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# Agricultural risk management practices and agribusiness performance: Insights from smallholder commercial farmers in Santa Subdivision, Northwest Region of Cameroon

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**Abstract:** The study examined how agricultural risk management methods influence the performance of smallholder commercial agribusinesses in Santa Subdivision, Northwest Region of Cameroon. A quantitative approach was employed, using a cross-sectional research design. A multi-stage sampling method was applied. Both primary and secondary data sources were utilized. Structured questionnaires were administered to 124 participants, selected through a convenience sampling technique. Data was analyzed using both descriptive and inferential statistics. Multiple regression analysis was conducted to explore how agricultural risk management techniques impact the success of smallholder commercial agribusinesses. Key agricultural risks identified included pest and disease outbreaks (42.7%) and weather-related risks (28.2%) associated with climate change. Regarding agricultural risk management strategies and performance, crop insurance (54.0%), crop diversification (62.1%), and resistant seed types (63.7%) were strongly endorsed by study participants. The challenges faced in implementing risk management practices showed that the use of resistant crop seed varieties ( $p$ -value = 0.000) was significant, farm size ( $p$ -value = 0.035) was significant for farm sizes ranging from 1 to 3 hectares, and membership of a cooperative society ( $p$ -value = 0.149) was statistically significant in enhancing the performance of smallholder commercial agribusinesses. Based on findings, the authors recommend the need for access to improved seed varieties and the need for government and private sector initiatives to train farmers on risk management, enhance access to agricultural insurance, as well as oversee seed development, certification, and pricing.

**Keywords:** agribusiness; risk management practices; small-holder farmers

## 1. INTRODUCTION

Risk is inherent in agriculture at all levels, and diverse stakeholders have implemented various risk management methods to deal with

shocks and improve performance. In 2024, agriculture accounted for 4.02% of global GDP (STATISTA, 2024). Agriculture's contribution to global GDP has decreased in developed countries because of industrialization and expansion

in the service sector. While its total contribution has been largely consistent, agriculture remains a key engine of economic growth, particularly in emerging countries (STATISTA, 2024). Agriculture often accounts for 30 – 40% of GDP in low-income countries (Van Vuuren et al., 2009). According to current estimates for 2023 – 2024, the agricultural sector's GDP contribution in low-income countries typically ranges between 15% and 35% (National Statistical Organizations and Central Banks, OECD National Accounts, and World Bank Staff Estimates, 2025). Agriculture accounts for more than 20% of GDP in Sub-Saharan Africa. Over than 60% of the Sub-Saharan African population relies on agriculture for a living, with many living in rural areas, where agriculture is the primary economic activity (Balgah et al., 2025). According to Canton (2021), agriculture employs around 26% of the global labour force. Agriculture is essential for food security, which is a key component of sustainable development. According to Mekouar (2021), agriculture accounts for 60% of the world's food supply, and countries such as the United States, Brazil, and China are among the top agricultural exporters, boosting their economic standing in the worldwide market.

Agriculture is vital to Africa's economics and socioeconomic development. The sector accounts for 15 – 30% of African GDP and employs more than 60% of the workforce (WHO, 2020). It remains critical to food security, poverty alleviation, and economic growth. Despite these contributions, climate change, weak infrastructure, and limited access to financing have all hampered African agricultural productivity (World Bank, 2020). Due to a heavy reliance on natural resources, limited and erratic rainfall with high inter- and intra-annual variability, as well as other natural disasters, create significant vulnerability for communities and economies, particularly in the agricultural sectors, resulting in challenges such as food insecurity, economic instability, and reduced water availability (Witt and Waibel, 2009). Numerous studies on climate change indicate that climate variability is likely to grow in the coming decades, with tropical areas facing

the most severe consequences. Building better intervention techniques that can stabilize the poor's income and reduce vulnerability, a thorough understanding of rural communities' livelihoods and the sorts of agricultural risks they confront is required. Africa is a key exporter of commodities such as coffee, cocoa, and cotton, and there is a growing opportunity for value-added agricultural products to access worldwide markets (Mekouar, 2021). However, the agricultural export sector is hampered by inadequate infrastructure and limited market access (Bjornlund et al., 2020).

Agriculture is an important sector in Cameroon, sustaining more than 70% of the population (Abia et al., 2016). It accounts for approximately 17.29% of GDP and employs over 43.42% of the population (STATISTA, 2023). However, smallholder commercial agribusiness farmers in Cameroon confront various problems that limit their production and profitability, such as exposure to environmental, financial, and market risks (Chilambwe, 2021). To mitigate these hazards, agricultural risk management practices (ARMPs) are critical instruments for strengthening the resilience and performance of smallholder commercial agribusinesses. Cameroon's agricultural sector is particularly vulnerable to climate change, with irregular rainfall patterns, harsh temperatures, and flooding becoming more common in recent years (Mbuli et al., 2021). These environmental concerns pose a substantial danger to food security, particularly for small-scale commercial agribusiness farmers, who lack the resources to adapt. Given the different hazards faced by smallholder farmers, ARMPs have emerged as critical tools for increasing agricultural resilience.

Smallholder commercial agribusinesses' success is often measured using indicators such as profitability, productivity, income stability, and long-term sustainability. According to research, effective risk management methods can improve these performance indicators by increasing farm output and decreasing revenue unpredictability. In recent years, technology has emerged as an important instrument for risk management in agriculture. Climate-smart technology, mobile phone-based market information platforms,

and weather forecasting systems have improved smallholder farmers' ability to respond to changing environmental and market conditions (Diao et al., 2023). Precision farming techniques, which use data to optimize inputs such as water, fertilizer, and pesticides, have the potential to increase output while lowering costs and environmental impact (Atamja and Yoo, 2021). Ondiek and Muathe (2017) found that adopting risk management methods such as crop diversification, integrated pest management, and market contracts improved the performance of smallholder commercial agribusinesses. These methods not only decrease risk exposure but also improve productivity and ensure access to stable markets, thereby increasing firm profitability and sustainability. Despite the evident benefits of ARMPs, contextual realities still make utilization challenging for smallholder commercial agribusiness farmers in Santa Subdivision, Mezam Division, Northwest Region of Cameroon. Thus, there is an urgent need to research the impact of agricultural risk management strategies on the success of

smallholder commercial agribusinesses in Santa Subdivision. Thus, the study identifies the main agricultural risks faced by smallholder commercial agribusinesses, investigates agricultural risk management practices and performance employed by smallholder commercial agribusinesses, and assesses the impact of risk management practices on the performance of smallholder commercial agribusinesses in Santa Subdivision.

## 2. METHODOLOGY

### 2.1. Study area

The investigation was carried out in Santa Subdivision, Mezam Division, Northwest Region of Cameroon (Figure 1). It is located between longitudes  $9^{\circ}58'$  and  $10^{\circ}18'$  east of the Greenwich Meridian and latitudes  $5^{\circ}42'$  and  $5^{\circ}53'$  north of the equator (Nsah et al., 2024). Bamenda I Subdivision borders it on the north, Bali and Batibo Subdivisions on the west, Wabane, Babadjou, and Mbouda on the south, and Galim on the east

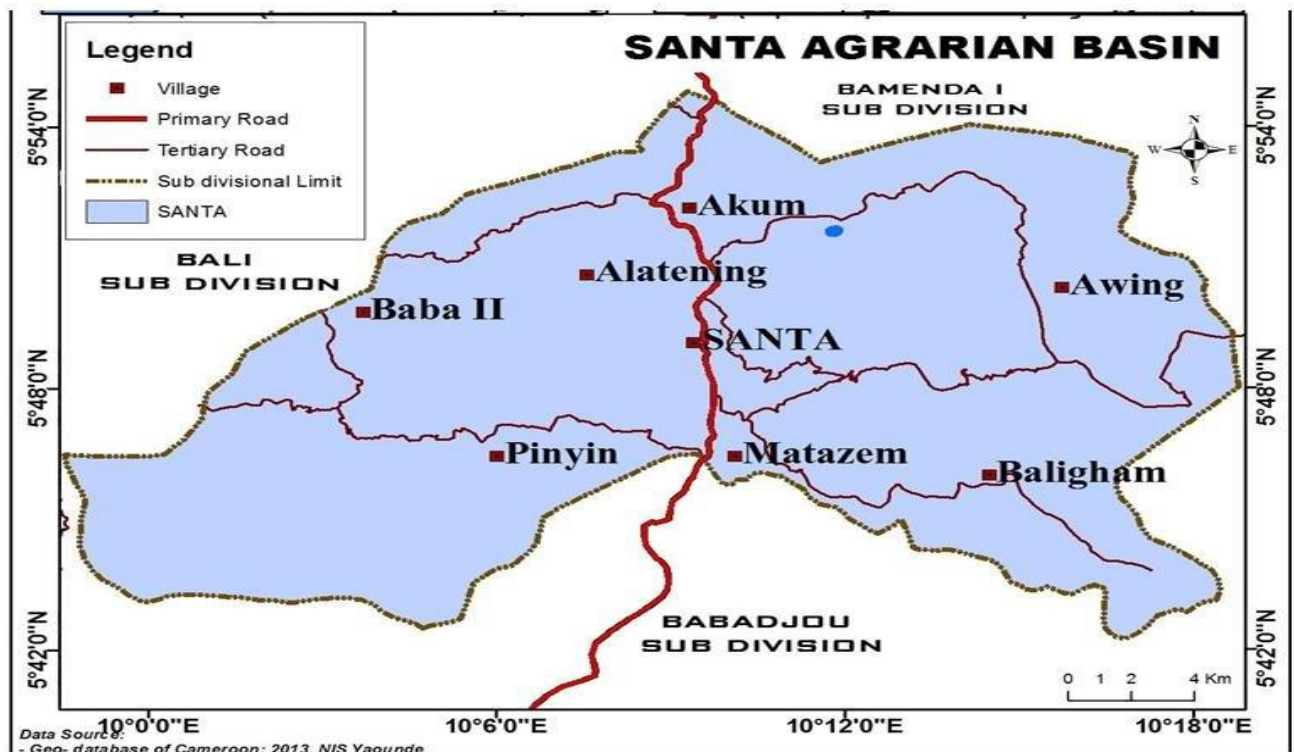


Fig. 1. Map of Santa Subdivision showing the various villages  
Source: National Institute for Statistics (2013).

(Konje et al., 2019). The anticipated population is 99 851, and the area is around 532.67 km<sup>2</sup> (Jocien and Frederick, 2022; Sama et al., 2025). Approximately 90% of the population works in agriculture and grazing. The average annual temperature of Santa Subdivision ranges from 21.8°C to 30.8°C (Mbuli et al., 2021). The Santa Subdivision experiences a long rainy season from March to September, and a brief dry season from October to February, with an annual rainfall of 2000 – 3000 mm (Jocien and Frederick, 2022). This region's fertile soil supports a large human population. With an altitude range of 600 – 2600 m, this highland is good for growing crops, vegetables, and rearing livestock (Konje et al., 2019). It is an ideal setting for our research since farming, which includes cultivating food crops, market gardening, and animal husbandry, is the primary economic activity and a necessary component of survival.

## **2.2. Research design**

The study took a quantitative approach and used a cross-sectional research methodology. The quantitative approach is a systematic method for collecting and evaluating numerical data to describe, forecast, or govern variables and events (Ghanad, 2023). It focuses on objective measures and statistical analysis to test ideas, identify patterns, and apply findings to a larger population (Ghanad, 2023). A cross-sectional survey was undertaken in the Santa Subdivision between January and June 2025, to investigate the influence of agricultural risk management methods on agribusiness performance. A cross-sectional research design is an observational study that gathers data from a population or a representative subset at a single point in time, to observe variables and assess their relationships (Wang and Cheng, 2020). It gives a “snapshot” of the population at that time and is largely used to determine the prevalence of a condition or feature (Wang and Cheng, 2020). This design is applicable for this study since the researchers collected and analyzed data during a brief period, allowing them to capture a snapshot of the phenomenon.

## **2.3. Population**

The study population was made up of Santa's registered smallholder commercial agribusinesses. The Sub-Divisional Delegation of Agriculture in Santa Subdivision has registered approximately 180 smallholder commercial agribusiness farmers, who produce crops, livestock, or both under various schemes. The sample excluded unregistered smallholder commercial agribusiness farmers.

## **2.4. Sample size and sampling procedures**

The survey included 124 registered smallholder commercial agribusiness producers from Santa Subdivision. A multiple-stage sampling procedure was adopted. Purposive sampling was used in the first stage to select five villages (Akum, Awing, Matazem, Pinyin, and Santa) from the eight villages that comprise Santa Subdivision, based on exposure to agricultural risks, level of agribusiness activities, productivity, and security challenges posed by the region's current sociopolitical crisis. The second stage involved convenience sampling to choose participants from each of the five villages chosen for the study. This decision was made due to the difficulty in obtaining smallholder commercial agribusiness farmers, and those who were easily accessible, given their location and willingness to participate, were chosen for the study. A sample of 124 participants was conveniently drawn from the five villages based on the number of registered smallholder commercial agribusiness farmers, who were both accessible and willing to participate in the study.

## **2.5. Data sources**

We used both primary and secondary data sources. Survey instruments, including questionnaires and observations, were sent to smallholder commercial agribusiness farmers in Santa Subdivision, who served as the primary (and only) data source. Observations were conducted on the farms of several smallholder agribusiness operators in the Subdivision. Secondary data was collected from a variety of sources, including the internet, Google Scholar, Science Direct, Research

Gate, Web of Science, journal articles, books, and theses, both published and unpublished.

## **2.6. Instruments of data collection**

Data gathering was mostly done using a standardized survey questionnaire and observation techniques. A statistician measured and evaluated the questionnaire, which included both closed and open-ended items. The questionnaire consisted of four sections. Section A focused on the respondent's personal details and household factors. Section B contains elements linked to agricultural risks encountered by small-holder commercial agribusinesses. Sections C address questions about agricultural risk management practices and performance, respectively, utilizing a four-point Likert Scale (Strongly Agree, Agree, Disagree, and Strongly Disagree), to indicate the level of agreement for each item. Section D examined the impact of risk management methods on the performance of smallholder commercial agribusinesses in the Santa Subdivision. Observations provided another source of data collection. Issues concerning research phenomena were observed in the field. The key aspects noticed were pest and disease indications, irrigation procedures, and the quality and quantity of farm productivity.

## **2.7. Data collection**

The questionnaires were administered by the researchers with the help of a former extension officer from Santa Subdivision, who was so excited that he decided to join the researchers in the field. The researchers spent two months (April – May 2025) collecting data from 124 smallholder commercial agribusiness producers. All ethical procedures for conducting research were followed, and administrative and traditional authorities were appropriately notified. Participants' agreement was obtained, and they were made aware that they might choose not to participate if they so desired. All participants were also informed about the importance of secrecy and anonymity, and they were assured that their identities would not be revealed in the final report. After that, the questionnaires were distributed to the

participants, who completed them and returned them immediately after asking for clarifying questions. Some participants, however, requested that the questionnaire be collected the next day, necessitating the researchers' return. The Sub-Divisional Agriculture Delegation for the Santa Subdivision, as well as several community leaders, assisted in identifying pertinent participants and their locations. Telephone calls were made to reach some of the participants.

## **2.8. Validity and reliability of the instrument**

To guarantee the instruments' validity, ten smallholder commercial agribusinesses in the Bamenda III Subdivision of the Mezam Division of the Northwest Region were given the survey instrument as a pre-test. This was done to ensure that the participants matched the characteristics of those in the sample. This approach was meant to identify instances of ambiguity and other difficulties that participants may encounter when filling out the questionnaire. In Tubah Subdivision, the researchers used a test-retest technique to improve the instrument's dependability. This was accomplished by presenting the same test to the same group of participants on two different dates, with the results correlating. Assuming the property being tested is stable, this method evaluates a test's consistency across time. The Cronbach Alpha Coefficient was used to determine the instrument's dependability. The Cronbach Alpha is the most widely used metric of internal consistency and reliability. The values vary from 0 to 1, and in terms of reliability, a value less than 0.6 is deemed unacceptable, but an alpha value greater than 0.6 is considered acceptable (Shah, 2025). Hair et al. (2003) proposed a rule of thumb for Cronbach's alpha value, suggesting that a value of 0.6 or above is regarded as an acceptable level of reliability for a questionnaire scale, especially in exploratory research.

## **2.9. Data analysis**

The data was analyzed utilizing quantitative data-specific statistical approaches. After gathering data, the researchers verified the equip-

ment to ensure its completeness. The data were coded and put into Microsoft Excel 13 and then analyzed with the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were employed to analyze participants' personal information, and the results were presented in a table with frequencies and percentages. Inferential statistics were examined using regression and correlation analysis. A detailed model specification was created using a multiple linear regression framework to investigate the effects of risk management strategies on the performance of smallholder commercial agribusinesses in Santa Subdivision. The dependent variable in this analysis was Financial Success (FS), which may be quantified using metrics like net income, profit margins, or return on investment. This variable is an important indicator for assessing the economic impact of various risk management strategies. The independent variables include a variety of risk management strategies, as well as economic, societal, and demographic elements that may impact financial success. The multiple linear regression model may be represented as follows:

$$PAB_i = \beta_0 + \beta_1 CI_i + \beta_2 Dc_i + \beta_3 Rsv_i + \beta_4 FSi_i + \beta_5 Edu_i + \beta_6 CM_i + \beta_7 EXP_i + \varepsilon_i$$

Where:  $PAB_i$  is the performance of the agribusiness index (dependent variable) constructed with MCA;  $CI_i$  is the crop insurance index constructed with MCA;  $Dc_i$  is the diversification index constructed with MCA;  $Rsv_i$  is the resistant crop varieties index constructed with MCA;  $FSi_i$  is farm size;  $Edu_i$  is the level of education;  $CM_i$  is a cooperative membership;  $Exp_i$  is the longevity of farming;  $\beta_0$  is the constant term;  $\beta_1$  to  $\beta_5$  are the coefficients of the independent variables to be estimated, and  $\varepsilon$  is the error term.

$\beta_0$  is the constant term, which can be assimilated to autonomous or natural performance of agribusinesses, while  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$ ,  $\beta_6$  and  $\beta_7$  are the coefficients of the independent variables, which measure the marginal effect of each variable on the dependent variable, holding all other variables constant. They are all parameters of the model to be estimated.  $\varepsilon$  is the error term of the

model, which captures all omitted variables in the model.

### 3. RESULTS

#### 3.1. Demographic profile

To ensure that quality data was obtained, demographic information about the participants was collected, including gender, marital status, level of education, farm size, cooperative membership, and farming activities (Table 1). The participants' demographic data give valuable background for interpreting the findings on agribusiness performance and related issues. The sample had a male-dominated gender distribution, with 73 (58.9%) of individuals being male and 51 (41.1%) females. This shows a moderate gender imbalance, which, depending on social and cultural dynamics, may affect access to resources, decision-making authority, or adoption of specific agricultural technologies. Land in the Northwest Region of Cameroon, including Santa, is primarily owned by men, which explains why men account for most farmers in the study. In terms of marital status, most participants (68 or 54.8%) are married, followed by widowed individuals (24 or 19.4%) and single participants (20 or 16.1%). Divorced and separated participants account for 6 and 4.8% of the sample, respectively. The large number of married people may represent the age and social structure of the farming community, as well as increased household labour capability or land ownership stability. The participants have a pretty high level of education. Nearly half, 61 or 49.2%, have a tertiary education, while the remaining 29 or 23.4% and 28 or 22.6% have secondary and primary education, respectively. Only six people, or 4.8%, have no formal schooling. This generally educated populace may be more open to training, innovation, and improved agronomic methods.

#### 3.2. Main agricultural risks faced by smallholder commercial agribusinesses in Santa Subdivision.

To identify the main agricultural risks faced by smallholder commercial agribusinesses in Santa

**Table 1.** Demographic Characteristics of the Sampled Participants

Description	Elements	Frequency	Percent
Distribution of respondents by gender	Male	73	58.9
	Female	51	41.1
	Total	124	100.0
Distribution of respondents by Marital Status	Single	20	16.1
	Married	68	54.8
	Separated	6	4.8
	Widowed	24	19.4
	Divorced	6	4.8
	Total	124	100.0
Distribution of respondents by educational attainment	No formal education	6	4.8
	Primary education	28	22.6
	Secondary education	29	23.4
	Tertiary education	61	49.2
	Total	124	100.0
Distribution of respondents by farm size	Less than 1 hectare	27	21.8
	1 hectare to 3 hectares	78	62.9
	3 hectares to 5 hectares	19	15.3
	Total	124	100.0
Distribution of respondents by registration as a cooperative Member	Yes	69	55.6
	No	55	44.4
	Total	124	100.0
Distribution of respondents by farming activity	Crop farming	104	83.9
	Mixed farming	20	16.1
	Total	124	100.0

Subdivision, data were collected on the types of agricultural risks encountered by most farmers, the frequency of crop failure, farmers' perceptions of pest and disease risks on crops, financial challenges in obtaining funding for agribusinesses, and risks associated with agricultural policies and regulations. This can be seen in Table 2. Pest and disease outbreaks were indicated as the most common risk by 53 participants (42.7%). Weather-related hazards are 35 or 28.2%, indicating the vulnerability of smallholder crop farmers to climate unpredictability, particularly in rain-fed agriculture. Market and financial hazards are reported by 18 and 14.5%, respectively, indicating that price volatility and capital availability, while important, are not as extensively felt as biological and climatic dangers. In terms of real crop fail-

ures caused by weather, the vast majority, 101 or 81.5% of participants, report encountering such failures seldom (1-2 times in 5 years), whereas 17 or 13.7% experience them occasionally (3-4 times in 5 years). Only 4.8% claimed having never experienced such failures. This shows that, while weather-related occurrences are a known danger, they rarely result in complete failure for most farmers, probably due to existing adaptation methods such as resistant seeds or shifting planting timings.

Pests and diseases are perceived to be a key source of concern. Nearly 74 participants, or 60%, believe the impact is moderate, while 38 participants, or 30.6%, believe it has little influence. A small proportion, 9 or 7.3%, regard the impact as severe, while very few, 3 or 2.4%, feel pests and

diseases have no effect. These perspectives support the high frequency of stated pest and disease risks and help explain the widespread adoption of pest-resistant seed variants among participants. Access to capital is a fundamental impediment to agribusiness expansion. An overwhelming 109 participants (87.9%) reported financial difficulties in funding their operations.

This reflects prior findings that crop insurance and diversification, two major risk mitigation techniques, were not widely adopted or influential, potentially due to cash constraints or risk aversion among underfinanced farmers. Finally, 53 (42.7%) of participants perceived dangers associated with agriculture policies and regulations, whereas 71 (57.3%) did not. This difference indicates that, while nearly half of the sample views policy inconsistencies or regulatory hurdles as a burden, it may not yet be a universal constraint.

However, in a sector that relies on government assistance for inputs, subsidies, or market mechanisms, this view is relevant. The findings point to a dangerous environment characterized by biological (pests and diseases) and climatic (weather-related) risks, as well as major financial restrictions. These problems influence farmer conduct and underscore the importance of focused interventions, particularly in pest management, weather resilience, and financial inclusion.

### **3.3. Agricultural risk management practices and performance employed by smallholder commercial agribusinesses in Santa Subdivision**

Crop insurance, diversification, and the use of resistant crop seed varieties were among the agricultural risk management techniques collected from Santa Subdivision's smallholder commer-

**Table 2.** Main agricultural risks faced by smallholder commercial agribusinesses

Description	Elements	Frequency	Percent
The type of agricultural risks encountered the most	Weather-related risks	35	28.2
	Market risks	18	14.5
	Pest and disease risks	53	42.7
	Financial risks	18	14.5
	Total	124	100.0
Frequent crop failures due to adverse weather conditions	Never	6	4.8
	Rarely (1-2 times in 5 years)	101	81.5
	Occasionally (3-4 times in 5 years)	17	13.7
	Total	124	100.0
Perception of the risk of pests and diseases on crops	No impact	3	2.4
	Minor impact	38	30.6
	Moderate impact	74	59.7
	Severe impact	9	7.3
	Total	124	100.0
Financial challenges in accessing funding for agribusiness	Yes	109	87.9
	No	15	12.1
	Total	124	100.0
Risks associated with agricultural policies and regulations	Yes	53	42.7
	No	71	57.3
	Total	124	100.0

cial agribusinesses. The results are presented in the following sections.

### 3.3.1. Crop insurance as a risk management practice in Santa Subdivision

Crop insurance data was evaluated using six criteria, including financial stability, crop insurance's importance in risk management, claims processing, insurance costs, adequate crop insurance information, and planting and investment decisions (Table 3). The findings show that a large majority (96.7%) agreed that crop insurance gives them a sense of financial stability, with more than half, 67 or 54.0%, strongly agreeing. Only a small percentage, 4 or 3.2%, strongly disagreed, while none disagreed, indicating widespread faith in crop insurance's protective financial role. Furthermore, 96.8% of participants agreed or strongly agreed that crop insurance is crucial for risk management in agriculture. Among them, 78 or 62.9% strongly agreed, demonstrating that crop insurance is viewed not just as useful, but also as an essential component of risk management measures. Only 2 or 1.6% disagreed or strongly disagreed, indicating that the need for crop insurance in farming operations is widely recog-

nized and relatively uncontested by respondents. The claims process was also scored favourably. A total of 96.8% agreed that the claims process is simple and easy to understand, with 81 or 65.3% strongly agreeing. Only a small percentage, 4 or 3.2%, strongly disagreed, indicating isolated incidents of discontent or potential gaps in awareness or service delivery.

When we asked whether the cost of crop insurance is justified by the benefits it provides, 96.7% said yes, with 69 or 55.6% strongly agreeing. Only 2 or 1.6% strongly disagree and disagree, respectively, indicating little concern about pricing relative to value. In terms of access to information, 93.5% of participants agreed or strongly agreed that they had received appropriate information on the crop insurance choices available. While 82 or 66.1% strongly agreed, a tiny group of 6 or 4.8% strongly disagreed, and another 2 or 1.6% disagreed. Finally, crop insurance appears to be an important factor in affecting agricultural decisions. 98.3% of participants agreed or strongly agreed that crop insurance had a beneficial impact on their planting and investment decisions. With 85 or 68.5% strongly agreeing, insurance gives farmers the confidence they need to

**Table 3.** Crop insurance as a risk management practice

Variables	Strongly Disagree	Disagree	Agree	Strongly Agree	Total
Crop insurance provides me with a sense of financial security.	3.2% (4)	0.0% (0)	42.7% (53)	54.0% (67)	100% (124)
I believe that crop insurance is essential for managing risks in agriculture.	1.6% (2)	1.6% (2)	33.9% (42)	62.9% (78)	100% (124)
The claims process for crop insurance is straightforward and accessible.	3.2% (4)	0.0% (0)	31.5% (39)	65.3% (81)	100% (124)
I feel that the cost of crop insurance is justified by the benefits it provides.	1.6% (2)	1.6% (2)	41.1% (51)	55.6% (69)	100% (124)
I have received adequate information about crop insurance options available to me.	4.8% (6)	1.6% (2)	27.4% (34)	66.1% (82)	100% (124)
Crop insurance has positively impacted my decision-making regarding planting and investments.	0.0% (0)	1.6% (2)	29.8% (37)	68.5% (85)	100% (124)

invest and plan. Only 2 or 1.6% strongly disagree and disagree, indicating that crop insurance has a broad positive influence on agricultural planning and risk-taking behaviours.

### **3.3.2. Diversification of crops as a risk management practice in Santa Subdivision**

Data on crop diversity as a risk management approach were obtained using six variables. These include lower total risk exposure, improved financial stability, fewer financial losses, access to new markets, challenges in managing a broad crop portfolio, and enhanced overall productivity (Table 4). A total of 93.6% of participants agreed or strongly agreed that diversifying their crops lowered their overall risk exposure, with 77 (62.1%) highly agreeing. Only 2 or 1.6% strongly disagreed, and 6 or 4.8% disagreed. In terms of financial stability, 95.2% of participants agree that crop diversification improves the financial stability of their agribusiness. Among these, 62 or 50.0% strongly agreed, while 56 or 45.2% agreed, demonstrating that financial returns from diversified farming are recognized and valued. The very small fraction of participants who disagreed, 6 or 4.8%, demonstrates that nearly all participants understand and verify the economic justification for diversity based on their farming experiences. Crop diversification was also

praised for reducing pest and disease losses. A strong majority, 93.6%, agreed or strongly agreed that diversifying their crops resulted in less pest and disease losses, with 70 or 56.5% strongly agreeing. Only 8 or 6.5% disagreed, which could indicate isolated incidents or contextual issues such as a lack of understanding about efficient crop combinations.

Market access was particularly noteworthy. A staggering 96.8% of participants agreed or strongly agreed that diversifying their crops has enabled them to enter new markets, with 92 or 74.2% strongly agreeing. The minor disagreement, 4 or 3.2%, demonstrates that market expansion is a commonly recognized benefit of diversification initiatives. Interestingly, 93.5% of participants agreed or strongly agreed that it is difficult to manage a diverse portfolio, with 80 or 64.5% strongly agreeing. Only six, or 4.8%, strongly disagreed, while 2, or 1.6%, disagreed. Finally, the productivity improvements associated with crop diversity became generally recognized. A total of 96.8% of participants said that diversification has boosted their overall production, with 76, or 61.3% strongly agreeing. Only 2 or 1.6% strongly disagreed or disagreed, respectively, corroborating the notion that a wider range of crops adds to higher yields and, potentially, increased food security or profitability.

**Table 4.** Diversification of crops as a risk management practice

<b>Variables</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>	<b>Total</b>
Diversifying my crops has reduced my overall risk exposure.	1.6% (2)	4.8% (6)	31.5% (39)	62.1% (77)	100% (124)
I believe that crop diversification leads to better financial stability for my agribusiness.	3.2% (4)	1.6% (2)	45.2% (56)	50.0% (62)	100% (124)
I have experienced fewer losses due to pests and diseases by diversifying my crops.	0.0% (0)	6.5% (8)	37.1% (46)	56.5% (70)	100% (124)
Diversifying my crops has helped me access new markets.	0.0% (0)	3.2% (4)	22.6% (28)	74.2% (92)	100% (124)
I find it challenging to manage a diversified crop portfolio.	4.8% (6)	1.6% (2)	29.0% (36)	64.5% (80)	100% (124)
Crop diversification has increased my overall productivity.	1.6% (2)	1.6% (2)	35.5% (44)	61.3% (76)	100% (124)

### 3.3.3. Use of resistant crop seed varieties as a risk management practice in Santa Subdivision

To investigate the use of resistant crop seed varieties, quality data were collected using the following variables: reduced crop losses, resistant crop seed varieties essential for sustainable farming, increased crop yield, training on the benefits of using resistant crop seed varieties, long-term cost-effectiveness of using resistant crop seed varieties, and influence on farming practices (Table 5). The poll results suggest that participants have a strong positive attitude toward the usage of resistant crop seed variants. A considerable 79 (63.7%) of participants strongly agreed that utilizing these types has greatly reduced crop losses, with an additional 41 (33.1%) agreeing. Similarly, 95.1% agreed or strongly agreed that resistant seed varieties are necessary for sustainable farming. In terms of productivity, 90.4% of respondents, 42 or 33.9%, agree, and 70 or 56.5% strongly believe that the availability of resistant seeds will result in increased crop yields. The sense of cost-effectiveness is also high: 93.6% of participants agreed or strongly agreed that resistant seeds save money over time, indicating significant farmer support for sustained investment in such seed varieties despite potential upfront

expenses. Training and knowledge dissemination appear to be satisfactory, with 90.3% reporting that they have received adequate instruction on the benefits of resistant seeds. Finally, the study found that 96.8% of participants felt that resistant cultivars have had a good impact on their farming operations, with only 2 or 1.6% expressing significant dissent and disagreement.

### 3.3.4. Performance of smallholder commercial agribusiness in Santa Subdivision

To assess the performance of smallholder commercial agribusiness farmers in Santa Subdivision, data was gathered on the following variables: increase in profits over the previous year, overall production, adaptability to market changes, customer base expansion, products meeting market standards, investment in new technologies, and good reputation with the local community (Table 6). The statistics showed that more than 95% of participants reported greater profits in the previous year, with 55 or 44.4% agreeing and 63 or 50.8% strongly agreeing, indicating strong financial performance. This financial success is supported by a similarly high 95.1% satisfaction with total productivity, indicating that activities are not only profitable but also efficient.

**Table 5.** Use of Resistant Crop Seed Varieties as a Risk Management Practice

Items	Strongly Disagree	Disagree	Agree	Strongly Agree	Total
Using resistant crop seed varieties has significantly reduced my crop losses.	1.6% (2)	1.6% (2)	33.1% (41)	63.7% (79)	100% (124)
I believe that resistant seed varieties are essential for sustainable farming.	1.6% (2)	3.2% (4)	29.8% (37)	65.3% (81)	100% (124)
The availability of resistant crop seed varieties has improved my crop yields.	8.1% (10)	1.6% (2)	33.9% (42)	56.5% (70)	100% (124)
I have received sufficient training on the benefits of using resistant crop seed varieties.	1.6% (2)	8.1% (10)	29.0% (36)	61.3% (76)	100% (124)
I find resistant crop seed varieties to be cost-effective in the long term.	4.8% (6)	1.6% (2)	33.9% (42)	59.7% (74)	100% (124)
Using resistant varieties has positively influenced my farming practices.	1.6% (2)	1.6% (2)	38.7% (48)	58.1% (72)	100% (124)

Adaptability to market adjustments is another quality, with 93.6% claiming that their agribusiness has effectively adapted to changes in market demand. This adaptation is expected to help businesses maintain their resilience and competitiveness. In keeping with this, 91.9% of respondents claimed to have successfully extended their customer base, indicating both market expansion and maybe enhanced marketing or distribution techniques.

The quality of output appears particularly strong, as 95.2% of respondents agreed or strongly agreed that their products consistently meet market standards, with a notable 93 or 75% strongly affirming this. This indicates a strong emphasis on product quality, which is crucial for both customer retention and market reputation. Additionally, 93.6% reported having invested in new technologies or practices, which are likely to support the high productivity and adaptability figures. Finally, 93.5% of participants agreed or strongly agreed that their agribusiness maintains a good reputation within the local community. This social capital can further reinforce business stability and support.

### 3.4. Challenges of types of risk management practices in the performance of small-holder commercial agribusinesses in Santa Subdivision

Eight explanatory variables were utilized, to identify the obstacles that small-holder commercial agribusinesses confront in Santa Subdivision. Crop insurance, crop diversification, the adoption of resistant crop seeds, farm size, level of education, membership in a cooperative group or not, and farming experience are all factors to consider.

*Ordinary Least Squares (OLS), with heteroskedasticity-robust standard errors for the studied variables*

The Ordinary Least Squares test was used in the investigation. The goal was to extract the coefficient, robust standard error, and P-value for each variable (Table 7). The total model is statistically significant, as evidenced by the F-statistic ( $F(10, 113) = 3.11$ ) and a probability value of 0.0015, which is less than 1%. The R-squared value of 0.5849 indicates that the model's variables account for approximately 58.5% of the variation

**Table 6.** Performance of Agribusiness

Variables	Strongly Disagree	Disagree	Agree	Strongly Agree	Total
My agribusiness has shown a significant increase in profit over the past year.	3.2% (4)	1.6% (2)	44.4% (55)	50.8% (63)	100% (124)
I am satisfied with the overall productivity of my agribusiness.	4.8% (6)	0.0% (0)	26.6% (33)	68.5% (85)	100% (124)
My agribusiness has effectively adapted to market changes and demands.	3.2% (4)	3.2% (4)	34.7% (43)	58.9% (73)	100% (124)
I have successfully expanded my customer base in the last year.	1.6% (2)	6.5% (8)	43.5% (54)	48.4% (60)	100% (124)
The quality of my products consistently meets market standards.	1.6% (2)	3.2% (4)	20.2% (25)	75.0% (93)	100% (124)
I have been able to invest in new technologies or practices to enhance my agribusiness.	1.6% (2)	4.8% (6)	45.2% (56)	48.4% (60)	100% (124)
My agribusiness has maintained a good reputation within the local community.	1.6% (2)	4.8% (6)	37.9% (47)	55.6% (69)	100% (124)

in agribusiness performance. Crop insurance has a negative coefficient (-0.0827), demonstrating an unfavourable link with agricultural performance. A unit increase in crop insurance utilization does not imply a comparable increase in performance. However, this finding is not statistically significant, because the p-value is 0.281, which is greater than 10%.

The coefficient for crop diversification is positive (0.0486), indicating a direct association with performance. However, this conclusion is not statistically significant ( $p = 0.519$ ), implying that crop diversification does not have a substantial impact on agribusiness performance in the model. The usage of resistant crop seed varieties has a strong positive correlation of 0.5707, indicating a direct and significant impact on agribusiness performance. A unit increase in the use of resistant seeds results in significantly improved performance. This conclusion is statistically sig-

nificant, with a p-value of 0.000, which is significantly below the 1% level. A less resistant crop seed variety will have a significant negative effect on agribusiness' performance in the study area.

In terms of farm size, less than 1 hectare is considered the base category. The coefficient for those farming 1 to 3 hectares is 0.0377, which is positive and statistically significant ( $p = 0.035$ ), indicating that farmers in this category outperform those farming less than one hectare. However, the 3 to 5 hectares category exhibits a minor positive coefficient (0.0099), which is not statistically significant ( $p = 0.568$ ), indicating no discernible difference from the base group.

Regarding schooling, with no formal education as the reference group, the coefficients for elementary (0.0186), secondary (0.0108), and tertiary education (0.0137) are all positive but not statistically significant, as all p-values are significantly higher than 0.10.

**Table 7.** Ordinary Least Squares for the variables of the study

Variable	Coefficient	Robust Std. Err.	t	P > t	[95% Conf. Interval]	
Crop insurance	-.0827063	.0763907	-1.08	0.281	-.2340499 .0686374	
Diversification of crops	.0486385	.0751042	0.65	0.519	-.1001565 .1974334	
Use of resistant crop seed varieties	.5707002	.1182153	4.83	0.000	.3364944 .8049061	
Farm size (Less than 1 hectare is the base)						
1 hectare to 3 hectares	.0377262	.0176465	2.14	0.035	.0027653 .072687	
3 hectares to 5 hectares	.0099435	.017385	0.57	0.568	-.0244994 .0443865	
Level of education (No formal education is the base)						
Primary education	.0186314	.0343466	0.54	0.589	-.0494155 .0866783	
Secondary education	.0107735	.0304565	0.35	0.724	-.0495663 .0711133	
Tertiary education	.0136733	.0279284	0.49	0.625	-.041658 .0690045	
Registered in a cooperative society is the base.						
Not registered in a cooperative society	.0510558	.0351482	1.45	0.149	-.0185791 .1206907	
Experience in farming	.0007513	.0013392	0.56	0.576	-.001902 .0034046	
_cons	-.0614546	.0377912	-1.63	0.107	-.1363258 .0134166	
F(10, 113) = 3.11						
Prob > F = 0.0015						
R-squared = 0.5849						

For cooperative society membership, the coefficient for not being registered is 0.0511. This positive number indicates a potential performance advantage even outside of cooperative networks, but the link is not statistically significant ( $p = 0.149$ ). Finally, farming experience has a very modest positive coefficient (0.00075), which is not statistically significant ( $p = 0.576$ ), implying that years of agricultural experience do not greatly affect agribusiness performance.

#### 4. DISCUSSION

##### ***Agricultural risks faced by smallholder commercial agribusinesses***

The study's findings clearly reveal that pest and disease outbreaks account for 42.7% of the agricultural hazards encountered by smallholder commercial agribusinesses in Santa Subdivision. This is highly corroborated by Konje et al. (2019), who undertook a thorough evaluation of pest and disease prevalence in the same area. Their discovery of destructive pathogens such as *Plasmodiophora brassicae* (clubroot) and *Phytophthora infestans* (late blight), as well as pest species such as black cutworms and aphids, supports the claim that biological risks are not only widespread but also pose significant threats to productivity and income. According to Konje et al. (2019), the fact that pest outbreaks are more severe during the dry season may explain why farmers are more interested in resistant agricultural seed variants that have been shown to considerably minimize crop losses. Pesticides, herbicides (Azos-star and Gramazol), and insecticides against insects that consume crops are widely used to prevent crop damage.

Weather-related dangers (28.2%), the second most stated threat, are consistent with the findings of Awazi et al. (2020). In their research of the Western Highlands (including Santa), they highlight the increased frequency of unpredictable rainfall, lengthy dry spells, and rising temperatures. These climatic conditions deteriorate farming conditions, particularly for rain-fed agriculture, which is relied on by most smallholder farmers. Despite their proven impact, 81.5% of participants report-

ed weather-induced crop failures. This seeming contradiction may represent increasing adaptation efforts such as crop diversification and the use of climate-resilient inputs, which echo the necessity for such activities, highlighted by Awazi et al. (2020). The perception data verifies the moderate to minor impact of pests and diseases stated by most farmers (almost 90% combined), with 7.3% reporting severe impacts.

Access to capital, or the lack thereof, is identified as a significant barrier by 87.9% of participants. This finding is consistent with Kibebssii et al. (2024), who describe that restricted access to modern tools, improved seeds, and farm-to-market infrastructure, frequently due to financial limitations, has resulted in low productivity among small-scale farmers in adjacent funding. The significant financial constraints may also explain why certain risk-mitigation methods, such as crop insurance, are underutilized, despite their high perceived value (as observed previously in the survey). Financial constraints hinder farmers' capacity to adopt or scale up new technologies, purchase insurance, or diversify production properly.

In addition, 42.7% of participants recognize policy-related hazards as a cause of concern, even though the majority do not report them. This could be due to ambiguous subsidy programs, bureaucratic inefficiency, corruption, or insufficient access to agricultural incentives. While Asfaw et al. (2017) focus on Malawi, their finding that membership in farmer associations and access to improved technology improve efficiency is applicable here. The perception of policy risks may be linked to the need for more transparent and inclusive support structures that enable farmers to access such efficiency-enhancing services and goods. These findings offer a picture of a farming population confronting multiple dangers, including biological, climatic, and economic, yet demonstrating knowledge and partial adaptation.

##### ***Agricultural risk management practices employed by smallholder commercial agribusinesses***

The nearly unanimous opinion among participants (over 96%) that crop insurance provides

financial security, which is critical for risk management and supports informed investment decisions, is consistent with the findings of Litika et al. (2024) and Salazar et al. (2019). Litika et al. (2024) emphasize in their study of Cameroon's Grass fields that crop insurance, when combined with quality inputs and improved practices, significantly decreases financial risk and stabilizes income. Similarly, Salazar et al. (2019) show that crop insurance and forward contracts considerably reduce financial risks for Chilean farmers. The high satisfaction rate with the claims process (96.8% find it accessible) and perceived cost-effectiveness (96.7% agree) indicate strong institutional trust and a well-functioning insurance plan in the research area. This institutional efficacy could explain why 98.3% of respondents cited insurance's favourable influence on planning and investment decisions as a necessary condition for long-term agribusiness viability.

According to the poll, most participants (more than 93%) use crop diversity as a risk management approach. This leads to increased financial stability, profitability, and market access. These findings are consistent with Wanger et al. (2022), who suggested that diversification among crops, livestock, and revenue streams is an effective risk management strategy, particularly for smallholder farmers, who are exposed to land constraints and market changes. The significant recognition of market access (96.8%) and productivity increase (96.8%) adds to this. It indicates diverse farmers' capacity to access different demand sectors, which was also documented by Mishra et al. (2018) in their study on contract farming in India, where market security was a major benefit. However, it is worth noting that 93.5% find diversification difficult to manage, echoing von Loeper et al. (2018), who discovered that smallholders rely on informal tactics but face structural limits. The difficulty of maintaining a diversified crop portfolio necessitates training, input, and extension services to be completely effective. However, it was determined throughout the research period that all extension personnel in the study region were no longer available to help farmers.

The use of resistant agricultural seed varieties is another risk management approach that the study population (95.1%) considers vital for sustainable agriculture, with 90.4% reporting increased yields and 96.8% claiming positive changes in farming methods. These findings are consistent with the findings of Sokhan et al. (2024), who also emphasize the importance of technological and input-based improvements in enhancing output and stability. Konje et al. (2019) support these findings in the Cameroonian context. Given that pest and disease risks were also recognized as the top hazards in the initial study (42.7%), it is obvious that widespread adoption of resistant agricultural seed variants is both strategic and required. In addition to the techniques stated above, smallholder commercial agribusinesses in Santa Subdivision are presently using traditional risk management practices to improve their performance and resilience. Bamboo and ropes are utilized to protect against wind, which is a weather-related concern, particularly on tomato and cucumber fields. The bamboos are fastened to the ground, and ropes are connected to them in a straight line to assist in keeping the blooming tomatoes and cucumbers stable against the wind. During a lengthy dry season or drought, farmers adopt a local irrigation technology known as "piping or canon". This is a system of irrigation that uses generators and pipes to tap water from far-off locations and deliver it to farmland. A sprinkler is attached to the pipe, which rotates and waters the farmland. In addition, wood ash is used on maize two months after planting in cases of constant sunshine. This is done to keep armyworms and stem borers, which are highly harmful, from eating the maize. During the farming season, "ankara" is also used to convey tribal knowledge. Certain areas of the land are torched specifically, and ridges are built on them to increase output. Pumpkins and coconuts are common crops, grown along these mountains. However, this is not good practice because it degrades the soil. Finally, smallholder commercial agribusiness farmers in Santa Subdivision use scarecrows in their fields as a risk

management strategy. These are human-like figures that are typically placed on farms to deter birds from harming crops.

### ***Challenges of risk management practices in the performance of small-holder commercial agribusinesses***

Crop insurance has a negative Ordinary Least Squares coefficient (-0.0827) and an insignificant p-value (0.281), indicating that it has no statistically significant effect on smallholder agribusiness performance in this setting. This contrasts with previous survey findings, which showed that 96.7% of participants positively perceived crop insurance and agreed more closely with Myeni and Moeletsi (2023). Sandra observed that marketing techniques and flexibility were chosen over contracting and futures (such as insurance). One probable explanation is that, while farmers value the crop insurance conceptually (as seen by survey findings), its actual use may not be optimal, either due to insufficient coverage, delayed reimbursements, or mismatched insurance systems. Change (2016) also warns that the efficacy of risk management measures such as insurance is strongly dependent on context-specific implementation and access, which may be lacking in this case.

Crop diversification has a positive coefficient (0.0486) that correlates with smallholder commercial agribusiness performance, although it is not statistically significant ( $p = 0.519$ ). This is consistent with Wanger et al. (2022) and Pingpoh et al. (2007), who emphasize diversification as an effective risk management approach for income stability and resilience. Similarly, the poll results showed that more than 93% agreed that diversity decreased risk and improved market access. The statistical insignificance here could be attributed to the complexity of managing varied systems, as evidenced by 93.5% of farmers, who found managing a broad crop portfolio difficult. These managerial challenges can lower the net performance benefit of diversification, particularly if technical support is inadequate.

The usage of resistant agricultural seed varieties has a strong and statistically significant

influence (coefficient = 0.5707,  $p = 0.000$ ), making it the most important predictor of agribusiness performance in the model. This is consistent with Change's (2016) findings, which show how resistant seeds increase productivity while reducing biological risk. The survey results also clearly support this: 90.4% of participants reported higher yields, while 96.8% believed that these seeds enhanced their practices. These seeds are anticipated to reduce exposure to pests and diseases, which Myeni and Moeletsi (2023) highlight as a major problem, and will allow farmers to operate more efficiently even in volatile market or climate situations. The researchers discovered that some of the resistant seeds utilized in the area include Green Coronet and Gotra Hybrid for cabbage, Professional Lies, Royal Lies, and Euniene seeds for leeks, and Advanta seeds for carrots.

Farmers with 1 – 3 hectares outperformed those with less than 1 hectare ( $p = 0.035$ ), but this advantage did not extend to the 3 – 5-hectare category, where the effect was minor and non-significant. This shows that marginal returns to scale decline beyond a certain threshold, maybe due to labour constraints, capital intensity, or restricted mechanization, all of which are common in smallholder farming systems. These findings are consistent with those of Tey and Brindal (2015), who found that input costs became increasingly crucial as scale increases, particularly for conventional farmers. Despite having positive coefficients at all levels of schooling, none were statistically significant. This is surprising considering the theoretical expectation that education will increase production. However, Myeni and Moeletsi (2023) discovered that practical measures (such as spreading sales and remaining flexible) were more beneficial than formal learning in controlling real-world farm hazards. The poll also emphasized training in specific practices (for example, the usage of resistant seeds), which may have a greater impact in this rural context than conventional schooling.

Cooperative society membership had a favourable but statistically insignificant influence on performance (coefficient = 0.0511,  $p = 0.149$ ), whereas agricultural experience had no effect

( $p = 0.576$ ). This finding is consistent with the research by Ali et al. (2024) that examined the effects of cooperative participation on household income in Zanzibar. The probit model results show that gender, educational performance, property ownership, and credit availability all have a statistically significant impact on cooperative participation. Furthermore, the Propensity Score Matching (PSM) results reveal that cooperative members and non-members have varying income levels. Cooperative members frequently earn 28% more annually than non-cooperative members.

## 5. CONCLUSION

The study looks at agricultural risk management practices and agribusiness performance, with insights from smallholder commercial farmers in Santa Subdivision, Cameroon. The study identified the main agricultural risks faced by smallholder commercial agribusinesses, investigated agricultural risk management practices and performance employed by smallholder commercial agribusinesses, and assessed the impact of risk management practices on the performance of smallholder commercial agribusinesses in Santa Subdivision. The forms of agricultural risk that affect smallholder commercial agribusiness were classified as pest and disease outbreaks, weather-related risks, market risks, financial risks, crop failure experiences, and agricultural policies and regulations. This means that agricultural hazards have a substantial influence on smallholder commercial agribusinesses, mostly resulting in lower revenue, food insecurity, increased debt, and vulnerability to poverty traps. These dangers, which often interact, have a negative influence on farmers' livelihoods and long-term sustainability. Interventions aimed at improving access to finance, boosting pest and disease control tactics, increasing weather resilience, and providing better regulatory guidance are critical for assisting smallholder commercial agribusinesses in managing and reducing these risks more effectively. Crop insurance, crop diversification, and resistant

seeds are effective tools that contribute to productivity, stability, market access, profitability, decision-making, and confidence. This suggests that for smallholder commercial agribusinesses, these factors are critical, complementary risk management methods, primarily by lowering the production and financial risks connected with agriculture. Because private solutions might be costly for smallholder commercial agribusinesses, the key implication is that the government must take steps to make insurance more accessible and affordable. The study found that the use of resistant crop seed varieties, farm size, and cooperative society membership are all statistically significant in improving the performance of smallholder commercial agribusinesses. This suggests that increasing farm size can enhance efficiency, whilst resistant seed varieties can boost yields and resilience. Membership in a cooperative provides smallholder commercial agribusinesses with resources and market power that they would not otherwise have. The study indicates that to ensure smallholder commercial agribusinesses, farmers should have access to these enhanced seed types, and regulations should handle their development, certification, and pricing. Membership in cooperative societies can empower smallholder commercial agribusiness farmers, but to ensure inclusive growth, legislation must address potential barriers.

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**Conflict of Interest:** We declare no conflicts of interest.

## Data availability

The proprietary questionnaires used to collect data for this manuscript are owned by both the community and the authors. The information is

kept in a cabinet for five years before the authors can dispose of it. If you have any legitimate demands, you can contact the appropriate author.

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