers of tobacco in developing economies encounter rising risks of tobacco farming reduction due to rising debt burdens. Some of the discovered underlying challenges is the failure of these farmers in adopting integrative production management framework that improves farmers' access to markets, cheap inputs and best and sustainable production systems. The next chapter delves into analysis of the procedures that were used in collecting and analysis of the research data.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

The research methodology chapter presents the procedures that were taken in addressing the research objectives with clear showing of the case for selection of the different techniques. The study adopted individual interviews and conducted surveys among TIMB staff and smallholder tobacco farmers. The underlying overall rationale for mixing the techniques was entirely to triangulate these methods for a more comprehensive introspection of the study phenomenon. It is in this chapter that the entire research is unfolded from the underlying research beliefs on challenge being encountered by smallholder farmers across the entire production chain. The chapter also provides the adopted approach and research design. Descriptive design science research was adopted to provide a system reflective of real-life experiences of the farmers. This led to the sampling description and how data was collected with the aforementioned research instruments. The process of data collection and the descriptive and inferential data analysis is also presented in this chapter. The values that guided this study are also given in section 3.7.

3.1 Research Philosophy

The underlying set of beliefs that can commonly be shared within the smallholder farming community and management systems is that interventions to the production chain of tobacco is hinged on the experiences of the very persons involved in that chain. Lived experiences provided better perspective though this should be situated in the understanding that such study phenomenon is objective but partially understood by the social actors. The research acknowledged that smallholder tobacco challenges from production to marketing are real issues but understanding such cannot be isolated from the personal judgements of the very persons affected or observing the study phenomenon. Therefore, a post-positivism philosophical stance was adopted. It was perceived that the production system for tobacco farming was an objective reality. However, understanding this reality depended on personal perspectives of the smallholder farmers and critical players such as TIMB employees. The meanings they attach to the objective reality results in the reality only being partially understood. Therefore, the study considered that there is no absolute truth about tobacco production as all observations made are fallible to subjective biases of the observer (farmers and TIMB staff) though the study phenomenon may be structured and

objective in nature (O'Gorman, 2016). The supply chain information management system designed was objective reality as it constituted of real components and nodes but understanding the determinants of such as system was only impartially understood from the subjective opinions of participants (farmers and TIMB staff) surveyed. It could not be attained to isolate the subjective opinions in understanding this reality.

3.2 Research design

The current study phenomenon is a practical problem being encountered by the smallholder farmers. However, several theoretical frameworks and understanding have provided some potential interventions. Therefore, fusing the theoretical underpinnings with the practical realities serves to compliment responsive measures rooted in real-experiences of the farmers. Therefore, developing the production system based on empirical evidence remained the core thrust of the study. Against this background and thrust, the study was informed by descriptive design science research. The design helped to identify the underlying factors that influence smallholder supply chain system and then designed the smallholder production information management system. The overall plan guiding the study was informed by the study objectives and also the underlying research philosophy: post-positivism. Akinlua (2019) articulates that such a design provides the opportunity to formulate problem based on real-life experiences to inform the design of system that is responsive and reflective of the realities of smallholder farmer production challenges.

3.3 Sampling

Under this section, the procedures for selection of the respondents and participants of the study is discussed beginning with exposition of the total population from which the samples were drawn. It then describes the sample size considered and the sampling strategy selected.

3.3.1 Population

Population referred to the total number of persons of interest to the study: TIMB employees and smallholder farmers of tobacco. In this study, the study population consisted of 99 TIMB staff and 684 registered smallholder tobacco farmers (TIMB, 2022). Therefore, the population is described in Table 3.1

Table 3.1: Study population

Stratum	Total Number
2023 registered smallholder tobacco farmers in Goromonzi	684
TIMB staff	99
Total	**783**

3.3.2 Sample size

The sample size referred to the total number of persons who were selected into the sample. In this research the following sample size for finite population size was used:

$$n = \frac{N}{1 + Ne^2}$$

Where n is sample size, N is the population size (783) and e is the level of significance. The study assumed a 95% significance level meaning e = 0.05.

Replacing the symbols in the formula resulted in the following output:

$$n = \frac{783}{1 + 783\ (0.05^2)}$$

$$n = \frac{783}{1 + 1.9575}$$

$$n = 264.75$$

$$n = 265$$

Therefore, a sample size of 265 was used.

3.3.3 Sampling strategy

The sampling strategy related to how the 265 persons as determined in the sample size calculation were picked from the study population. Given that the study population was heterogeneous in

terms of area of specialisation: smallholder famers and TIMB employees. The TIMB employees supervises tobacco farming in Zimbabwe while the smallholder farmers depended on tobacco farming as source of revenue and their livelihood. It was then perceived that this difference should be reflected in the sampling strategy. A disproportionate stratified sampling was used. Attempting to use other methods would have jeopardising undermining of the minority but such minority who possess richer set of information on tobacco farming: TIMB employees.

Disproportionate stratified sampling was used as depicted in Table 3.2.

Table 3.2: Disproportionate stratified sampling

Stratum	**Total Number**	**Stratum sample size (ns)**
registered farmers	684	231
TIMB staff	99	34
Total	**783**	**265**

Disproportionate stratified sampling was used as the TIMB staff were not equally represented as the registered tobacco farmers. Such an approach improved the sample representativeness and allowed for fair capturing of the diversity of the views of the respondents.

3.4 Data collection techniques

In this section, the different was that were used to collect data are discussed. The study adopted a structured survey approach to collect data from the smallholder farmers and then selected the TIMB staff members and farmers for an evaluation interview meant to validate the tobacco production system (framework) that was developed. All the data was collected upon clear consent from the potential interviewees and respondents. Furthermore, the study ensured that each of these participants was briefed in detail of the nature of the academic study. An introduction was always provided to furnish the respondents with all relevant information so as to encourage uncoerced information.

3.4.1 Survey questionnaires

The study included survey questionnaires to solicit data mainly from farmers and TIMB staff members. The survey questionnaire was a list of questions with given response format so as to encourage the respondents to complete in the shortest possible time. Less time taken to complete the questionnaire the more people are encouraged to respond (Saunders, 2006). Total number of targeted respondents was 265 as defined by the sample size. The number of questionnaires distributed to smallholder farmers was 231 while 34 were distributed to TIMB staff members. The questionnaires were distributed both electronically and physically in person by the researcher and her assistant. The questionnaire was organised into sections. The introduction part provided the respondents with relevant contextual information of the study inclusive of some key ethical considerations to take care of. Section A then focused on providing clear instructions for the respondents to complete the questionnaire. Anonymity remained a key aspect for each respondent to take care of. Furthermore, the respondents were to respond by way of simply ticking or marking ☒ in the boxes provided for each question item.

Section B as depicted in Appendix 1 contained data on the demographic profile data of the respondents. The data included gender, education, and even experience in tobacco farming. These details were relevant to contextualise the study. It provided profile information relevant to understanding the nature of smallholder farmers engaged in tobacco farming in Goromonzi.

Section C contained data on the analysis of the current production management system with respect to its socio-economic performance dimension, its political outlook and also the environmental consideration. This led to Section D which focused on identifying the challenges smallholder farmers are encountering in farming of tobacco. Section E then described the framework elements for a technology-driven tobacco production system.

3.4.2 Evaluation interview guide

Beside the structured questionnaire, the study also included an interview guide to validate and evaluate the comprehensive and responsive of the proposed technology-driven tobacco production framework for smallholder farmers. The interview guide is described under Appendix 2.

The researcher had to book for venue and time with the interviewees to ensure that each of the participant was not inconvenienced in the process. The research involved 10 farmers and 5 TIMB staff. Only key informants were involved who were purposively believed to possess relevant information. This included TIMB secretary and smallholder farmer representatives in Goromonzi.

The researcher had to seek consent and also conducted the interviews at venues and time agreeable by the interviewees. All interviewees preferred non-recording of the interview beside field notes. The study depended on purposively sampled interviewees to evaluate the adequacy of the production system in attaining the farmers' goals (efficiency, cost reduction, access to production and market information).

3.5 Data analysis plan

The study collected structured data from survey questionnaires and unstructured data from the in-depth interviews.

3.5.1 Qualitative analysis

The interview data was analysed using manually analysed using theoretical thematic analysis. The researcher and her assistant had to read and re-read the interview transcripts several times to draw on small texts with meanings (codes). The codes were coloured coded to differentiate different meanings. The codes were also read and re-read in cycles to draw on some themes. The themes were then compared to the study objectives to draw on the conclusive themes of the interview results.

3.5.2 Quantitative data analysis

The structured data that included survey responses and socio-demographic data were analysed using both descriptive and inferential statistics. The response rate and socio-demographic data was analysed using descriptive pie charts, bar graphs and frequency counts and percentages. The study also presented the data on bar graphs for visual displays. However, the study also explored the association for independence between various determinants of the adoption of technology-driven tobacco production system.

3.6 Ethical considerations

3.6.1 Informed consent

Consent was sought from farmers and also permission sought from TIMB. Informed consent encouraged many respondents to provide data for the study.

3.6.2 Voluntary participation

The study did not coerce nor force any of the participants and respondents to provide data against their will. Each of the respondent was allowed to withdraw if they ever felt discomfort or risk of any nature without being victimised.

3.6.3 Validity and Reliability

The validity and reliability of the data collection process were addressed through several methodical steps. To enhance the overall representativeness, a disproportionate stratified sampling technique was employed (as shown in Table 3.2), ensuring that the views of the TIMB staff were adequately captured alongside the registered farmers, despite the disparity in their total numbers. This approach improved sample representativeness and allowed for a fair capturing of the diversity of views.

For data collection, a structured survey approach using questionnaires was primarily adopted to ensure consistency and ease of data management. The questionnaire was carefully structured into sections, including demographic data (Section B), analysis of the current production system (Section C), identified challenges (Section D), and the proposed framework elements (Section E). Furthermore, the design of the survey, which used a list of questions with a fixed response format, was intended to encourage a high response rate and completion in the shortest possible time, a strategy supported by principles of efficient survey design (Saunders, 2006). The study also included an evaluation interview guide with selected TIMB staff members and farmers, a step that served as a critical means to validate and evaluate the comprehensive and responsive nature of the proposed technology-driven tobacco production framework, thereby improving the construct validity of the final output. Ethical rigour, including obtaining clear consent and providing detailed briefings on the academic nature of the study, was consistently applied to encourage uncoerced and honest information, which contributes to the credibility of the data.

3.7 Chapter summary

The chapter presented the techniques that were used to collect and analyse data. The research largely depended on mixed methods approach underlined by post-positivism to comprehensively understand the lived experience challenges being faced by smallholder tobacco farmers in Goromonzi. The next chapter presents the study findings.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

The chapter presents the research results. It follows from the chapter on data collection and analysis – Chapter Three. In the present chapter the findings from each of the statistical and thematic analysis described on Chapter Three are presented and discussed. The chapter begins with analysis of the responses obtained from the survey and interviews. It then discusses the socio-demographic data of the research. The socio-demographic data of the farmers and the TIMB staff are presented which include the distribution of the gender, qualifications and even tobacco farming experience. The chapter then presents the analysis of the quality of the survey instruments: questionnaires and the interview. This leads to analysis and discussion of the main research results pertaining to an outlay of the current tobacco production practices, the challenges in adopting technology-driven farming practices and then the proposed tobacco production framework which may provide farmers with a more efficient and effective tobacco production chain system.

4.1 Distribution of the responses and participation of farmers and TIMB staff

In this part of the study, an analysis of the responses of the surveyed persons and interview participation pattern of the TIMB and farmers are given.

4.1.1 Analysis of survey responses

A total of 265 questionnaires were distributed as 231 to farmers and 34 to TIMB staff as depicted in Table 4.1.

Table 4.1: Distribution of survey questionnaires

Stratum	Distributed	Returned	Percentage response (%)
registered farmers	231	123	53.2
TIMB staff	34	26	67.6
Total	**265**	**149**	**56.2**

The results show that TIMB staff had higher response of 67.6% while farmers had low response of 53.2% leading to overall response of 56.2%. The low response among farmers was influenced by the widely dispersion of the farmers. Furthermore, some farmers were less willing to provide their own personal opinions on the subject for unclear reasons. However, the use of multiple methods of data collection that included electronic and physical options. This encouraged flexibility in the mode and format of responding. The physical options allowed for physical conduct that promoted more personal emotional support for the respondents.

4.1.2 Analysis of the interviews

As depicted in Table 4.2, the study targeted an average of 10 representative farmers and five TIMB staff members.

Table 4.2: The interview participation pattern

Stratum	Targeted	Participated	Percentage participation (%)
registered farmers	10	7	70.0
TIMB staff	5	4	80.0
Total	**15**	**11**	**73.3**

The data shows that the representative farmers had a participation rate of 70% while TIMB staff had higher participation of 80%. The results reveal that TIMB staff were more encouraged to provide data for the study while some farmers were reluctant to participate in the research. Overall, the interviews had a 73.3% participation rate which was way above the survey rate of 56.2%. The results suggest that interviews offer better success rate in data provision compared to survey questionnaires.

4.2 Measures of quality of the research instruments

The quality of the instruments were assessed using different techniques: Cronbach alpha test of reliability for the questionnaires and measure of trustworthiness for the interviews.

4.2.1 Interviews

To ensure trustworthiness of the feedback given by the interviewed TIMB staff and farmers, the researcher had to member check all responses to ensure that each of the collected data represented the views of the participants. In addition, the researcher ensured that feedback was aligned to the study objectives through use of prompts and follow-up questions.

4.3 Measure of reliability of the survey questionnaires

The Cronbach alpha test of reliability was used to assess the internal consistency of the survey instrument.

Table 4.3: Cronbach alpha test values for the questionnaire

Reliability Statistics		
	Cronbach's Alpha	N of Items
Current socio-economic, environmental and technology practices	.658	19
Challenges of adopting technology-driven production system	.726	6
Technology-driven framework	.798	8
Overall	.722	33

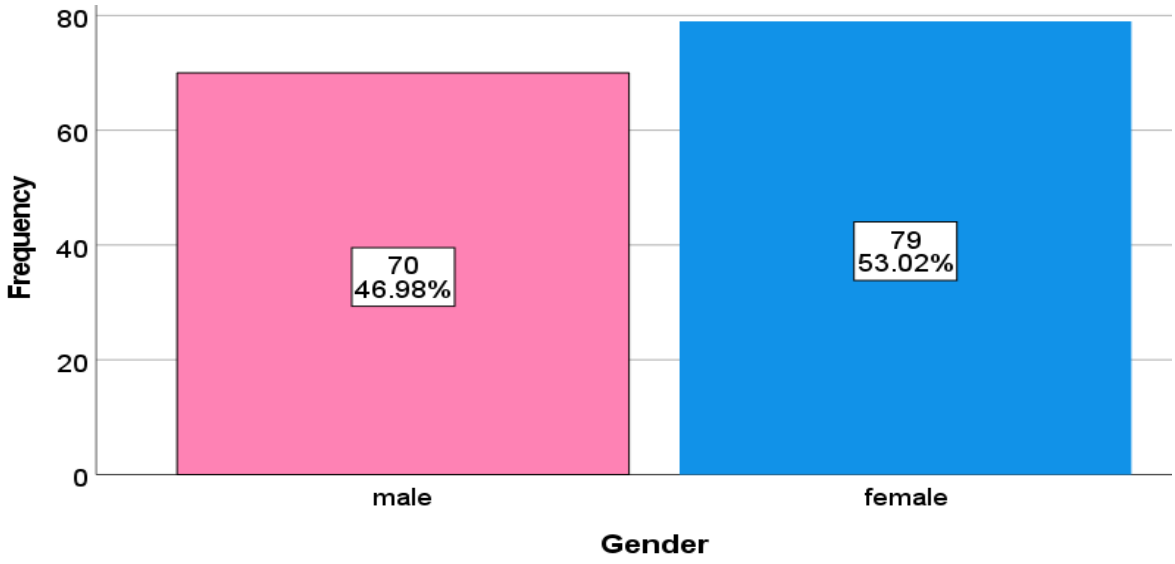
Excluding the socio-demographic data, the questionnaire had 33 items with 19n for current practice analysis, 6 for challenges in adopting technology-driven tobacco framing and 8 for the describing the optimal technology-driven tobacco production system. The overall reliability value of 0.722 showed that the questionnaire had high internal consistency though assessment of current practices had average reliability values. The results suggest that the instrument used was of high quality with respect to consistency meanings. Most respondents understood the meaning of the questionnaire items.

4.4 Distribution of the sociodemographic data of the respondents

In this part of the research, the socio-demographic data are analysed and presented.

4.4.1 Gender distribution

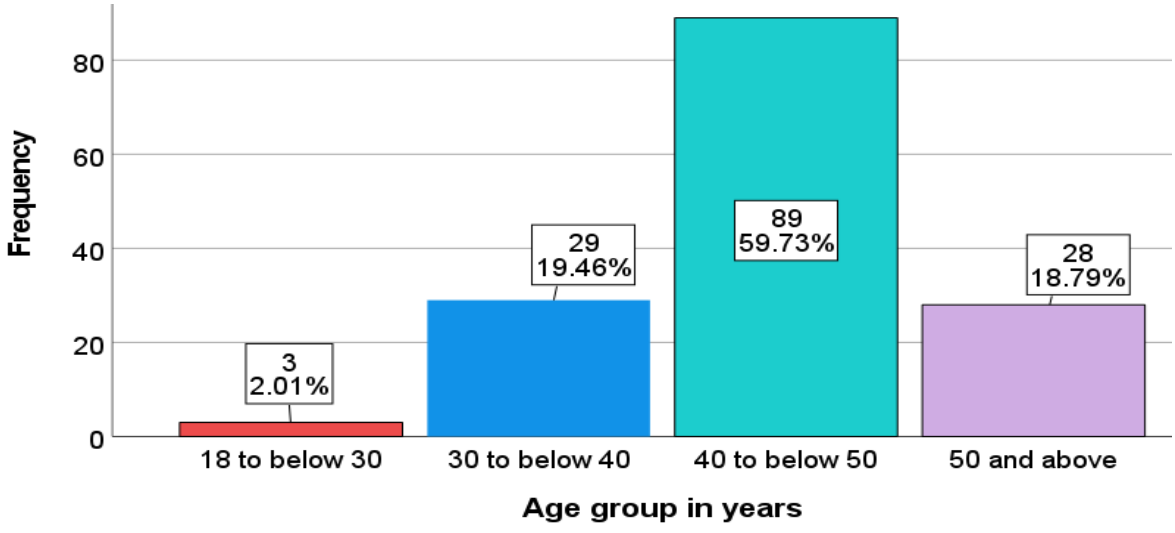
Figure 4.1: Gender distribution of respondents



The data indicates that females dominated with a 53.02% representation while males represented only 46.98% of the surveyed people. The results show that most of the smallholder tobacco farmers are females who commonly take care of families in rural family set-ups in Zimbabwe. It may suggest that the opportunities and risks of tobacco farming are more pronounced for females than males.

4.4.2 Age groups of respondents

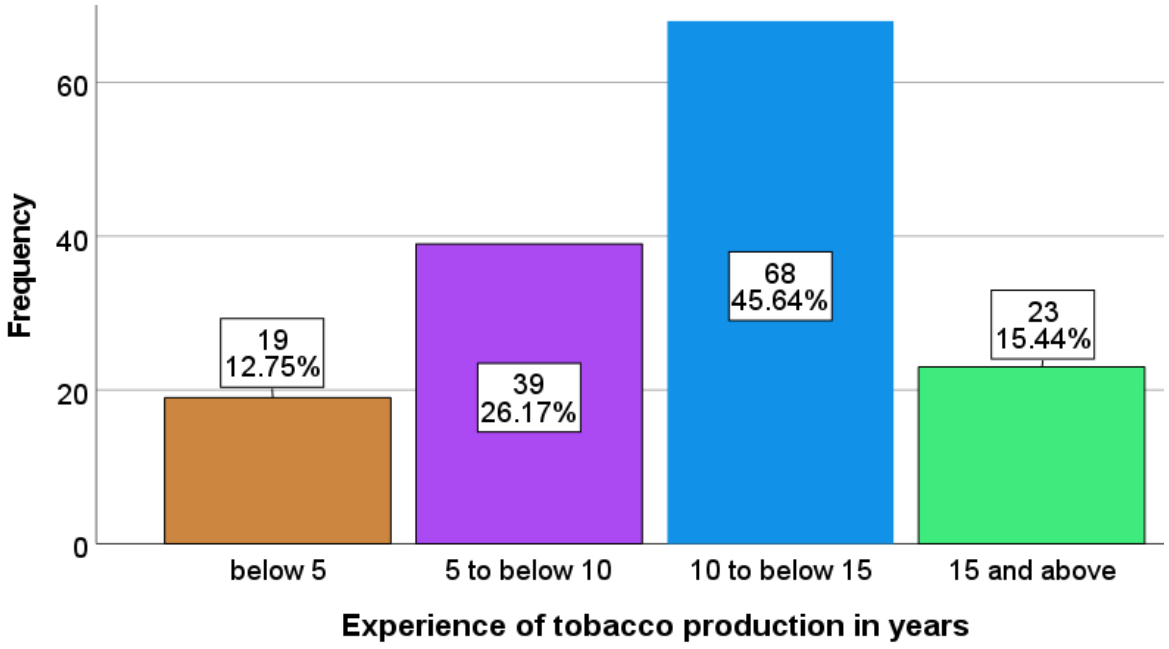
Figure 4.2: Distribution of age groups of respondents



The results show domination of the young and active age groups between the ages of 40 to 50. However, there is a significant portion within the 30 to 40 who represent 19.46% relatively equal to the older age groups representing 18.79% of the farmers. The study shows that most of the tobacco farmers are those who should have been formally employed in other industries.

4.4.3 Tobacco work experience of the respondents

Figure 4.3: Analysis of the work experience in tobacco production

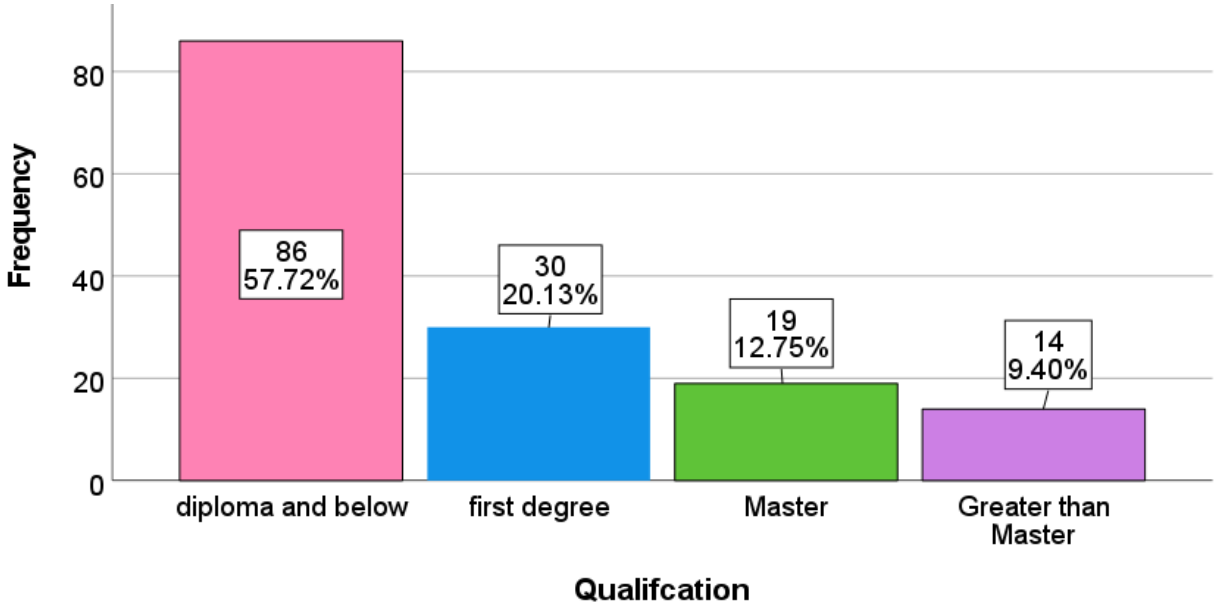


The study also show that 45.64% of the respondents exhibited higher work experience between 10 to 15 years. Generally, the study shows that 87.25% of the respondents were people with higher work experience of at least 5 years in tobacco production. The response thus given in this study are those of intellectual people who understood well the tobacco production supply chain.

4.4.4 Highest qualifications of the respondents

Under this part, the respondents had to provide their education qualifications as depicted in Figure 4.4.

Figure 4.4: Distribution of the highest qualifications of the respondents



The results reflect that most of the farmers (57.72%) had moderate qualifications of at most diploma level. However, the data shows that 42.28% of the respondents had higher qualifications indicating a growing literate population of tobacco farmers.

4.5 The current production management system

In this section, the respondents had to provide relevant information on the practice of tobacco farming peculiar to Goromonzi tobacco farming systems. The results were categorised into economic, environmental and technology-oriented behaviour and practices.

4.5.1 Socio-economic production practice

In this part, the respondents had to assess various social and economic characteristics of the tobacco producing farming systems in Goromonzi as depicted in Table 4.4.

Table 4.4: Socio-economic behaviour pattern of the farmers

Dimension/ Practice	Key: 1 strongly disagree, 2 disagree, 3 not sure, 4 agree, 5 strongly agree Std – standard deviation, M for mean					M±std
	1	2	3	4	5	
Poor infrastructure	4(2.7)	5(3.4)	14(9.4)	16(10.7)	110(73.8)	3.81±1.446
Low market information	3(2.0)	3(2.0)	15(10.1)	17(11.4)	111(74.5)	3.53±1.063
Poor price negotiation	3(2.0)	7(4.7)	11(7.4)	114(76.5)	14(9.4)	3.44±.961
Contract farming	2(1.3)	8(.4)	12(8.1)	15(10.1)	109(73.2)	3.21±.751
Viable revenue source	2(1.3)	2(1.3)	7(4.7)	122(81.9)	16(10.7)	3.99±.575
High debt burden	0(0.0)	2(1.3)	0(0.0)	23(15.4)	124(83.2)	4.81±489
Limited inputs	2(1.3)	6(4.0)	10(6.7)	21(14.7)	110(73.8)	3.21±.581
Child labour concern	2(1.3)	3(2.0)	4(2.7)	119(78.9)	21(14.1)	4.03±.609
Limited access to finance	3(2.0)	2(1.3)	6(4.0)	20(13.4)	118(79.2)	4.66±.754

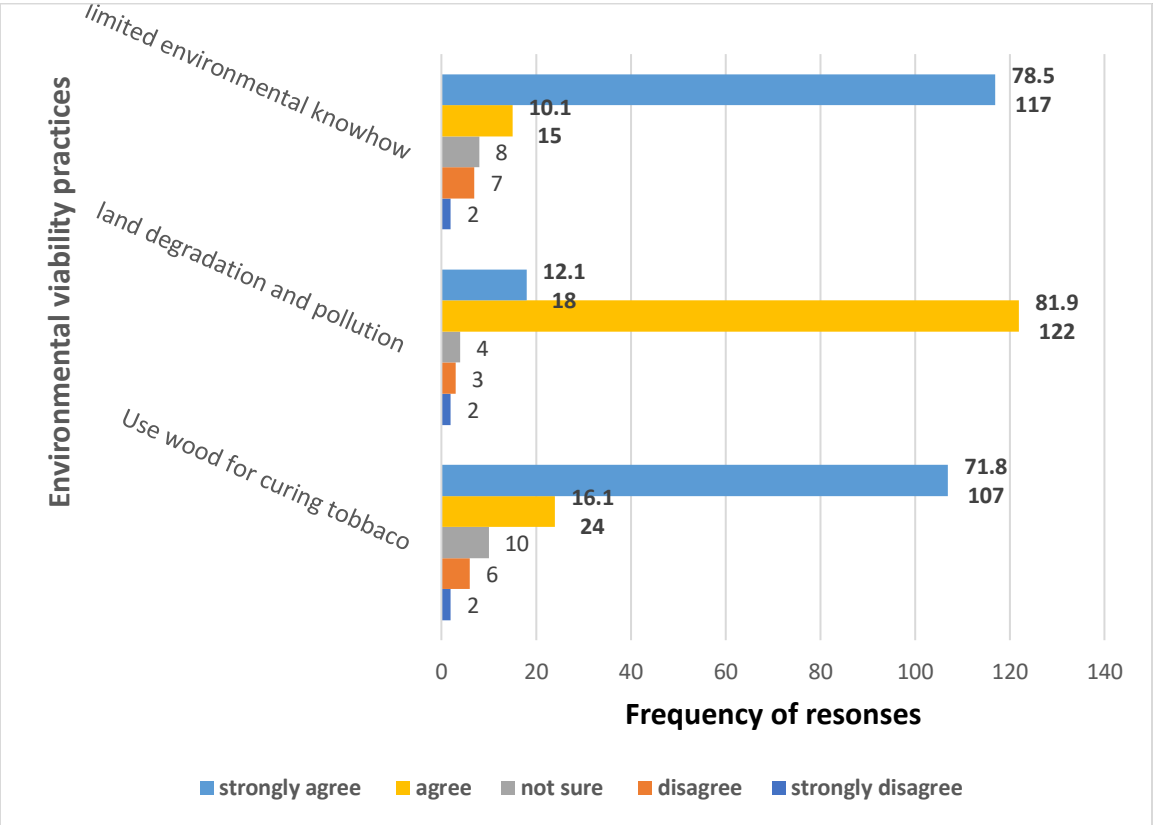
Examination of Table 4.4 shows that there are various prevailing socio-economic behaviour and practices among the Goromonzi smallholder tobacco farmers. On a scale of 1 for strongly disagree to 5 strongly agree, the responses showed that most respondents acknowledge that poor infrastructure characterised tobacco production among smallholder farmers (response mean score of 3.81±1.446); limited access to proper market data (3.53±1.063); farmers had poor price negotiation posture (3.44±.961); most farmers are negatively affected by contract farming arrangements (3.21±.751); and these farmers were characterised by huge debt burden (4.81±489). Furthermore, the tobacco production systems was featured with limited inputs (3.21±.581); and high exploitation of child labour (4.03±.609). One common belief among the farmers was that they considered tobacco farming as a viable and profitable business entity even though there was not enough evidence to such business belief set. This was reflected by 92.6% of the respondents who reported that tobacco production was their means of survival and source of income (response mean score of 3.99±.575).

The findings contradict growing concern that tobacco production is an increasing source of high costs of farming production. Research shows that there is growing public concern on tobacco health problems and also increasing carbon footprints as most tobacco farmer rely on wood for curing their tobacco. While these concerns are arising from climate change and environmental concerns, the economic problem of tobacco farming in emerging markets is that of contract farming. It is well-acknowledged as was in this study that contract farming is a common feature and practice for marginalised farmers. Makoka et al. (2017) perceive that contract farming has its shortfalls especially with regard to increasing costs for the farmers in form of debts and also loss sovereignty control over the tobacco product and even control over the market trends. Pangapanga-Phiri et al. (2024) argue that contract farming has not reduced the labour-intensive requirements for smallholder farmers and neither has it been accessible evenly across all the farmers especially the elderly and women. The studies including the findings from the current study suggest that smallholder farmers might not necessarily require supervised farming nor contracted farming posture which have empirical evidence of economic prosperity for the farmers.Makoka et al. (2017) and Chingosho et al. (2021) demonstrate that CFA has raised losses for smallholder farmers through increased costs with marginal market gains. These underlying farming strategies have not improved access to cheap finances nor resources as is generally perceived. As revealed in the current research, the tobacco farmers also encounter some poor quality inputs dilemma. Chingosho et al. (2021) report that smallholder tobacco production systems are affecting by limited availability and affordability of high-quality inputs (seeds and fertilisers) despite the fact that tobacco is a heavy-input product. A system that helps smallholder farmers access high quality inputs is pertinent and much needed (Maulidah, 2020). Accessibility to cheap financial resources is also undermined by the farmer' lack of collateral security and limited global market data (Chikozho, 2022). The incidence of child labour among the smallholder tobacco farmers is common feature which was also revealed in the current study (Mazwi et al., 2023).

4.5.2 Environmental viability parameters for smallholder tobacco farmers

The study sought to explore the environmental-oriented practices of tobacco farmers in Goromonzi. This included knowledge on the environment on tobacco production, the negative effects and exploitation of natural resources such as wood for curing tobacco. The results are displayed on bar graph shown as Figure 4.5.

Figure 4.5: Environmental dimensions and practices affecting tobacco production



The results indicate that 71.8% of the respondents concurred that tobacco farmers rely on natural wood to cure their tobacco while 81.9% allege that the farming practices among the smallholder farmers has led to numerous land degradation and pollution. One of the underlying explanation for such behaviour to rely on wood is the limited know-how among the tobacco production farmers. This was reflected by 78.5% of the respondents. The high dependence on wood for curing tobacco is negatively affecting the natural ecosystem. One of the TIMB staff had this to say:

> While we encourage the growing of tobacco as a board, the increasing loss of the natural forests through farmers who cut down wood for curing their tobacco is doing more harm than good. Most of the surrounding areas are laying bare, with no tree coverage leading to land degradation. Furthermore, the burning of the wood is polluting the atmosphere and contributing to climate change due to increasing carbon footprint. (TIMB staff 4)

The findings echo several findings from past studies which substantiate that curing tobacco using natural wood is a growing negative environmental practice that is leading to lack of biodiversity

and increasing land degradation (Lecours et al., 2012). Lakatos et al. (2024) propound that such practices may eventually lead to the disruption of the ecosystems and diminishing biodiversity. The practice of destroying forests in search for wood is hardly an alternative for the smallholder farmers but the only means to cure their tobacco. Wood provides the much-needed fuel to cure the product. Furthermore, the burning of wood is contributing to huge carbon footprint into the atmosphere. The high dependence on traditional techniques in the production of tobacco among smallholder farmers is leading to high concerns for the unsustainable production management systems. Therefore, the results point to the fact that high dependence on the forest and limited technology to recover the lost forest have long-term implications on the climate and the earth. It is apparent that due to poor environmental management information among the smallholder farmers, the existing production systems are negatively affecting biodiversity and disrupting ecosystems.

4.5.3 Technology-oriented behaviour and practice

The respondents were asked to report the practices among the tobacco farmers with respect to exploitation of technology as depicted in Table 4.5.

Table 4.5: Technology-oriented behaviour

Dimension/ Practice	Key: 1 strongly disagree, 2 disagree, 3 not sure, 4 agree, 5 strongly agree				
	1	2	3	4	5
Limited access to technology	0(0.0)	3(2.0)	6(4.0)	126(84.6)	14(9.4)
Limited technology use	3(2.0)	10(6.7)	5(3.4)	112(75.2)	19(12.8)
Modern communication	109(73.2)	17(11.4)	6(4.0)	6(4.0)	5(3.4)
Precision agriculture	120(80.5)	11(7.4)	7(4.7)	15(10.1)	109(73.2)
Viable revenue source	2(1.3)	2(1.3)	7(4.7)	122(81.9)	16(10.7)
Sensor and GPS collection	113(75.8)	13(8.7)	8(5.4)	4(2.7)	11(7.4)
Drones and e-learning systems	116(77.9)	20(13.4)	5(3.4)	8(5.4)	0(0.0)
Easy access to e-commerce	115(77.2)	20(13.4)	3(2.0)	3(2.0)	8(5.4)
Limited technology competency	5(3.4)	4(2.7)	16(10.7)	13(8.7)	111(74.5)

The results reveal that smallholder tobacco farmers do not only suffer from lack of the relevant technology such as drones and modern communication technologies, they also do not have the requisite know-how of using such emerging technologies with the tobacco production chain. This was revealed by 84.6% of the respondents who stated that they had limited access to technology, 75.2% of the respondents even stated that they had limited of production technologies with 74.5% of the respondents even revealing that they had limited capacity to adopt and use technology across the supply chain of the product. Some of the major technology deficiencies are limited use of drones (77.9% of respondents), 73.2% of the respondents stated lack of precision agriculture and 75.8% articulated that precision agriculture is one of the missing link.

The study also showed that 73.2% of the respondents stated that tobacco farmers use modern communication technologies such as cell phones but 77.2% disagreed that they had access to modern sensor and satellite technology to manage and control the production of tobacco. The farmers also denied having access to easy e-commerce but do consider tobacco farming as viable source of revenue. This was reported by 77.2% and 81.9% of the respondents respectively.

Interviews with some of the farmers indicated several important concerns on technology among smallholder farmers.

> As it appears we lack access to most advanced technologies such as drones and use of precision agriculture. Without access to such technologies, most farmers can hardly experience the best out of the tobacco farming. While we have access to mobile communication technologies, the exploitation of the same for farming is still low. (Farmer 7)

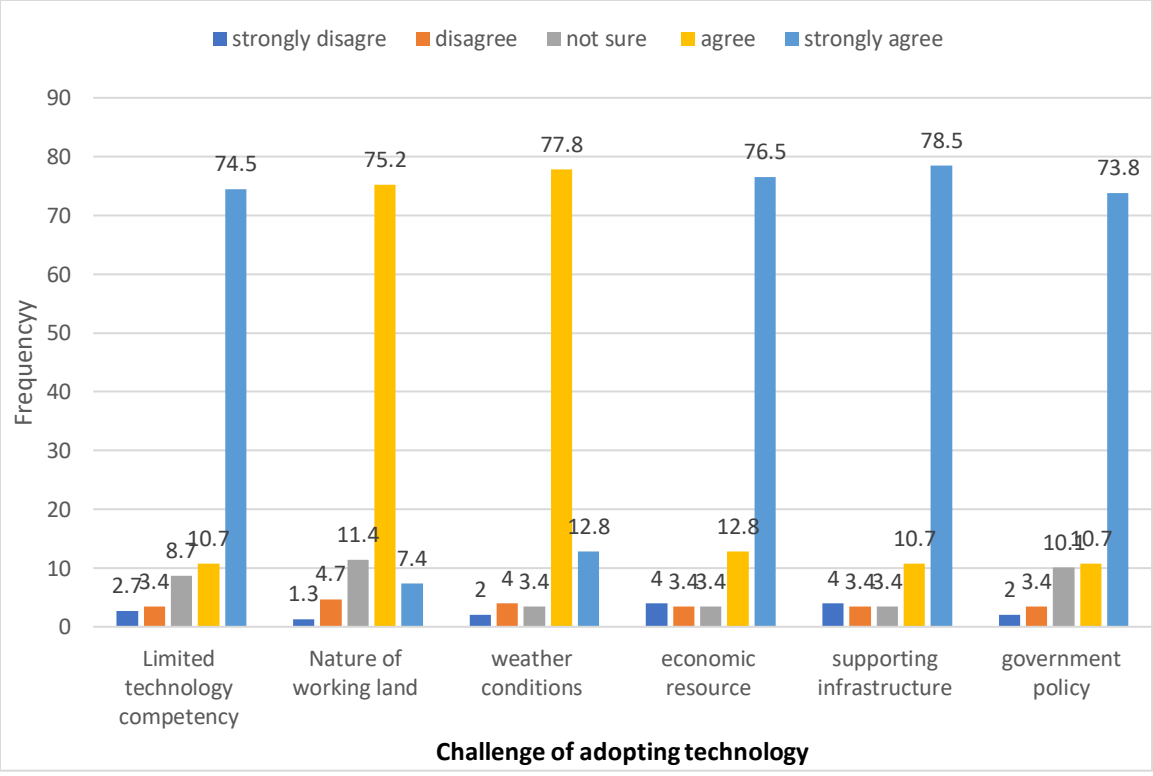
Similar sentiments on the role of tobacco production technology in improving efficiency of farmers have been expressed by other authors (Makoka et al.,2017). Technology plays a crucial role in shaping modern tobacco production systems that commonly result in improved efficiency, overall tobacco management and sustainability thrust. Zant (2020) emphasises that technological advancements reduce high dependency on conventional natural resources such as fire wood for curing tobacco. Hopkins (2024) even goes on to identify some critical such technology that may assist in the planning and planting processes to monitoring of the tobacco growing trends. Chikozho (2022) articulates that tobacco is sensitive product that requires farmers to have proper

information. Ndoro-mkombachoto (2024) propounds that the key to improving smallholder tobacco farming yields and productivity is the adoption of an integrated systems that include various other technologies such as drones, satellite imagery, sensors and climate data analytics can easily be integrated into a production management system that may help even the poorest farmers access relevant data and production strategies. Furthermore, various e-commerce platforms such as direct sales and online global markets can easily be accessed. This way farmers can improve their profit posture and capabilities. Maulidah (2020) suggests that a modernised business model for the farmers which includes clear sustainability metrics and production performance metrics may help smallholder farmers even adopt modern farming techniques that may reduce their losses and high dependency on traditional production systems such as contract farming arrangements.

4.6 The challenges of adopting technology-oriented production systems

Under this section, the respondents were to opine their own opinion and lived experience on the role of the various factors in defining its adoption. The data is presented in Table 4.6.

Figure 4.6: Hindrance to technology adoption among tobacco farmers



Examination of Figure 4.6 shows that 74.5% of the respondents acknowledged that the limited competency is an underlying factor for low adoption of technology among the tobacco farmers. Furthermore, 75.2% of the surveyed farmers and TIMB staff perceived that farming technology is highly hinged on the characteristics of the land upon which the farming will take place. Furthermore, the adoption of the technology also depends on the weather and climatic realities. For instance, precision agriculture is peculiar in large scale farms while use of advanced irrigation systems might be common among smallholder farmers. This was reflected by 77.8% of the respondents. In addition, 76.5% of the surveyed persons and 78.5% of the same did concur that adoption of tobacco production technology is a product of supporting infrastructure while 73.8% of the same did infer to the supporting nature of the government policy.

The results show that adoption of tobacco production technology does not occur in a vacuum but are influenced by various underlying factors that include competency, nature of the ground and climate. Furthermore, adoption is a product of the supporting infrastructure such as the Internet for modern communication systems. The characteristics of the technology have been found to play a critical role in the adoption pattern (Ndhlovu and Mlanga, 2023). Bath (2023) clearly demonstrates that adoption of tobacco production systems depends on the complexity of the technology and degree of awareness and know-how of the people. Technologies such as drones may require rigorous training. Training improves the individual characteristics to adopt the technology. Thus technology influence is depended on its various features such as usefulness, ease of use, and also tangibility of the results of the technology (Bath, 2023). Excluding the technology-related features, the individual farmer conditions also play an important challenge to the farmer. Smallholder farmers have limited access to modern and emerging technologies such that they are largely predisposed to adapting to new changes. According to Maulidah (2020), smallholder tobacco farmers have unique individual characteristics which includes different attitudes, subjective influences and also background on the use of modern technologies. Tobacco farming highly depends on weather elements and also on the nature of the land (Ngwira, 2021). The farmers have to adopt new farming techniques that include precision irrigation and other such tobacco farming strategies (Mango and Kugedera, 2022). An important adoption to technology-driven farming practices among tobacco smallholder farmers is the economies around the tobacco farming supply chain. Availability of required resources such as availability of the necessary infrastructure and finances to support the new technology. The deliberate policy position taken especially by the

government and various lead entities in any farming community has implications on available farming options and nature of technology that the farmers may adopt (Mango and Kugedera, 2022; Ruckert et al., 2022). The smallholder farmers can hardly adopt emerging drones and precision farming due to prescriptive strategies imposed by the contractors. In addition, the government policy that all tobacco in Zimbabwe has to go through the registered auction floors has limited the ability of farmers on adopting latest online marketing platforms for their products.

4.7 Technology-based tobacco production management system for smallholder farmers

Table 4.6: Various dimensions appropriate for technology-driven tobacco production system

Factor	KEY: 1 =strongly disagree, 2 – disagree, 3 – not sure, 4 – agree, 5 -strongly agree				
	1	2	3	4	5
Diversified technology	5(3.4)	9(5.4)	9(5.4)	16(10.7)	112(75.2)
Accessibility to required technology	6(4.0)	2(1.3)	5(3.4)	119(79.9)	17(11.4)
Digitalise the entire production chain system	5(3.4)	5(3.4)	3(2.0)	121(81.2)	15(10.1)
Dedicated tobacco information management system	5(3.4)	8(5.4)	10(6.7)	111(74.5)	15(10.1)
Establish an integrative production system	5(3.4)	7(4.7)	5(3.4_	114(76.5)	18(12.1)
Enable technology to collect data (IoT and satellite)	3(2.0)	8(5.4)	12(8.1)	112(75.2)	14(9.4)
Integrate local with global tobacco production systems	3(2.0)	6(4,0)	14(9.4)	111(74.5)	15(10.1)
Measurement system for the performance metrics of the tobacco production system	3(2.0)	5(3.4)	14(9.4)	17(11.4)	110(73.8)

The data in Table 4.6 indicates the following:

4.7.1 Characteristics of the technology to be adopted

The nature and features of the technology to be adopted is very critical to enhancing the tobacco production supply chain. The diversity, complexity, usefulness, and compatibility of the technology is critical in defining the degree of success and adoption among the different smallholder tobacco farmers.

With regard to diversification of technology, 85.9% of the surveyed farmers and TIMB staff concurred that the entire tobacco production chain system should incorporate technologies of wide range types and modes. One of the farmers had this to say:

> As farmers we are different people with different capabilities and needs. It is quite prudent that we also need different technologies at different times. For instance, in my farm I have some level of irrigation and yaah I may need some assistance in precision agriculture. You understand that tobacco needs proper water and yes precision agriculture may help me improve my yields. However, others as you can witness as you move from farm to farm may require basic training and thus maybe require some access technology to the Internet. (farmer 5)

The results show that the required technology for each farmer varies with different requirements. The level of usefulness, ease of use and compatibility with existing technologies may define the degree to which the technology may be used and adopted by the farmers. Data shows that technologies such drones and satellite systems are complex to deploy and use. Therefore, most farmers are dissuaded from using such technologies due to the complexity in operation and the limited scope of use among smallholder farmers.

> Yaah while modern technology might seem lucrative in solving many of the tobacco production system with respect to pest controls and also monitoring diseases, such technology is complex and very difficult to use and maintain (farmer 3)

The results suggest that tobacco production system require some level of simplicity and functionality compatible with smallholder needs. Direct technology characteristics are crucial in enhancing the production of tobacco among smallholders. Not all new technology is good for the smallholder tobacco farmers. This is contrary to Ndhlovu and Mlanga (2023)'s recommendations

that who suggest that technologies such as satellite imagery and drones are pertinent to tobacco farming. The degree of complexity may require huge effort and competency on the part of the farmers which many smallholder farmers can hardly afford. However, some of the needs of the farmers include selection of seed varieties, fertilisers and even climate pattern data which are common features of modern and complex technologies (Bath, 2023). Another factor affecting adoption is the compatibility of the technology with existing knowledge and use of the farmers. The various technologies available and their various characteristics pose some significant opportunities for smallholder farmers and these may easily be gleaned from an integrative information management system.

4.7.2 Characteristics of the smallholder farmers

Beside the direct features of the technology, the individual differences of the farmers themselves may predict the level of adaptability of the farmers to any new tobacco production system. As already depicted in section 4.5.3 and 4.5.4, the competency of the farmers cannot be underestimated in understanding the required tobacco production systems. The data shows limited competency of the farmers though with high level of experience. Interviews indicated that most of the farmers were used to traditional methods of farming. Adjusting to new technology presented unique challenges especially for the older generations. The low level of qualifications suggest that the farmers had basic knowledge of tobacco production which did not provide them with adequate knowledge of modern farming technologies such as precision agriculture nor value of integrated and online information management systems.

The results clearly demonstrate that any production system has to take into account the individual characteristics of the smallholder farmers. This is one of the biggest challenges in designing a production system for the many diverse smallholder farmers. The farmers do not require generic solutions but those tailor-made for their unique needs. For instance, the farmers indicated that they may prefer systems written in their local languages and also convenient to their needs. Maulidah (2020) states that smallholder tobacco farmers have unique individual characteristics which includes different attitudes, subjective influences and also background on the use of modern technologies. A common feature of smallholder farmers that may be utilized to design an effective tobacco production system is the low level of competency. Therefore, the technology should have some basic training widely deployed online to reach out to many of the dispersed farmers. This

was also echoed by Ngwira (2021) who state that emergent technologies such satellite imagery, and even data analytics depends highly on the knowledge of how such technologies are applied. Use of drones and also online learning tools depends on the adeptness of the farmers to modern technologies.

4.7.3 Policy position

The government position on tobacco production technologies is critical in shaping the production management system for the farmers. This was revealed by 81.3% of the respondents who highlighted that the government position on the accessibility of specialized farming technologies such as precision agriculture is determinant to the type of tobacco production supply chain. One such policy stance is to ensure all the production system for smallholder tobacco farming is digitalized and well connected. This was reported by 91.2% of the respondents.

The study clearly shows that government deliberate policy position has implications on available farming options and nature of technology that the farmers may adopt (Ruckert et al., 2022). Mango and Kugedera (2022) highlight that government policies such as promotion of CFA has resulted in smallholder tobacco farmers adopting technologies defined and promoted by the contractors. Contract farming has constrained the growth of tobacco farming among the smallholder farmers. CFA prevents farmers to exercise their full control of the farming decisions including marginalising the farmers from taking marketing options lucrative to their businesses.

4.7.4 Characteristics of the environment

The working environment of the smallholder farmers ma prohibit or allow the farmers to adopt and use advanced technologies. The study showed that 88.6% of the respondents perceive that adopting an integrative production system is most preferred. Furthermore, 83.3% of the respondents also acknowledge that systems that can easily collect environmental data are crucial to provide farmers with relevant farming information. The need for an open and well-connected working environment was also echoed by 85.6% of the respondents who opined that the network of the production systems should be globalized to enable farmers reach out to more lucrative markets and cheap finances.

An important decision factor on adoption of technology-driven tobacco production mechanisms is the conditions of the climate, soil and also farming culture (Ngwira, 2021). Zimbabwe frequent droughts and dry seasons is increasingly demanding adoption of modern technologies such as precision agriculture and sustainable farming practices (Shonhe et al., 2022). The worsening environmental conditions that include poor soils and weather hazards in Zimbabwe is persuading tobacco farmers to adopt drought resistant tobacco variety(Mango and Kugedera, 2022).

4.7.5 Economic characteristics

The affordability and also accessibility of some technology have bearing on the ability of the farmers to adopt any new production technology. The data showed that 85.6% of the respondents believed that accessibility of unique and specialized tobacco production system may enable many farmers to adopt the technology and even improve their production posture. Furthermore, the provision of relevant resources and also systems which can easily measure the production performance are much needed. This was revealed by 85.2% of the respondents. The prevalence of economic hardships do predict low adoption of modern tobacco production systems. The financial and resource capabilities of the smallholder farmers define the nature of production system available and applicable to the farmers.

> Many of our farmers live below the national poverty datum lone. It is very difficulty to expect many of such farmers to focus nor even envy for advanced tobacco production systems. Most of the farmers are focused and motivated to provide basic revenue to live the next day (TIMB staff).

The study results point to a number of economic dimensions already underlined in several past researches. The availability of resources and proper infrastructure necessary for effective production systems is well acknowledged (Zant, 2020). The study demonstrated that countries such as Zimbabwe that are characterised by economic crisis provide bottlenecks to the tobacco production supply chain. The limited infrastructure such as Internet backbone networks and also limited road network humper the ability of the smallholder farmers adopting modern tobacco production mechanisms (Ruckert et al., 2022). The limited availability of finances to procure such advanced technologies is prohibiting a number of smallholder farmers from adopting such technologies.

4.7.6 Discussion of findings

Based on the findings presented in Table 4.6, the study overwhelmingly suggests strong support among respondents for the adoption of a multifaceted, technology-driven tobacco production system. Specifically, the majority of respondents either agreed (4) or strongly agreed (5) across all proposed dimensions, indicating a high level of consensus regarding the necessary features of a successful system. The highest agreement levels were observed for the need for accessibility to required technology (91.3% combined Agree/Strongly Agree) and the need to digitalise the entire production chain system (91.3% combined Agree/Strongly Agree), which highlights the perceived importance of both physical access to tools and seamless data integration.

Furthermore, dimensions related to modern data collection for example enable technology to collect data (IoT and satellite) with 84.6% agreement) and strategic integration (e.g., Integrate local with global tobacco production systems with 84.6% agreement) were also met with significant approval, collectively reinforcing the idea that smallholder farmers recognize the necessity of implementing a comprehensive, digitally enhanced, and globally competitive approach to improve production management.

4.8 Chapter summary

The chapter presented the research findings with respect to evaluation of the current smallholder tobacco production pattern, the challenges farmers encounter in attempting to use advanced and modern production systems. The chapter also discussed the required production systems for the farmers. In the next chapter, the final remarks of the research are given showing some areas that may require further investigations.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMEDNATIONS

5.1 Introduction

The chapter presents a summary of the research findings leading to the conclusion of the research contained in section 5.2. Recommendations are contained in section 5.4 with clear analysis of the contribution of the study to education 5.0 – industrialisation and innovation thrust.

5.2 Summary of findings

The study adopted a mixed method under the post-positivism philosophical stance. Using disproportionate stratified sampling, 265 questionnaires were distributed to 231 farmers and 34 TIMB staff. Furthermore, 10 interviews with relevant farmers and 5 with TIMB staff were held to gain insights into the production system being used by farmers in Goromonzi. A response rate of 56.2% for surveys and 73.3% participation for interviews were recorded. The data was analysed using SPSS version 24 while the qualitative data was analysed thematically. The results showed the following:

5.2.1 Assessment of the current smallholder farmer tobacco production management system

The study indicated that smallholder tobacco farmers in Goromonzi are engaged in various practices due to underlying structural conditions, The farmers rely on traditional farming methods highly labour-intensive characterised by poor infrastructure, low competency, based on contract-farming arrangements with limited price negotiating powers nor decision of the quality of tobacco inputs. The high dependence on traditional resources such as wood for curing tobacco and use of child labour is raising concerns over the climate, degradation of the land and also exploitation of cheap family resources which include child labour and inferior inputs. The contract farming arrangements are not improving the costs structures for the farmers. The results demonstrate limited modernisation of the farming methods. The general perception among farmers that tobacco farming is a viable source of revenue is an underestimate of the costs they are incurring and the limited revenue space they gain from the market.

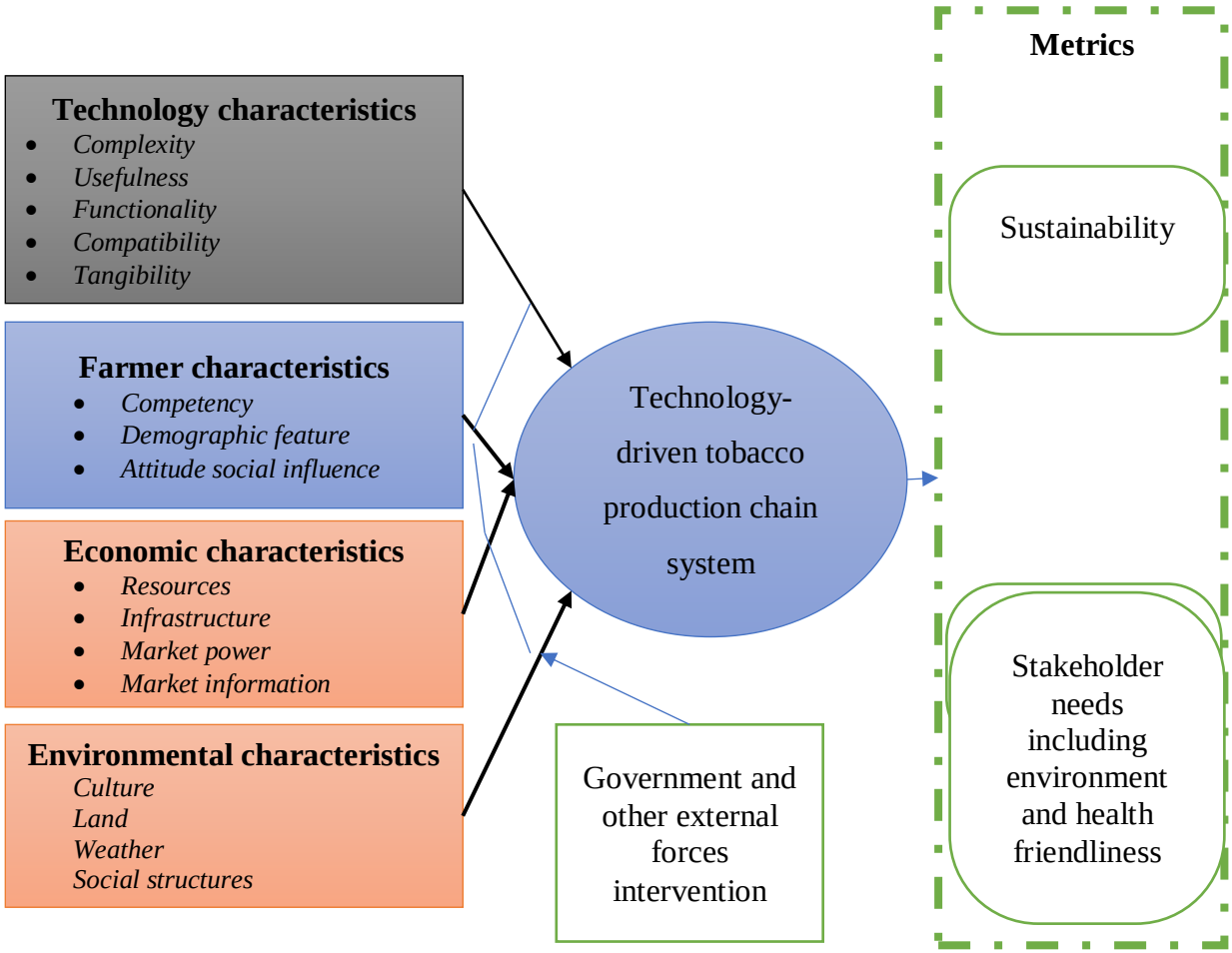
5.2.2 The challenges of farmers adopting technology-driven production systems

Several key challenges were identified low competency in technology-driven production systems as reported by 74.5% of the respondents; 75.2% of respondents highlighted issue degraded land

and harsh climatic weather conditions, and 77.8% of the respondents stated the lack of precision and advanced agricultural practices. In addition, 76.5% of the surveyed persons and 78.5% of the same did concur that adoption of tobacco production technology is a product of supporting infrastructure while 73.8% of the same did infer to the supporting nature of the government policy.

Figure 5.2.3 A technology-based tobacco production management system for smallholder farmers

Source: Author, 2024



5.3 Conclusion

The study clearly demonstrates that current tobacco farming practices among the smallholder farmers are inundated with less advanced faming systems including high dependence on cheap and environmentally unfriendly techniques. Borrowing from growing global concerns for negative

climate, health and legal challenges of tobacco farming, the smallholder farmers face increasing risk of global ban on tobacco farming. Their high emission of carbon, child exploitation and threats to ecosystem suggest that the current farming practices need significant change for future sustainable tobacco production mechanisms.

Low adoption of modern tobacco farming practices is affected by a number of underlying factors inclusive of poor weather and land systems, limited farmer competency, harsh economic conditions and complexity and incompatibility of most prescribed tobacco production technologies such as drones and satellite information management systems.

The results clearly demonstrate that a complete reconfiguration of the current tobacco production system needs be done across the entire production chain. Technologies relevant to farm preparation, distribution, marketing and even revenue management are critical to enhance the stamina of smallholder tobacco farmers in the tobacco production industry. The system has to consider the growing global and national pressure for reduction in tobacco production arising from health concerns, child exploitation and also increasing damage to climate (high carbon emission footprint) and destruction of the ecosystem.

5.4 Recommendations

The following recommendations were made:

- Smallholder tobacco farmers do not require contract farming unless they are empowered to make price negotiations and make decision on the inputs layout. Furthermore, the farmers need prevent the exploitation of child labour to comply with both national and international best practices.
- Government may need relook into the current contract farming and bonding policy for smallholder farmers to reduce the increasing debt burdens on the farmers. The huge debt burdens are impoverishing the smallholder farmers.
- The disintegrated production chain for smallholder farming community need be seamlessly integrated into the global community with increased adoption of digitalisation to ensure farmers access cheap funds, viable tobacco market and also adopt sustainable practices.

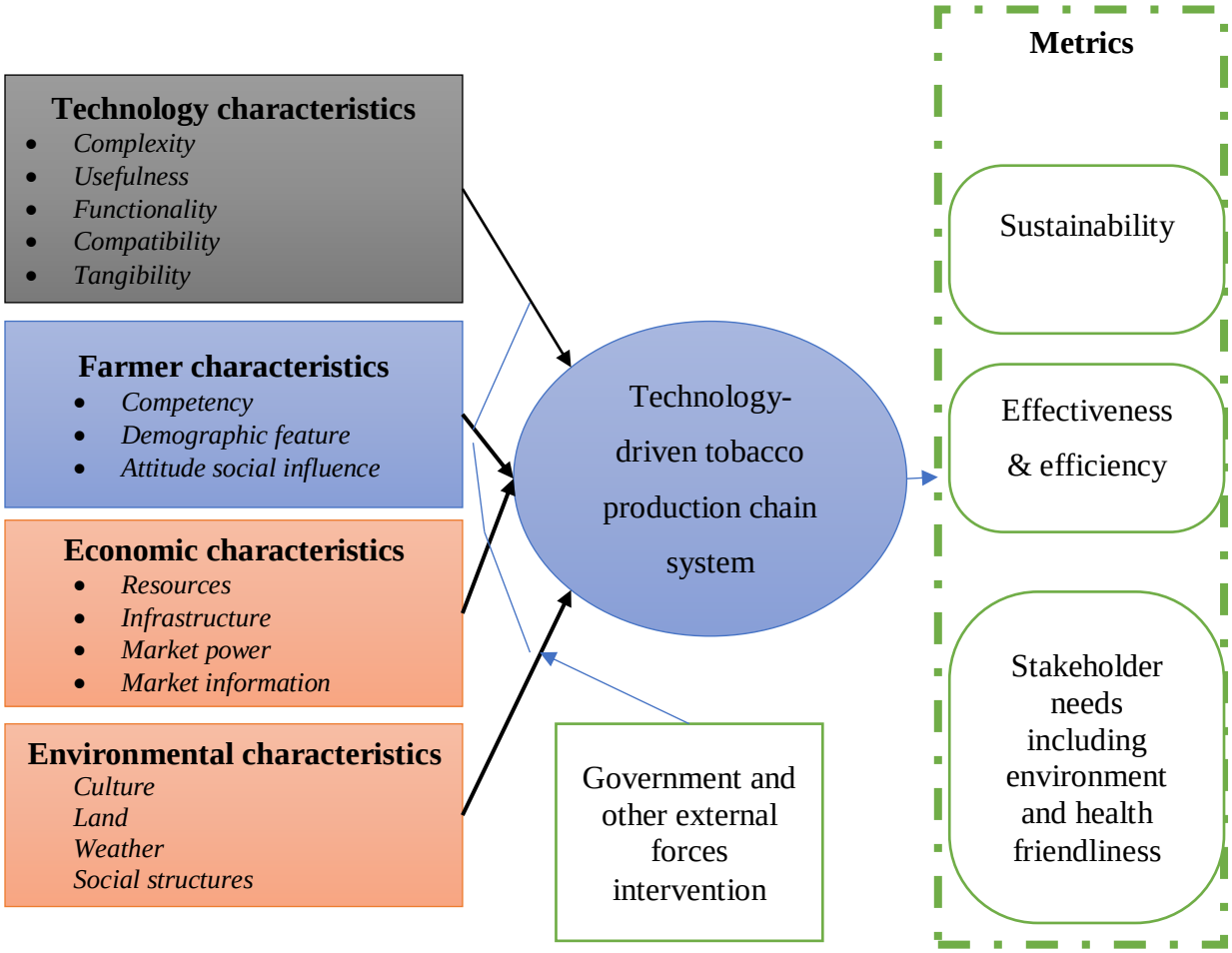
- Technology that is compatible with existing climate and land realities in Goromonzi is more preferable than generic prescriptive technologies such as advanced precision agriculture. The government may need subsidise the technology base for smallholder farmers as part of a positive policy position to enhance effectiveness and efficiency of the production system.

5.4.1 Education 5.0

The study established a tobacco production management system driven by technology with the real context of the smallholder farmers and external interventions as depicted in Figure 5.1.

Figure 5.4.1: Proposed technology-driven tobacco production system model

Source: Author, 2024



The tobacco production system is a chain of activities from farming, transportation to marketing at each stage which several factors determine the ultimate revenue for the smallholder farmers. The performance of the tobacco production system is measured against several high level metrics including sustainability, effectiveness, efficiency, and the ability to meet the needs of several actors inclusive of health, climate and the environment. The production system is thus highly influenced at each stage by environmental, economic, individual smallholder farmer characteristics, and also nature and characteristics of the technology used. Tobacco production is sensitive to each of the its production chain. It is thus critical to ensure that appropriate underlying conditions particularly the technology used in the production system is appropriate and availed. For instance, the use of appropriate precision agriculture reflective of the smallholder farmer's realities may improve the performance metrics of the production system. This is also true for marketing technologies that seamless integrate each individual smallholder farmer with the ultimate buyers in the globalised market system. Thus the production require to be a seamless integration of the entire production system in a technology-driven work environment.

5.4.2 Areas for further research

The study proposed the architecture of the technology-driven production system for smallholder tobacco farming system. However, the system needs extensive validation before it may be fully deployed as comprehensive farming protocol for the farmers.

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APPENDICES

Appendix 1: Structured Survey Questionnaire

I, am TARIRO C CHITSUNGE (B232532B) a student with Bindura University of Science Education (BUSE) doing a Master's degree and as part of the degree requirements am conducting a research study to design a technology-driven tobacco production management framework (system) mainly for smallholder tobacco farmers. The study will also find the challenges being faced and explore the status of the current such system. Therefore, the questionnaire in this correspondence serves as the tool to collect relevant data towards this end. You are therefore being kindly requested to assist the student by way of completing the questionnaire. The data will entirely be used for academic purpose and used anonymously. Your assistance is greatly appreciated.'

Section A: Instructions to respondents

- Only tick or mark ☒ in the boxes provided
- Do not write any of your personal identifying details on any part of this questionnaire
- You are encouraged to take at most 10 minutes to complete the questionnaire
- For question responses marked 1 to 5 consider 1 as strongly disagree, 2 disagree, 3 uncertain/not sure, 4 agree and 5 strongly agree
- The entire process is anonymous and should be treated so always
- The completed questionnaire to be returned through the same channel you received it

Section B: Demographic data

Gender	
Male	☐

Female	☐

Age group in years	
18<30	☐
30<40	☐
40<50	☐
50>	☐

Tobacco farming experience in years	
<5	☐
5<10	☐
10<15	☐
15>	☐

Highest qualification	
Diploma and below	☐
First degree	☐

Master	☐
Greater than Master	☐

Section C: Status of the current production supply chain system

STATUS	5	4	3	2	1
Socio-economic conditions					
I experience infrastructure problems	☐	☐	☐	☐	☐
I lack access to proper market information	☐	☐	☐	☐	☐
I experience poor price negotiation	☐	☐	☐	☐	☐
Am into contract farming	☐	☐	☐	☐	☐
I perceive tobacco farming is viable source of revenue	☐	☐	☐	☐	☐
Many tobacco farmers I know have significant debts	☐	☐	☐	☐	☐
I am encountering limited availability and affordability of high-quality inputs (seeds and fertilisers).	☐	☐	☐	☐	☐
I make use of family labour resource including my children	☐	☐	☐	☐	☐
Have limited access to financial resources	☐	☐	☐	☐	☐

STATUS	5	4	3	2	1
Environmental conditions					
I rely on wood for curing my tobacco	☐	☐	☐	☐	☐
I perceive that the farming methods being used is leading to deforestation and land degradation	☐	☐	☐	☐	☐
I don't have adequate know-how on environment protection interventions	☐	☐	☐	☐	☐
Technology viability factors					
I have limited access to production technology	☐	☐	☐	☐	☐
I consider my farming as limited in use of technology	☐	☐	☐	☐	☐
I rely on modern communication systems for tobacco production data	☐	☐	☐	☐	☐
I use precise agriculture techniques	☐	☐	☐	☐	☐
I have technology such as GPS and sensors to collect and analyse my farming data	☐	☐	☐	☐	☐
I make use of drones and online learning systems to improve my farming	☐	☐	☐	☐	☐
I can easily access various e-commerce data	☐	☐	☐	☐	☐

Section D: Challenges of adopting technology-oriented production system by farmers

CHALLENGE	5	4	3	2	1
Technology chrematistics					
Tobacco technology is complex	☐	☐	☐	☐	☐

CHALLENGE	5	4	3	2	1
Tobacco farming equipment is user friendly	☐	☐	☐	☐	☐
The tobacco farming technologies available have right functionality	☐	☐	☐	☐	☐
Personal characteristics					
Most smallholder farmers lack proper skills and knowledge	☐	☐	☐	☐	☐
I have limited competency on using the farming technology	☐	☐	☐	☐	☐
Environmental features					
The type of technology to be adopted depends on nature of the land	☐	☐	☐	☐	☐
Choice of technology depends on weather conditions	☐	☐	☐	☐	☐
Economic conditions					
I consider resources and finances as critical in deciding to adopt tobacco farming technology	☐	☐	☐	☐	☐
Availability of supporting infrastructure affects adoption of tobacco technology	☐	☐	☐	☐	☐
Political characteristics					
Government policy position affects farmer's decision to adopt technology	☐	☐	☐	☐	☐

Section E: Technology-based tobacco production management system

Technology-based system	5	4	3	2	1
Use diverse technology system is required	☐	☐	☐	☐	☐

Technology-based system	5	4	3	2	1
Access and availability to the required technology	☐	☐	☐	☐	☐
Computer and digitalise the tobacco supply chain system	☐	☐	☐	☐	☐
Develop dedicated tobacco information management system	☐	☐	☐	☐	☐
An integrative online information management systems is required	☐	☐	☐	☐	☐
Embed IoT sensor network in the production system to enable real-time monitoring of farming supply system	☐	☐	☐	☐	☐
Integrate local systems with global systems for enhanced tobacco farming opportunities	☐	☐	☐	☐	☐
System to measure performance metrics of tobacco farming	☐	☐	☐	☐	☐

Thank you!

Appendix 2: Interview guide

I am TARIRO C CHITSUNGE (B232532B) a student with Bindura University of Science Education (BUSE) doing a Master's degree and as part of the degree requirements am conducting a research study to design a technology-driven tobacco production management framework (system) mainly for smallholder tobacco farmers. The study will also find the challenges being faced and explore the status of the current such system. Therefore, the questionnaire in this correspondence serves as the tool to collect relevant data towards this end. You are therefore being kindly requested to assist the student by way of completing the questionnaire. The data will entirely be used for academic purpose and used anonymously. Your assistance is greatly appreciated.

The researcher to brief interviewees on nature of the voluntary study and their need to protect their personal rights through either withdrawing or asking for further clarity from researcher or her assistant

1. May you please explain what you understand by tobacco production system?

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2. Given your understanding of tobacco production system, what are the current challenges smallholder farmers are encountering? Please explain in detail.

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3. If you were to design your own system what may you suggest to be included in the system and how such may be connected?

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4. Do you have any question you may want to ask?

Thank you for your time.