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KEY POINTS

- Extreme weather events can lead to significant adverse economic impacts, particularly in the agriculture sector, that is costly to recover. In many developing countries, contingency funds, mostly financed by the state budget, have traditionally played a significant role to offer financial compensation to the affected population.
- Agriculture insurance eases post-disaster recovery by ensuring policyholders to receive compensation in the event of an occurrence of an insured peril. Commercial insurers, the public-sector, or farmers' cooperatives, through either a formal (mutuals) or informal agreement, offer such forms of insurance.
- Insurance removes uncertainty in payment and eligibility requirements compared to compensation through contingency funds. Where the premium is financed, at least partially, by policyholders, it helps relieve pressure on the public budget. Insurance mechanisms based on risk-based pricing also incentivize risk-mitigating behavior.
- The policy framework and the regulatory environment, the risk management system in vogue, budgetary constraints, exposure, vulnerability, and the credibility of the institutional arrangements in place all determine its effectiveness. All of them are also critical factors for implementing successful agriculture insurance schemes.

AGRICULTURE INSURANCE

Arup Chatterjee
Principal Financial Sector Specialist
Sustainable Development and Climate Change Department
Asian Development Bank

Arman Oza
Consultant
Sustainable Development and Climate Change Department
Asian Development Bank

AGRICULTURE: A RISKY BUSINESS

Agriculture is risky. Indeed, the exposure to a wide variety, complexity, and scale of risks can make it one of those rare activities where the risks are too high and the rewards too low, especially for smallholder farmers.

Table 1 shows the many risk classes agriculture is exposed to, especially rain-fed agriculture, which, naturally, is more vulnerable to the risk of too much or too little rainfall. In addition, extreme weather, though perhaps rare, can frequently cause catastrophic losses. Farmers' exposure to weather risks also varies significantly with the choice of crops. Every crop requires watering at various stages of planting, tilling, heading, and ripening. Crop output is significantly reduced when water is insufficient or excessive during each of these phases.

Pest infestations are more likely during heading and ripening and are generally less severe, but in rare cases can damage an entire crop. In addition, infestation can be localized or widespread depending upon a crop's vulnerability to pests. Pest resistant seeds and pesticides can be helpful, but in some cases become ineffective. High use of pesticides, meanwhile, is connected to noncommunicable diseases such as cancer.

Water and soil quality also impact agricultural output. Groundwater or surface water that is contaminated by industrial effluents and pollutants undermines the quantity and quality of agricultural output. In addition, indiscriminate use of chemical fertilizers that do not match with the soil conditions can be detrimental to the crop yields and, although occurring with low to medium frequency and severity, can become more severe if ignored.

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Table 1: Risks in Agriculture

Nature of Risk	Description	Risk Category	Frequency	Severity
Weather risks	Deficit/excess rainfall, extreme temperature (heat or cold)	Pure,[a] covariate[b]	Low to medium	Medium to high
Biological risks	Pest, disease, contamination, soil degradation	Pure, idiosyncratic[c]	Medium	Medium
Price risks	Input output price Volatility, Shortage of inputs	Speculative,[d] covariate	Medium to high	Medium to high
Institutional risks	Credit supply, interest rates, market distortions, support prices	Financial,[e] covariate	Medium	Medium
Labor and Health Risks	Illness, death, injury, availability of labor	Pure, idiosyncratic	Low to medium	Medium to high
Political risks	Agriculture policy, taxation, subsidies	Dynamic,[f] covariate	Low to medium	Medium to high

[a] The risk involved in situations that present the opportunity for loss but no opportunity for gain. Pure risks are generally insurable.
[b] The risk where neighboring households in a locality suffer similar shocks such as rainfall and market price conditions.
[c] The risk where one household's experience is unrelated to neighbors such as field specific problems, a disease that affects a household member.
[d] The risk involved in situations that present the opportunity for loss or gain. Speculative risks are generally not insurable.
[e] The risk involved in situations where the chance a business's cash flows are not enough to pay creditors and fulfill other financial responsibilities.
[f] Risk that arises as a result of organizational change.

Source: Insurance Glossary, International Risk Management Institute.

Input and output price volatility is one of the subtler yet equally precarious risks farmers face. It is one of the few speculative risks and, as such, has an up and downside, that is, it can operate in the farmer's favor. Uncertain price movements of inputs such as seeds, fertilizers, and pesticides, on one hand, and the final output on the other, can disturb a farmers' margin estimations, affecting profitability. This risk is particularly high for smallholder farmers, as they enjoy no benefits of scale on procurement or sales. Theoretically, price volatility arises because of demand and supply factors. But in practice, frequently, it results from active manipulation by cartels of large traders or processors. Management of speculative risks is more complicated and depends more on the level of regulation and efficiency in the agriculture markets.

Agricultural credit is always in high demand from smallholders. Access to credit by small farmers from formal institutions such as banks has remained a challenge. The microfinance sector filled the gap to some extent in some countries, but informal lenders nonetheless still control a large part of the agriculture credit market. More often, these moneylenders are a part of the agriculture value chain on the farmer's demand or supply side.

From the farmer's perspective, the risk arises on two counts. First, the limited credit supply from formal financial institutions makes credit availability a big uncertainty. Changes in the credit policies of these institutions also affect farmers' eligibility to credit. Second, informal credit is often exorbitantly expensive. Here the risk is about the rate of interest, the repayment terms, and the resultant effect on farmers' profitability.

Most smallholders rely on family for labor, indeed, the cost savings often become the effective profit margin, and it is crucial for the farmer to deploy all family members during the peak season. When the model is so tight, sickness or death in the family not only results in additional health or last-rite expenses, but also hiring outside labor, can wipe out a farmer's margins. Despite this, farmers pay little attention to these factors, exposing themselves to this rare but financially severe risk.

Agriculture as a sector is also highly vulnerable to political developments. In most jurisdictions, agriculture enjoys subsidies at various levels of the value chain and any change in the structure of subsidies because of the fiscal or political situation can have a big impact on fortunes.

The diversity of all these risks makes agriculture unique. Practically speaking, weather seems to be the only class of risk that can inflict catastrophic losses. Severity for all other risks varies from low to medium, with a remote chance of very high financial impact. That said, because all categories of risk are independent of each other, their cumulative severity can often become devastating.

Moreover, frequency makes things more complex. Almost all risks have the propensity to strike with medium or high frequency. Typically, prevention or control is the best strategy for handling high-frequency risks. But here we have a situation that, apart from biological risks that can be controlled through better farm management, almost all other risks are beyond individual control. It is this tricky combination of frequency and severity, coupled with the uncontrollable nature of most risks, that makes agriculture a high-risk business.

Yet, the rewards are quite modest, especially for smallholders operating without economical volumes. Even if risks do not strike, market distortions and logistical issues most often preclude the farmer from getting the best price for his produce, keeping him

hand to mouth even after a good harvest. This skewed risk-reward equation makes agriculture an unviable activity for many small farmers.

Indeed, the rural exodus and distress in many parts of the developing world largely reflects this failure to cope with the repeated impact of risks of agriculture, and people thus decide to take up paltry alternative employment in cities or resort to extreme actions such as suicide.

TRADITIONAL RISK-COPING MECHANISMS

Farmers have faced risks since time immemorial. And over generations, a diverse set of traditional risk-coping strategies, approaches, and mechanisms has evolved. These strategies have become part of cultures and the nature of farming communities. Coupled with the way governments have dealt with problems in agriculture, the strategies have largely shaped farmers' attitudes toward risk and risk management.

Table 2 shows traditional coping strategies. Many of these are highly effective in mitigating, controlling, and avoiding the risks, despite their informal character. But they come with their own set of costs and limitations.

Cultivating a mix of crops with varying water and nutritional requirements, for example, is a common strategy to reduce reliance on one crop. Crop rotation over the years also preserves soil nutrients. But for smallholders, this results in smaller produce per crop, and those farmers can, as a result, neither economically procure inputs like seeds and fertilizers nor sell their produce at reasonable rates. This disadvantage on both sides of the value chain reduces already thin margins.

Similarly, without accurate weather forecasts, farmers resort to staggering planting dates. This overcomes the risk of total failure of the crop due to erratic rainfall. But it can also hinder attainment of optimal yields. Moreover, crops planted on different dates may not produce the same quality of output, putting the farmer at further disadvantage.

Farmers most often try to diversify income streams by engaging in allied, but different activities, in addition to agriculture, such as dairy farming, forestry, horticulture, sericulture, floriculture, and so on. This ensures a basic minimum income even if the core agricultural crop fails. In many areas, small farmers even resort to manual labor in nearby cities during off-season. This does not allow them to specialize and forces them to perform at suboptimal levels.

Mostly, farming communities enjoy solidarity among themselves, making them behave collectively in cropping decisions and allowing them to help each other during crisis. This obviously reduces risks, but, during catastrophic or covariate events like a drought or a massive pest infestation, it fails, since the entire community is exposed to a loss. Moreover, unwillingness or inability to formalize these informal collectives into institutions such as cooperatives deprives them of benefits of credit, procurement, storage, management, and so on.

Aligning with value-chain players is yet another strategy that can assure the farmer of services such as supply, credit, and sale of produce. Contract farming is the best example. But here, also, the farmer may end up exploited due to his limited bargaining power, as compared to the value-chain participant. And many of these arrangements are informal and carry the risk of nonfulfillment by the value-chain participant if a highly unanticipated event occurs.

Thus, while these traditional risk-coping techniques can be highly effective at times, they suffer several limitations that can be counter-productive or even cause failure. Reflecting these typical characteristics, governments normally adopt enabling policy, regulatory, and fiscal approaches toward agriculture. In most countries, interventions include input subsidies, interest rate subventions for credit, loan and interest waivers during bad years, minimum support prices, relief measures following catastrophic events, subsidized insurance coverage, and promotion of farmer collectives such as cooperatives.

Table 2: Traditional Risk-Coping Strategies

Strategy	Risks Addressed	Limitations/Costs
Cultivating a mix of crops	Weather and biological risks	Smallholders cannot get good prices for their output
Staggering crop planting dates	Weather risk	Forgoing optimal output
Nonagricultural activities	Diversification of income	Losing focus on core activity
Follow peers	Overcoming knowledge and information gap	Herd mentality results in lost opportunities
Reciprocal arrangements within the community/mutual help	Protecting cash/income flows	Not effective when covariate risks strike
Aligning with value chain players	Credit and price risk	Risk of being exploited by powerful value chain participants

Source: Authors.

Farmers attitudes toward risk and risk management could be significantly influenced by the complex risk-matrix they face, the traditional risk-coping strategies they practice, and the policy environment the sector functions in. Tendencies observed include the absence of a long-term outlook, extreme loss aversion resulting in insensitivity to rare but costly events, fatalism toward life in general, resistance to new technology and innovations in the sector, lack of confidence in formal mechanisms, and overreliance on ex-post measures, including government support. These attitudes go a long way in shaping their behavior; any intervention to reduce risks therefore needs to factor in such behavior to be successful.

GLOBAL TRENDS IN AGRICULTURE INSURANCE

Insurance is a risk-transfer tool that offers indemnity against pure risks. It is ideal for handling risks that rarely occur but carry a big financial impact. Risks in agriculture such as weather, biological, labor, and health are easily insurable. Since farmers face a portfolio of risks, it is all the more important to reduce their exposure by insuring them against insurable risks.[1] A mix of parametric and indemnity covers can significantly transfer the risks, increase ability to access and repay credit and, ultimately, increase incomes. Insurance therefore can indirectly play a significant role in achieving income security for farmers and food security for countries.

The conceptual importance of insurance in agriculture has by and large been recognized the world over. Many countries have launched public as well as private agriculture insurance schemes. A 2013 Swiss Re study estimates that agriculture insurance premiums worldwide almost tripled—from $8 billion in 2005 to $23.5 billion in 2011.[2] Emerging market premiums were $5.2 billion in 2011, and their share in total premiums increased from 13.4% in 2005 to 22% in 2011. India and the People's Republic of China were the key growth drivers, accounting for 62% of agriculture insurance premiums from emerging markets

Various types of insurance products are in vogue for agriculture and allied activities such as livestock (Table 3).

Multi-peril crop insurance, as a comprehensive cover, offers near to full indemnity in the event of losses and hence is offered in most middle-income countries. But it requires farm-level underwriting and loss assessment, making it costly to administer. The risk-cost of this kind of cover is also relatively high since it covers a wide range of agricultural risks. Moreover, global experience shows that it is more vulnerable to adverse selection and moral hazard. More and more countries are therefore moving from multi-peril crop insurance to index-based covers.

By contrast, named-peril covers are less costly and easy to administer because they have a narrow range of risk they cover. For the same reason, however, they are less attractive to farmers.

Index-based products were developed to overcome the limitations of named-peril and multi-peril crop insurance covers. The product design ensures minimum claims administration costs and almost complete elimination of moral hazard. The limitation is that the operation of basis risk can often lead to pay outs not aligned with actual losses,[3] resulting in dissonance to farmers. Index-based insurance is a relatively new entrant in the agriculture insurance market, however, and with expanding coverage and enhanced experience is expected to better address this issue in future.

Table 3: Types of Agriculture Insurance

Cover	Description
Crop Insurance	
Multi-peril crop insurance	All risks cover offering comprehensive yield-based indemnity based insurance against all losses other than those specifically excluded.
Named peril insurance	Covers only specified perils like hail, dew, etc.
Index-based insurance	Parametric cover offering payouts based on a historic underlying index like rainfall, area yield, etc.
Livestock insurance	
Cattle insurance	An indemnity-based cover offering payouts in the event of death/disability of insured cattle.
Index-based insurance	Parametric cover based on national census/mortality data of cattle.

Source: Authors.

[1] Eventuality for loss or damage that is definable, fortuitous, similar to a large number of known exposures, and pays a premium that is commensurate with the potential loss.

[2] Swiss Re. 2013. *Partnering for Food Security in Emerging Markets.* Sigma No 1/2013. Zurich, Switzerland.

[3] In index insurance "basis" is defined as the difference between the pay out, as measured by the index, and the actual loss incurred by the insured. The risk associated with the variability and unpredictability of the "basis" is defined as the "basis risk". Basis risk arises out of multiple factors, such as distance of farms from reference weather stations and failure of the product to capture farm-level behavior, such as the exact date of planting

Livestock insurance is a small but important part of the agriculture insurance basket. The conventional indemnity based insurance suffers from limitations such as high cost of administration and vulnerability to moral hazard and hence has not been viable in most cases. In some places, cattle insurance on a mutual model seems to be succeeding, but those schemes are very small and may take a long time to scale up. Efforts to develop index-based cattle insurance in Mongolia have yielded mixed results.

Governments are increasingly recognizing the benefits of ex post to ex ante financing solutions to manage agriculture risks. This has helped increase demand for risk protection and insurance solutions. Public-private partnerships involving governments and private reinsurers have contributed to innovation in agriculture insurance products and successful implementation of commercially viable agriculture insurance schemes and products, such as index-based insurance using remote-sensing technology for loss settlement.

However, due to the high cost of agriculture insurance, most middle-income countries offer heavy subsidies. While most countries offer premium subsidies, claims subsidies or indirect reinsurance is also offered to keep premiums affordable. Almost 50% of the gross premium is subsidized across the world, while the total cost to governments for agriculture insurance, including premium subsidies, works out to almost 68% of the gross premium.[4]

Subsidies have not been able to significantly increase agriculture insurance uptake in most cases. Not only is agriculture insurance penetration low, but a large part of the area under cultivation remains uninsured. As a result, governments have to come out with huge doles of relief to farmers after catastrophes, adding to the public cost of agricultural risks. Climate change is expected to aggravate these costs. So, while governments are spending substantially to support agriculture, the business remains unattractive for farmers, especially smallholders. A more holistic approach toward de-risking agriculture will be required.

CHALLENGES EXPANDING THE OUTREACH OF AGRICULTURE INSURANCE

Progress has been limited, despite the urgent need to protect agriculture from ever-increasing risk exposure and relentless government and development agency effort to expand the outreach of agriculture insurance by providing financial and technical support, especially in developing countries. By and large, agriculture insurance remains restricted to subsidy and credit-driven initiatives and has not gained credence as an insurance product that should be voluntarily purchased. This has been a problem with all insurance products in general, but it is more so for agriculture insurance because of the following additional challenges:

- *Products*: As Table 3 shows, a diverse set of agriculture insurance products do exist, but each of them suffers constraints and do not provide reliable protection to farmers. Experience from weather index insurance in India reveals that products should be designed based on sound agronomic principles. Further investments are needed for reducing the level of basis. Hybrid products that combine both area yield and weather indices seem promising, with the potential to combine the strengths of the individual indices. Moreover, typical insurance products only cover low-frequency, high-severity risks and hence become less attractive to clients. However, offering coverage against high frequency risks can make the product disproportionately costlier. This product development challenge leaves big scope for innovative design and testing of many more types of indemnity and index-based products. Regulations for index insurance products should address the issues related to product design, product standardization, longer-term contracts, and consumer protection.

- *Residual risks*: Agriculture is exposed to a huge burden of a variety of pure and speculative, idiosyncratic, and covariate, as well as catastrophic and non-catastrophic risks. Insurance addresses only part of these and leaves farmers to manage the residual risks. Even assuming insurance will provide full indemnity against pure risks, uninsurable residual risks, such as price risk, supply chain risk, and institutional and political risk, are serious enough to inflict regular losses on farmers. Being more frequent in occurrence, they become more conspicuous for farmers. Farmers may be looking for a total risk management solution that can help them manage all their risks, and they may even be ready to pay a higher price for that. Insurance may suffer because, thus far, it has been able to offer only a partial risk management solution. Crop-revenue insurance products that cover the decline in price that occurs during the crop's growing season, as available in the United States. should also be explored as a form of additional coverage. It does not cover declines that may occur from one growing season to another.

- *Pricing*: Due to the relatively higher frequency and severity of risks and limited availability of actuarial data in many cases, the premium for agriculture insurance products is mostly on the higher side, making it unaffordable for many farmers. Premiums often remain high despite premium and claims subsidies offered by governments. If the premiums are to be reduced, deductibles have to be imposed, which, again, makes the product all the more unattractive.[5] Consumers weigh the cost of a product against the expected value or

[4] O. Mahul and C. Stutley. 2010. *Government Support to Agriculture Insurance: Challenges and Options for Developing Countries*. Washington, DC: World Bank.

[5] A fixed amount or percentage of an insurance claim that is the responsibility of the insured and which the insurance company deducts at the time of claim payment.

benefit it offers. Insurance products often fail this litmus test and agriculture insurance is no exception. If the cost-benefit equation can be made favorable in the eyes of consumers, affordability may become a fringe issue.

- *Behavioral Issues*: It is well established that consumers suffer several behavioral anomalies that prevent them from buying insurance. Insurance is a financial instrument where the sacrifice (payment of premium) is real and immediate, while the benefits (claim pay outs) are distant and contingent. Due to this, the mental math often considers premium as a "loss" and not as "cost". People are risk averse when it comes to choosing between possible gains. But the same ones may become risk takers when confronted with "bad" choices. When a certain but small loss (premium) is pitted against a large loss that is less likely but can have severe financial impact, loss aversion provokes avoidance of the almost certain loss, thereby preventing purchase of insurance. Events with extremely low probabilities tend to be ignored and addressing these anomalies is difficult as well as costly. It requires sustained effort in consumer education and product design. This is why, it is said, insurance is always sold and never bought. The complexities of risk in agriculture aggravates loss-aversion tendencies. Moreover, relief measures from governments and aid agencies after calamity are almost assured, further jeopardizing the prospects for ex-ante mechanisms like insurance.

ATTAINING SCALE AND CLIENT VALUE

Insurance is a long-term business for insurers. The actuarial assumptions behind product design and pricing are tested only over time in light of claims experience. Similarly, from a client's viewpoint, the real benefits of insurance should be viewed in the long term. Individuals, families, and enterprises are exposed to an uncertainty about the timing of an insured event and insurance could be helpful only if the coverage continues over a period of time. To be offered for purchase over a long period, insurance needs to be sustainable. For attaining sustainability, an insurance product has to achieve scale and client value. But often one comes at the cost of the other. Social insurance schemes subsidized by governments can achieve scale, but their client value remains uncertain. By contrast, voluntary insurance products involve active selling and hence are often high on client value, but generally take time to attain scale. Attaining scale and client value is thus the biggest challenge in insurance, especially insurance for the low-income segment.

In agriculture insurance, apart from the People's Republic of China and India, hardly any country has been able to achieve scale relative to potential. Many of the agriculture insurance risks are covariate and hence rationalization of premiums is possible only if a decent scale with geographic diversification is attained. This may require a fundamental shift in the approach to agriculture insurance in light of the challenges and limitations mentioned earlier. Some of the new approaches to expand the reach of agriculture insurance are discussed below.

- *Introducing mutuality*: It may not be economical for commercial insurers to underwrite the entire spectrum of risks in agriculture, as many of them are high-frequency. However, excluding them completely from insurance coverage may make the product unattractive as farmers do want protection against high-frequency risks as well. As mentioned earlier, farmers are seeking a total risk management solution for their risks, which includes these high-frequency risks, such as localized damage caused by pests or non-catastrophic weather formations. To address this, a hybrid model comprising commercial and mutual insurance can be worked out, where the low-severity idiosyncratic risks are carried by community structures like self-help groups and larger risks are transferred to commercial insurers. This kind of model will not only enable coverage of risks that are otherwise uneconomical for insurers, but will also entail other benefits such as reduced scope for moral hazard due to peer pressure and lower costs of administering enrolments and loss assessments. The mutual component of the product will create a new layer of risk sharing by the community that is positioned between the individual farmer and the commercial insurer, and which can act as a cushion for both. The mutual character of the product will also inculcate a sense of ownership among the insured farmers that will help in overcoming their dissonance toward insurance. If the surpluses generated by the mutual component of the product can be shared with the insured farmers, it would also address some of the loss-aversion tendencies among farmers. Regulatory restrictions, product design, consumer education, product management, and accounting treatment of premium and claims could pose challenges under this model. Moreover, getting commercial insurers on board for such an initiative may be difficult. If pilots can be rolled out in different geographies by overcoming these challenges, it could bring lessons that can be incorporated before scaling up.

- *Bundling parametric covers with comprehensive indemnity-based covers*: It has been seen that indemnity-based covers such as multi-peril crop insurance or index-based products such as weather insurance carry disadvantages, both for insurers and farmers. Hence, if offered separately, both will face challenges in scaling up. A bundled product that offers indemnity-based and index-based coverage can be tested to overcome their respective limitations. Non-catastrophic risks such damage by pests or inadequate rainfall can be covered on an indemnity basis, while catastrophic covers of floods, severe drought, cyclone, and so on, can be included as index-based covers. The idea is to provide indemnity coverage for idiosyncratic risks and parametric coverage for covariate risks. Instead of a graded pay out, such as a put and call option that is normally offered in index-based insurance products, a single pay out, or at best pay outs,

based on two or three triggers depending on the scale of insured parameter should be provided for. This will make the product less complex. Instead of a single parameter such as rainfall, effort should be made to include multiple parameters such as severe drought, cyclone, or flood, depending on the availably of independent data source. Importantly, the indemnity and index-based coverage should operate on a mutually exclusive basis, which means that claims are possible only under one of the two covers. This will curtail the maximum probable loss[6] under acceptable limits and therefore restrict the premium loading. The loading for loss assessment will also be restricted, since the indemnity cover will not apply in case of covariate risks. Such a product can again be positioned as a total risk management solution. The premium worked out for such a product may still be higher than stand-alone multi-peril crop insurance or index-based insurance, and thus may have to be subsidized.

- *Value-added services to overcome dissonance*: Risk transfer through insurance is just a part of a larger risk management process. High-risk activities such as agriculture are also exposed to speculative and operational risks that cannot be insured. Even for insurable risks, scope is considerable for risk reduction through loss prevention and minimization measures. The client value of insurance products can be considerably enhanced if, apart from carrying the insured risks, insurers can offer value-added services for risk reduction. For example, localized weather forecasts, cropping patterns in other geographies, real-time price information, proper advice on fertilizers, and assessment of soil quality and its nutritional deficiencies are valuable inputs that can reduce risks and enhance the intrinsic value of the insurance product. The farmers may even be willing to pay a slightly higher premium for an insurance product that carries such value-added services. More importantly, insurance coverage bundled with such useful services will help reduce customer dissonance and thereby ensure higher renewal rates. Risk reduction through such inputs will also eventually reduce the claims costs for insurers and help make the product profitable. Like health, agriculture is a specialized insurance business that requires closer engagement with the client, much beyond the conventional underwriting of risk. Increased engagement with clients through value-added services can benefit farmers and insurers.

- *Mobile and satellite technology to improve efficiency*: Mobile and satellite technology can be widely used in agriculture insurance to offer value-added services, reduce moral hazard, build a credible database of farm-level behavior, and reduce transaction costs. Customized mobile applications can be provided to insured farmers, to transmit information and inputs to insurers on farm-level data such as date of sowing or various stages of crop growth. Geo-tagging of insured farms can also be done to offer farm specific guidance. Such use of technology can reduce risks and enhance value for the farmers. As volumes pick up, the data collected can be used for policy, regulatory, and market interventions. The data can also be used for agricultural research and better behavioral analysis of farmers.

- *Fine tuning ex-post relief and ex-ante risk management*: High-risk activities like agriculture need both ex-ante risk management in the form of risk control and transfer as well as ex-post support in relief and loss minimization. Sometimes, financing these activities can pose a challenge as each can have a crowding-out effect on the other. Ex-ante measures need subsidies and ex-post measures relief funds. For better fiscal planning, governments should devise and adopt long-term strategies that adequately balance these approaches and ensure that the financial resources needed are set aside. In this context, various disaster risk financing instruments such as risk pools, contingency funds, disaster relief funds, can be considered.

Agriculture insurance can reduce farmer and herder risk and increase average productivity and incomes. It can also increase access to credit. However, agriculture insurance is effective when combined with the adoption of risk management measures. De-risking agriculture and making it a viable activity requires comprehensive effort from multiple stakeholders, including the private sector. Governments and development agencies have to play a bigger role in partnering with private re/insurers, technology providers, input suppliers, and financial institutions. They need to do this in initiating sustainable risk sharing and transfer schemes and products that increase the financial resilience of farmers, as part of their broader agricultural risk management strategy.

[6] The probable maximum loss represents the worst-case scenario for an insurer.

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Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444

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