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Effects of Crop Insurance and Finance on Small-Scale Maize Productivity in Zambia

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Abstract

Productivity of maize is dependent on facilitative and competitive interactive effects on resource availability and other moderating factors. The study investigated the impact crop insurance and financing had on the productivity of small-scale maize farmers in Southern province of Zambia. It also sought to see the effect moderating factors have on maize productivity. The relationship between crop insurance and financing, and maize productivity was explored by interviewing 602 farmers in Mazabuka, Monze, Choma and Kalomo districts through a structured questionnaire. This also included interviews with insurance and finance providers. SPSS and hierarchical multiple regression analysis were used to evaluate the data after making some assumptions. The regression analysis was run to determine the relationship between maize productivity, loan, insurance and the interaction between loan and insurance over and above the control variables. The results showed that the relationship was not supported ($t = -0.750$, $p > 0.05$) and that insurance and financing in the four districts studied did not have any effect on productivity. There was no significant relationship between crop insurance and productivity ($t = -1.741$, $p > 0.05$). The model used to analyze the data excluded financing as it did not bring any additional significant information. The results further indicated that there was linearity as determined by partial regression plots, as well as residual independence as determined by the Durbin-Watson statistic of 1.745. Results showed no evidence of multicollinearity based on correlations and Variance Inflation Factors (VIFs) and that farmers relied heavily on the government subsidy program, the FISP which resulting in less or no effect of commercial crop insurance and financing on productivity.

Keywords: crop finance, crop insurance, maize, productivity

1. Introduction

Farming is a risky venture and its outcomes are subject to variations in weather and market forces. Climate change is causing increasingly large weather variations and is likely to have heterogeneous impacts across geographical regions (Lobell et al., 2008; Dell et al., 2008). Countries in South Asia and Southern Africa are likely to suffer more from climate change and these changes are likely to have an impact on both the production and yield of major crops such as maize. The risk and uncertainty in production and crop yield are likely to impact not only the food security of the nation (Wheeler & Von Braun, 2013) but are also expected to have a direct impact on income and poverty among rural populations in general and farming households in particular (Barnwal & Kotani, 2013). The authors note that rural livelihoods are under threat of increased vulnerabilities in food security.

Crop insurance is given to the farmers for protecting them against the loss of crops due to the occurrence of mainly natural disasters like floods, hail, and drought. It is a strategy used by farmers and agricultural producers to protect them against the unexpected loss of crop yield that lowers the revenues and profit margins (Sinha & Tripathi, 2016). This paper talks about research that was conducted on crop insurance and crop financing from the perspective of smallholder farmers in Zambia and how they cope with catastrophes. In the world, the hardest hit groups are the smallholder farmers who are negatively affected by the consequences of a changing climate. They are very vulnerable because they are dependent on weather conditions. Kalisch et al. (2011) intimated that farmers can be led into poverty by having their harvest destroyed by a catastrophe which can be as small as rains that arrive too early or too late in the season. Successful implementation of agricultural micro insurances throughout the world and Zambia, in particular, is still limited. Thus, the main difference with regular insurance is that micro-insurance is targeting low-income clients with an affordable premium cover (Hochrainer et al., 2010). The focus of this research was on the ability of smallholder farmers to cope with weather-related shocks and stresses that only increases due to climate change.

Agriculture is the most active sector in the Southern Province which is the supreme sector for primary economic activity. The province has a series of maize trade enterprises that dominate the region, as stated by Chisanga and Chapoto (2018). The reason is that Southern Province has abundant land and can easily access abundant water, even though it receives less rainfall in comparison with other provinces in Zambia.

Maize (Zea mays L.), one of the world's most essential staple crops, is particularly crucial for developing countries (Zhang et al., 2018). Drought is at the heart of the problem in sub-Saharan Africa, and maize which is the main food crop of the continent, accounts for 50% of the population, but is vulnerable to drought (Aslam et al., 2015; Sangoi & Salvador, 1998). Maize is the most important grain crop in Zambia and in the agro-political economy of the country both as a basic foodstuff and as the main crop for smallholder farmers as reported by Chapoto et al. (2015). Zambia was positioned at number thirteen out of 51 countries in Africa that produce maize. In 2006, 0.865 million tons of maize were produced in total as cited by Japan Association for International Collaboration of Agriculture and Forestry [JAICAF] (2008). Since then, there has been a significant increase in maize production, with around 3.607 million tons produced in the year 2016, as reported by Chapoto et al. (2017). Chamberlin et al. (2014) attributed this significant increase in maize production to the expansion in the area cultivated and the government spending on maize that had increased. Out of the total available arable land, a third in 2011/2012 was used for maize production. 50-80 percent of the Zambia's agricultural budget has been spent on subsidies for inputs and outputs under the Farmer Input Support Program (FISP) as well as the Food Reserve Agency (FRA) in search of achieving maize defense at the national level (Kuteya et al., 2017; Chapoto et al., 2015).

1.1 The Problem

Notwithstanding maize's significance and also the intensive efforts by the government within the maize industry, the Republic of Zambia continues to fight low and fluctuating productivity of maize that hovers around two tons per hectare due to drought, in comparison to the international 5.5 tons on average, with high rural rates impoverishment 77 percent (Chamberlin et al., 2014). Eastern province is the country's largest producer of maize while the provinces of the South and the Centre come in second and third, respectively (JAICAF, 2008; Chamberlin et al., 2014).

Meteorologists are currently very confident that the incidence and severity of extreme weather events are increasing and may increase further with warming (Alexander, 2016; Ummenhofer & Meehl, 2017). This means that farmers dependent on rainfed agriculture will face ever-increasing risks of crop damage due to these extreme weather events. In Zambia, nearly all smallholders are dependent on rainfed agriculture; in 2013, only 16% of smallholder households had access to irrigation. Farmers have always been exposed to weather risks, but evidence suggests that their current risk management and risk coping strategies are not sufficient to shield them from welfare losses due to these shocks. For example, Aslam et al. (2015) showed that farm households in Zambia suffered losses in both crop production and gross income from bad climate, despite taking steps to reduce potential losses and cope with shocks ex-post. In this environment, access to agricultural insurance should complement existing risk management strategies and help households cope with weather extremes.

Zambia can be compared to Singh (2010), who examined the dependence of Indian agriculture on crop insurance and uncertain risks in India. Zambian agriculture has been affected increasingly by the occurrence of severe weather conditions as well as seasonal dry spells and droughts, floods and changes in temperature. This has badly affected many Zambian smallholder farmers and hence has restricted access to inexpensive and dependable technologies and approaches to cope with drought and other extreme weather events linked to climate change.

It was expected that the results from the research would be of great importance to the various participants in the crop insurance and financing of small-scale maize production. Firstly, the government of Zambia through the agricultural policies and planning would be able to use the research results to improve crop insurance and financing to enhance maize productivity not just in Southern Province, but in the whole country as maize is cultivated in all the ten provinces of Zambia.

Secondly, the research results would benefit investment professionals including the small-scale farmers, prospective commodity dealers of agriculture produce, and both insurance as well as financing bodies in the maize industry. It would also be possible for other non-bank financiers like the Miro finance institutions (MFIs) to utilize the research findings.

Finally, the research would contribute to the body of information and field of researchers concerned with crop financing, insurance, and maize production enhancement. This is in addition to the work of other academics who have conducted similar research to support or refute crop insurance and finance ideas related to productivity for small-scale farmers.

Crop insurance is seen as a rudimentary tool to preserve steadiness with the farm revenue, by way of promotion of skill, promoting expenditure, and credit flow in the agricultural sector is increasing. It does contribute to independence in addition to confidence in the farming community, subsequently, they are entitled to compensation in the event of crop failure since it's a legal requirement. Pishro et al. (2011) stated that crop insurance reduces crop damage shocks which can guarantee farmers protection from natural disasters beyond their control and is one of the most important means of mitigating agricultural risk which helps reduce the income of farmers. The Farmer Insurance Scheme has been launched in the last 3 seasons in the Southern Province under the Farmer Input Support Program (FISP) in collaboration with Musika and Mayfair Insurance.

1.2 Theoretical and Practical Implications of the Study

In this study, the variables that were investigated were crop insurance and crop finance as independent variables while productivity was the dependent variable. Districts were also included as moderating factors in the study while environment, demographics, and production systems were considered to be control variables. Crop insurance was measured by checking how many farmers used insurance, while crop finance was measured by how much credit went to the farmers. Productivity was also measured by the output which was the maize yield. Productivity is mainly affected by the two major variables of finance and insurance with all other sub-factors falling within the two as indicated by the conceptual framework presented by figure 1.

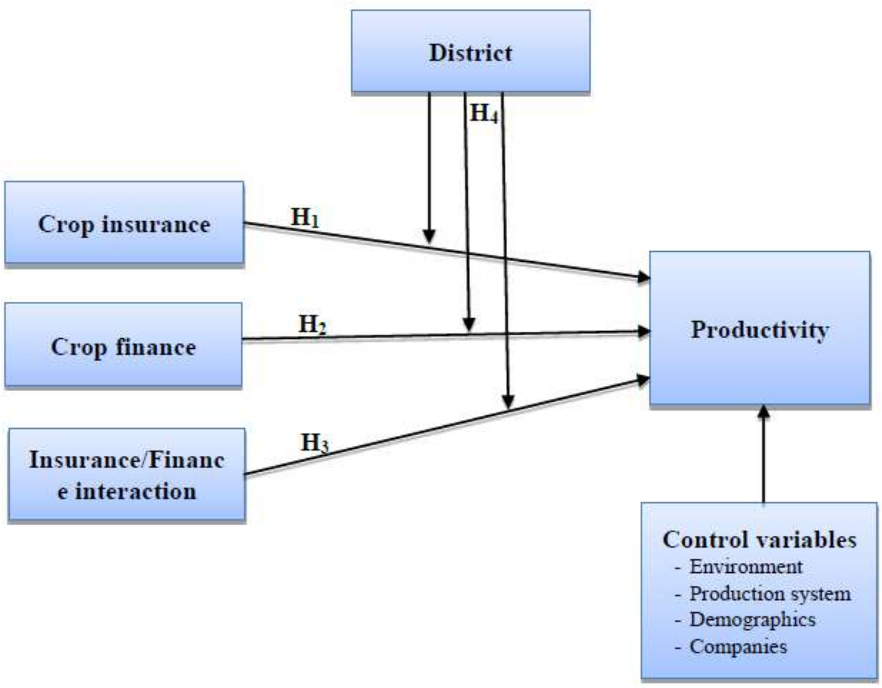

Figure 1. Conceptual framework for maize productivity

1.3 Importance of the Problem

Drought is at the root of the problem in Sub-Saharan Africa. Maize is the continent's principal food crop, feeding half of the continent's population, yet it is prone to drought (Aslam et al., 2015; Sangoi & Salvador, 1998). According to Chapoto et al. (2015), maize is the most significant crop in Zambia's agro-political economy, both as a basic food and as the major crop for small shareholders. Zambia was positioned at number thirteen out of 51 countries in Africa that produce maize. 0.865 million tons of maize were produced in total in 2006 as cited by JAICAF (2008). Since then, there has been a significant increase in maize production, with around 3.607 million tons produced in the year 2016, Chapoto et al. (2017) reported.

Zambia faced a lengthy drought in the 2018/2019 crop season, owing to below-average rainfall from the regular rains (November-March). The huge rainfall deficit, which was most noticeable in Southern and Western provinces, had resulted in decreased agricultural production. As a result, households' food stores were severely reduced, and they became increasingly reliant on market purchases, driving up the price of key goods like maize. Droughts in the past had made people more vulnerable.

Because maize is Zambia's primary food, its availability and accessibility is a good predictor of the country's food security. Smallholder farmers have long been the primary producers of maize; nevertheless, smallholder maize production has declined in recent years. Maize cultivation is fraught with dangers and uncertainties that can result in massive losses for farmers, such as a lack of rain and unpredictable weather patterns. There has been a very low uptake of crop insurance and few smallholder farmers seek for external financing to enhance their maize productivity.

The low productivity of smallholder farmers is seen as the result of the effect of credit constraints. Theoretically, credit constraints harm agricultural productivity. The poor, who lack sufficient collateral, are usually excluded from formal financial services due to high transaction costs and knowledge gaps, which make formal banks reluctant to provide these services to them (Stiglitz & Weiss, 1981; Akerlof, 1970). As a result, the majority of poor smallholders are unable to invest in new technology or inputs such as fertilizer, improved seeds, and so on (Higgins & Leturque, 2010; Markelova et al., 2009; Conning & Udry, 2007). Credit, according to Feder et al. (1990), enables producers to obtain the resources they require to meet the finance needs produced by the production cycle. This agricultural production cycle is particularly long because of the period between sowing and harvesting. The availability of credit allows for greater consumption and greater use of purchased inputs, which increases farmers' production and subsequently their income.

Even though some studies have shown that these effects are sometimes limited, it is not surprising that a large part of the literature shows the positive effects of producers' access to credit on agricultural productivity (Akudugu, 2016; Kashif, Zafar & Arzoo, 2016; Khandker & Koolwal, 2014; Guirkinger & Bourcher, 2008; Carter, 1989). Nonetheless, some recent studies have cast doubt on the many benefits of agricultural finance, demonstrating that the outcomes are not as predictable as one might believe (Nakano & Magezi, 2020; Agbodji et al., 2019; Njeru et al., 2016). Agbodji et al. (2019), for example, find opposing results, showing the negative impact of cash credit on productivity. Nakano and Magezi (2020) point out that a credit enhancement policy is insufficient to guarantee enhanced production. Such results highlight variations in the effects of access to credit and therefore call for specific reflections within countries.

This research follows this logic and provides answers to several questions for the specific case of Zambia. As a result, the purpose of this research was to determine the impacts of crop insurance and crop financing to increase productivity and losses in events of a natural catastrophe. The literature reviewed did not show any studies done in Zambia related to the topic. Thus, this study intended to fill this research gap.

1.4 Describe Relevant Scholarship

Maize farmers in Kenya's Kimilili district increased their maize yield after receiving credit, according to research conducted by Nzomo and Muturi (2014). This was all because the farmers were able to purchase the right certified seed and used fertilizers and chemicals optimally. This translated to increased maize productivity. However, the study only focused on crop financing and did not go deeper into discussing the effects of crop insurance on productivity. Similar studies conducted in the past and the results are shown in Table 1 and different gaps have been identified.

Table 1. Past Research on the Effect of Informal Credit on Maize Productivity

Authors	Methodological	Contextual	Findings	Research Gaps
Joshua Anamsigiya Nyaamba	• 150 respondents • Face-face questionnaires • Linear regression with endogenous treatment effects model	Tolon District, Ghana	Sex of farmer plays a role in insurance adoption	No relationship connecting crop insurance, crop finance and crop productivity
Mary Nzomo Willy Muturi	• Purposive and stratified • 123 respondents • Questionnaires used	Kenya	Credit increased productivity significantly	The study did not focus on insurance but showed that credit can help increase agricultural productivity
Kenneth W. Sibiko Matin Qaim	• A random sample of 386 • Surveys used • Regression models	Kenya	Insurance uptake is positive and significantly increases productivity	The research did not link finance to productivity
Kelvin Mulungu Gelson Tembo Hilary Bett Hambulo Ngoma	• Just and pope model	Zambia	Yield increases for maize with increased rainfall	The model underpredicts yield and shows no relationship between crop insurance, finance and crop productivity
Christopher Sebatta Mukata Wamulume Chibamba Mwansakilwa	• Purposive and random • Sample size 1,326 households • Questionnaires used • Double huddle model	Zambia	Education level, and size of household influence the decision to access finance	No relationship was established for the three variables (insurance, finance & productivity)

1.5 State Hypotheses and Their Correspondence to Research Design

To guide the study, the following research hypotheses were developed:

H1: Crop insurance has a significant positive effect on maize productivity

H2: Crop finance has a significant positive effect on maize productivity

H3: There is a significant interaction effect of crop insurance and crop finance on maize productivity

H4: The effect of crop insurance and crop finance is moderated by the district in which the farmers are located

2. Method

This research took a deductive method. This method is frequently based on a set of fundamental principles or axioms. Deduction is the process of drawing conclusions about a phenomena or behavior based on a set of premises and logical or theoretical considerations (Creswell, 2014). Because the purpose of this study was to collect data to evaluate assertions or hypotheses connected to the theory, the deductive technique was adopted. The technique also intended to show the connection between theories, facts, and logic (theory to observation). Using this approach, the two hypotheses (financial intermediation theory and neoclassical economic growth theory) were changed depending on the testing of the conceptual framework through observations or investigations (Saunders et al., 2012).

2.1 Participant Characteristics

The fact that they are smallholder maize farmers is shared by at least one basic trait of this population. Other characteristics shared by population members include education, tenure, and gender, however being a smallholder maize farmer in one of the four districts of the Southern province was the most prevalent common trait of interest, given the research purpose.

The target population was comprised of small-scale farmers registered under the Farmer Input Support Program (FISP) program for the 2020/2021 farming season. Each district kept a register of farmers under each camp. In the 2020/21 farming season, these farmers were provided with insurance and loans. In the 2020/2021 season, all farmers in Kalomo, Mazabuka, and Monze got insurance for their crops under Mayfair and Zambia State Insurance Corporation (ZSIC) while all farmers in Choma had no insurance. Some of the farmers got financed through loan schemes from Zambia National Farmers Union and Vision fund while others did not.

2.2 Sampling Procedures

The study took place in the Southern Province of Zambia. Specifically, in Choma, Kalomo, Mazabuka and Monze districts as shown in figure 2 of the study sites. In each district, all the agricultural camps were part of the sites as indicated in table 2. A total of 118 agricultural camps were considered in the four districts which are among the highest maize producing districts in Southern Province. The general population constituted the farming population in the 118 agricultural camps of the four districts totaling 205 273 farming households. Stratified sampling was followed to ensure that the required sample was met. All the participants willingly participated in the research without receiving any payment and the research was approved by the University of Zambia Biomedical Research Ethics Committee (UNZABREC).

Figure 2. Study sites

2.2.1 Sample Size, Power, and Precision

According to Kombo and Tromp (2006), "a sample is a finite part of a statistical population whose properties are studied to obtain knowledge about the complete population." A total of 205 273 farmers in the four districts were used to obtain a sample size of 602 with a margin of error of 4% and a significance level of 5% (Bartlett & colleagues, 2001). Respondents were chosen via stratified sampling, with each district serving as a stratum. This method ensured that each group of interest was fairly represented (Sudman, 1976). From each district, the households were gotten as a proportion representative of the total households in a district as indicated in table 2.

With confidence level of 95% and the error margin of 4%, Cochran's formula for sample size determination was used to determine the sample size from a population of 205 273 homes. The 4% margin of error ensured that the figure was 95 percent of the time within 4 percentage points of the true population value.

Cochran's formula

$$n = \frac{Z^2 pq}{E^2}$$

Where:

- e is the anticipated level of accuracy (i.e., the margin of error at 4%).
- p is the (estimated) proportion of the population that has the attribute in question at 0.5.
- q is 1 – p.

The z-value was found in a Z-table and was 1.96.

Table 2. Sample size per district

District	Number of camps	Total farm households	Percentage households	Sample size
Choma	27	51 706	25.19	152
Kalomo	36	67 079	32.68	197
Mazabuka	22	32 440	15.80	95
Monze	33	54 048	26.32	158
Total	**118**	**205 273**		**602**

Source: 2020/2021 FISP Farmer Register; Author generated, 2022.

2.2.2 Measures and Covariates

Focus group talks, questionnaires, interviews, and observations are some of the instruments utilized in research according to Kombo and Tromp (2006). Questionnaires were used in this study to collect data from a large sample size. The questionnaires were chosen because they protect respondent confidentiality (Kombo & Tromp, 2006) as the sample size was substantial, and individual replies were required.

This research argued that questionnaires are the most appropriate tools to collect survey data in a method that aids in answering research questions and reaching conclusions. It achieves its objectives more effectively and professionally than any other tool.

Anonymity was ensured as participants were not required to reveal their identity on the questionnaire and hence felt free to express themselves knowing that their responses would not be tied to them. In this study, a single type of questionnaire was utilized to collect data from which the researcher could extract information important to accomplishing the research objectives and answering the research questions. A total of 602 questionnaires were issued.

2.2.3 Research Design

A quantitative approach was adopted in this study and it was correlational. The design that was employed was a cross-sectional survey. A cross-sectional survey, according to Creswell (2009), is a technique that uses a questionnaire to collect data from participants. The study aimed at collecting information from respondents (small-scale maize farmers) in the Southern Province of Zambia in four districts namely Choma, Kalomo, Mazabuka and Monze. Data was also collected from farmer supervisors, insurance and lending institutions and the Meteorological Department. The data collected from small-scale farmers were from each agricultural camp in each district using a Tonga-translated questionnaire that was administered to randomly selected households.

3. Results

The findings of the research were based on the four objectives. The first objective was to determine the impact of crop insurance on small-scale maize productivity. The study then looked at the impact of agricultural financing on small-scale maize production as the second objective. The third objective was to examine the interaction effect of crop insurance and financing, while the fourth objective was to assess the district's moderating effect on maize productivity. The responses were organized around each topic of discussion and compared to the empirical and theoretical literature reviewed. Descriptive statistics were used to present and interpret the data. The hypotheses were tested using reliability and regression analysis.

A total of 602 questionnaires were given out to the respondents. From the 602 questionnaires, 595 valid answers were received, representing a response rate of 98.8% and a non-response rate of 1.2%. Case number 120 was deleted from the dataset because it had too many missing responses. Additionally, the variable Goat Manure had too many missing values and so it was deleted from the dataset. The dataset was also screened for any values entered that were outside of the 5-point Likert scale and several values were found and corrected.

3.1 Sample Profile

From the data collected, 68.7% of the respondents specified that they were male, while 31.3% indicated that they were female. Kalomo had the highest number of respondents at 31.6% while Mazabuka had the least number of respondents standing at 16.1%. Respondents from Monze stood at 26.7% while those from Choma stood at 25.5%. on Marital Status, 83% of the respondents specified that they were married, 7.7% indicated that they were widowed, 3.9% indicated they were divorced, then 3.4% indicated that they were single and 2% indicated that they were separated. On farming methods used by the smallholder farmers, 95.3% of the respondents indicated that they used oxen, 3.2% used a hoe and the remaining 1.5% small scale farmers indicated that they used a tractor. 63.5% of the small-scale farmers practiced conservation methods while 36.1% did not practice conservation farming. About 64.0% of the smallholder farmer's respondents indicated that they had used medium maturing seed varieties to plant while 25.9% and 4.9% had used early maturing and late maturing seed varieties respectively. Regarding the sources of the loans, 96.8% of the respondents did not borrow, 1.3% did not indicate where they got their loans from and only 1.9% indicated that they got their loans from various sources such as Agola, Savings Group, Local Lenders, Micro Finance and Village Banking. For crop insurance, 61.5% of the respondents indicated that they had insured their crops through the FISP program, while 38.5% of the respondents indicated that they had not insured their crops. Regarding the experience with crop failure, 75.3% of the respondents indicated that they had not experienced any crop failure, while 24.7% of the respondents indicated that they had experienced crop failure. As for the insurance payouts, 89.7% of the respondents indicated that they had not received any insurance payout, while 0.3% indicated that they had received an insurance payout. Table 3 shows the sample profile.

Table 3. Sample profile

Variable	Item	Frequency	Percent	Variable	Item	Frequency	Percent
Gender	Female	186	31.3	Type of soil	Sandy soil	165	27.7
	Male	409	66.7		Clay soil	117	19.7
District	Mazabuka	98	16.1		Loamy soil	312	52.4
	Monze	159	26.7	Flooding	No flooding	459	77.1
	Choma	152	25.5		Scanty flooding	118	19.8
	Kalomo	188	31.6		Severe flooding	17	2.9
Marital Status	Single	20	3.4	Drought	No drought	337	56.6
	Married	494	83.0		Scanty drought	216	36.3
	Separated	12	2.0		Severe drought	42	7.1
	Widowed	46	7.7	Pest attack	No	83	13.9
	Divorced	23	3.9		Yes	509	85.5
Farming methods	Hoe	19	3.2	Loan	No	576	96.8
	Oxen	567	95.3		Yes	19	3.2
	Tractor	9	1.5	Loan Source	Did not borrow	576	96.8
Use of Conservation method	No	380	63.9		Agola	1	.2
	Yes	215	36.1		Kasikili Saving Group	1	.2
Seed variety	Early Maturing	154	25.9		Local Lenders	1	.2
	Medium Maturing	381	64.0		Micro Finance	1	.2
	Late Maturing	29	4.9		Micro Finance 1	2	.3
Use of fertilizer	No	18	3.0		Savings Group	1	.2
	Yes	576	96.8		Village banking	2	.2
Use of pesticides	No	406	68.2		Vision Fund	1	.2
	Yes	188	31.6		ZANACO	1	.2
Rainfall	Low	85	14.3		Did not indicate	8	1.3
	Normal	468	78.7	Insured crops	No	229	38.5
	High	42	7.1		Yes	336	61.5
Average Temperature	Low	32	5.4	Crop failure	No	448	75.3
	Normal	486	81.3		Yes	147	24.7
	High	79	13.3	Insurance payout	No	534	89.7
					Yes	61	10.3

3.2 Descriptive Analysis

Individual demographic analyses and interpretations for age, years of schooling, household size, field size, agricultural experience, bags of maize harvested, and income from sales were part of the descriptive study. Table 4 provides descriptive statistics on respondents and their production activities.

Table 4. Descriptive Statistics

Variable	Mean	Std. Deviation	Skewness	Kurtosis
Age	47.39	10.619	.224	-.133
Years of schooling	9.40	2.481	.607	3.141
Household Size	9.09	4.627	1.858	6.841
Field Size	3.910	4.1 210	5.447	46.250
Farming Duration	19.52	10.471	.586	-.029
Bags Harvested	128.00	131.188	2.555	9.159
Income from Sales	12 957.68	20 471.954	7.157	91.115
Bags of Compound D used	8.15	8.046	2.606	9.677
Bags of Urea used	8.02	7.888	2.547	8.922
Visits by the extension officer	3.36	3.199	2.296	6.610
Amount Borrowed	112.773 1	787.874 14	9.232	97.358
Interest Charged	30.823 5	274.574 35	12.771	198.784
Insurance Premium paid	66.062 9	58.097 47	.980	5.466
Insurance Payout	34.778 9	119.570 09	4.123	19.047
Bags Harvested per Hectare	36.908 5	34.958 21	8.938	128.471

Source: Primary Data

3.3 Normality Test

Normality tests were employed to determine if the study's random variables were normally distributed. A normality test was performed on all the descriptive variables due to the high skewness and kurtosis values of several of the variables. The variables' mean, P-value, Kurtosis, and Skewness were calculated, and the normality test found that none of the variables were distributed normally as shown in Table 5. This, however, was not a prerequisite for performing a multiple regression analysis.

Table 5. Test of Normality

	Kolmogorov-Smirnov[a]			Sharpiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.046	508	.013	.993	508	.018
Years of schooling	.162	508	.000	.916	508	.000
Household Size	.131	508	.000	.869	508	.000
Field Size	.088	508	.000	.966	508	.000
Farming Duration	.234	508	.000	.561	508	.000
Bags Harvested	.185	508	.000	.759	508	.000
Income from Sales	.265	508	.000	.526	508	.000
Bags of Compound D used	.195	508	.000	.752	508	.000
Bags of Urea used	.201	508	.000	.755	508	.000
Visits by the extension officer	.212	508	.000	.763	508	.000
Amount Borrowed	.525	508	.000	.134	508	.000
Interest Charged	.525	508	.000	.091	508	.000
Insurance Premium paid	.372	508	.000	.680	508	.000
Insurance Payout	.508	508	.000	.336	508	.000
Bags Harvested per Hectare	.195	508	.000	.511	508	.000

a. Lilliefors Significance Correction

3.4 Hierarchical Multiple Regression

Hierarchical multiple regression was used find out the relationship between Maize productivity, Loan, Insurance and the interaction between Loan and Insurance over and above the control variables of Age of the respondent, their Household Size, how many years they had spent Farming, their Income from the sale of their crops, whether they used Mulching, whether they used Minimum Tillage, whether they used Pot Hoeing, whether they used Crop rotation, whether they used Fertilizer, the number of Compound D fertilizer bags they used, whether they used herbicides, how many visits were made to their farm by an agricultural extension officer, whether they had pests, and whether they had any crop failure. Dummy variables were created to control for district variables (Monze, Choma, and Kalomo, with Mazabuka as a reference), type of manure used (Compost, with no manure as a reference), temperature (Normal temp and high temp, with low temperature as a reference), type of soil used (Clay and loamy, with sandy soil as a reference), flooding (Scanty flooding and severe flooding, with no flooding as a reference), drought (Scant (Medium maturing and Late maturing using early maturing as a reference) as represented by the regression analysis in table 6.

Table 6. Regression analysis with maize productivity as a Dependent variable

	Maize Productivity			
	Model 1		Model 2	
	B	β	B	β
(Constant)	25.229		36.116	
Age	-0.065	-0.035	-0.073	-0.039
Household_Size	-0.432	-0.101	-0.413*	-0.096
Farming	-0.001	0.000	-0.002	-0.001
Income	0.001	0.415	0.001**	0.415
Mulching	-3.483	-0.059	-2.837	-0.048
Minimum _Tillage	4.249	0.108	3.489	0.089
Pot_Hoeing	-10.663	-0.181	-10.444**	-0.177
Crop_Rotation	4.911	0.109	4.841*	0.107
Fertilizer	8.849	0.069	7.850	0.061
Compound_D	0.231	0.095	0.223	0.092
Herbicides	0.127	0.003	0.214	0.006

Visits	0.120	0.020	0.157	0.026
Pests	-4.968	-0.092	-5.138*	-0.095
Crop_Failure	-3.872	-0.087	-4.654*	-0.104
D_Mon	4.066	0.093	4.495	0.103
D_Cho	0.668	0.014	1.044	0.022
D_Kal	-4.704	-0.112	-3.681	-0.087
D_Normal_Temp	2.562	0.050	3.521	0.069
D_High_Temp	7.825	0.134	8.240*	0.141
D_Clay	-1.231	-0.025	-1.178	-0.024
D_Scanty_Flooding	-5.162	-0.106	-4.901	-0.101
D_Severe_Flooding	-2.591	-0.021	-2.026	-0.016
D_Scanty_Drought	-4.134	-0.101	-3.901*	-0.096
D_Severe_Drought	-3.557	-0.047	-3.240	-0.042
Insurance2			-3.135	-0.076
D_Loan_and_Insurance			-3.051	-0.031
R^2	0.340		0.345	
F	9.763**		9.188**	
ΔR^2	0.340		0.005	
ΔF	9.763		1.660	
Note: n = 498*p<.05, **p<.01				

Partial regression plots and a histogram of studentized residuals against anticipated values demonstrated linearity as shown in figure 3 and figure 4. A Durbin-Watson score of 1.745 indicated that residuals were independent as shown in table 7 of the model summary. Visual inspection of a plot of studentized residuals versus unstandardized expected values revealed homoscedasticity.

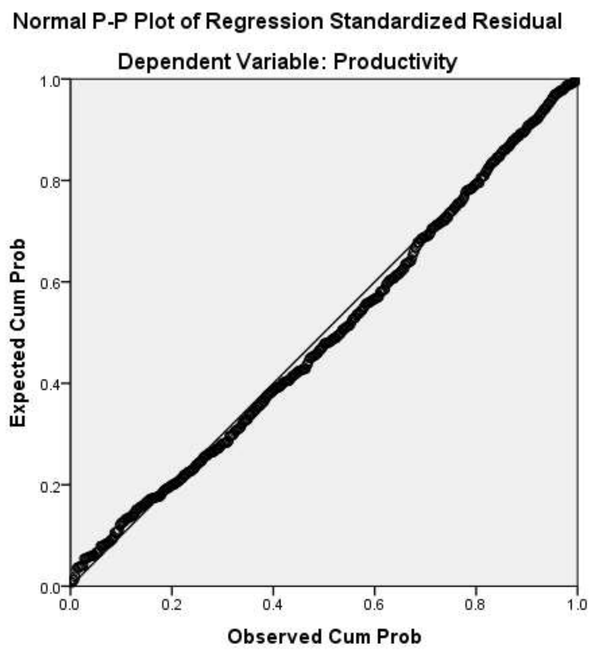

Figure 3. P-P Plot of Regression Standardized Residual

Table 7. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.583[a]	.340	.306	16.48744	.340	9.763	25	473	.000	
2	.587[b]	.345	.307	16.46448	.005	1.660	2	471	.191	1.745

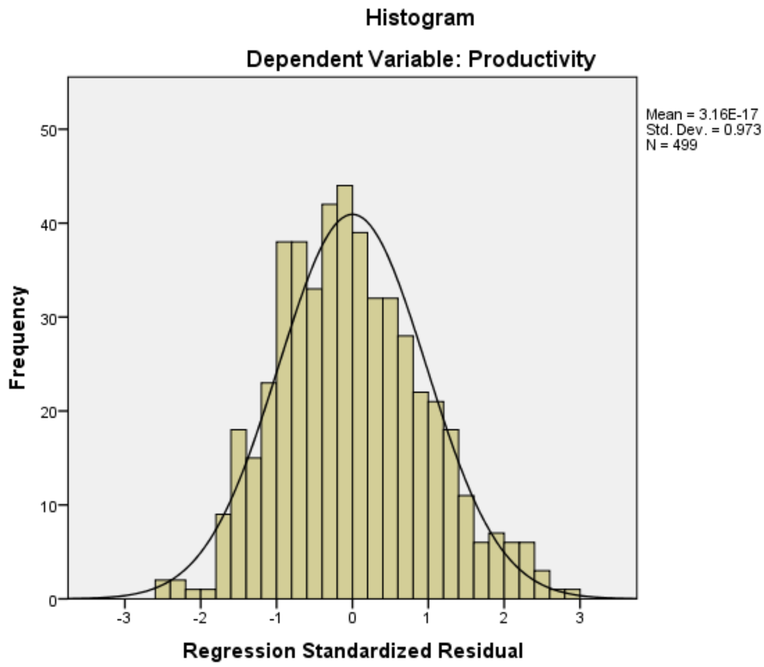

Figure 4. Studentized Residuals

According to correlations and Variance Inflation Factors (VIFs), there was no evidence of multicollinearity. There was just one (3.002) studentized deleted residual with a value more than 3 standard deviations, no leverage value greater than 0.2, and no Cook's distance value greater than 1 as shown by residual statistics in table 8. The assumption of normality was met, as evidenced by the residuals histogram and the P-P plot, and a normality test for standardized and studentized residuals yielded no results of non-normality.

Table 8. Residuals Statistics[A]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	6.7288	99.3707	34.3383	11.62065	499
Std. Predicted Value	-2.376	5.596	.000	1.000	499
Standard Error of Predicted Value	2.269	7.191	3.796	.897	499
Adjusted Predicted Value	6.0695	96.1 046	34.3281	11.66599	499
Residual	-40.32104	48.24491	.00000	16.01193	499
Std. Residual	-2.449	2.930	.000	.973	499
Stud. Residual	-2.529	3.002	.000	1.001	499
Deleted Residual	-43.38176	50.62824	.01014	16.98405	499
Stud. Deleted Residual	-2.543	3.028	.001	1.003	499
Mahal. Distance	8.459	93.990	26.946	14.428	499
Cook's Distance	.000	.042	.002	.004	499
Centered Leverage Value	.017	.189	.054	.029	499
a. Dependent Variable: Productivity					

3.4.1 Analysis of the Effect of Insurance on Maize Productivity

One of the key objectives of the study was to determine the effect of insurance on the productivity of maize by smallholder farmers of Southern province. Of the 595 farmers interviewed, only 366 had insured their maize crop through a government subsidy program, the FISP while 299 never insured their maize crop (Table 3). Insurance uptake on the sampled farmers was 61.5% and did not affect the maize productivity. This could be attributed to the areas having received normal rainfall in the 2020/2021 farming season but also the dependence on subsidized insurance premiums under the FISP program.

3.4.2 Analysis of the Effect of Finance on Maize Productivity

The next specific variable was the effect of finance on maize productivity were only 3.2% of the sampled farmers had accepted loans from various organizations. In the 2020/2021 season, 96.8% of the sampled farmers did not get any loans for maize production. This had no significant effect on maize productivity for the season. The established Farmer Input Support Programme (FISP) by the Zambian government in 2002 was attributed to the low uptake of maize financing by lending institutions. The FISP was established by the government in 2002 to subsidize farming inputs for small-scale farmers (Sianjase, 2013).

Subsidies are often referred to as subventions. All subsidies have the same basic feature: they lower the market price of an item beneath its cost of production. A subsidy is a type of financial assistance or support given to a particular economic sector (or institution, firm, or individual) to improve economic and social policy. According to Business Dictionary, a subsidy is a financial benefit (such as a cash grant or soft loan) provided by the government to support a desired activity (such as exports), keep staples prices low, maintain the income of producers of critical or strategic products, maintain employment levels, or induce investment to reduce unemployment.

Bunde et al. (2014) evaluated the link between fertilizer input subsidies and maize yield in Kenya's Nandi District. In terms of food security at the home level, this study found that the district's farm input subsidy program contributed to higher maize output, which, paired with favorable weather, improved family food security. The study's findings suggest that farmers' general perceptions of the farm input subsidy program have been positive. This helped to improve family food security by providing inputs to farmers who would not have used them under regular conditions.

Ricker-Gilbert and Jayne (2011), as well as Mason et al. (2013), have looked at crop output consequently found that every additional kilogram (kg) of subsidized fertilizer boosts maize yield by1.82 kg and 1.88 kg, respectively, in Malawi and Zambia. When evaluating maize output response in Malawi, Chibwana et al. (2010) and Dorward et al. (2013) revealed the beneficial advantages of farm input subsidies. All of these studies suggested that farm input subsidies increased food availability, which was backed up by research on the household welfare effects of farm input subsidies in Malawi, which found an increase in the adequacy of food availability at the household level using subjective self-assessment indicators (Dorward & Chirwa, 2011; Dorward et al., 2013).

Some researchers, on the other hand, contend that microfinance's impact on agricultural production is not always favorable. They say that because of their goal of funding the poor and several perceived issues associated with the seasonal nature of agricultural operations, microloan providers have not traditionally addressed the credit and financial needs of small and marginal farmers (Suleman & Adjei, 2015). This is also supported by the responses received from lending institutions in this study where only one lending institution, FINCA, had financed a few farmers in Mazabuka district out of the nine lending institutions interviewed.

3.4.3 Analysis of Combined Loan, Insurance and Loan and Insurance Interaction

The full model of Loan, Insurance, and Loan and Insurance interaction (Table 6, Model 2) was statistically significant, $R^2 = 0.345$, $F(2, 471) = 9.188$, $p < 0.05$; adjusted $R^2 = 0.307$. The addition of the control variables of Age of the respondent, their Household Size, how many years they had spent Farming, their Income from the sale of their crops, whether they use Mulching, whether they use Minimum Tillage, whether they use Pot Hoeing, whether they use crop rotation, whether they use Fertilizer, the number of Compound D fertilizer bags they use, whether they use herbicides, how many visits were made to their farm by an agricultural extension officer, whether they had Pests, and whether they had any crop failure was done to the model. Dummy variables were created to control for the variables of the district (Monze, Choma and Kalomo, using Mazabuka as a reference), type of manure used (Compost using no manure as a reference), temperature (Normal Temp and High Temp using Low temperature as a reference), type of soil used (Clay and Loamy using Sandy soil as a reference), flooding (Scanty Flooding and Severe Flooding using No flooding as a reference), drought (Scanty drought and severe drought using no drought as a reference) and type of seed used (Medium maturing and Late maturing using early maturing as a reference) (Model 1) did lead to a statistically significant increase in R^2 of 0.340, $F(25, 473) = 9.763$, $p < 0.05$.

3.5 Hypothesis Testing

Table 9. Hypothesis testing results

Hypotheses	**t-value**	**p-value**	**Comment**
H_1: Crop Insurance has a significant positive effect on Maize Productivity	-1.741	.802	Not supported
H_2: Crop Insurance has a significant positive effect on Maize Productivity	-	-	Not supported
H_3: There is a significant interaction between Crop Insurance and Crop Finance on Maize Productivity.			
Dummy for Loan and Insurance	-0.750	0.82	Not supported
Dummy for Insurance but no Loan	-	-	Not supported
Dummy for Loan but no Insurance	-	-	Not supported
H_4: The effect of Crop Insurance and Crop Finance is moderated by the district in which the farmers are located.			
Dummy for Monze	1.678	0.094	Not supported
Dummy for Choma	0.378	0.705	Not supported
Dummy for Kalomo	-1.337	0.182	Not supported

H_1 – There was no significant positive relationship between the variable Crop Insurance and Maize Productivity ($t = -1.741$, $p > 0.05$). The sign on the coefficient shows negative. Hence, this hypothesis was not supported.

H_2 – There was no significant relationship between the variable Crop Financing and Maize Productivity. This variable was excluded from the model because it didn’t bring additional significant information. Hence, this hypothesis was not supported.

H_3 – There was no significant relationship between the variable Interaction of Crop Insurance and Crop Finance and Maize productivity.

The Dummy for Loan and Insurance: The farmers that had both the loan and Insurance had worse maize productivity than those that had no loan and no insurance. However, this relationship was not significant ($t = -0.750$, $p > 0.05$).

The Dummies for Insurance but no Loan and Loan but no insurance were excluded from the model because they didn’t bring any additional significant information.

Hence, this hypothesis was not supported.

H_4 – There was no significant positive relationship between the moderating variables of District and Farm Productivity.

The Dummy for Monze: Farmers in Monze had better Maize productivity than those in Mazabuka, however, this relationship was not significant ($t = 1.678$, $p > 0.05$).

The Dummy for Choma: Farmers in Choma had better Maize productivity than those in Mazabuka, however, this relationship was not significant ($t = 0.378$, $p > 0.05$).

The Dummy for Kalomo: Farmers in Kalomo had worse Maize productivity than those in Mazabuka, however, this relationship was not significant ($t = -1.337$, $p > 0.05$).

Hence, this hypothesis was not supported.

4. Discussion

The main focus of the conversation in this segment is to attempt to address the precise objectives of this study.

4.1 Objective 1: Effect of Crop Insurance on Maize Productivity

One of the specific objectives of the study was to find out the effect of crop insurance on small-scale maize productivity. The hypothesis test results showed that crop insurance did not affect the maize productivity of small-scale farmers in the Southern province ($t = -1.741$, $p > 0.05$). The findings contradict those of Wu (1999), Goodwin et al. (2004), and Yu, Smith, and Sumner (2018), who found that crop insurance and subsidies have a slight but statistically significant impact on crop productivity. Furthermore, even though indemnity payments were reported to increase the use of no-till and lower the use of conservation till, Weber, Key, and O'Donoghue (2016) find no significant evidence of moral hazard associated with crop insurance participation, while Schoengold, Ding, and Headlee (2015) find no significant evidence of moral hazard associated with crop insurance participation.

The finding in this study of insurance does not affect productivity could also be attributed to the support given by the Zambian government through subsidies where insurance premiums are a requirement when a farmer is accessing the FISP. When looking at the number of farmers who acquire insurance through FISP, Somwaru and

Makki (2001) can be backed up in their assertion that the number of insured farmers increased dramatically when crop insurance payments were increased. FISP makes insurance mandatory for participating farmers in Zambia. Although crops insurance has evolved as an essential policy instrument for strengthening household resilience against climate risks in recent years, and FISP is a prominent example, the concept of agricultural insurance is not popular in Africa except among large-scale farmers.

According to the conclusions of this study, crop insurance demand is noticeably low, and the main reason for this is the revenue situation of many farms. Insurance is usually bought because it is required by financial institutions or other stakeholders to mandate it (Gábor et al., 2011), as is the case with the FISP.

4.2 Objective 2: Effect of Crop Finance on Maize Productivity

The findings in this study showed that crop financing of small-scale maize farmers in the southern province does not affect productivity. The findings of this study contradict those of Girabi and Mwakaje (2013), who investigated the impact of MFI on sunflower and maize farm productivity in smallholder farms, finding a significant difference in input consumption and farm production between credit and non-credit borrowers, with the former consistently higher than the latter.

However, this finding agrees with Chabala (2019), who stated that empirical assessments of the impact of credit on any outcome are scarce in Zambia, and none exist in the case of maize productivity, to the best of the authors' knowledge. The outcomes of this study on lending institutions' responses also support this. All but one lending institution interviewed did not offer any financial support or loans to the small-scale farmers during the 2020/2021 farming season.

This is due to the fact that the majority of agricultural finance is directed at commercial farmers and agricultural processors. Only a few financial service providers, such as FINCA, are actively involved in rural and agricultural lending. Smallholder farmers, according to Ledgerwood (1999), require government assistance to increase their productivity and livelihoods.

The 3.2 percent of studied farmers who borrowed during the 2020/2021 farming season primarily borrowed from local lending groups, according to this study. It's possible that this is due to the fact that a group understands its members better than anybody else. Many microfinance and credit cooperatives have employed group lending or joint liability to reduce idiosyncratic risk and moral hazard at the local or community level (Ghatak & Guinnane, 1999). When it comes to microfinance institutions, group lending is frequently combined with other incentives that entice farmers to borrow, such as increasing loan amounts over time, short maturities, the threat of cutting off future borrowing if a borrower defaults, frequent repayment schedules, and frequently imposed savings. Gine (2004), however, discovered that empirical investigations on whether these strategies improve borrower wellbeing and production are mixed.

4.3 Objective 3: Interaction Effect of Crop Insurance and Crop Financing

The results revealed that there was no interaction effect of crop insurance and crop finance on the maize productivity as shown in table 6 of the regression analysis. This implies that farmers' maize production is currently not affected by whether they have insurance or credit from a lending institution. This can be attributed to the dependence on FISP which supplies them with subsidized farming inputs hence many farmers see no need of getting additional financing. Crop insurance for farmers, which is defined as financial instruments that compensate farmers in the event of crop loss, can be in the form of a portion of the loan principal being covered by the insurance product. Insurance coverage decreases the risk of default for lending institutions, making lending more profitable for them. Thus, crop insurance and credit have the potential to benefit smallholder farmers by stabilizing and boosting their income, making it easier for them to repay their loans.

The risk of an agricultural loan, on the other hand, is shifted to an insurer, who faces the same issues as the lender and hence cannot be the solution. Crop insurance's failure or widespread reliance on subsidies around the world demonstrates its inability to handle these concerns (Hazell, Pomareda & Valdéz, 1986).

4.4 Objective 4: Moderating Effect of District

There was no significant positive relationship between the moderating variables of District and maize Productivity. Though the data showed that farmers in Monze and Choma had better maize productivity compared to Mazabuka and Kalomo was the least in terms of productivity.

The farming system and agroecology, or natural capital, as well as historical elements relating to settlement and language group, and density of market and services infrastructure, are all reflected in district dummy variables. The results show that these were not different from one another in these four districts of Mazabuka, Monze, Choma and Kalomo. They all experience the same weather pattern, have the same farming systems of mainly using oxen, and mainly plant the same varieties of maize which are mainly medium maturing and early, they speak the same language.

5. Conclusion

Farmers in Mazabuka, Monze, Choma, and Kalomo have varying access to their income sources, according to the findings of the study. It was also concluded that, despite insurance companies' repeated attempts to reach farmers, there are barriers to farmers' full commitment to insurance schemes, as evidenced by information provided by insurance companies during data collection for this study. Farmers are completely reliant on insurance offered through the subsidy program, the FISP. This means that farmers were unsure whether or not they needed insurance coverage, even though the risks of farming are well-known to them.

According to the findings, the major insurance companies were focusing on large-scale farmers rather than small-scale farmers. Secondary sources show that the firms' lower acceptable insurance level was indicated. As a result, both lending banks and insurance companies had stringent policies in place to ensure that these small-scale farmers received their products. As a result, the farmers' options for financing and insurance were limited, and they were forced to rely primarily on the government's FISP program.

Many studies (Gunther, Kelsey & Masiye, 2014; Mike et al, 2009) have emphasized the shortcomings in accessing credit and financial services, which have been a major source of concern for farmers and a major stumbling block to the modernization and diversification of the economy. This is confirmed by data gathered from lending institutions on small-scale funding for maize production in the 2020/2021 farming season, which revealed that small-scale farmers were not granted any loans.

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