Proceedings of the First Australian International Conference on Industrial Engineering and Operations Management, Sydney, Australia, December 20-21, 2022

Why is the Variation of Weather Insurance Index Adoption/ Uptake Exhibited as such among Small Holder Farmers: Testing the Theory of Technology Adoption if it Applies, Case of Zambia

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Abstract

Understanding the reasons why smallholder farmers do not use financial instruments to protect themselves against losses brought on by climate change concerns is currently a subject of rising relevance. Getting to the bottom of the underlying issues contributing to this status is important for future designs of financial innovations like a weather insurance index (WII) that can help farmers hedge their losses. Therefore, this study considered testing the 5 technology characteristics that Rodgers identified for uptake to take place. These include trialability, complexity, compatibility, relative advantage, and observability, covering a period from 2014 to 2020. The study used a concurrent mixed-methods approach to ensure both quantitative and qualitative aspects of the study were considered, given the complexity of the inquiry. The study used purposive sampling to select 4 districts in Zambia: Choma, Petauke, Chongwe, and Mumbwa using the standard sample size table provided by Sekeran (2003), which provided for a sample size of 1024 at a concentration of 0.035 with an accuracy level of 95% confidence. The farmers were interviewed using structured questionnaires. An IBM statistical analysis in social science (SPSS) was used to analyze quantitative data, and thematic analysis was used to analyze qualitative data. From the study 50.82% of the farmer's said WII is not consistent with the p-value of 0.001, which was significant, and further, 40.8% of the farmers indicated the importance of bundling the services to have relative advantages of the product with a p-value of 0.001. 47.87% of farmers indicated they were not satisfied with the payout system, with a p-value of 0.001, which was significant. The study concluded that paying attention to the innovation characteristics as suggested by the diffusion innovation theory by Rodgers is important and that the theory can extend its views by considering the functionality of the market. Farmers do not adopt innovations at the same time, which has practical ramifications for the study's findings.

Keywords
Uptake, Weather insurance index, financial diffusion, and Adoption.

1. Introduction and Background

The issues of low productivity and poor access to technical information have challenged the smallholder farmers for a long time in the agricultural sector in most developing countries including Zambia(Ngoma et al., 2021). Complex Climate change problems continue to be one of the factors that pose a threat to the future production and productivity of smallholder agriculture (Muhammad et al., 2018). In many developing countries, there is enough evidence which shows that the majority local and rural communities involved in agriculture are the most marginalized among many agricultural based stakeholders(Branca and Perelli, 2020; Nara et al., 2021). Some researchers have posited that smallholder farmers are marginalized in the market systems because of the business risks they are involved in which are termed as multidimensional in nature(Rapsomanikis .,2015) . Therefore risk transfer mechanisms, such as weather index insurance (WII) which have been proven in recent times to help buffer farmers against many complex hazards are being suggested (Munkombwe et al., 2022; Mwiinde et al., 2022). However, WII programs struggle to attract the clients most in need of protection, including marginalized women and men (Aheeyar et al, 2019). Evidence shows that the uptake levels of WII varies from country to country according to the implementation strategies (Bucheli et al., 2022). Worse off, the uptake of WII between farmers is also considered insignificant as shown by many studies(Jianjun et al., 2015; Olorunfemi et al., 2020) To some extent this can be attributed to the level of technology maturity, a country's level of social-economic development and the financial transactions ecosystem (Wamuyu,2017). In some case, the political buy in have been cited as another reason that trigger the uptake level of WII insurance in some developing countries such as Bangladesh , Angola and Kenya (Global Hunger Index, 2021; Janzen et al., 2021). It, therefore, requires and calls for different practioners in the sector to re-think the workable solutions that offer continued hope for smallholder farmers to increase their agriculture production and productivity while mitigating the challenges of climate change. Weather Index Insurance (WII) tend to increase the ability of vulnerable farmers to face climate shocks and disruptions(Munkombwe et al.,2022). Weather index insurance has been designed to using mainly satellite images to help predict damage and assess losses and also helps to facilitate faster compensation payouts for farmers (Siankwilimba et al., 2022; Wang et al., 2019). However supportive the programs have been, Fernado et al (2021) submitted that they still struggle to attract the clients most in need of protection. Why?(Fernado et al.,2021). Indeed, while use of insurance products for transferring weather risks holds much promise, practical realization of sustainable and scalable products in developing country contexts is an ongoing effort. Understanding the underpinning reasons for participation and utilization of certain financial innovations becomes important. The financial innovations choices should be answering the interests of different stakeholder including customers, farmers, and government or policy makers to some extent. The level of engagement and awareness required would be difficult without the support of local partner organizations such as local Non- Governmental Organizations (NGOs), multinational organisations and Micro-Finance institutions. According to Rachael McDonnell "Insurance needs to be seen and understood from a resilience lens and also from the lens of climate justice, where ensuring social inclusion is central."(Fernado et al., 2021).

Famers, however, have tried to put up mitigation measures to the problems of climate challenges including growing early maturing crop varieties. Despite these traditional risk management measures, research has established that risks which the smallholder farmers face are not fully eliminated. In fact, Hott et al (2023). observes that the measures tend to be sub-optimal, limiting the potential to earn more, and at times costly to implement.

To buffer against such risks, and to encourage investment in intensified and high-value production, weather-index insurance (WII) is increasingly suggested for smallholder farmers (Munkombwe et al., 2022) .

From this scenario, it appears that there is a problem from both the demand and supply side of Weather insurance index. The insurance companies are not marketing or selling the instrument aggressively to the smallholder farmers and hence adoption remaining low or poor. If this status quo of poor uptake of the weather insurance index continues, the future of the small-scale farmers and the agriculture sector remain threatened. It is for this reason that a pragmatic study on enhancing uptake of weather index financial innovation among the smallholder farmers was sought aimed at developing recommendations that would help stimulate the demand for the WII by the small-scale farmers. The study was guided by the financial diffusion innovation theory as the main theory supported by the technology adoption theories and market systems development.

1.1 Research objectives

The main objective of the study was to examine the variation in diffusion of weather insurance index financial instrument by smallholder farmers in Zambia.

1.2 Specific objective

To support the main objective, the study focused on two distinct goals, namely:

1. To examine variations in the diffusion (understand the extent) of weather insurance index uptake among the smallholder and emergent famers.
2. To test the theory of innovation diffusion if it applies in explaining the uptake of WII

2. Literature Review

2.1 Progress Made in Weather Index Implementation

Literature indicates that, over the past decade, as early as 2005, more than US $40 million has been committed to WII programs in developing nations, including at least eight countries in Eastern and Southern Africa(Adeyinka et al., 2022; Jensen et al., 2016)). For example, USAID has funded several programs that have been implemented by United States (US) agricultural universities. Through the World Bank, more money has been set aside for experimental programs in Africa (Carlos, 2016). A review of these programs raises several important questions. Is WII fulfilling its goal of helping smallholder farmers manage risk? Do the farmers see a value proposition in acquiring the insurance? Are the technical constraints to providing a cost-effective product being resolved? Is the WII becoming commercially profitable? Are there any signs that commercial insurance companies will expand investments in WII on their own? Are there any thoughtful strategies in place to promote the technological characteristics of farmers? If the basics are not addressed, adoption may be a nightmare. The underlying problems and evidence must be found to explain why the status quo of low uptake has stayed the same. Many developing countries have gotten involved because of subsidies. This means that the intervention is driven by donors, which is questionable because it is either based on what the farmers really need or, as usual, tries to force solutions on the farmers. Mahul and Stutley (2010) carried out a study on a sample of 65 countries (including seven of the eleven countries offering insurance in Africa) concluded that agricultural insurance penetration was mostly low in large parts of the surveyed countries, particularly in low- and middle-income countries, where it was less than 0.3%.

As we keep looking at the problems with getting people to use WII, we must remember that farmers face many different risks and have come up with many ways to deal with them. Most of the time, weather and biological factors like disease and pests cause risk during the production cycle. Such production risks can be managed by a combination of strategies. Typically, and most often, farmers do not know whether rainfall will be good or bad over a season; they do not know the prices they will receive for produce sold; and they do not know whether their crops will be infected by disease. These risks are not under the control of farmers, but some have developed ways of coping with and managing them (Karlan, 2014; Carlos, 2016;). However, the farmer's resilience net should begin with some measures he may have some level of control over. First, mitigation measures (such as good agricultural practices, irrigation, and drainage) lower the losses when risks are realized. Second, risk transfer instruments (i.e., insurance) shift all or some of the risk to a third party in exchange for a fee. Lastly, coping strategies (like selling assets, reducing consumption, moving, or getting help from the government) lessen the effects of realized risks that cannot be reduced or moved. In practice, farmers tend to rely on all these strategies. The combination chosen depends on the country's risk profiles, levels of institutional and market development, and fiscal constraints (Khan, 2008; Carter et al., 2011). So, getting farmers to use new technologies like WII will require a process that helps them understand and value the technology, starting with the reasons why they should use it instead of other ways to deal with climate change. Farmers may be more likely to use new technology if they understand how it works, but this needs to be combined with efforts to change the way farmers think, such as by being open, building trust, giving them information, and letting them learn by doing. Farmers have different reasons why they can or can't use certain technologies, so promoting WII should take these different types of farmers into account. In fact, how and why individuals adopt innovations has motivated a great deal of research (Straub, 2009).

Traditional weather insurance products, which are mostly sold in developed countries, are meant to cover a wide range of production risks(Janzen et al., 2021). These products include named peril crop insurance (NPCI), in which the insurance claim is calculated by measuring the percentage of damage caused by a specific, named weather loss in the field soon after the damage happens, and multiple peril crop insurance (MPCI), in which multiple sources of loss (like hail, drought, and floods) may be considered. Both sorts of policies tend to be yield-based. Usually, an insured yield is calculated as a percentage (usually between 50% and 70%) of the farmer's average historical yield. If the actual yield is less than the insured yield, the insurance company pays an indemnity (Carlos 2016).

Several scholars such as Ghosh et. al. (2020), Raj and Hall (2020), and Kim et. al. (2020) claimed that traditional agricultural insurance products have been hard to adapt for small-scale farming in developing countries, even though they work well in developed countries. Ghosh et. al. (2020) and Raj and Hall (2020) believe that the reasons for the problems are that the countries don't have much commercialization, the average farm size is small, farmers are spread out geographically, there is fraud and adverse selection, and transaction costs are high. But the question of whether a person will use a certain technology and how long it will take them to decide has been studied for a long time in many fields and affects business, school, and everyday life (Straub, 2011). Therefore, it is essential to understand such aspects of the process as the following Why does one individual choose to adopt a technology while another resists? What is the influence of social context on the decision to adopt? The theories of adoption and diffusion (Straub 2011, Kiwanuka, 2015) try to answer these questions.

Therefore, understanding the different perspective around innovation/ adoption will require interrogating and relating theory to the way people adopt technologies. Past studies on technology adoption have focused predominantly on a single action (i.e., a snapshot – to adopt or not adopt) (Miguel et al. 2012) without considering other actions (e.g., information search, evaluation and trial). Such explanation prevents a holistic understanding of the technology adoption process especially for organisations having widespread technology resources where the process needed to arrive at the final decision is a far more complex phenomenon (Salim et al. .2014).

Rodgers (2003)'s diffusion of innovation theory considers five constructs that influence technology adoption. The constructs include complexity-(how difficult it is to understand), observability visibility, compatibility (consistent), trialability(experience) and relative advantage(usefulness)(Rodger 2003;Wamuyu 2017; Dube 2017).

2.2 Weather insurance index Innovation contribution toward solving the problems.

Climate change and social and economic vulnerability are big problems for development, and they often need systematic and systemic solutions to fix them(Siankwilimba et al., 2021; Sweeney and Sterman,2000). Index-based microinsurance for weather risk transfer could be a part of long-term management solutions that can be scaled up (Kaunda and Chowa. 2023).

A multifaceted strategy that considers supply and demand dynamics may be necessary to solve the issue. For a farmer to have the chance to escape poverty, several players on the agriculture market must work together to provide the necessary services. These players include the policy environment, capacity building and extension services, regulations, innovation platforms, and traditional leadership that upholds and oversees the regional fabrics. Therefore, it will take coordinated efforts to create an equilibrium between supply and demand in the small business insurance program. when farmers purchase insurance, they tend to increase investments in inputs such as fertilizer and enterprises with higher risks (Cai, 2016; Karlan et al., 2014). Taking up agricultural insurance not only led to increased incomes, but also decreases income fluctuations (de Nicola, 2015).

2.3 Market systems helping to solve the uptake puzzle

Many donors and development agencies that defined a "market system as a multi-function, the multiplayer arrangement comprising the core function of exchange by which goods and services are delivered and the supporting functions and rules which are performed and shaped by a variety of market players" (Garloch, 2015). Market systems include households and communities that thrive to operate and benefit from the operations of the market system . The low expansion and uptake depicted above could be seen as a snapshot of past market development trends which are not well functional. Studies also show that non-functional markets lack coordination and organization among market participants, which results in a lack of grading systems and standards, which is made worse by a lack of accountability and transparency(Hasin et al., 2014; Mutambara, 2015;Raj and Hall 2020).

3. Methods

Our research follows an interactive approach with the communities. Therefore, setting the right enquiry for the challenge of smallholder poor uptake of WII sets that basis for unlocking the puzzle. It required establishing the reality on the ground with the different stakeholders that include the farmers, insurance companies, input suppliers and government agencies. This required to have both the ontology (positivism) , realistic and rationalist approaches .Therefore, the study used qualitative and quantitative or a mixed method and pragmatic approach as propagated by (Cresswell et al., 2013). Cresswell et al.(2013) advise that qualitative inquiry is necessary to deepen the understanding of issues from the farmers while quantitative plays a critical role for generalisation after induction inquiry is done.

The choice of questions was done carefully to allow the farmers to bring out the inner issues on adoption of WII. Focused group discussion was conducted to ensure rich and deep discussion with the farmers on WII over the period from 2017 through up to 2020. The quantitative approach brought out the status core of the adoption rates, perceptions or understanding on the technology characteristics to establish quantitatively the viewpoints and the established reality on the ground. The qualitative approach brought in and attached meaning to some of the numbers and further pushed in for detailed explanations why the farmers expressed themselves as such. This required structured discussions with the farmers. Further thematic analysis was employed to understand the trends around certain themes such information asymmetric for example.

Bivariate and multivariate analysis was used statistical package SPSS was used to help with descriptive statistics. A mixed approach was used because qualitative and quantitative methods can also support each other, both through a triangulation of findings and by building on each other (e.g., findings from a qualitative study can be used to guide the questions in a survey). For qualitative analysis, thematic network analysis which take more of the exploratory approach which the study is looking at and framework analysis was used. For quantitative data, used statistics to summarize the data, describing patterns, relationships and connections. Statistics can be descriptive or inferential. The study, therefore, followed an analytical cross-sectional survey design as it envisioned seeing the frequency, characteristics, and snapshot picture of the utilization of WII in the four clusters namely Choma, Mumbwa, Chongwe and Petauke no weights were used. As mentioned briefly, for descriptive statistics real numbers and percentages were reported for the study did not have continuous variables. Further, bar charts, pies were used to present the percentiles or proportions. For bivariate analysis to check for associations between categorical variables against the outcome uptake of WII the Chi squared test were used for variables that satisfied the assumptions of the Chi squared test which had the sample of five and more, however for those variables that did not satisfy the assumption the Fishers exact test was used at 95% confidence interval. Any p-value that was below 0.05 was deemed significant. To check for further associations at multivariable analysis and further adjust or control for confounding between utilization and factors associated with utilization, the simple and adjusted multivariable logistic regression were used.

4. Data Collection

The study used the multistage sampling procedure to obtain the farmers covered by the study . The districts were purposively sampled. The vulnerability assessment of the district was considered before selecting the districts. The selected provinces and districts are suitable because the areas are prone to adverse weather effects and have farmers that both participated on the government supported WII and the private sector driven WII and this gave a broad perspective of adoption and diffusion. Climatic shocks such as prolonged dry spells and late onset of rains impacted negatively on agriculture production during the 2017/18 agriculture season, while flash flooding in some southern districts in Zambia led to widespread leaching and loss of crop nutrients. At district level different agricultural camps were sampled to get the different perspectives of farmers from the different farming communities and villages. 1024 farmers were sampled from the 4 districts of Choma, Mumbwa, Petauke and Chongwe districts.

5. Results and Discussion

5.1 Numerical Results

5.1.1 Demographic characteristics

Table 1 shows the demographic study results.

Table 1. The demographic study results.

Variable		Utilized WII	Didn't Utilize WII	P-value
Age	15-20	12(3.93%)	3(3.30%)	0.234f
	21-35	57(18.69%)	18(19.78%)	
	36-50	137(44.92%)	31(34.07%)	
	>50years	99(32.46%)	39(42.86%)	
Gender	Male	237(77.70%)	70(76.92%)	0.875c
	Female	68(22.30%)	21(23.08%)	
Education	Tertiary	25(8.20%)	8(8.79%)	0.975f
	Secondary	107(35.08%)	30(32.97%)	
	Primary	158(51.80%)	49(53.85%)	
	No education	15(4.92%)	4(4.40%)	

Marital status	Single	57(18.69%)	19(20.88%)	0.585C
	Monogamously married	208(68.20%)	57(62.64%)	
	Polygamously married	40(13.11%)	55(13.89%)	

The study interacted with a total of 1024 farmers of which 77.70% were male farmers and 22.3% of their female counterparts indicating agriculture as a male dominant sector. 68% were monogamously married families and 18.69% were single or not married with majority being women households. 44% of the farmers engaged were between the age range of 36-50 years old representing the very active age that is involved in agriculture production ,18.69% represented the age between 21years to 35 which represent an active age in agriculture production but similarly should be an age that is receptive to new ideas and but also more vulnerable to agriculture risk such as climate change, cost of production, limited agriculture finance and limited mitigation measures. 51% indicated those had reached up to primary educated, 35.08% indicated secondary education whilst 4.92% indicated those that had not attained any education at all. It was clear from the findings that without information and awareness of the technology, gender, education, and marital status had limited influence on the adoption process of the WII in the context of Zambia and the specific districts. The farmers needed some level of awareness to appreciate WII as an innovation to the farmers. To some extent we see the active youthful age of between 15-20 years indicating some relationship though weak similarly gender had an influence on some extent though weak. But this indicates and agrees with the diffusions theory that indicates some prerequisites for technology adoption. The clear case of less influence shows that the farmers across all the ages had on adequate interaction of the technology and the insurance companies that are supposed to drive the process from the supply side. Indeed, some studies have indicated influence positively of some of the demographic's variables however, in this study not significant quantitatively but qualitatively depicts some gaps due to information asymmetric issues that are necessary for the farmers to understand the new ideas, products, innovations and or technologies.

5.1.2 Technology characteristics

Table 2 shows technology characteristics (Relative advantage, Complexity, Compatibility)

Table 2. Technology characteristics (Relative advantage, Complexity, Compatibility)

Variable		**Utilized**	**Didn't Utilize**	**p-value**
What are the reasons for not purchasing insurances	It is expensive	5(3.05%)	4(4.49%)	0.553
	it is not accessible	7(4.29%)	13(14.61%	0.004
	I see no benefit	3(1.84%)	4(4.49%)	0.202f
would you say WII is easy to use	Yes	209(68.52%)	11(12.09%)	<0.001
	No	96(31.48%)	80(87.91%)	
How would you describe weather insurance index as a climate mitigation instrument?	Complicated	63(20.66%)	17(18.68%)	0.681
	Not consistent	155(50.82%)	7(7.69%)	<0.001
	Expensive	25(8.20%)	6(6.59%)	0.617
	Very risk	52(17.05%)	8(8.79%)	0.054
What do think should be done to improve information provision on WII to farmers?	Increased farmer sensitization	279(91.98%)	82(90.11%)	0.687
	Increased rate of timely pay-outs	28(9.18%)	4(4.40%)	0.142f
	Clear information on the base rates	76(24.92%	14(15.38%)	0.057
How do you get your pay-outs from the insurance company	No clear known systems to the farmers	102(33.44%)	24(26.37%)	0.204
	Through the farmer cooperative chairman	54(17.70%)	4(4.40%)	0.001f
	Through the MoA system	152(49.84%)	19(20.88%)	<0.001c

	Through the insurance company	10(3.28%)	7(7.69%)	0.068

From the results obtained adoption of WII has a relation with the characteristics of the technology 50.82% of the farmers that utilized WII indicated that it was not consistent with p-value of <0.001 which indicated very strong relationship between WII adoption and its advantage in terms of consistence. Similarly, the payment systems where not clear to the farmers as the relationship between the farmers and the insurance companies was not there but the systems where between the Ministry of agriculture in terms of the source of payment systems with the P-value of -,0.001c indicting strong relationship as opposed to p-value of 0.068 through the insurance companies indicating very weak relationships with the farmers in-terms of an established and transparent payment systems. Similarly, the farmers indicated 0.001f p-value indicating a stronger relation amongst farmers as opposed to the insurance companies indicating a totally weak system with the insurance companies themselves in the eyes of the farmers. A clear and transparent payment systems driven by the insurance companies is more appealing to that farmer and hence may attract more farmers. In as long as the payment system seem to be complicated the farmer adoption is highly compromised just as the theory of technology adoption is indicating. The study as well indicated that 76% of the farmers indicated the need for increased information of WII which is critical if farmers are to appreciate and understand the WII. Lack of increased information has implications of farmers failing to understand firstly the benefits of WII, access, how it is used, what parameters WII considers, how other farmers have utilized WII and the cost structures making it difficult for sound decision for farmers.

The study established huge gaps in terms of information on WII. Regardless of the government driven supported program that interacts with farmers only 49.84% farmers indicated receiving information from the ministry of agriculture camp officers and indeed not even WII focused information. 91% farmers indicated the need to improve WII and that there was need to increase information provision to the farmers As the adoption theory indicates for the farmers to adopt the technology demonstrated experiential learning, demonstrated information provision , information of clear operative systems are extremely important if farmers are to adopt the technology.33% of the farmers indicated that there was no clear know payment system to the farmers which raises a lot of doubt for the majority farmers more especially the vulnerable farmers who are the target for such programs making them completely or impossible to adopt WII. 63% of the farmers indicated that WII was a complicated system that makes it difficult for them to adopt though the relationship with adopting was weak with a p-value of 0.681 which brings in the social dynamics and or the lack of clear understanding of information. Clearly the farmers need to understand the technology characteristic if adoption is to be enhanced. The process needs to take a process of pursuing strategies that allows the farmers learn, understand, try or experiment, believe and finally buy -in the technology.

5.1.2 Technology characteristic

Table 3. Relative advantage, observability, trialability

Variable		**Utilized**	**Didn't Utilize**	**p-value**
Satisfied with the pay-out time laps	Very satisfied	7(2.30%)	2(2.20%)	<0.001
	Satisfied	47(15.41%)	7(7.67%)	
	Partially satisfied	101(33.11%)	8(8.79%)	
	Not satisfied	150(49.18%)	74(81.32%)	
Satisfied with the pay-out amount you received	Very satisfied	9(2.95%)	2(2.20%)	<0.001s
	Satisfied	51(16.72%)	7(7.69%)	
	Partially satisfied	99(32.46%)	10(10.99%)	
	Not satisfied	146(47.87%)	72(79.12%)	
pay-out amounts were able to cover some of you loses?	Yes	65(21.31%)	9(9.89%)	0.014
	No	240(78.69%)	82(90.11%)	
How confident are you in investing more in WII?	very confident	40(13.11%)	14(15.38%)	0.001
	Confident	162(53.11%)	27(29.67%)	
	Barely confident	47(15.41%)	23(25.27%)	
	Not confident	56(18.36%)	27(29.67%)	

What do you think you can do to better the WII service?	Bundle WII with other services	122(40.00%)	3(3.30%)	<0.001
	More education on WII	193(63.28%)	65(71.43%)	0.152
	GRZ policy on climate mitigation to famers	42(13.77%)	1(1.10%)	0.001
	Increased participation by the insurance companies	71(23.28%)	14(15.38%)	0.107
Compared to the other insurance products, how would you describe WII?	Very effective	29(9.51%)	10(10.99%)	<0.001
	Effective	117(38.36%)	29(31.87%)	
	Very poor	93(30.49%)	5(5.49%)	
	Poor	66(21.64%)	47(51.65%)	
Would you say WII is profitable in your farming activity	Very profitable	27(8.85%)	11(12.09%)	<0.001
	Profitable	139(45.47%)	28(30.77%)	
	Average	89(29.18%)	12(13.19%)	
	Not at all	50(16.39%)	40(43.96%)	

From the result 49.13% farmers indicated they were not satisfied with WII, 33.11% partially satisfied and 2.3% very satisfied with p-value of 0.0001 that indicated a greater relationship with adoption of WII (Table 3). This is indicating that for the farmers to adopt and uptake WII, it must demonstrate real benefits that are addressing the farmer needs. If the advantages are not experienced by the farmers, this proves the theory of adoption that the innovation should have relative advantage for the farmers to adopt. If only 2.3% farmers saw benefits and 49.13% never saw any benefits adoption of WII in Zambia will take several years. this agrees with the theory technology diffusion. However, 78.69% of farmers indicated that they did not see any benefits from the payout they got. Most of the farmers indicated the payout were not sufficient to cover their resources and that they were given at a wrong time of the season, meaning they could not re-invest back into agriculture production. This has serious implication for the farmers to adopt any technology including WII regardless of the incessant failure of weather patterns.

Influence around profitability of WII with the p-value of <0.0001 demonstrate the stronger relationship between adoption of WII and the perceived profits and or benefits the farmers will get because of buying WII. If this is not clearly demonstrated adoption of innovations is next to impossible. 33.49% farmers indicated that compared to other insurance packages WII is very poor agreeing with the status core of poor WII adoption in the 4 districts. The technology characteristics needs to demonstrate relative advantage over the other offerings for the farmers to willing adopt the innovation.

WII insurance to farmers becomes very ideal for example this must be a package that include information, inputs, offtake markets or commodity markets as bundled service providing a well-rounded solution to the farmers. From the study results 40.00% of the farmers indicated the need for bundled services with a p-value of <0.001 indicating strong relationship of uptake of WII. The solution needs to take care of inputs and offtake or commodity markets that would help the farmers build confidence to invest into WII.

Government policy on adoption of WII indicated a p-value of 0.0001 which indicated significant need for the policy holder's government and ministry of agriculture in this case to provide clear policy direction on WII in the agriculture sector and specifically the smallholder markets which governments supports through the subsidized input support programs.

5.2 Graphical Results

Experience of famers by changes in climate

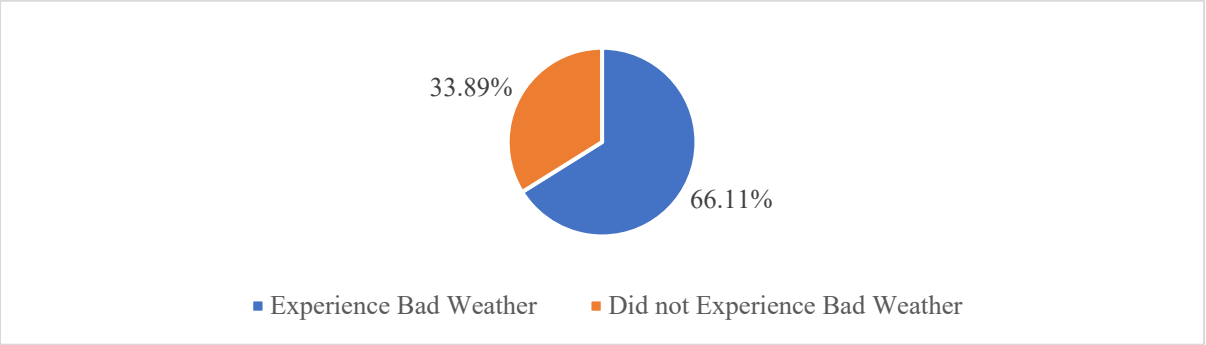

Figure 1. The percentage distribution of participants experiencing or not experiencing bad weather.

From the target group interviewed, about 66.11% of the farmers indicated had experienced bad weather and about 33.89% did not (Figure 1). During farmer group discussions, it was indicated that bad weather over the years has negatively affected crop production and productivity per unit area due to reduced rainfall amongst the many factors. Most of the farmers are reliant on the rainfed crop production systems making the farmers vulnerable resulting into poor crop yields, poor incomes, and most importantly poor food security. It may appear from first values that this status core could be enough motivation for the farmers to adopt WII as a mitigation measure, but this is not the case as adoption of WII is still poor. Weather insurance distribution amongst the public and private sector market players.

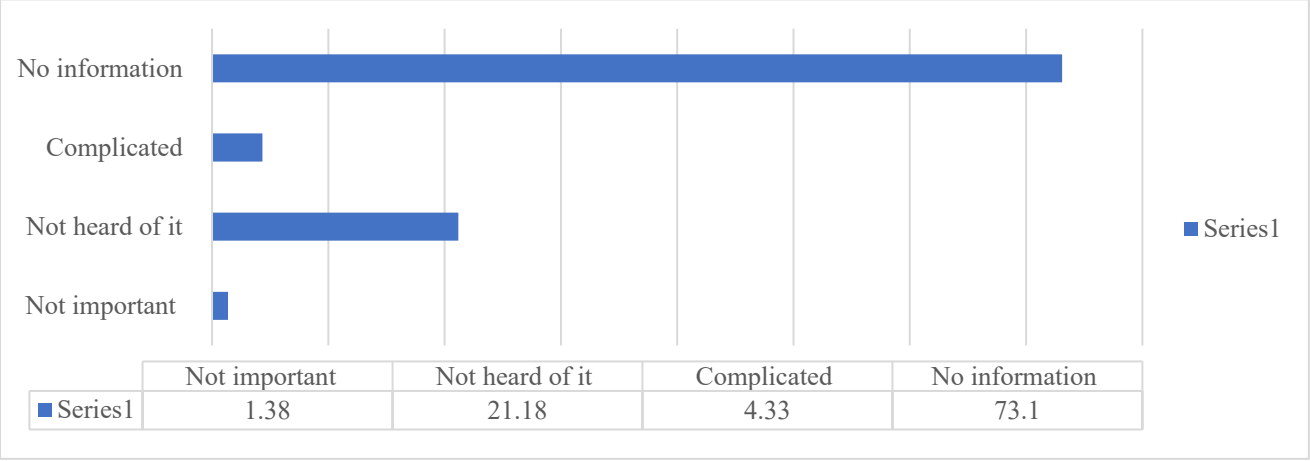

Figure 2. Percentage distribution of reasons

Figure 2 shows the percentage distribution of reasons why participants didn't know about WII. From the results, the information gap was the major reason farmers felt they don't adopt WII. About 73.1% indicated information was not available for them to make decisions to either uptake or not. The diffusion theory clearly indicates that knowledge is the first step even before the influence of the technology characteristics influence the farmer's decision.

5.3 Proposed Improvements

The objective of this stage was to test the theory of adoption innovation/technologies characteristics have influence on the process of innovation uptake. Looking across adoption and diffusion theories, there is an abundance of different factors that influence whether an individual will choose to adopt a technology. These factors constantly interact to inhibit and/or promote change (Adler and Clark, 1991, Straub 2011).

1. Index insurance needs a regulatory framework to provide standards for consumer protection. This framework should include standard insurance regulations, such as minimum capital-to-liability holdings requirements for insurer and reinsurers, clear index certification processes, and a process for speedy and accessible disputed settlement resolutions (Jensen and Barret.,2017)

2. A continuous approach of engagements that is based on market principles is required if companies involved in WILL are to adopt and adapt to this business. Donor dependent approaches continue to disturb the organic growth of the innovation which is otherwise very important for the agriculture sector especially the majority poor farmers in sub-Sahara Africa and Zambia in specific. Victoria (2017) – posed a question as to whether market systems approach.

3. Education campaigns need to be aggressive and indeed persuade enough to allow the farmers make decisions based on knowledge and not on handouts through subsidies that provided more especially to the poor countries. Knowledge should be the target rather than the handouts approach. It must be appreciated that the process of innovation adoption takes time and in stages.

4. Farmer social networks and farmer organizations – this is an important aspect if farmers are to adopt technologies -well organized and aggregated farmers are easily reached. Though the cooperatives around the farmer input support program supported by the government of Zambia have not proven this case.

5.4 Validation

The study employed a mixed method in which it combined qualitative and quantitative data. Although it was a mixed method, it leaned more toward qualitative research, as highlighted by Cresswell (2013). The enumerators that were used were those residing in the study districts of Choma, Mumbwa, Petauke and Chongwe who were familiar with the topic under investigation. It therefore followed that before the enumerators started collecting data on a large scale, they tested the questionnaire first and took out any parts that were wrong. After that, a quantitative questionnaire was given out and analyzed with the SPSS package to make sure it was valid and consistent. Also, the quantitative data was combined with qualitative data from focus group discussions and key informants to get a more complete picture. Additionally, the results were presented at the first Australian international conference held on December 20-21,2022 where they were criticized by many scholars.

6. Conclusions

It appears regardless of the vulnerability appeal of climate change and the threats it presents, the uptake of WILL is by far below expectation. It is clear and agreeing with the theory of innovation adoption that the technology characteristics as indicated by Rodgers matters if the farmers are to adopt the technology. From the findings, farmers adoption of the innovation is dependent on information, seeing the benefits visibly, experiential learning, accruing benefits of the technology and having a well-rounded solution that allows for both inputs and offtake arrangements that builds in the confidence of farmers to invest into their own production. If the commercial mind is not developed, farmer adoption of technologies or innovations may remain a nightmare.

The technology characteristics appeal to the farmers is very critical for adoption. The study agreed with the diffusion of innovation theory by Rodgers though this will happen overtime in stages. However, we can suggest an addition consideration of the commercial markets' interactions to the theory. The farmers need to have or develop a commercial orientation for them to easily consider innovation uptake.

The authors have no conflict of interest to declare.

Acknowledgements

The authors wish to thank Mr. Enock Siankwilimba for the support rendered during data collection and review of the manuscript.

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