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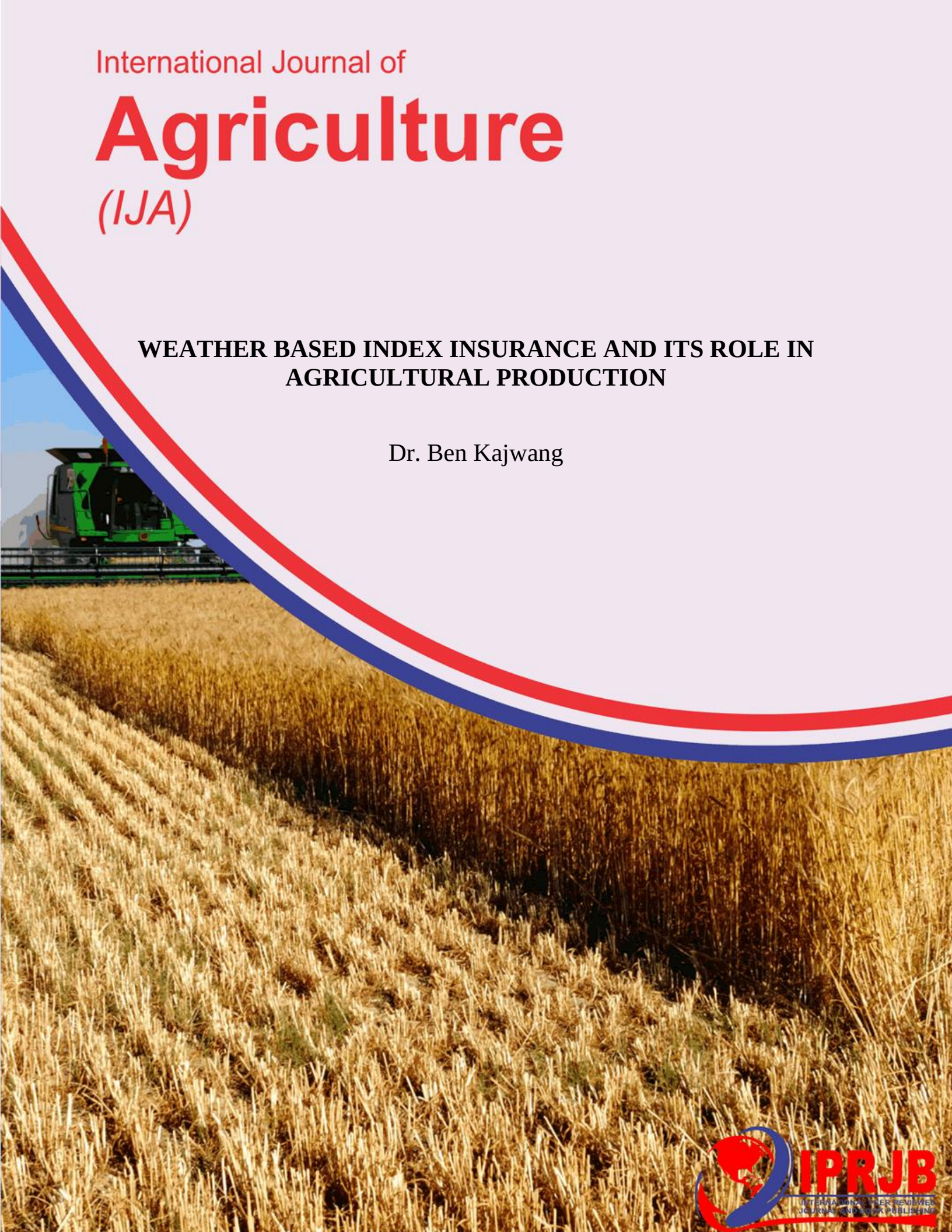
Dr. Ben Kajwang



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WEATHER BASED INDEX INSURANCE AND ITS ROLE IN AGRICULTURAL PRODUCTION

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Abstract

Purpose: Insurance not only is a shock absorber for farmers and other actors in the agricultural value chain, but it also enables access to credit and hence is an integral part of financial inclusion, and it enables/protects investments in better inputs and technologies which increase productivity. The different forms of insurance also reduce the government's budget exposure to agricultural risks. Crop insurance could incentivize farmers to increase their input use but indemnity-based crop insurance programs are plagued by market failures. The purpose of this research work was to examine weather-based index insurance and its role in agricultural production. This study highlights the key opportunities for weather-based index products and bring further clarity to how the use of weather-based index insurance can help to transform agriculture production.

Methodology: Relevant book references and journal articles for the study were identified using Google Scholar. The inclusion criteria entailed papers that were not over five years old.

Findings: This study found that the uptake of weather-based index insurance is positively and significantly associated with the use of chemical fertilizer and improved seeds, and also with crop yield. The study concludes that upscaling of weather-based index insurance programs may help to spur agricultural development in agricultural production.

Recommendations: The study recommends that weather-based index insurance be linked to an existing development program or other market opportunities to provide added value to the client. As a stand-alone product, weather-based index insurance may be seen as an unnecessary cost and have little demand from farmers who face a variety of risks in addition to weather risks. The study also recommends partnership between weather-based index insurance programs and complementary agricultural development or risk management programs. NGOs in particular could play an important and independent role in the extension of information to farmers, possibly in conjunction with official extension services.

Keywords: *Weather Based Index, Insurance, Agricultural Production*

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INTRODUCTION

Weather risk is a severe problem in agriculture sector that always worsen as a result of climate change. Nonetheless, farmers, communities, markets, and governments have evolved official and informal coping strategies. Boosting agricultural production and revenue is a critical precondition for developing-country rural poverty reduction and food security. Natural calamities such as droughts and floods have a negative influence on national income and economic development. Output fails at the local level, and impoverished families are frequently compelled to embrace short-term survival methods in the midst of a shock that might weaken their long-term resilience, food security, and economic potential.

According to Falco, Rotondi, Kong, and Spelta (2021), weather disruptions can trap farm owners and families in distress, but the possibility of shocks also restricts farmers' desire to invest in measures that could raise production and enhance their economic standing. Weather-based index insurance is a type of insurance service that allows weather-related risk to be protected in situations when standard agriculture insurance may not be practical. In the early 2000s, some of the first weather index insurance pilots were conducted in Mexico, India, Mongolia, Ethiopia, and Malawi. Since then, at least 30 weather index insurance plans have been tried in low- and middle-income nations.

The advancement of index insurance and the typically excellent performance of well-designed pilots has been explored as a viable approach to mitigating the effects of weather risk. Weather-based index insurance protects against a weather occurrence that is significantly connected with output loss as a proxy for individual loss (Hansen et al., 2019). For example, one of the first weather index insurance schemes in a low-income nation began in India and protected groundnut producers against famine based on rainfall observations. The utilization of weather indexes to insure farm projects or to assist catastrophe risk finance for African governments has been explored, discussed, and tried in the last 10 years in particular. Because of the adaptability of these weather-based index insurance tools in comparison to traditional agro - based insurance products, a wide range of uses have been identified and, in some cases, implemented. These diverse techniques have provided a tremendous potential for weather index instruments, but they have also generated substantial controversy and, at times, uncertainty about the most suitable uses for these goods.

Weather-based index policies, according to Vroege, Dalhaus, and Finger (2019), employ an underlying index to assess losses due to a given occurrence. In contrast to traditional insurance, which looks at real losses to compensate the policyholder, the index functions as a reference for losses. The index is nearly always dependent on meteorological data, and the loss caused by weather is calculated by the index's divergence from previous weather trends. This emphasis on actual data as the primary signal of a payment rather than on-the-ground inspection enables for a cost-effective and objective evaluation of loss. It also provides for faster payouts to policyholders and greater transparency in an application. Weather index insurance is a valuable agricultural insurance product, but it is far from the only one (Daniel, Gastaldi, Gallacher, and Galetto, 2019). It is well suited in some instances, and is frequently the only viable answer, although there are superior insurance alternatives in others. The range of agricultural insurance options available ranges from classic indemnity-based policies (such as multi-peril crop insurance) to various types

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of index insurance (weather, satellite-based vegetation indices, area yield-index) as shown in Figure 1.

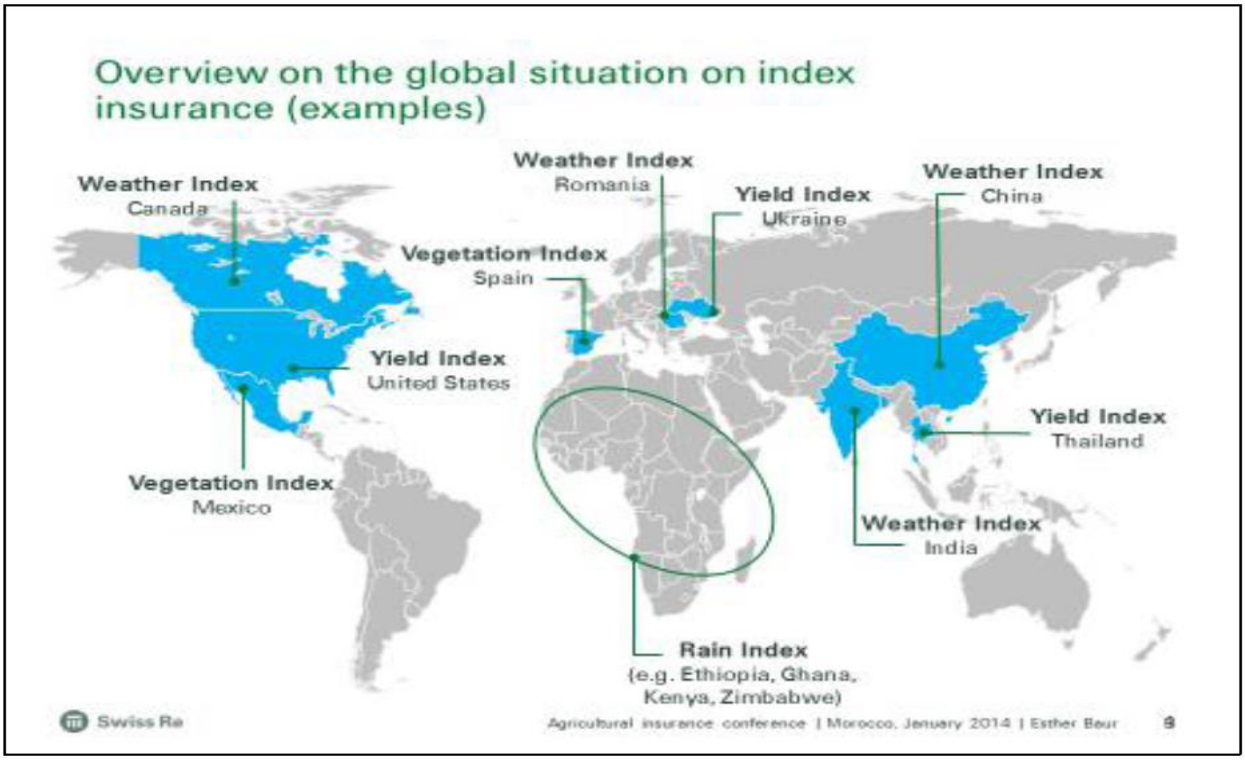

Figure 1: Overview of the global situation on weather-based index insurance

Source: Swiss Reinsurance (2018)

Weather-based index insurance-like services became widely used in the late 1990s to support applications in the energy business (Smith & Watts, 2019). Energy providers started exploring for ways to control the financial effect of unseasonably high energy demand for heating and cooling. To accommodate this demand, insurers and other financial institutions began selling index-based products that paid out when the temperature rose or fell above or below average. These early applications demonstrated the effectiveness of an index-based technique for transfer of risk and smoothing and managing the volatility of profit streams. These trailblazing applications also paved the way for the creation of an infinite variety of comparable goods, which currently cover a wide spectrum of sectors. Agro applications followed fast, most notably in India in 2003, and development on similar products in Africa began in 2004. (Smith et al., 2019).

Although there is no one method to describe the many uses of weather-based index insurance in the region, the various techniques can be roughly classified as macro-level, micro-level, and meso-level weather insurance (Tartarini, 2021). Individual farm insurance is handled at the micro-level. Weather-based index insurance at the micro level, under this wide definition, is the use of index-based policies for direct sale to individual farmers. These farmers might be commercial farmers or smallholders with the potential to become commercial producers, although insurance for impoverished farmers has also been explored. Individual clients are primarily the direct

policyholders under the plans. This necessitates that the product being marketed corresponds to the policyholder's individual risk profile, as the policyholder will most likely pay for the insurance and be paid directly in the event of a loss.

As a result, micro-level weather-based index insurance plans are frequently offered at the community scale, and product design necessitates extensive ground-truthing with policyholders to guarantee that the policy being sold accurately anticipates losses on the ground (Singh, Anand & Khan, 2018). The potential misalignment between the index and whatever has occurred on the ground is referred to as "basis risk." These plans may and have been sold through a multitude of channels, including direct sales from insurance firms, agribusinesses, input suppliers, and banks, to name a few. In Africa, there's been a huge number of modest pilot initiatives to test these services and decide how to effectively use them to the advantage of policyholders (Afriyie-Kraft, Zabel, & Damnyag, 2020). Most of these initiatives have yet to scale, while some are exhibiting encouraging results as they try to overcome some of the major restrictions in creating and executing these products. These encompass the index's quality as a measure of damages, the necessity for major investment in product design, and clients' desire and capacity to pay.

Meso-level insurance is for companies and finance organizations. At the meso-level, weather index insurance is used by institutions and enterprises to safeguard their assets. Farm owners are subject to the weather, just as banks, service providers, and dealers that engage with farmers are (Fisher, Hellin, Greatrex, & Jensen, 2019). Their risk management skills enable them to stay afloat in the face of defaults and volatility in the quantity of agricultural items provided, loans returned, and services consumed. These customers frequently choose plans that cover a broader geographical range and more extreme occurrences than direct buyers. Despite the fact that there some technological hurdles to execution at the meso-level, the expenses of retailing are greatly lowered because customers are organizations rather than individuals. Policies can be offered to bigger businesses, according to Mahato and Saha (2019), and these customers can frequently better withstand possible basis risk because to their larger economic capability.

Governments need macro-level insurance. Macro or sovereign-level index insurance is the use of index-based products by governments - municipal, federal, and sub-national - to manage liquidity restrictions during disasters or to react to constitutive requirements. This rise is the result of weather uncertainty and its effects on food security, lives, and livelihoods. According to Hohl (2020), most work on weather index insurance at the sovereign level in Africa has concentrated on aiding administrations in reacting to humanitarian requirements caused by weather unpredictability. Famine insurance was initially trialled in 2006 and 2008 by the governments of Ethiopia and Malawi, with assistance from the United Nations World Food Programme and the World Bank, respectively (Makaudze, 2018). More lately, the African Risk Capacity (ARC) was founded in 2012 as a Specialized Agency of the African Union and has been collaborating with African Member States to insure their drought risk through ARC's financial subsidiary ARC Ltd. since 2014. These macro policies directly insure governments, but they require a large deal of upfront preparation to be efficient. To gain entry to ARC's insurance, for example, governments must integrate these products into their disaster operations by developing contingency plans for how payouts will be used, perform technical work to customize an index that precisely foretells governments' requirements, and eventually stump up a premium to enter into the contract

(Makaudze, 2018). The ARC Agency assists nations in completing these conditions and joining the ARC Ltd insurance pool by providing institutional capacity.

Principles of Weather-based Index Insurance

Traditional crop or livestock insurance is based on direct evaluation of the farmer's loss or harm (Michler, Viens & Shively, 2022). However, field loss assessment is usually prohibitively expensive or impossible, especially in areas with a significant number of small-scale producers or where insurance markets are underdeveloped. The key element of weather-based index insurance is that the insurance contract reacts to a measurable variable (e.g., rainfall or temperature measurement) at a specified weather station over a certain time period. The contract's criteria are designed to coincide as closely as feasible with the policyholder's loss of a certain particular crop. Afshar (2021) claims that all policyholders within a specific region get rewards based on the similar contract and assessment at the same station, removing the requirement for in-field evaluation. A weather-based index insurance contract typically includes a reference station, a trigger, a payout, a limit, and an insurance duration. The baseline station is a specific meteorological station (Tyagi & Joshi, 2019). A trigger weather indicator, such as cumulative millimeters of rainfall, is set as the point at which the contract begins to pay out. A flat amount or progressive payout, such as a dollar amount per mm of rainfall above or below the trigger, is made. An optimum payout is provided when a measurable parameter, such as cumulative rainfall, reaches a certain limit (Tyagi et al., 2019). The insurance duration is specified in the contract and corresponds to the crop growth period; it may be split into phases (usually three), each with its own trigger, amplification, and limits.

Weather index insurance is not a cure-all. It is ideally appropriate to weather threats that are well-correlated over a large area and when weather and agricultural output are closely related. The strongest associations, as per Hohl et al. (2020), often entail a single crop, a distinct rainy season, and no irrigation. Until now, the majority of weather-based index insurance initiatives have concentrated on the risk of rainfall deficiency (drought). Where more complicated situations prevail, weather-based index insurance is less beneficial. Weather-based index insurance is not appropriate for regional hazards such as hailstorm or where microclimates occur, such as in hilly places. Likewise, the prospect for weather-based index insurance is restricted where crop output is influenced by several or complex causes of loss, as in the humid subtropics, or where pests and disease have significant effects on yields (Mühlenhoff, 2021). Other insurance products, such as area-yield index insurance or named-peril crop insurance, may be better suited for a specific region. Multi-peril crop insurance is also another service that is commonly used in extremely high nations for large estate companies. MPCI calculates insured yields as a proportion of historical average yields. An indemnity is payable if the yield falls below the guaranteed value. Individual farmers MPCI is unsuitable for agricultural production in poor nations, and it is a product that has required considerable subsidies in the nations where it is used.

Advantages of Weather-based index insurance

One advantage of weather-based index insurance, according to Xu (2018), is accountability. Index insurance policies often provide the policyholder immediate access to the data used to compute benefits. Transparency helps to build trust. Further benefit is that no on-farm loss adjustments is required. This is a fundamental benefit of index insurance, as on-farm loss adjustment is

complicated and expensive, and may be untrustworthy in several low-income nations. Additional benefit of weather-based index insurance is that there is no adverse selection (Torabi, 2019). Adverse selection happens when potential insured parties have secret knowledge about their risk vulnerability that the insurer does not have, making the insurer more inclined to overestimate the insured's risk.

Conventional insurance promotes high-risk producers to insure, whereas risk and premium are computed on an average producer's risk and premium (Torabi, 2019). Index insurance stipulates that all covered producers within a designated region have the same insurance payout terms, irrespective of risk susceptibility. As a result, insurers and customers gain from less adverse selection.

Another advantage of weather-based index insurance is the absence of moral hazard (Pu, Chen, & Pan, 2018). When people engage in concealed behaviors that raise their exposure to risk as a result of acquiring insurance or seeking to control the outcome of claims, this is referred to as a moral hazard. These covert operations might subject the insurer to greater levels of risk than were expected when premium rates originally set.

Individual producers attempting to influence claims have no advantage with weather-based index insurance (Mahato et al., 2019). Everyone in the given region is treated equally. Another benefit of weather-based index insurance is that it handles risk correlation. Index products are most effective when there are associated risks. Perils such as famine are difficult to insure with standard products. Weather-based index insurance also has the benefit of having relatively low operating and transaction expenses. Individual underwriting for index insurance is limited (client assessment). It may be delivered and claims handled at a far lesser rates. Product education is still crucial, both before and after the product is released. Lastly, additional benefit of weather-based index insurance is its quick payout (Afriyie-Kraft et al., 2020). Rapid payments are possible due to the measurement of weather station data with no field loss correction. Basis risk is one of the drawbacks of weather-based index insurance. A major restriction in weather-based index insurance is basis risk. The basis risk is the gap between the farmer's loss and the compensation triggered (Clement, Botzen, Brouwer, & Aerts, 2018).

The weather-based index insurance also have some shortcomings. When there is no apparent link between loss and the indexed weather threat, basis risk might be substantial (Clement et al., 2018). Weather-based index insurance is most likely to function for rain-fed products and at severe levels of the event, when losses may be more broad and uniform. Additional downside of weather-based index insurance is its restricted peril coverage. Weather-based index insurance typically covers only one, or occasionally two, weather dangers (Sutomo, Kusumaningrum, Anisa, & Paramita, 2019). Though it lowers the cost of crop insurance when matched with multi-peril crop insurance, the policy may not provide comprehensive enough coverage to meet risk management objectives. A downside of weather-based index insurance is also repeatability. To represent the weather characteristics of each weather station, the triggers, restrictions, and increases of a given product must be updated. Different product designs are required for different crop kinds, as per Sutomo et al., (2019). Weather-based index insurance necessitates significant technical effort in its execution and maintenance. The absence of weather data is yet another downside of weather-based index insurance. Meteorological-based index insurance is dependent on the availability and quality of

weather data, which might vary greatly between countries. In developing nations, a lack of historical and real-time meteorological data is frequently a serious impediment.

Role of Weather-based index insurance in support of agricultural development

Climate change has emerged as a critical problem on the developmental agenda. There is a lot of attention in the possible role of weather-based index insurance in agricultural climatic shift resilience (Adriana & Penagos-Londoo, 2022). Climate change is projected to cause changes in normal climatic condition in diverse places as well as increasing in weather fluctuation, with more frequent or intense weather catastrophes. Adapting to these alterations is based on efforts that promote resilience while decreasing vulnerability (e.g. appropriate crops, varieties, and cropping patterns; irrigation; and soil and farm management techniques). Notwithstanding these steps, according to Rambukwella (2020), hazards exist or will rise (particularly to extreme weather events). Weather-based index insurance can help fund acceptable climate change policies, but it cannot be used to avoid pursuing suitable adaptive strategies, nor should it be used to replace existing initiatives that combat the consequences of climate change. Weather-based index insurance involves willing parties, such insurers, national meteorological agencies, and distributing and supporting channels, as well as agri-chain actors and the government, which supports the legal framework. Weather-based index insurance is effectively promoted through market-based concepts and economic processes, but it is frequently accompanied with a significant psychosocial and behavioral goal (Rambukwella et al., 2020).

Weather-based index insurance can help agricultural growth when it is used as component of a comprehensive risk management or market expansion plan. Index insurance protects farmers' assets and is element of a larger effort to alleviate poverty (Ramkumar, 2020). Weather-based index insurance, in addition to moving risks away from the farmers, can focus on providing accessibility to large markets, sophisticated technology and inputs, agricultural knowledge, and loans and other banking services. Weather-based index insurance appears to have the most potential for assisting households, FSPs, and input providers in managing low-to-medium-frequency covariate risks such as droughts, large insect outbreaks caused by weather extremes, and excessive precipitation (Afshar et al., 2021). As compared to typical agriculture insurance, weather-based index insurance reduces the insurability requirement (the economic size of an insurance transaction that can be reasonably serviced by an insurer).

The product's simplicity provides further options to reach a broader variety of homes - and for imaginative design to attract the disadvantaged (Tyagi et al., 2019). Nevertheless, the most probable target market will be emerging and commercial farmers, as the bulk of impoverished smallholders are unlikely to obtain insurance on a consistent basis. In that situation, a comprehensive market analysis may propose entering through an aggregator (for example, agricultural processors, input suppliers, FSPs, farmers' groups). Aggregators are critical to lowering transactions expenses and engaging more customers (Tartarini et al., 2021). In this framework, index insurance policies might be created to protect aggregator investments (through meso-level solutions) along with each farmers' household level vulnerability (through micro-level products distributed by the aggregator). The design for different policyholder and marketing platforms for weather-based index insurance is described in table 1.

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Table 1: Micro, meso, and macro levels of weather-based index insurance (WII) application

Policyholder	Sales or distribution model	Potential benefit(s) of WII
	Micro	
Farmers Households Small businesses	Farmers buy insurance as part of a package (e.g. financial services, technology, agricultural information) or occasionally as a stand-alone product Note: FSPs, farmers' associations, processors, input suppliers, or NGOs can also act as a distribution channel for micro products retailed to individual farmers	WII payout can: • Allow farmers to avoid default and restart production • Compensate for additional livestock feed costs • Provide income support in lean periods • Supplement other sources of household income that may be disrupted • Facilitate access to credit • Encourage investment in higher-quality inputs
Meso		
FSPs Processors Input suppliers Farmers' associations NGOs	Meso-level institutions buy WII policies (e.g. portfolio or group insurance) to protect their exposure and may create payout rules that directly or indirectly benefit farmers	• WII opens access to a new client base and helps manage mass defaults caused by weather shocks. • Meso-level actors can develop innovative linkages along the supply chain (e.g. contract farming, packaging of credit, and inputs) to help manage their risk and open market opportunities
Macro		
Government (or relief agencies)	The government or relief agency is reinsured	• Government receives early liquidity following disasters; relief agencies can fund operations

Source: IFAD and WFP (2010)

Index insurance could be implemented at many levels. IFAD's target group might gain from a variety of implementation strategies (table 1). At the microlevel, it is commonly assumed that farmers who are insured would have better access to finance, greater resilience to shocks, and access to higher-cost, higher-yielding inputs, all of which will boost revenue. Policyholders (the insurer's clients) are farmers, families, or small company owners who acquire insurance to protect themselves from probable damages triggered by natural disasters.

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These entities can serve as policyholders at the meso-level (Cole et al., 2019). At the meso-level, it is expected that these goods would enable banking institutions to function more effectively and service providers to expand their reach and lower their charges. At this level, weather-based index insurance can be organized through a policy given to the organization, but with payout terms that might assist farmers directly or indirectly - for instance, to reduce mass nonperforming loans in a microfinance bank (MFI). Lastly, index insurance may be marketed at the macro level to assist governments and humanitarian organizations in catastrophe and economic management (Xu et al., 2018).

While operating at the micro and meso levels, it is also critical to consider how any new weather-based index insurance effort would fit with present risk management rules, as well as how these policies would effect incentives for weather-based index insurance. Weather-based index insurance is a major element of CTA's flagship project, "Scaling-up climate-smart agricultural solutions for cereals and livestock producers in Southern Africa," which launched in August 2017 (Makaudze, 2018).

The project's goal was to improve food security, nutrition, and income for 140,000 rural smallholder families impacted by changing climatic variables in maize-livestock agricultural systems. This is accomplished by expanding proven climate-smart agriculture solutions like insurance in Malawi, Zambia, and Zimbabwe (Makaudze, 2018). The initiative implemented a package of solutions that includes, in addition to insurance, access to drought-tolerant maize, weather information services, and diverse livelihood possibilities for farmers. Insurance firms have historically avoided targeting these farmers, in part due to the high expenses of interacting with individual farmers in rural locations. Farmers, on the other hand, frequently lack adaptive ability, making them subject to climate fluctuations.

Index-based insurance transfers risk from farmers to insurers by providing compensation in the case of climatic or weather-related crop loss (Pu et al., 2018). Total yearly rainfall is employed as a 'index' in this project to trigger insurance payouts. Farmers are thus compensated when dry spell or extended drought spells have a significant effect on crop yield, and the compensation enables farmers to purchase agricultural inputs (specifically seeds) to replant lost crops, thereby assisting farmers' adaptive capacity and increasing their resilience to climate change. According to Pu et al. (2018), CTA assisted industry and farmers' organizations in scaling up successful insurance products for smallholder farmers in packaged packages that included, among other things, farmer organization enrollment, weather information predictions, and extension financial advisory.

Weather index insurance is a promising adaptation instrument where losses and payouts are determined using measured variables such as rainfall, and insurance companies don't have to send claims adjusters out to assess damages (Sutomo et al., 2019). Participating farmers can purchase insurance at a relatively low cost that can help them recover from floods and other disasters and

lower various forms of risk. Weather extremes can have long-lasting impacts on smallholder farmers' livelihoods through at least two channels. First, they destroy assets and production, and to make up for the lost income households may resort to costly coping strategies (Hohl, 2020).

These coping mechanisms include high-interest-rate borrowing and lowering expenditures in children's education, all of which jeopardize future household welfare. Second, the mere prospect of weather extremes might have serious repercussions, as risk inhibits agricultural investment. Ex-ante, without the shock occurring, this risk decreases welfare significantly, especially when compared to the welfare losses caused by shocks themselves. Various financial and commercial models have been created in the target regions to facilitate the development and delivery of weather-based index insurance services. Insurance, savings, loans, and mobile money are all examples of well-designed monetary products and services that may help smallholder farmers become more resilient (Kousky, Wiley & Shabman, 2021). They assist agricultural families in preparing for risk, responding to emergencies, and obtaining funding to invest in risk-reducing technology. They can also assist families in increasing their investments in a volatile environment, in attractive yet hazardous chances that boost income over time; this, in turn, assists households in rising out of impoverishment, which renders them more exposed to catastrophes in the first place. Many experiments suggest that weather-based index insurance products can lead to larger investments by crop and livestock producers by lowering risk exposure (Afriyie-Kraft et al., 2020). Weather-based index insurance products are often most successful when designed to protect against severe weather disasters in terms of development.

When weather shocks cause associated damages, farm households' risk management techniques, such as labor and crop diversification, risk-sharing reciprocal ties among community members, and distressed asset sales, fail. The poverty traps research, according to Mühlenhoff (2021), presents solid theoretical reasons and facts that provide credence to the premise that uninsured, impoverished households suffer long-term and often irreversible damage as an outcome of a catastrophic incident. Indemnities are based on evaluations of an objective third-party index, such as a specific meteorological parameter taken at a certain weather station during a pre-specified time (Fisher et al., 2019). Weather-based index insurance is often issued for a particular threat, the most important weather risk to output. Weather index insurance, by design, avoids many of the operations that make multi-peril crop insurance so costly to administer - collecting farm-level yield data, controlling for moral hazard and adverse selection, and conducting individualized loss assessments - opening up possibilities to insure crop or livestock businesses that would otherwise be too costly to insure.

CONCLUSION AND RECOMMENDATIONS

Conclusion

According to the findings of this study, data and information alone are insufficient to assist farmers. Many farmers may not be able to read weather prediction information and data received via mobile phones, therefore they may want further assistance in order to use it to make educated decisions about their agricultural activities. This may be addressed by ensuring that extension staff operating in project target regions subscribe to the service and have access to information from the farmers' digital portal. This allows them to acquire the same information and data as farmers and better handle farmers' enquiries in their region. The data delivered via SMS, or accessible via the

mobile portal, could therefore be used as a 'toolkit' for field-based extension staff. "Extension workers can play a pivotal role in interpreting weather information for farmers. Once registered, even farmers who are not on the ICT platform benefit through the extension workers' daily advisories. Despite the economic advantages of multi-peril crop insurance, producing weather index insurance products at affordable costs for smallholders remains a substantial difficulty. Weather-based index insurance fits into a larger financial services development framework, supplementing recent advances in microcredit and savings. However, like with many new goods and services, voluntary take-up of index insurance is often modest, especially when premiums are subsidized, and scaling up is difficult. Because of the scarcity of data in low-income nations, estimating the "pure" risk is frequently problematic when pricing weather index insurance. Weather data are used to develop a probability distribution of the underlying weather variable. Triggers and pay-out rates are chosen based on previous catastrophic events and their effects on, for example, crop growth, household livelihoods, or loan defaults, depending on the needs of the target market. From these estimates, actuaries determine the pure risk (the expected loss cost) of the insurance contract.

Recommendations

This study recommends the development of improved seed varieties for future food insecure regions. The development of seed varieties that are suitable for the emerging climate conditions can greatly benefit farmers who have sunk costs and specialized skills in a particular type of farming. The study also recommends that weather-based index insurance be linked to an existing development program or other market opportunities to provide added value to the client. As a stand-alone product, weather-based index insurance may be seen as an unnecessary cost and have little demand from farmers who face a variety of risks in addition to weather risks. The study also recommends partnership between weather-based index insurance programs and complementary agricultural development or risk management programs. NGOs in particular could play an important and independent role in the extension of information to farmers, possibly in conjunction with official extension services.

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