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**AGRICULTURAL MICROINSURANCE IN KENYA: DETERMINANTS OF
THE LOSS AND PROFIT EXPERIENCED IN INSURANCE COMPANIES IN
KENYA IN 2014**

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself.

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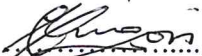
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ABSTRACT

The Kenyan agricultural production sector is faced with a lot of risks that will affect a farmer's level of income. The Kenyan insurance market offers two types of agricultural micro insurance products, index based crop insurance and indemnity based crop insurance. This study has investigated the significant factors that affect profitability of an insurance company. To provide answers to the research questions quantitative methods were employed. Use of simulation of variables, correlation tests, and regression analysis were the major quantitative tools used to analyse the data availed. The results of the study conducted showed that companies that offer index based products are more profitable compared to companies that offer pure indemnity products. It was also noted that a combination of both products leads to a higher profit margin as opposed to offering pure based products.

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LIST OF ABBREVIATIONS

AFC- the Agricultural Finance Corporation

AKI- Association of Kenyan Insurers

AYII- Area Yield Index Insurance

GMR- Guaranteed Minimum Return

ILRI- International Livestock Research Institute

IRA- Insurance Regulatory Authority

KNBS- Kenya National Bureau of Statistics

MPCI- Multiple-Peril Crop Insurance

NPCI- Named Peril Crop Insurance

WII- Weather Index Insurance

1. INTRODUCTION

1.1 Background Information

Agriculture production is one of the main contributors of Kenyan economy. As per KNBS, 80% of Kenya's population depends on production, processing of crops and livestock as a way of livelihood. Kenya's agricultural sector provides 18% of formal employment and 60% of informal employment. In addition it also contributes to about 24% of the country's GDP and 65% of its export. Therefore it is concluded that the agricultural sector is a key concern of the Government of Kenya.

In developing countries, agriculture production is exposed to a lot of risks that affect the price and yields that make farmers' incomes unstable and unpredictable. These risks include catastrophic risks like drought and floods; pests, diseases and even climate change. Failure to mitigate these risks will result to devastating results such as a slow economic development and high poverty rates (Goodwin & Smith, 1995) . In WorldBank (2011), the study suggests that there are two methods that farmers in developing countries can use to mitigate risks, that is through formal and informal methods.

The informal or traditional methods is where farmers pool risks within their communities by share-cropping and sharing food stocks; they may also use crop diversification and farm fragmentation. The traditional method helps to a small extent to manage covariate risks that affect seasonal production and income but it is not effective in managing catastrophic risks. The formal methods are therefore required to supplement the traditional methods to enable an efficient management of risk.

Churchill and Matul (2012) describe formal methods as the use of insurance and other financial services as tools of managing risks. They further state that agricultural micro insurance is a tool designed to help farmers insure their farm inputs against risk such as drought, excess rain, pest and diseases. The policy offers farmers who plant as little as one acre insurance policies to shield them from significant financial losses when the risk

occurs. Smith and Watts (2008) further divided the agriculture micro insurance products into index based micro insurance and indemnity based micro insurance.

This study will focus on agricultural micro insurance in Kenya. The dominant agriculture products planted in Kenya are maize, beans, tea, coffee, sorghum and wheat. Farmers in Kenya face a lot of risks like floods, pest and diseases, hail, drought and unpredictable rainfall. These risks brought about the need for the development of micro insurance products to help mitigate them. There are two types of micro insurance products offered in Kenya, Indemnity insurance and Index based insurance.

Indemnity insurance is an insurance cover that protects the farmers against yield or revenue loss. It is divided into two categories, Multiple- Peril Crop Insurance (MPCI) and Named Peril Crop Insurance (NPCI). Multiple- Peril Crop Insurance (MPCI) protects farmers against yield or revenue loss from multiple sources of risk. A claim is paid out to the farmers if the yield or revenue loss is caused by the predefined multiple sources of risks (Smith & Watts, 2008) .

Named Peril Crop Insurance (NPCI) on the other hand offers protection against well-defined single perils like fire or hail that have potentially catastrophic consequences for their crop production. A claim is paid out to farmers if the yield or revenue loss is caused by the predefined single peril (Smith & Watts, 2008).

Index based insurance is an insurance cover whose claim payout is based on a specific weather parameter for example, rainfall that has high correlation with yield production. It is usually measured over a specific period of time at a particular weather station. It is divided into two, Area Yield Index Insurance (AYII) and Weather Index Insurance (WII). Area Yield Index Insurance (AYII) is where an indemnity is paid if the realized yield for the area is less than the insured yield regardless of the actual yield on a policyholder's farm. Weather Index Insurance (WII) on the other hand make payouts whenever rainfall, temperature or another stated element of climate exceed or fall short of certain levels, which are likely to cause crop yield losses (Smith & Watts, 2008).

In 2006, indemnity crop insurance began to be offered to large scale farmers in Kenya and in 2008 it was offered by Swiss Re in conjunction with local insurance companies to small scale farmers. In 2009, UAP in partnership with Equity Bank and ILRI developed the first index based insurance to mitigate against livestock mortality for Marsabit District. Indemnity crop insurance is highly developed in the Kenyan insurance market but index based insurance is still being offered on a pilot bases to test its suitability in the market. There are seven companies that offer agricultural micro insurance. They are Kenya Oriental insurance, Heritage insurance, Jubilee, APA, CIC, UAP and ICEA Lion.

1.2 Purpose of the Study

The motivation of this study is to seek the reason behind the high loss ratio that was experienced in the agricultural insurance market in Kenya in the year 2014. Loss ratio is the ratio of total losses incurred in claims plus adjustment expenses divided by the total premiums earned.

Many authors example Hazell (1992), World Bank (2011) and Goodwin and Smith (1995) found out that indemnity based insurance especially MPCCI was not an effective method of mitigating risks because it led to the experience of a high loss ratio. In addition , WorldBank (2011) proposed WII as a more effective risk mitigation tool in developing countries due to the unpredictability of weather patterns. This study will therefore take a keen interest in the effectiveness of index based insurance in comparison of indemnity based crop insurance. The study will be conducted in the Kenyan Agricultural market.

1.3 Problem Statement

Kenya's agricultural sector is an intrinsic component of the country's economy performance. The Kenyan insurance market provides indemnity based insurance products and index based insurance products to help manage risks that are faced by farmers. In 2014, among the seven companies that offer agricultural insurance, only two of the companies reported a profit. There was a combined total loss of (131million) among the insurance companies; the worst hit was Kenyan Oriental Insurance and Heritage

Insurance each with a loss of (6.9 million). The companies that experienced profit were ICEA Lion with a profit of (3.75million) and a loss ratio of 5% and APA with a profit of (3.38 million) and a loss ratio of 7% percent. It was noted that the two companies that reported the worst loss ratios used indemnity based crop insurance while ICEA used index based insurance product (Kilimobora) and APA used a combination of the multiple peril crop insurance and index based insurance (Gibendi, 2014) .

The intention of this study is therefore to identify the key causes of loss and profit for an insurance company offering agricultural insurance products. In addition it will also seek to identify which method between indemnity based crop insurance and index based insurance contributes to a profitable financial performance.

1.4 Research Objective

The overall objective of this study is to determine the relationship between profitability of an insurance company and the agricultural insurance products that they offer.

1.5 Research Questions

1. What factors affect the profitability of an agricultural insurance product?
2. Is there a relationship between profitability of an insurance company and the type of agricultural insurance product offered?
3. Is index based insurance product more effective than indemnity based insurance product as a risk management tool?

1.6 Scope of the Research

The area of concern in this study is Kenya. The insurance market is analyzed in the aspect of the agricultural products that they offer. The profitability of the company will be modelled against loss ratios, area of agricultural coverage. The loss ratios will be divided into two, indemnity based and index based. The indemnity based loss ratio will be modelled using Hazell (1992) financial performance ratio and index based loss ratio will be modelled using a method adopted from Skees (2003) .

The data is collected from seven insurance companies that offer agricultural micro insurance. This study will show that the profitability index of a company is highly affected by the following variables: loss ratio index and acres under insurance cover. It will further show that index based products are more effective as a risk management tool in Kenya than indemnity based insurance products.

2. LITERATURE REVIEW

2.1 Introduction

This chapter outlines the theoretical and conceptual underpinnings upon which the premise for this study is built. Section 2.2 discusses the history of agricultural insurance. Section 2.3 states the types of agricultural micro insurance products. Section 2.4 compares the advantages of index based crop insurance and indemnity based crop insurance. Section 2.5 presents the key challenges of index based insurance and section 2.6 discusses the profitability of agricultural insurance.

2.2 History of Agricultural Insurance

Agricultural micro insurance has been offered to farmers in many different countries and in very different forms since the 1920s (Smith & Watts, 2008). It was first used in the US as an experimental program for major crops in major producing areas until the 1980s when the Federal crop insurance act was passed (WorldBank, 2011). Index based insurance on the other hand came about due to the challenges faced by traditional agricultural crop insurance (Cole, Bastian, Vyas, Wendel, & Stein, 2012).

In Kenya, after the economic depression of 1930, the colonial government introduced a number of reforms to compensate for the slowdown in agricultural lending and the worsening food security situation due to droughts and locusts. One of the reforms was the Guaranteed Minimum Return (GMR) which guaranteed farmers a minimum price for their produce and it also insured their production against unavoidable crop failure. The reform made it compulsory for every farmer who received an agricultural loan to purchase the insurance (Kerer, 2013).

The GMR scheme further continued with the Independent government of Kenya after the country's independence in 1963. It addressed the key risks faced by agricultural production through a guaranteed market and price. It also provided agricultural risk mitigation which ensured farmers are protected against risks which they cannot manage

individually .In addition, the scheme offered farmers access to credit which made it possible to mechanize and increase their agricultural output (Kerer, 2013).

GMR was a success because it was a closed system where credit and insurance was linked .The credit provider was the Agricultural Finance Corporation (AFC) which was established in 1963.AFC is still being used in Kenya today but GMR was discontinued in 1970s due to its abuse and its exploitation by farmers and politicians(Kerer, 2013).

For many years after the discontinuance of GRM, agricultural insurance was not available until the 2000s where it made a comeback. In 2006, indemnity crop insurance was offered to large scale farmers only and in 2008 it started being offered by Swiss Re in conjunction with local insurance companies to small scale farmers. In 2009, UAP in partnership with Equity Bank and ILRI developed the first index based weather insurance to manage risks associated with livestock mortality for Marsabit District. The product indemnified pastoralists in the event an animal died as a result of lack of pasture due to drought. UAP acted as the first insurance and Swiss Re provided Reinsurance.

In 2010, UAP with the support of Syngenta offered the first index based crop insurance called *Kilimo salama* (meaning safe farming). It was designed based on pilot findings in Laikipia district where several hundred maize farmers insured their farm inputs against drought in the long rains season of 2009. The district experienced a drought season, as shown by local weather stations hence there was a payout and all farmers were compensated depending on the extent of the drought as measured at their weather station (Kerer, 2013; SwissRe, 2013).

In Kenya today, the providers of index and indemnity based insurance are shown in figure 1.

Figure 1 List of Insurance Companies and Crop insurance product offered

COMPANY	PRODUCTS	
Jubilee	Area-yield-tea farms	Index Based Crop Insurance: Embu Maize farmers
CIC	Multi-peril Crop Insurance	Index Based Crop Insurance
APA	Multi-peril Crop Insurance	Index Based Crop Insurance
UAP	Multi-peril Crop Insurance	Index Based Crop Insurance
Kenya Oriental insurance	Multi-peril Crop Insurance	
Heritage insurance	Multi-peril Crop Insurance	
ICEA LION		Index Based Crop Insurance

This table shows the seven companies in Kenya that offer crop insurance. There are two types of crop insurance, index based and indemnity base insurance. Jubilee and ICEA LION offer only index based products. Kenya Oriental Insurance and Heritage insurance offer only indemnity based products. CIC, APA, UAP offer a combination of both index based and indemnity based insurance products.

2.2.1 Types of Agricultural Risks Faced by Kenyan Farmers.

Agriculture production is exposed to many types of risks. They range from natural disasters, diseases, pests, to production and price risks. Farmers in Kenya face both idiosyncratic risks like fire and hail which affect them independently and systemic such as drought which affect a large number of producers at the same time (Kerer, 2013).

Kerer (2013) found that floods and epidemic are the major risks experienced in Kenya. On average, Kenya is hit by one epidemic and one flooding event per year. Droughts occur on average every four years. Rainfall patterns can be very volatile with some years having virtually no rainfall and others having excessive rainfall. The study, for example

attributed decline of rain in Central province to the global warming effect on The Indian Ocean where the water levels in the ocean is dropping. An increase in the frequency and severity of hydro-meteorological events will negatively affect agricultural production and the livelihood of millions of Kenyan farmers hence the need for agricultural micro insurance.

2.3 Types of Agricultural Micro Insurance Products Offered in Kenya.

WorldBank (2011) states that there are two types of indemnity-based insurance offered, damaged-based and yield base. One of the types is Damage-based Indemnity Insurance or Named Peril Crop Insurance (NPCI). This is a crop insurance in which payout claim is calculated by measuring the percentage damage in the field after the damage occurs. The measured damages in the field, less a deductible expressed as a percentage, are applied to the sum insured. The sum insured is usually pre agreed and may be based on the expected revenue or the production costs. Where damages cannot be measured accurately immediately after the loss, the assessment is deferred until later in the crop season. This method is best applied for hail and excess rainfall.

The other type of indemnity crop insurance is Yield-based Crop Insurance or Multiple Peril Crop Insurance, MPCCI. In this case, the coverage of an insured yield is based on a percentage of the farmer's historical average yield. The insured yield is usually between 50 and 70 percent of the average yield on the farm. When the realized yield is less than the insured yield, a claim is paid equal to the difference between the actual yield and the insured yield, multiplied by a pre-agreed value. The claim payout is paid only if the yield loss is caused by the pre-stipulated multiple perils (WorldBank, 2011).

There are also two types of index based insurance, Area Yield Index Insurance (AYII) and Weather Index Insurance (WII). Area Yield Index Insurance (AYII) is where claim payout is based on the realized average yield of an area such as a county or district but not the actual yield of the insured party. The insured yield is calculated as a percentage of the average yield for the area. Claim payment is triggered when the realized yield for the

area is less than the insured yield regardless of the actual yield on a policyholder's farm. For accuracy, this index insurance requires historical area yield data (WorldBank, 2011).

Weather Index Insurance (WII) is another type of index based insurance. Indemnity payout is based on realizations of a specific weather parameter measured over a pre specified period of time at a particular weather station. Index realizations can either be high or low and they can lead to crop losses, therefore, this insurance can be structured to protect against the index realization effect. For example, the insurance can be structured to protect against either too little or too much rainfall. A claim is paid whenever the realized value of the index exceeds a pre specified threshold. The indemnity is calculated based on a pre-agreed sum insured per unit of the index (WorldBank, 2011).

2.4 Advantages of Index Based Crop Insurance versus Indemnity Based Crop Insurance.

Cole et al. (2012) noted that index based insurance came about because of the challenges faced by traditional crop insurance. Some of the studies, for example, Mark and Arias (2003), WorldBank (2011) and Islam, Turvey, and Hoy (1999) identified these challenges as high administration cost and asymmetry of information; which is adverse selection and moral hazard. Therefore the main advantages of index based insurance are based on solving the mentioned shortfalls of indemnity crop insurance. The literature on the advantages will be based on the study done by WorldBank (2011), Mark and Arias (2003), Smith and Watts (2008) and Goodwin and Smith (1995).

One of the advantages of index based insurance is a reduction of the risk of adverse selection. A farmer is highly likely to buy indemnity insurance if they are of a high risk caliber because they are assured of a claim settlement when the risk occurs. Therefore, the insurance company will likely pay more claims than anticipated resulting in high loss ratio. On the other hand, index based insurance indemnify farmers on the basis of the

payout scale for all farmers in a designated area hence eliminating the probability of adverse selection (Goodwin & Smith, 1995; Islam et al., 1999; WorldBank, 2011).

Secondly, Smith and Watts (2008) and Mark and Arias (2003) studies state that index based insurance reduce moral hazard. In indemnity insurance, a farmer might act with negligence for example; fail to water the crops to influence a claim. This will result in large numbers of claims to the insurance companies than anticipated. On the other hand, with index insurance, farmers have no ability to influence the claim, since payout is based on an independent weather parameter. Hence the risk of moral hazard is reduced (Islam et al., 1999).

Index based insurance eliminates field loss assessments. In indemnity based insurance, there is a need for individual assessments of the field when a loss occurs , hence large numbers of skilled and semiskilled assessors are mobilized resulting to high administration cost. On the other hand index based insurance make payouts without field assessment hence eliminate the need for assessors resulting in low administrative cost and hence a more profitable insurance product (WorldBank, 2011).

Fourthly, index based insurance facilitates reinsurance and access to financial services. Index based insurance removes most catastrophic and correlated risks hence it can be used to facilitate other financial instruments that are important for poverty reduction and economic development. In addition, reinsurance companies are willing to charge lower premiums by reducing the uncertainty loading since indemnity is based on independently measured weather events (WorldBank, 2011).

Finally, Index based insurance ensures transparency. In the indemnity methods there is a high likelihood that there will be conflict between the assessors and the farmers due to the nature of the loss adjustment process. Weather index based contract are based on weather measurements by independent weather stations and hence they are extremely objective and likely to reduce disputes between farmers and insurance companies (WorldBank, 2011).

In Kenya, the insurance penetration is still very low (Kerer, 2013). This has been attributed to lack of trust between the Kenyan market and the insurance companies. There have been cases where an insurance company fails to pay claims because of moral hazard but the policy holder will view this as the insurance company failing to fulfil its contractual agreement. Index based insurance will eliminate this aspect of lack of transparency and hence increase agricultural insurance uptake.

The mentioned advantages of index based insurance is of benefit to this study because it will offer the explanation as to why companies offering index based insurance reported profits while those offering indemnity based insurance reported losses.

2.5 Key Challenges of Index Based Contract

One of the key challenges of index based insurance is basis risk. Basis risk is the difference between the payout as measured by the index and the actual loss incurred by the farmer (Churchill & Matul, 2012). Index based insurance lacks individual loss assessment; payout is based entirely on index measurement which can be either lower or higher than the actual loss. Therefore farmers are not guaranteed of indemnity when they experience a loss, nor does it guarantee that if they do receive an indemnity cheque, the size of the cheque will be commensurate with the losses the farmers incurred. Moreover, some farmers will be indemnified when they have incurred no losses hence nullifies the principles of insurance that states that insurance should not be a profit making venture for the insured.

Basis risk has been acknowledge by many index based analyst as a huge problem for example, Miranda (1991), Smith and Watts (2008) and Skees (2003). However the point of disagreement is the scope, the size of the problem and the differences among insurance index products (rainfall indexes, vegetation (NDVI) indexes, and area yield indexes) and farm yields. Vedenov and Barnett (2004) suggest that the correlation between weather and area yield index products and farm yields can be relatively large; therefore, it can be an effective and desirable risk management tool for farmers. However Miranda (1991)

and Smith and Watts (2008) suggested that the correlation between precipitation or weather index and farm yields are likely to be much smaller hence not an effective risk management tool.

Another challenge of index based insurance is data availability. For index based insurance to be successful there is need for accurate and complete data. The contract requires historical data for weather parameters to be used for underwriting, pricing, assessing the risk, designing the product and recording of the parameter(s) for payout calculations during the period of insurance. This is a huge problem for developing countries since there is lack of high-quality time series of meteorological data resulting in poorly priced product that leads to losses to the insurance company (WorldBank, 2011).

Kenya being a developing country lacks proper historical meteorological data. This will largely affect the premium charged by the insurance companies and hence affect the loss ratio. In addition, Insurance companies in Kenya offering index based insurance are affected by basis risk which intern affects their revenue streams. The mentioned challenges of index based insurance will therefore be of great significance to this study because they affect the loss ratios of Kenyan companies and hence influence conclusions made on the research question of whether index based is better than indemnity based insurance.

2.6 Determinants of Profitability of Agricultural Micro Insurance.

Churchill and Matul (2012) stated that there are three main drivers of profitability of an insurance company. They are achieving scale, managing claim costs and administration costs.

Achieving scale is one of the drivers of profitability. Achieving scale means that the insurance business is selling and still maintaining large business volume. This can be achieved effectively if the company defines and access the market, provides valued benefits and meets the needs of the market with reasonable premiums and Incentivizing distribution channels to sell and renew. In order to achieve scale then one must look at

the demand for crop insurance. Goodwin and Smith (1995) and Smith and Watts (2008) found that the higher the premium rate, the lower the level of participation by farmers since they deem it as too expensive.

Another aspect that will affect demand for crop insurance is adverse selection. Farmers with more volatile yields are likely to receive crop insurance indemnities more frequently and in large amounts (Smith & Watts, 2008). This is because the premium rates are based on individual contracts. McCarthy (2003) and Sarris, Karfakis, and Christiaensen (2006) reported that farmers located in regions where rainfall is less variable are less willing to pay for insurance since they are assured of high yields and they are at a low risk of experiencing yield loss.

Claim cost and administration cost are other factors that affect the profitability of a country. They can be managed by pricing the risk, managing anti-selection and moral hazard. This is done by insurance companies providing group covers and taking up agricultural reinsurance. When working with groups the risk of anti-selection is reduced because group covers are inclusive of high risk farmers and low risk farmers. Reinsurance reduces the costs because the reinsurance companies absolves the excess claim cost in case of large numbers of claims (Churchill & Matul, 2012; WorldBank, 2011).

In this study, achieving scale will be calibrated as the numbers of acres insured when calculating the profitability of an insurance company. In addition, claim cost and administration cost will be also be included in the formulae for calculating the financial performance of a company through the calculation of loss ratios.

The overall profitability of a micro insurance product is determined by loss ratio. Churchill & Matul, 2012 states the formulae as

$$\text{Gross insurance profit ratio} = \frac{\text{gross insurance profit}}{\text{gross earned premiums}}$$

Similarly, a form of Churchill & Matul, 2012 formulae will be used in this study as a measurement metric for the financial performance of the insurance companies that offer agricultural micro insurance products.

3. METHODOLOGY

3.1 Introduction

This chapter contains the details of the procedure employed in conducting the study. The research design, target population and the model definition and specification.

3.2 Research Design

This study used a descriptive research design. This design will enable the use of descriptive statistics in the data analysis segment. The variables of this study are the profitability index and the factors affecting the profitability index. These factors include the loss ratios and the acreage. The dependent variable is the profitability index and the rest are the independent variables.

3.3. Target Population

The target population is Kenya's insurance companies. There are only seven insurance companies in Kenya that offer any form of agricultural insurance.

- Kenya Oriental: indemnity insurance (MPCI)
- Heritage Insurance: indemnity insurance (MPCI)
- Jubilee: indemnity insurance and index based insurance
- APA Insurance: indemnity insurance (MPCI) and index based insurance
- CIC Insurance: indemnity insurance (MPCI) and index based insurance
- UAP Insurance: indemnity insurance (MPCI) and index based insurance.
- ICEA LION: index based insurance (WII)

3.4 Data Collection Procedure

The data collection methods used in this research involved secondary data obtained from records of insurance companies and AKI reports.

3.5 The Data Analysis Technique

The technique will involve fitting data into a simplified version of the model of agricultural insurance suggested by Islam et al. (1999). Islam 1999 used the model on agricultural insurance to evaluate the relationship between the optimal output and asymmetric information that is moral hazard and adverse selection. The study tried to estimate yield with and without insurance. This study on the other hand will use the model to estimate the profitability index with indemnity insurance products and index based insurance products.

3.6 Model Definition and Specification

The model used in this study is a replication of the model of agricultural insurance used by Islam et al. (1999). Given that this study was aimed at determining the profitability of agricultural insurance, a comparison of the profitability with an index based insurance cover, the profitability with indemnity based insurance cover and the profitability with a combination of both indemnity and index based was used to make inferences.

$$\gamma_1 = f(p, i, a) \dots \dots \dots \text{(I)}$$

$$\gamma_2 = f(p, i, r) \dots \dots \dots \text{(II)}$$

$$\gamma_3 = f(p, i, r, a) \dots \dots \dots \text{(III)}$$

γ_1 – The loss ratio of indemnity based insurance i – indemnity paid

γ_2 – The loss ratio of index based insurance a – average administration cost

γ_3 – The loss ratios of the combined r – index trigger

p – average premium received

Equation I of the model represents loss ratios with indemnity based insurance, equation II represents loss ratios with index based insurance and equation III represents a combination of both.

Loss ratio for indemnity based insurance is influenced by average administration cost, indemnity paid and average premiums received. Loss ratio for index based insurance is influenced by indemnity paid, index trigger and average premiums received. Loss ratio for a combination of the two is influenced by indemnity paid, index trigger and average premiums received and average administration cost. The generalized model equation is:

$$C = \alpha_i \gamma_i + \alpha_i \beta_i + \alpha_{i_2} \delta_{1_2} + \epsilon_i \dots \dots \dots (IV)$$

C – profitability index

β – number of acres

α – the coefficient relationship

δ – other factors

γ_1 – the indemnity index loss ratio

γ_2 – The index based loss ratio

γ_3 – the combined index and indemnity loss ratio

$i = 1, 2, 3$

$i = 1$ indemnity based insurance

$i = 2$ index based insurance

$i = 3$ combined index and indemnity

$\epsilon = error$

3.6.1 Model Explanation

The model aims to describe the profitability index. The profitability index is the best index to describe the financial performance of a company based on (Hueth & Furtan, 1994). It will be used to answer the research question of “*What factors affect the profitability of an agricultural insurance product?*”

From the equation, α is a coefficient that will be used to determine the correlation between profitability and the variables that affect the profitability index.

The loss ratio described as γ will seek to answer the question “Is index based insurance product more effective than indemnity based insurance product as a risk management tool?”

The operation efficiency i.e. (administration cost, and the area coverage of the insured products) relationship to profitability is measured using $\alpha_{i_2}\delta_{1_2}$.

The error term means that the model will not be completely accurate, and will result in differing outcomes during real world applications.

3.6.2 Linear Function for Index Based Insurance

Skees (2003) mentions two types of index insurance, those that are based on area yields where the area is some unit of geographic aggregation larger than the farm and those that are based on weather. He further suggests a way of calculating indemnity as

$$\text{indemnity} = \max\left(0, \frac{\text{index trigger} - \text{realized index trigger}}{\text{index trigger}}\right) \times \text{Liability}$$

Index trigger is the product of a coverage level selected by the policyholder and the official estimate of the expected county yield per acre. Coverage usual levels range from 70 to 90 percent in 5 percent increments.

$$\text{Liability} = \text{Expected County Yield} \times \text{Indemnity Price} \times \text{Scale} \\ \times \text{Farmer 's Planted Acreage}$$

Skees (2003) gives an example using the US agriculture insurance. If the corn yield forecast for the county yield is 100 bushels, the farmer can obtain a contract that will pay any time the actual estimate of the county yield is below 90 bushels (the trigger= 90 bushels). Assume that the expected price on corn is \$2.00 per bushel. The farmer can purchase a liability that is equal to 150 percent of the product of the expected county yield and the expected price, times their acres planted.

The calculations for a farmer with 100 acres follow:

$$\text{Liability} = 100 \times \$2 \times 1.5 \times 100; \text{ or } \$30,000$$

If the farmer has a yield average that is above the county they have incentives to purchase the maximum protection or liability by using the maximum scale factor of 1.5. For a farmer who purchases a 90 percent coverage level, indemnity payments will be calculated by multiplying the percent shortfall in county yields times the \$30,000 of liability. Thus, if the realized estimate of county yields for the year is 60 bushel (which is 1/3 below the 90 bushel trigger) the indemnity payment calculation is

$$\text{Indemnity} = (90 - 60) / 90 * \$30,000; \text{ or } \$10,000$$

Premium payments are based upon premium rates. Thus, if the rate is 5 percent for the 90 percent coverage level policy, the calculations for the premium would be

$$\text{Premium} = .05 \times \$30,000; \text{ or } \$1,500.$$

This study will use the mentioned formulae to calculate the liability, indemnity and the average premiums in the insurance companies that use index based insurance product. The found figures will be used to calculate the loss ratio of index based insurance in order to be used in the general profitability equation.

3.6.3 Linear Function of Indemnity Based Insurance.

Hazell (1992) supported that multi-peril crop insurance has been underperforming because the premiums collected by insurance companies would exceed the administration cost and the indemnities paid out. He calculated the insurance actuarial performance using the equation below:

$$\frac{A + I}{P} < 1$$

A = average administrative costs

I = average indemnities paid

P = average premiums paid

The equation was used in the study to show that the government supported insurance program was paying nearly 50% of indemnities. Skees (2003) also noted a ratio of 4 for US crop insurance from data historic data, this shows that the insurance was operating on extremely high loss ratios.

This equation will be used in this study to calculate the indemnity based loss ratio that will be used to measure profitability in the general equation.

4. RESULTS AND FINDINGS

4.0 Introduction

This chapter gives the results from regression analysis. In section 4.1, the analysis and results will be outline. In section 4.2, the limitation of the study will be outlined.

4.1 Analysis and Results

To answer the research question 1, *what factors affect the profitability of an agricultural insurance product?* A regression and correlation analysis was carried out between accumulated profits and accumulated acres and loss ratios.

Figure 2: Results from correlation

	CORRELATION	PVALUE
ACCUMULATED ACRES	0.819041583	0.004249032
ACCUMULATED LOSS RATIOS	-0.407157533	0.017534883

From the results, the value of profits is correlated to acreage and loss ratios. It is highly correlated with acres than with loss ratios. This is because premiums are charged by acre and claims are paid by acre (Kerer, 2013). Profit is premium less claims. It is therefore expected that acreage will be highly influence profits. Profits are correlated with acres with 0.8 units. Insurance works on the principle of risk pooling. The higher the numbers of acres covered, the higher the probability of making a profit since it is highly unlikely that all farmers in the country will experience the same amount of loss at the same time. Therefore profits and acres will have a positive relationship.

The loss ratio and profits have a negative relationship of -0.4. The lower the loss ratio, the higher the profit and the higher the loss ratio, the lower the profits. This is because a loss ratio is the ratio of claim and premium received. For example, in scenario 1, collected premium is 1000\$ and claims are 800\$; in scenario 2, premium collected is 1000\$ and claims are 200\$. The loss ratio in scenario 1 is 80% while the profits are 200, scenario 2, loss ratio is 20% and profits is 800.

Both variables have a P Value that is less than 0.05. This implies they are both statistically significant. From the above analysis, it is concluded that loss ratios and acreage influence the profitability of an insurance company.

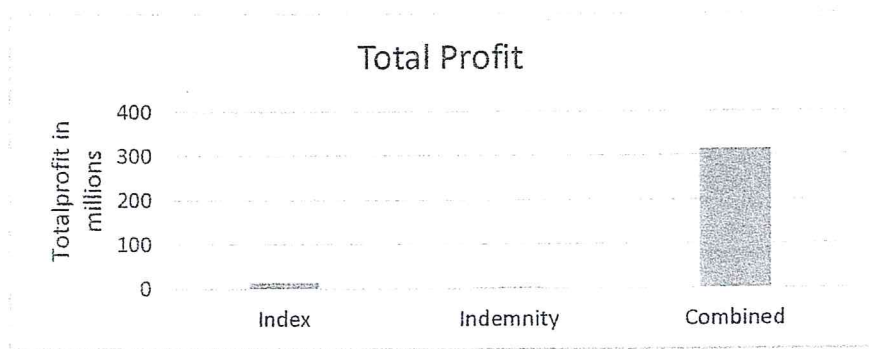
However, to answer research question 2; *is there a relationship between profitability of an insurance company and the type of agricultural insurance product offered?* The loss ratio will be further analyzed to determine if there is a relationship. A correlation test between accumulated profitability and the different types of products loss ratios (index, indemnity and combined index and indemnity) will be carried out.

Figure 3 Correlation of profit with insurance products

	ACCUMULATED PROFIT	COMBINED LOSS RATIO	INDEX LOSS RATIO	INDEMNITY LOSS RATIO
ACCUMULATED PROFIT	1			
COMBINED LOSS RATIO	-1	1		
INDEX LOSS RATIO	-1	1	1	
INDEMNITY LOSS RATIO	1	-1	1	1

When profits move up by 1 unit, the loss ratios for combined and index loss ratios move down by one unit. This is because the higher the loss ratio the profitable the insurance company since it's the ratio between net claims to net premiums. The relationship is opposite for indemnity product. This leads to a conclusion that pure index based and combined indexes are more effective than indemnity based insurance. To further explain this, a graph of profit versus type of products will be used.

Figure 4 Relationship between profit and type of insurance cover

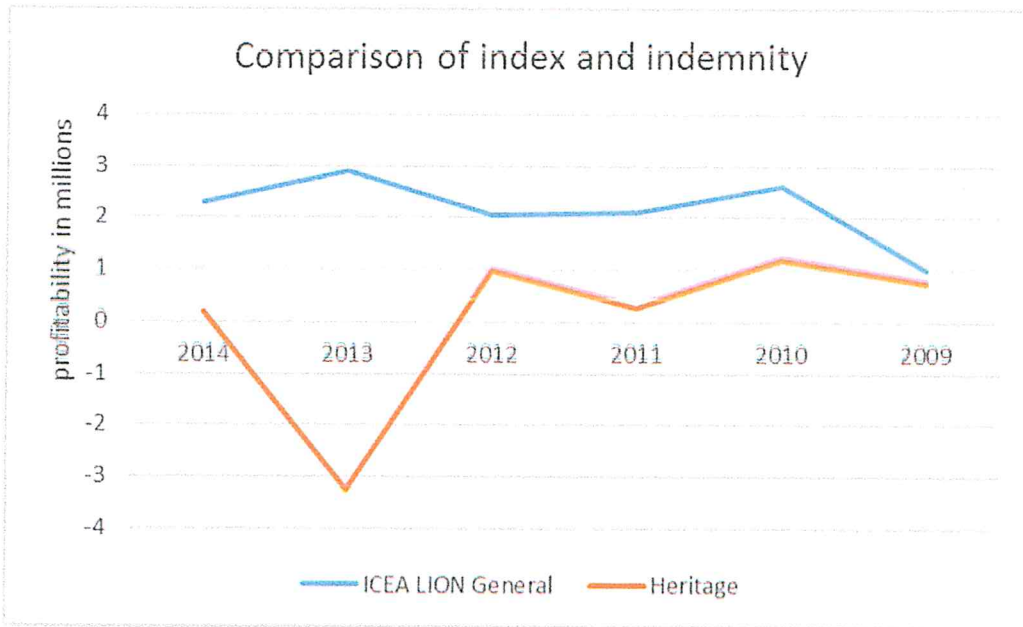


Source collected data

Figure 4 shows a plot of total profits among the products. The companies that offer a combination of index based products are more profitable than those that offer pure index based products and indemnity based products. Pure index based products are more profitable than indemnity based products.

This study seeks to find out why and index based product is more profitable than indemnity product. To do this, two companies' profits from both categories will be analyzed over the last five years. For a fair comparison, the companies with the highest profit in each category was chosen, that is ICEA LION and Heritage Insurance

Figure 5 Comparison of Profitability Index and Indemnity Insurance



Source data collected

Figure 5 shows a comparison of the profits for ICEA LION and Heritage Insurance over five years. It's a graph that the study uses to compare the performance of pure index based contracts and indemnity based contracts over five years.

Figure 6 Loss ratios over five years.

YEAR	ICEA LION	Heritage
2014	1%	4%
2013	0%	243%
2012	22%	70%
2011	10%	90%
2010	0%	20%
2009	60%	65%

Source data

Figure 6 shows the loss ratios of ICEA LION and Heritage Insurance over five years

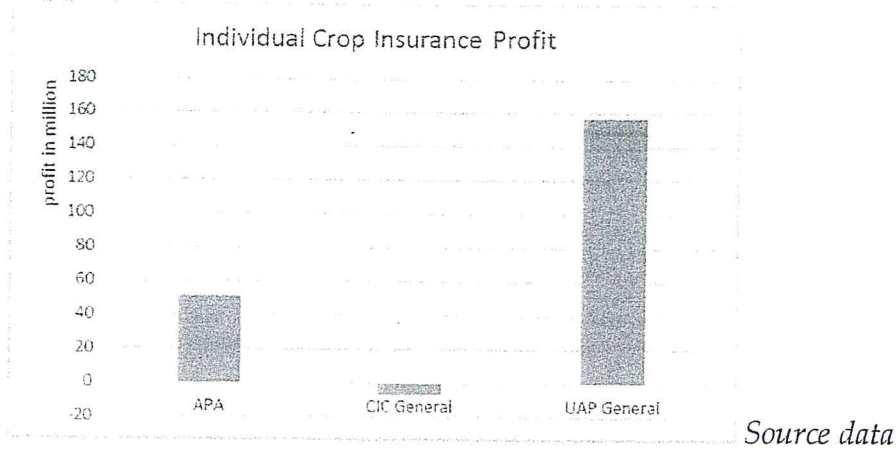
From figure 5 & figure 6, both companies had a high loss ratio in 2009. ICEA LION offered indemnity based insurance in 2009 and started offering pure index based contracts from 2010 (Sina, 2012). The company saw its lowest profits in 2009 and an increase in profit as the years progressed. This shows that index based products are more profitable than indemnity based products.

The company has very low loss ratios compared to Heritage Insurance which offers only indemnity based insurance. In the year 2013, Heritage insurance paid the most claims while ICEA LION made the highest profits in five years. This is because in 2013, ICEA LION, received premiums and they paid zero claims while their counter parts paid the most claims in the five years. According to the weather stations, the rainfall was normal hence there was no index trigger in the case of low yield nullifying claim payment (Sina, 2012). On the other hand, Heritage insurance was forced to pay claims because low yields triggers payment. This shows that index based insurance is more effective than indemnity based insurance when mitigating risks.

From figure 4, companies that offer both index based and indemnity based insurance are more profitable than the pure products. The companies that offer combined products are UAP, APA and CIC General. The financial performance of the three are shown below.

Figure 7 Crop Insurance Profit for Companies that Offer Both Index and Indemnity Contracts

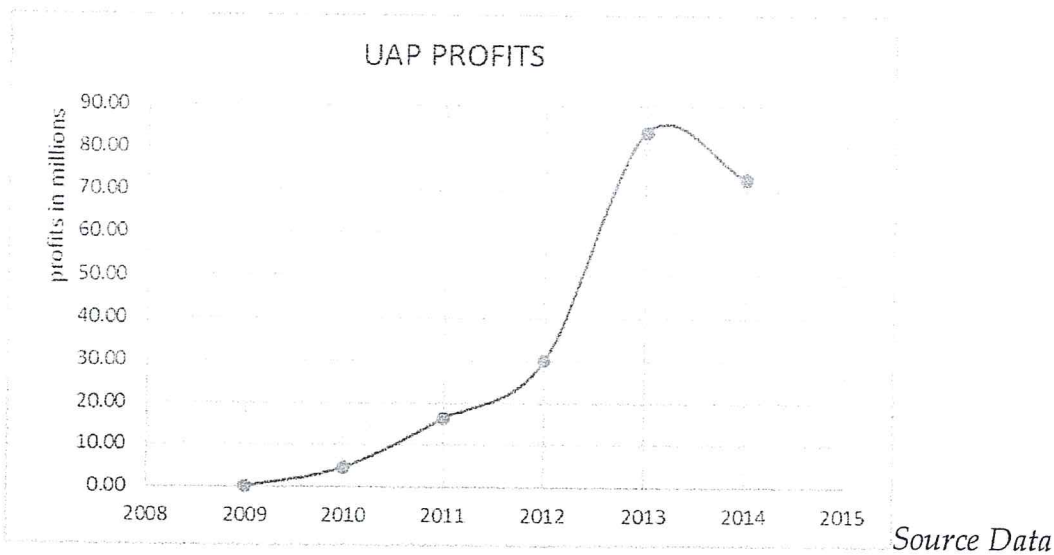
The figure7 shows the financial performance of UAP, APA, and CIC General over a period of 5 years.



In the table above, UAP is the most profitable insurance company in agriculture. Sina (2012) found that UAP has been the most successful because it was the first to pilot index based products as well as an effective marketing strategy.

Figure 8 UAP Profits over five years

This figure shows the profits for UAP over the last five years.



The profits have been increasing steadily over the years. UAP index based insurance was introduced in 2009 through a partnership with Syngenta Foundation. The product is known as Kilimo Salama. The product was offered to over 200 maize farmers. There wasn't any payout in the 1st year because the rainfall was adequate. Sina (2012) attributes the success of UAP to the partnerships it formed over the years. Through Syngenta, the company managed to pilot its first index product. The distribution for the product is through Agrovests a factor that contributes to its success. Kilimo Salama offered farmers more than just insurance: insured farmers receive tailored extension messages using the local weather information from nearby automated weather stations hence making it more efficient. In 2010, "Kilimo Salama Plus" a new extension was introduced and developed a focus to go beyond just inputs and give farmers the opportunity to insure the value of their harvest. This led to the program insuring over 47,000 farmers in its second year and the number has been increasing and up to date they have over 100,000 farmers.

To conclude from the above analysis, the study has found out Index based insurance is more effective than indemnity based insurance. In addition, in order for an insurance company to make substantial profits, it should offer a combination of index based and indemnity based insurance contracts.

4.2 Limitation of the Study

The limited period over which the analysis was based had limited the amount of data available for a credible analysis to be conducted. This is because agriculture insurance is still fairly new and hence the only available data is from 2009. In addition, crop insurance is not considered as a major class. It is classified under miscellaneous classes making available secondary data to be estimates hence high margin of error.

The study has modelled only two factors which can affect profitability of an insurance company. In reality there are many factors which can affect profitability for example, a farmer's ability to cater for the products efficiently. This is qualitative data which cannot be measured by statistics. Other factors that affect profitability of an insurance company

are, the types of crops covered, the county covered and the methods of weather data collection.

This study analyzed crop insurance as an independent insurance product. In reality, crop insurance is sold in conjunction with livestock insurance. Therefore the independent contribution of crop insurance to financial performance of a company cannot be accurately predicted.

5. Discussion, Conclusions and Recommendations

5.1 Introduction

The study was conducted to figure out why there was a high loss ratio in companies that offer crop insurance in Kenya in the year 2014. From research, study found out that insurance companies offer two types of insurance contract that is index based and indemnity based insurance. This led to the research objective and questions of finding out what factors affect profitability of an insurance cover; what is the relationship between profitability of a company and the product offered and which product is more profitable and efficient.

The study used data from seven insurance companies that offer crop insurance to find out the relationship and effectiveness of the products. Use of simulation of variables, correlation tests, and regression analysis were the major quantitative tools used to analyse the data availed.

5.2 Summary

The results showed that there are two factors that affect the profitability of a company that is the acres covered and the loss ratios. The results further showed that companies that offer a combination of index based insurance products and indemnity products are more profitable than those that offer pure index based and indemnity based products. In addition, it also showed that pure index based insurance is more profitable than pure indemnity products.

5.3 Discussions

Index based products are more effective than indemnity based products because it eliminates the challenges faced by traditional crop insurance (Cole et al. ,2012). It eliminates field assessment hence its cost effective, it eliminates adverse selection and moral hazard of the farmers, and it ensures transparency with its calculation of claims and facilitates reinsurance and access to financial services (Goodwin and Smith, 1995).

A company that combines both index based and indemnity products is more profitable than a company that offers pure index products. This is because pure index products faces challenges that is basis risk and lack of historical data that will ensure affective calculation of loss (World Bank, 2011) . A combination of both indexes is more profitable in the Kenyan market because they eliminate each other's short falls. However, in the most profitable company that is UAP, the percentage of index based to indemnity based insurance is in a ratio of 70:20 (Sina, 2012). Therefore, pure index based insurance products have a potential to be profitable if more farmers are educated on how the product works and when accurate historical data is used to measure weather indexes.

5.4 Conclusions

To conclude, the study has effectively shown that the type of crop insurance product offered affects the profitability of a company. It therefore in overall affects the financial performance of the company. In 2014, the companies that experienced the most losses are the companies that offer pure indemnity. Therefore the loss in that year can be attributed to the type of product offered.

5.3 Recommendation

The study has been limited by lack of long-term data. The study has also analyzed crop insurance as an independent insurance product. To ensure accuracy of results, insurance companies should write crop insurance and livestock insurance as separate products. This will enable them to understand the singularity effect of each on profits.

One possible extension of the study is to analyses factors that hinder the successful performance of pure index based insurance in Kenya.

The study recommends that companies that offer pure indemnity products, should offer a combination of index based and indemnity based products in order for them to eliminate losses.

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