Understanding The Variation Of Weather Index Insurance Amongst Farmers In Zambia: To Recommend A Framework That Should Enhance The Uptake Of Wii In The Agriculture Sector For Smallholder Farmers

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Abstract

Understanding the importance of the Weather Insurance Index (WII) as a financial tool for risk mitigation is increasingly critical to the development of sustainable agriculture. This is because the effects of climate change continue to endanger and ruin the agriculture sector, which is dominated by smallholder farmers. Among the many climate change coping mechanisms used by farmers, microinsurance remains one of the key techniques available. However, its uptake is significantly low, coupled with a lack of empirical evidence to clearly understand the underlying reasons for the status quo. The main objective of this study was to develop and recommend a framework that could enhance the uptake of WII by farmers. Results from this study were generated using a mixed-methods approach and captured from 1,024 farmers who were purposively sampled from 4 districts in Zambia. The findings showed significant and positive results of payout systems as an important enabler in the uptake of WII. Further, the cooperative systems had a significant influence as an appropriate distribution model through which the farmers got information, premiums, payouts, and aggregation. This recommended framework will be key in facilitating the uptake and scale-up of WII and other financial instruments amongst farmers.

Keywords: Uptake, Framework, Smallholder farmer

1. Introduction

It is becoming more and more crucial for the growth of sustainable agriculture to comprehend the underlying causes behind the low uptake of the weather insurance index as a financial tool for risk reduction [79]. The agriculture industry is still in peril and is being destroyed by the effects of climate change [80]. As the world is expected to abolish hunger by 2030, low agricultural production and food security will be difficult obstacles to overcome in a business as usual manner. Because smallholder farmers dominate food production in many developing countries, the current climate shifts are concerning. [1] have argued that the largest known economic impact of climate change is upon agriculture because of the size and sensitivity of the sector [81]. Agriculture production depends in large part on the weather, which is unpredictable [1,2]. Changes in rainfall patterns and extreme weather conditions like drought and flooding are caused by climate change and variability. The most severe effects of global warming on agriculture are felt in underdeveloped nations, predominantly because many farms in low latitudes already experience excessively hot weather [4,5,6,7] equally the floods are a big concern. A farmer's wealth is reduced by almost 30% in a dry climate and by almost 20% in a wet one [8]. There is more agreement than ever that human activity has altered the climate system of the entire planet [84;85]. These changes, which are taking place in both natural ecosystems and human well-being, are expected to have a significant negative impact on the impoverished and those who are currently experiencing food insecurity [85]. The poor and those already struggling with food insecurity are anticipated to be severely harmed by these changes,[82] which are occurring in both natural ecosystems and human well-being [9,10]. Rainfed agriculture is the key driver of economic growth in rural nations like Zambia, but it is unknown how and to what extent future climate change will affect household welfare, agriculture, and economic growth [83]. For agrarian economies like Zambia, rainfed agriculture is the main effect source, but it is unclear how the future climate will be and how much it will affect agriculture, household welfare, and economic growth [7;5]. It is anticipated that warmer temperatures will negatively affect countryside residents whose livelihoods rely on agricultural products. Warmer weather is predicted to have a negative impact on rural populations who depend on agricultural produce for a living [6]. Rainfed agricultural systems are vulnerable to climate variability and change, as noted by [7,5] as well, and a higher frequency and intensity of extreme climate events is likely to disrupt food systems, which negatively affects food access and nutritional outcomes [1,11,12]. This necessitates greater mitigating efforts, not fewer. Smallholder farmers in developing nations face a significant problem in boosting production due to weather shocks [13], which is exacerbated by climate change [14]. Despite this appeal, new research shows that most developing countries have experienced low uptake [15,16,17,20,18,19,21], despite promising results in terms of demand and impacts on important household indicators.

2. Main objective

To examine/understand the variation in diffusion of weather insurance index financial instrument by smallholder farmers in Zambia.

2.1 Specific objectives

1. To recommend a framework that should enhance the uptake of WII in the agriculture sector by smallholder farmers.

3.0 Literature review

3.1 Understanding the farmers and the farming cycle.

For agriculture insurance to be successful and financially viable, it is critical to recognize and comprehend the small-holder farmer's cycle of crop production, the reason the farmer will pay for insurance, the farmer's expectations, the farmer's characteristics, the farmer's income cycle, which is typically annual for the majority of farmers, and the farmer social aspects/norms related to the adoption of innovations[1,23,22]. In reality, decisions regarding resource distribution are negotiated among members of the family and community and are impacted by factors such as incentives and expectations of the individuals involved, status and decision-making authority, a variety of socio-cultural norms and traditions, and physical constraints that limit the options that may be taken. In order to achieve development goals, it can be crucial to comprehend home and community systems, as well as how they connect with other systems [25,24]. There is no one-size-fits-all solution, which is why it is imperative to recognize the importance of local context [74]. The insurance markets have grown unusually because what is acceptable in one place might not be in another. Understanding the significance of local context is crucial because it demonstrates that there is no one-size-fits-all answer. What may be acceptable in one area may not be in another, which results in the atypical growth of insurance markets [26,27].

It appears that the WII's discussions and/or plans do not consider how well the final service corresponds to farmers' experiences. The farmers may be able to trust the system if the payments systems can accommodate their cycle of alternate survival after bad weather. Most smallholder farmers would want a response or payment that would enable them to start producing and/or give them hope of survival [28,29,30]. However, surprisingly little is known about how sensitive farmer demand is to basis risk, even though it is a significant barrier to the implementation of index insurance. Furthermore, evidence from numerous research in several developing nations suggests that people value the now more than the future and would choose the immediate benefit of a discount over the delayed benefit of a rebate [31,32]. In a similar vein, people might prefer the discount since it comes with more assurance now, but the promise of a reimbursement in the future involves some degree of uncertainty. Interestingly, despite the ambiguity, some farmers might find the prospect of a future payment

attractive. It has been demonstrated that rebates in the context of insurance are preferable in Burkina Faso because they guarantee a certain payout in the future whether or not the policy pays out [31, 32].

Figure 1: agriculture insurance coverage in smallholder farmers across developing and middle-income countries. Source: [48].

Table 1: Global number of insurance policy's view

	Latin America & Caribbean	Asia	Africa
No of small farms	21,005,083	420,078,903	59,056,107
No of insurance policies	3,315,626	194,185,463	600,975
% of insured smallholder farmers	15.8%	46.2%	1.0%
Current coverage			2,039,506
% of farmer currently insured			3.5%

Data sources: adopted [78, 79, ,23,15] and author computation.

3.2 Climate change challenges to agriculture production

Future climate change is anticipated to aggravate agricultural production unpredictability and decline, having an impact on rural livelihoods globally [33,5,36]. Therefore, it is believed that managing climate risk is essential for preserving agriculture and advancing development [34,35]. Over the next 10–20 years, climate change-related losses in agriculture are projected to cost US$ 2,200–3,130 million (Zambia country climate risk report, 2018). With either droughts or floods, climate change concerns are progressively dominating and causing farmers to fail in their produce. Although the pattern of droughts and floods is occasionally historical, locals often have expectations about when such occurrences happen. [37,38,39].

Beyond agriculture, climate has a significant impact on rural residents' quality of life, especially the rural poor, who make their living from agriculture are vulnerable to diseases linked to climate

change who depend on agriculture for a living, are unprotected against climate-related illnesses, lack secure access to food and/besides water, and are particularly susceptible to hydrometeorological hazards/risks [40]. Climate/Weather shocks like drought and flooding not only cause fatalities but also long-term loss of livelihood due to the destruction of infrastructure, loss of productive assets, and health problems [37,41].

Without a doubt, the present situation makes it clear that the impact of climate change on emerging nations won't be reversed anytime soon. For instance, rainy seasons in Zambia occur from October to March, with sporadic downpours in April and occasionally even May [42]. Rainfall in the nation ranges from around 1000 mm on average per year to roughly 1400 mm in the north and 600 mm in the south [43]. In Zambia, floods and droughts have been more severe and frequent during the past few decades [44]. According to estimates, preindustrial temperatures are currently 0.8oC higher than current levels [45]. It is difficult to continue agricultural production and, in fact, to provide food security when farmers continue to lose their whole investments. It is generally recognized that households with little resources who are exposed to risk are more likely to stay poor or fall into poverty traps [46].

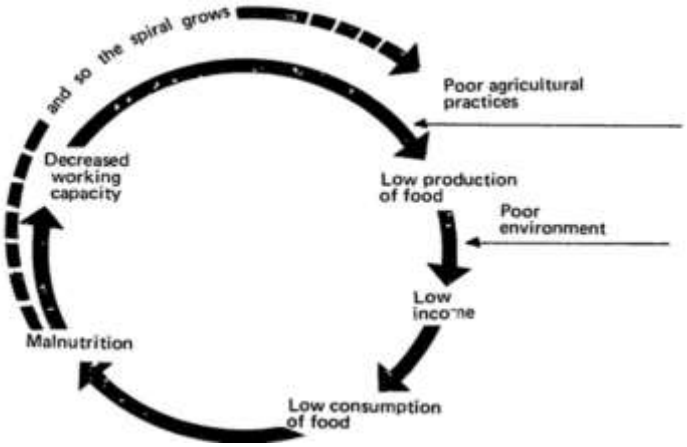

Figure 2: Showing the Poverty cycle. Adopted: FAO document [80]

3.3 Sustainable Insurance Markets

3.3.1 Multi player - multi function as a strategy to uptake

For WII adoption, market functionality is essential. A market system is defined by many donors and development organizations as a "multi-function, 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."[47] Several parties with various roles and interests on the market collaborate for the efficient operation of the market's processes. Incentives such as finance and, in certain circumstances, subsidies, distribution channels, and a variety of cutting-edge products that continue to satisfy the demands of smallholder farmers are just a few examples of these elements. Nevertheless, investing in the development of systems rather than

paying premiums will be crucial for long-term sustainability and significant change.

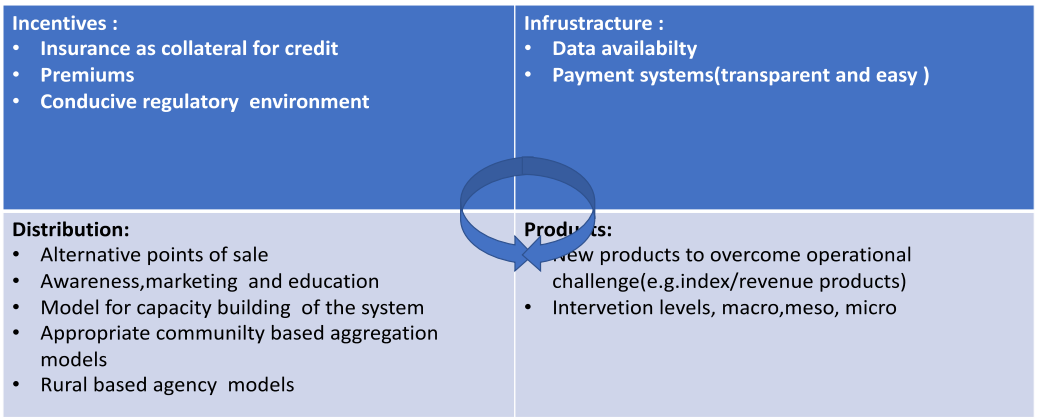

Figure 3: Showing incentives for sustainable insurance scheme. Data Source: Adopted from [48] and author computation.

3.4 Payout system key to uptake of WII

The systems' capacity to comprehend the farmer cycle and react to wants when they are most pressing is essential to WII adoption. Farmers' businesses, particularly those that are dependent on rain-fed agriculture, typically require them to rely only on their crop yields for income, unless they also engage in horticultural production [49]. As a result, a season-long crop loss puts a strain on the farmer's yearly revenue and household food security. As a result, any loss mitigation efforts should take the farmer's needs into consideration. Numerous research supports the idea that the timeliness of payouts and basis risk are the two biggest obstacles for farmers to adoption. According to [50], reimbursements under the WII program are contingent upon meeting certain weather threshold indicators. Systems must undoubtedly meet farmer demands if they are to have comparative advantages over others. The farmer might need more comprehensive insurance if he believes that other risks besides weather risk are more significant.

Farmers are often more concerned about revenue and wealth losses than they are with hedging rainfall shortages, which provides evidence for this claim. This suggests that for a WII to be desired, it must not only be correlated with the output of one or more crops, but also that these crops must account for a sizeable portion of the farmers' overall income. Basis risk can be defined as the absence of a negative relationship between insurance returns and current resource trend deviation [51].

At a group discussion in Choma district of southern province in Macha village respondents indicated they did not know how the payout systems work, payouts should be explained to farmers, payouts were not enough and did not match with the timing of the farming season. What was expected for us farmers did not come out.

For instance, the weather index insurance instrument was included in the Zambian farmer input assistance program. The exponential scale-up, however, also resulted in significant

implementation flaws. The program's primary flaw was its inability to pay out claims to farmers on schedule. Payments to farmers were delayed despite a sizable number (412,000) and amount (US$ 5.9 million) of payouts being triggered during the 2017–18 season. The insurance firm sent the funds to the Ministry of Agriculture in May 2018, but it took the Ministry until December to finish paying out the farmers. The payments were also made in the form of electronic vouchers that could only be redeemed for agricultural inputs during the 2018–19 crop season. As a result, the benefits anticipated from an agriculture insurance policy are significantly reduced by the delay in claim payouts and the non-monetary character of the reimbursements [44].

3.5 Cooperative model as a delivery channel

A key factor in determining whether farmers will adopt innovations and technology is their level of trust. The features of rural farmers tend to drive them to conduct the majority of their business based on faith in the suggestions, transactions, leadership, social contacts, goods, and services put in front of them. It is crucial that the delivery methods considered accommodate for this so that farmers have access to their own persuasion, communication, education, and organically appropriate norms and standards [52, 53]. The economic, social, and institutional requirements of development in the rural economy seem well suited for cooperatives. Cooperatives can offer the framework for mobilizing individuals for self-help action in order to supply the services/offerings that a farming and rural community needs. Co-operatives have the ability to reflect on and respond to the needs of its members as self-managed rural institutions. They can also support the development of attitudes of self-reliance and self-confidence within a framework of shared goals and reciprocal action. In the provision of services to its farmer-members, they can offer a vital assistance to both the farmers' and national development policy's development goals [54].

The cooperatives offer a potentially promising route for providing index insurance products, considering the significance of local networks as a way of disseminating information [55] and sharing the remaining risks in the face of an imperfect index/ besides distributing the remaining risks in the event that the index is inaccurate. [13, 56, [57]. We chose to market the product through the cooperative network but to designate specific individual buyers as the explicit beneficiaries of the insurance policies due to the potential trust issues with asking cooperatives to smooth risk [58] and the significance of ensuring that the input decision maker is directly aware of risk protection [59]. Because of the possible trust issues associated with asking cooperatives to smooth risk [58], as well as the importance of making sure the input decision maker is directly aware of risk protection [59], we decided to market the product through the cooperative network, but to explicitly designate specific individual buyers as the beneficiaries of the insurance policies.

Farmer organizations could affect WII demand in a number of

ways. First, groups can assist in lowering transaction expenses. Second, organizations can serve as effective vehicles for sharing knowledge about novel technology and goods [60, 61]. Thirdly, and connected to the previous/aforementioned point, groups/clusters might offer a forum for learning/knowledge that encourages farmers/growers to test out new insurance products. Additionally, farmer groups frequently comprise networks/linkages that interact/cooperate across several social dimensions and have rules/ social aspects and possess regulations for absorbing the unique risks/threats that each of their members face [62, 63].

3.6 Need for a collaborative approach

A collaborative and transformative strategy is crucial for these insurance programs in the expanding agricultural markets. The many participants necessary for the insurance markets to be strong, sustainable, and operational are depicted in Figure 4 below. Participants from financial institutions like banks, commodity traders for grains to package their offers with insurance, input markets to package their products with insurance, insurers and reinsurers with proper and transparent settlement systems, and a supportive environment provided by the government through the provision of fundamental frameworks, policy frameworks, and incentives to the participants at the micro and meso levels will all be necessary to achieve this [64].

It is widely acknowledged that intense collaborative planning among numerous public and private actors, as well as individuals, for the creation and execution of solutions from the beginning stages is an effective instrument to address difficult issues and find novel approaches. It is commonly known that intensive collaborative planning for the development and implementation of solutions from the outset, involving a large number of public and private players as well as individuals, is an excellent tool to solve challenging problems and identify creative solutions[74;75] .Such collaborations and partnerships, according to recent studies, are essential for adopting Nature-Based Solutions (NBS) successfully [65] fostering acceptance, a sense of ownership, and finally ensuring that measures are successful and put into action [66].

3.6.1 Private Sector

Private Sector Entities (PSE) stakeholders are essential in helping countries mitigate and manage the effects of climate change/ climate change's impacts, and the Climate Investment Fund (CIF) is trying to encourage private sector investment in some of the most difficult markets in the world. For these projects to be carried out and successful, replicable business models to be developed, private sector players' input is essential.

3.6.2 Civil Society

Civil society is a pillar of the Paris Declaration on Aid Effectiveness's notion of national ownership and represents a variety of

constituencies impacted by climate change [78]. Civil society is a crucial stakeholder for the climate investment fund to operate successfully inside a nation since it assists government planners in determining investment priorities and involves impacted communities in climate action. Lastly, it is recognized that civil society participation is essential for fostering networks and reawakening the potential of national communities who can support resilience efforts. Additionally, organizations from the commercial sector and Indigenous Peoples provide insights into the current industrial and traditional land usage, and they frequently collaborate on the design and execution of Pilot Program for Climate Resilience (PPCR) programs and initiatives [67, 68].

In fact, farmer-driven product design should be encouraged and prioritized, especially/ It is important to promote and give priority to farmer-driven product design, particularly at the early/initial design stages, /phases to boost insurance acceptability [69; 70]. Farmers and specialists in Ethiopia collaborated to compile historical rainfall distribution data for the region using resources found locally. Insurance experts used the information provided by farmers to determine the monthly weights for rainfall in these locations because it was determined to have a strong correlation with historical meteorological data. The second instance took place in Malawi, where farmers took part in farmer workshops to calculate the payout levels under various rainfall regimes, boosting their awareness and fostering confidence in the goods. [71] added a new perspective on farmer involvement. Using locally available resources, Ethiopian farmers and experts worked together to compile historical rainfall distribution data for the area. Farmers' information was found to have a significant association with historical meteorological data; therefore, insurance specialists used it to calculate the monthly weights for rainfall in these places. The second incident happened in Malawi, when farmers participated in farmer workshops to determine the payout levels under different rainfall regimes, increasing their knowledge and building trust in the products. [71] offered an original viewpoint on farmer participation.

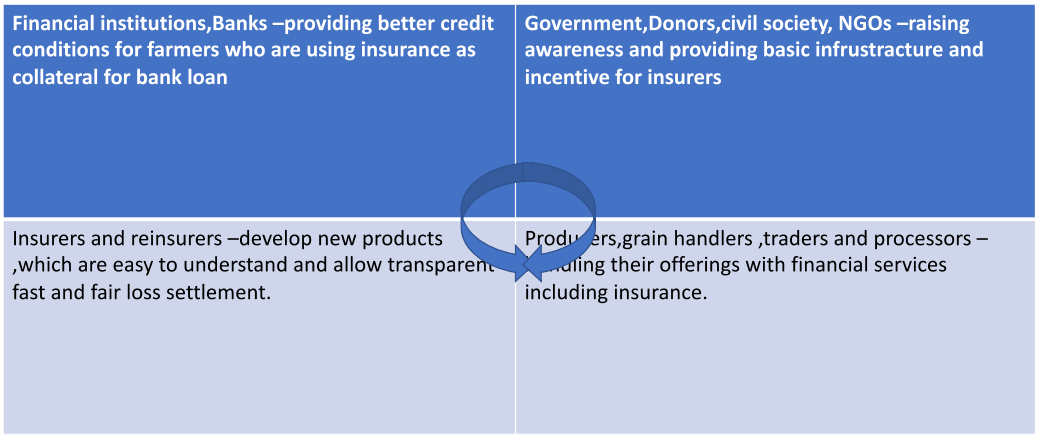

Figure 4: showing collaborations among stakeholders in the value to promotes robust financial risk management. Data source: [48] and authors computation

3.7 Commodity and derivative markets as key drivers

The majority of African nations lack well-developed functional and futures markets, and Zambia is no exception. Markets are essential for the push and pull factors that influence market innovation development, as shown on the market systems. Building confidence is necessary for farmers to participate in agriculture markets because there are platforms accessible that provide information about commodity trade for both immediate and future markets [72]. The commodity and derivative markets boost the confidence of farmers as well as a broader range of stakeholders, such as financial institutions that are wary of investing in smallholder agriculture production systems, private sector businesses that can offer extension services, inputs, and technologies, but most importantly, this will boost the confidence of insurance institutions at various levels, including the insurers, and the agriculture industry. These services needed to be bundled [1].

3.8 Warehouse receipt markets

Farmers should be able to trade their crop utilizing methods and/or trading mechanisms that provide them a chance to get favorable prices, like the warehousing system. However, this calls for properly licensed storage spaces with ample space in rural areas for farmers to deposit their produce [72]. Farmers have access to insurance and guarantee against fire and other mishaps thanks to the warehouse receipt system. And last but not least, it gives farmers access to greater markets since it allows them to sell huge amounts of their products to larger customers who will pay higher rates [73].

4.0 Methods and materials

Our research employs a participatory methodology with the communities. The key to solving the conundrum is to ask the correct questions about the problem of smallholders' inadequate adoption of WII. With the various stakeholders, including the farmers, insurance companies, input suppliers, and governmental organizations, it was necessary to establish the reality on the ground. 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 [74]. [74] 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 [75]. Realist, rationalist, and ontological (positivism) perspectives were all necessary for this. As a result, the study employed a mixed method and pragmatic approach, combining qualitative and quantitative methods, as suggested by [74]. [74] state that after induction inquiry is completed, quantitative inquiry is crucial for generalization, but qualitative inquiry is required to gain a deeper understanding of the problems from the farmers.

The questions were deliberately chosen to enable the farmers to

reveal any hidden concerns regarding the adoption of WII. To guarantee a thorough and in-depth conversation on WII with the farmers from 2017 to 2020, a focused group discussion was held.

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. In order to statistically establish opinions and the existing reality on the ground, the quantitative approach highlighted the status core of adoption rates, perceptions, or understanding on the characteristics of technology.

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. Some of the figures were given context by the qualitative method, which also pushed for in-depth justifications for the farmers' self-expression. This necessitated having formal conversations with the farmers. Additional thematic analysis was utilized to comprehend the patterns surrounding specific themes, such as information asymmetry, among others.

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). Due to the fact that both qualitative and quantitative methods can complement one another and build upon one another (e.g., the results of a qualitative study can be utilized to inform survey questions), a mixed approach was utilized.

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. Thematic network analysis, which adopts a more exploratory approach similar to the one the study is looking at, and framework analysis were utilized for qualitative analysis. Statistics are used to describe patterns, relationships, and linkages in quantitative data. You can use descriptive or inferential statistics.

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. Therefore, in order to see the frequency, characteristics, and overall picture of the usage of WII in the four clusters—Choma, Mumbwa, Chongwe, and Petauke—the study used an analytical cross-sectional survey design without the use of weights. As was briefly

indicated, actual numbers and percentages were provided for descriptive statistics because the study lacked 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. Additionally, the percentiles and proportions were shown using pies and bar charts. The Chi squared test was used for categorical variables that satisfied the test's assumptions and had a sample size of five or more in bivariate analysis to look for associations between the variables and the outcome uptake of WII. For variables that did not meet the assumptions, the Fishers exact test with a 95% confidence interval was used. A p-value of less than 0.05 was considered 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. Simple and modified multivariable logistic regression were used to test for further relationships at multivariable analysis and to further adjust or control for confounding between utilization and characteristics related with utilization.

5.0 Results

5.1 Graphical results

Major challenges farmers faced with weather insurance index.

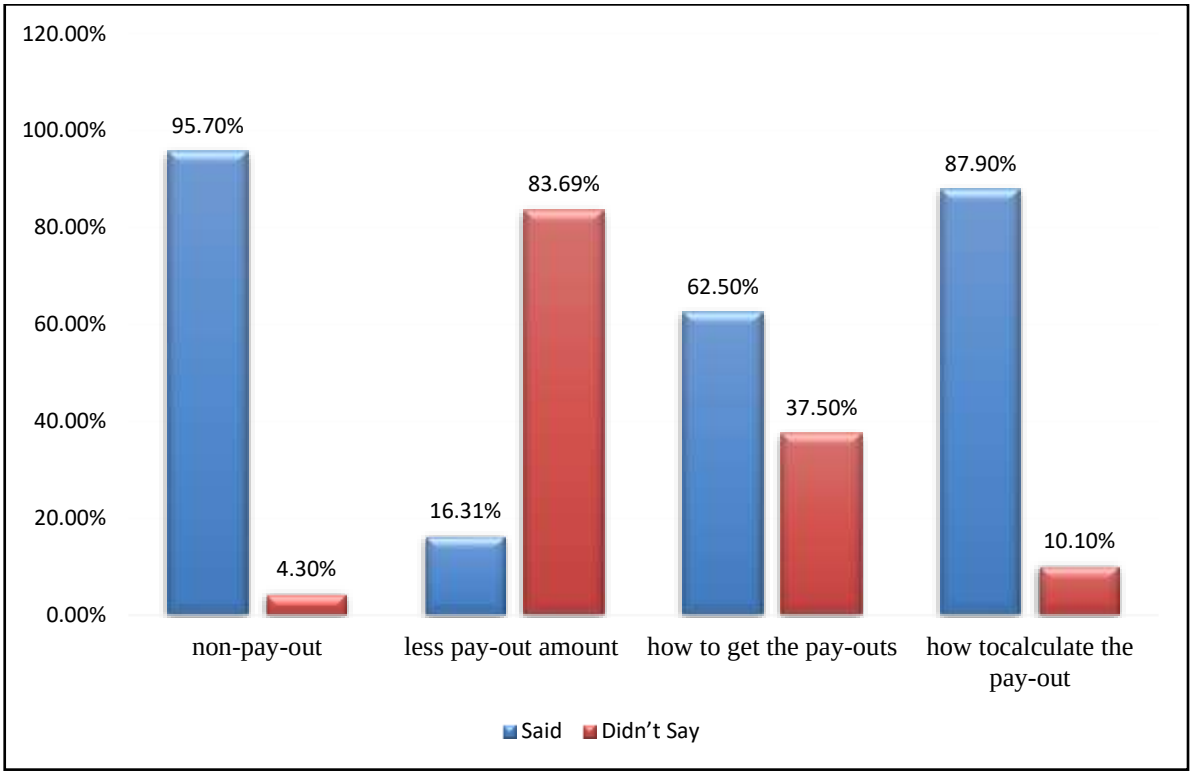

Figure 5: Showing major challenges farmers faced with weather index insurance.

From the figure above participants were asked about their challenges which they face with WII, 95.70% said yes that they have challenges with non-pay-out as a challenge they face and 4.3% did not say anything about non-pay-out as a challenge. For less pay-out amounts as a challenge, 16.31% yes, it is a challenge while 83.69% did not say that it was a challenge. Respectively, for those who said how to get the pay-outs was a challenge they were 62.50% and those who did not say they were 37.50%. Further, the results show that 87.90% said how to calculate the pay-out and 10.10% did not say it was a challenge.

5.1.1 Capacity Building and Training

The respondents and participants were asked to state whether they were capacitated and trained by stating Yes or No. The figure shows the responses of which 84.18% farmers were not trained and 15.82% were trained.

Figure 6:percentage of trained and untrained smallholder farmers

5.2 Numerical results

5.2.1 Technology characteristics

Table 2: showing technology characteristics bivariate analysis.

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 0.001 that indicated a greater relationship with adoption of WII. 2.3% farmers indicated they got benefits and 49.13% never got any benefits from WII. 33.49% farmers indicated that compared to other insurance packages WII is very poor. 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. Government policy on adoption of WII indicated a p-value of 0.001.

Based on the results, 49.13% of farmers said they were dissatisfied with WII, 33.11% said they were moderately satisfied, and 2.3% said they were very satisfied. A p-value of 0.001 suggested a stronger correlation with WII adoption. Of the farmers surveyed, 2.3% reported receiving rewards from WII, while 49.13% never received any. According to 33.49% of farmers, WII is extremely inadequate in comparison to other insurance plans. According to the study's findings, 40.00% of the farmers said they needed bundled services, and a p-value of less than 0.001 showed a substantial correlation between this and WII uptake. The government's implementation of WII policy revealed a 0.001 p-value.

6. Discussions

Discussion on the percentage distribution of major challenges faced in the districts system based – biased to payout. In addition, participants were asked about their challenges which they face with WII, 95.70% said yes that they had challenges with non-pay-out as a challenge they faced and 4.3% did not say anything about non-pay-out as a challenge. For less pay-out amounts as a challenge, 16.31% yes, it is a challenge while 83.69% did not say that it was a challenge. Respectively, for those who said how to get the pay-outs was a challenge they were 62.50% and those who did not say they were 37.50%. Further, the results show that 87.90% said how to calculate the pay-out and 10.10% did not say it was a challenge. From these results it is clear that ensuring that clients have a solid understanding of how the product works is critical. The extension messages need to tweak to emphasis the downside and risk protection role [75;85]. Lack of payout could have a negative impact on demand for the insurance products and services as observed by [86]. It is evident that making sure customers comprehend the product's operation is essential. The extension messages should be modified to highlight the function that risk protection plays and its drawbacks [75].

In an ideal system, the farmers must pay a pre-determined amount to the insurance firm to obtain the product. These are known as "premiums," to receive the product, the farmers must give the insurance company a certain sum of money. We refer to this as

"premiums., It should be noted that "premiums are not refunded if there is a payout [85;86]. If the weather has been terrible enough to trigger a payout as per the product criteria, a payout is expected with weather index insurance. In the event of drought or excessive rain, insured farmers can replant due to the early payout long before the conclusion of the growing season [69]. If there is no payout, they do not receive a refund. Weather index insurance pays out if the weather has been bad enough to meet the policy conditions and cause a payout. Because of the early payout well before the growing season ends, insured farmers can replant in the case of drought or excessive rain [69].

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. This is indicating that for the farmers to adopt and uptake WII, it must demonstrate real benefits that are addressing the farmer needs. Based on the results, 49.13% of farmers said they were dissatisfied with WII, 33.11% said they were moderately satisfied, and 2.3% said they were very satisfied. The p-value of 0.0001 suggested a stronger correlation with WII adoption. This suggests that in order for farmers to embrace and utilize WII, it must provide tangible advantages that cater to their needs. It appears that many families have never been exposed to this way of thinking, as such many families are not aware of WII which makes the appeal of WII unappealing to them. Further, many households/families may not be aware of the financial/monetary cost/expenditure of their production risk [76]. 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. If farmers do not feel the benefits, this validates the adoption theory, which states that an invention must offer a relative advantage for farmers to embrace it. If just 2.3% of farmers experienced benefits, and 49.13% never did, Zambia will need to embrace WII over a number of years. This supports the technological diffusion idea. Nevertheless, 78.69% of farmers said they saw no advantages from the money they were paid. Many of the farmers said they were paid too little to meet their expenses and that their reimbursement came at the incorrect time of year, which prevented them from putting the money back into growing their farms. This has significant implications for farmers who choose to use any technology, even WII, despite its constant failure.

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. The impact on profitability of WII, with a p-value of less than 0.0001, indicates a more robust correlation between the adoption of WII and the farmers' perceived gains and/or profits from purchasing WII. Innovation adoption is nearly difficult if this isn't amply shown. According to 33.49% of farmers, WII is extremely inadequate in comparison to other insurance plans, which is consistent with the 4 districts' low acceptance rate of the program. For farmers to be willing to adopt the innovation, the technology features must show a relative advantage over the competition.

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. For instance, a package that includes information, inputs, offtake markets, or commodity markets as bundled services offering a well-rounded solution to the farmers is highly ideal for WII insurance to farmers. According to the study's findings, 40.00% of the farmers said they needed bundled services, and a p-value of less than 0.001 showed a substantial correlation between this and WII uptake.

Government policy on adoption of WII indicated a p-value of 0.001 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. The policy holder's government and ministry of agriculture in this instance need to provide clear policy direction on WII in the agriculture sector, particularly the smallholder markets that the government supports through subsidized input support programs, as evidenced by the p-value of 0.001 for the adoption of WII.

On the distribution of participant’s who were trained (capacity building and training), the study revealed summarized statistics and researcher’ analysis. From the study 84.18% farmers were not trained on WII by the various stakeholders that included the government extension and insurance companies and only 15.82 were trained. This raises a lot of questions on how the program is running. WII is just mentioned to farmers during the process of FISP registration and not necessarily consistent training to farmers. Uptake by farmers with this low extension training to farmers will be compromised.

7. Proposed WII Framework – suggested change

The researcher developed the conceptual framework to be used in understanding the diffusion of WII adoption among smallholder farmers in Zambia based on the study's findings. WII will keep fighting to persuade smallholders to use its technology. This is a result of various elements that call for cooperation and a plan to pique farmers' interest in making an investment in the good. The study suggests three key elements that must be considered if uptake is to be raised.

i. The distribution method, which indicated that farmers could obtain the product and the payment more easily through the cooperative model.
ii. Access to information and awareness was significant for uptake of WII.
iii. Easiness of the product for the farmers to use was another factor for consideration.

Taking into consideration these three factors and other insights and observations from the study this framework has been suggested. The illustration is framed below.

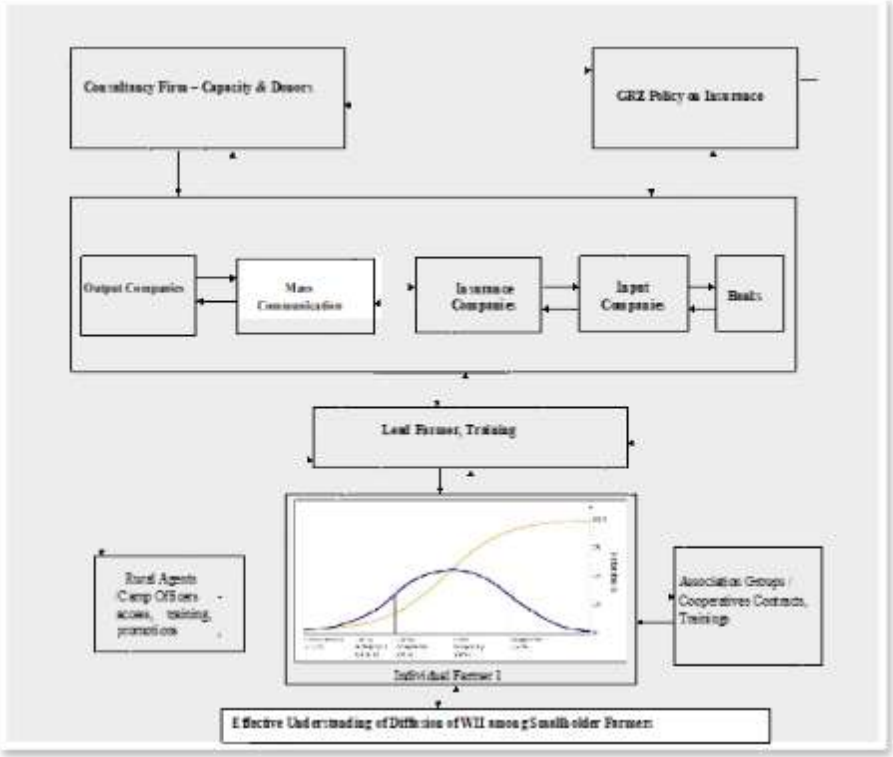

Figure 7: Showing the recommended framework for weather index insurance uptake improvements.

Several stakeholders need to be considered while determining the framework for WII's dissemination among smallholder farmers in Zambia. Participation of stakeholders in the decision-making process is required [86;87]. This will help to support and strengthen long-term sustainable development. The Zambian government needs to understand how crucial insurance is considering ongoing agricultural concerns. The participants in agriculture insurance must be identified

by the Zambian government. The following parties involved have been named. The donors, consultancy firms, mass communication institutions, input companies, output companies, insurance companies and banks [88]. Others include lead farmers, Association Groups / Cooperatives; and rural agents /camp officers among others. These stakeholders will impact on the farmers' diffusion process.

The first party involved in the spread of WII is the government of Zambia. The country's environment must first be conducive by the government. To stimulate private sector investment in the area, the government must immediately establish a system of guidelines and resources. There should be legal mechanisms for insurance to safeguard both enterprises and farmers.

The mass communication institutions will be interested in news gathering and disseminating to the masses. The insurance firms will give the stakeholders (the government, input insurance, banks, and off takers) a capacity-building organization that should concentrate on product innovation, adaptive research that is market-oriented, and capacity-building.

These (meso level) insurance firms, input firms, financial institutions, and offtake marketplaces. Farmers would feel more comfortable investing in WII if many stakeholders collaborated to suggest packaged services to them. The warehouse receipt system, structured markets, and derivative markets, for example, could have a significant impact on the commodity market by luring banks and input suppliers to participate due to the secured arrangements. Then, farmers could simply buy WII goods to safeguard themselves against unpredictability in the weather. The market's operation is essential if WII adoption is to rise. Simply stated, diffusion theory holds that an innovation or technology needs to have a relative advantage to be adopted, according to [77]. The pull and push impacts (supply and demand notions) must exist on the markets.

Once the mass communication institutions, input companies, output companies, insurance companies and financial institutions have taken their roles from government policy on insurance and provided the enabling environment, the uptake of WII should begin by considering the micro level where the farmers are and the support systems that exits at this level. At micro level-rural based, first clients considered are the lead farmers, general farmers, agents, agricultural camp officers. The lead farmer structure, private sector agents stationed in the communities, government agriculture camp officers, and farmers themselves. These stages interact directly with the farmers and, in some cases, continue to do so, which helps to increase the farmers' credibility. Farmers may need some time to develop confidence in a product that is purely being marketed by people outside of their local community who are seen as acceptable. These buildings may connect with farmers in a natural way to provide information, demonstrations, capacity building, and confidence building. Most investments should go toward increasing this level's capacity for a variety of innovative and supportive business partnerships, both financial and non-financial. Input aggregation,

offtake, and other services can be connected to these structures.

Secondly, at micro level, clients considered are farmer aggregation into farmer groups, cooperative or possibly associations. For WII adoption, farmer aggregation becomes crucial. It becomes crucial to invest in and identify organizations that can serve as conduits for delivering insurance goods. Individual centered insurance strategy for the farming community is costly especially in a country like Zambia with a sparsely population especially the rural areas. The individual target of individual farmers becomes very costly and unsustainable only can last as long as subsidy support programs exist without which can never be attractive. The cooperatives, farmer groups, and/or associations can function as aggregations for trainings, awareness-raising campaigns, marketing campaigns, premium payment systems, payment systems for inputs, finance (credit), and offtake aggregations that would give farmers stable markets and increase their confidence. However, the groupings should choose themselves to be depending on the need for sustainable engagements with agriculture markets. Wrong cooperatives that are focused on handouts will not add any value to the uptake of WII.

As a result, this level will interact and engage with the various service providers to ensure that insurance is included in their offers. It should be noted that this has already been attempted, albeit with improperly motivated partners who frequently lacked expertise about WII goods and services. In this situation, a team made up of many stakeholders would need to continuously increase this structure's capability for it to be responsive.

Smallholder farmers will adopt WII once all the aforementioned institutions—including the government, consulting firms, donors, mass media organizations, input and output companies, insurance and financial institutions, lead farmers, private sector agents stationed in the communities, and government agriculture camp officers—have assumed their respective roles. In this approach, it will be easier to understand how WII spreads among smallholder farmers.

8.0 Recommendations

8.1 Regulatory framework

In order to establish criteria for customer/farmer safety, weather index insurance needs a regulatory framework. Regulation of weather index insurance is necessary. Standard insurance rules such as minimum capital-to-liability holdings standards for insurers and reinsurers, transparent index certification procedures, and a process for swift and easily accessible contested settlement settlements should be included in this framework. This framework should incorporate typical insurance regulations, such as minimum capital-to-liability ratio requirements for insurers and reinsurers, open index certification processes, and a system for quick and convenient challenged settlement settlements.

8.2 Responsive market engagements

i. To embrace and adapt this business, organizations interested in WII need a consistent engagement strategy based on market principles. The spontaneous growth of innovation, which is otherwise crucial for the agriculture sector, particularly for most impoverished farmers in sub-Saharan Africa and Zambia in particular, continues to be hampered by donor-dependent techniques. Donor-dependent methods continue to impede the spontaneous emergence of innovation, which is otherwise essential for the agriculture sector, especially for most impoverished/disadvantaged farmers in sub-Saharan Africa and Zambia in particular.

ii. Education efforts must be forceful and convincing enough to allow farmers to come up with decisions that are based on information rather than on handouts/giveaways from subsidies/AIDS, which are more frequently given to developing nations. Instead of using the handouts technique, knowledge should be the goal. It is important to understand that adopting innovations takes time and happens in stages.

8.3 Responsive distribution model

i. Farmer social networks and organizations are crucial if farmers are to accept new technology since they make it simple to reach out to well-organized groups of farmers.

ii. The aggregator model is suggested as a technique to make project operations easier while also aggregating learning, capabilities, and achieving economies of scale.

iii. To facilitate operations and address the problem of individual claims, which are a nightmare in the current condition of the lack of adequate historical data, it is advised that farmers use a group or cooperative model.

8.4 Donor support

Instead of spending money on premium subsidies, donors and the government should devote more funds to figuring out the root causes of the lack of WII adoption. With care, incentive programs that promote farmer engagement should be implemented to avoid developing farmer dependent syndromes.

8.5 Policy direction

The government should reevaluate its climate change mitigation policies, especially its WII strategies. Although earlier declarations were beneficial, more must be done if smallholder farmers are to value WII.

8.6 Private sector and insurance companies

The industry actors need to create a model that is sensitive to the difficulties and demands of the farmers because they aren't doing anything with farmer interactions on WII. What incentives ought to be promoted by the private sector to encourage smallholder farmers to use WII? The difficulty is obvious. To get the attention of poor rural farmers, WII will need to be promoted in a multi-player, multi-functional way. What kind of incentives should the commercial sector offer to entice smallholder farmers to use WII? It's evident how difficult it is. Poor rural farmers will need to be drawn in by WII, which will require multi-player and multi-functional promotion.

8.7 Risk Assessment

Although thorough risk assessments have been conducted in the past, it is necessary to update them and better understand the present dangers, particularly in light of the ongoing weather issues that affect farmers' adoption of WII.

8.8 Capacity holding of the system. -Technical consulting

For farmers to employ WII, trainings and capacity challenges are crucial. Special purpose institutions, such as consulting firms, must be in place to support the various stakeholders in terms of technical expertise and ability to implement WII.

Declaration of competing interest/ A statement of conflicting interests

The authors state that none of their known financial conflicts or interpersonal connections might have had an impact on the work presented in this paper. The study provided in this publication, according to the authors, was unaffected by any of their known financial conflicts or personal relationships.

Author contributions

Joshua Munkombwe: concept formulation, methodology creation, data analysis, and writing—preparation, evaluation, and editing of the first draft.

Prof. Jackson Phiri: ideation, technique creation, data analysis, and composition—preparation, evaluation, and editing of the first draft.

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Data availability statement

Any researchers, persons, and academics who are interested may request the data used for the analysis and interpretation of the results in a suitable manner.

Conflict of interest

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