China: Innovations in Agricultural Insurance

Promoting Access to Agricultural Insurance for Small Farmers

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This report was authored by a team co-led by Nathan Belete (Sustainable Development, East Asia & Pacific Region, World Bank) and Olivier Mahul (Finance and Private Sector Development, World Bank).

The team comprised multidisciplinary specialists with responsibility for specific aspects of the report, namely, Barry Barnett, professor, University of Georgia (agricultural risk assessment); Richard Carpenter, attorney (legal and regulatory framework); Xiaopeng Cheng, economist (insurance data analysis); William Dick, Commodity Risk Management Group, World Bank (product development); Xing Li, research fellow, IFPRI/CAAS (agriculture and insurance data analysis); Jerry Skees, president, GlobalAgRisk (macro risk policy framework); Charles Stutley, underwriter (underwriting and reinsurance); and Alene Tchourumoff, economist (researcher).

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Executive Summary

Context

1. China has about 328 million people involved in agricultural labor, and a vast majority of them are small and marginal farmers operating 0.4 hectares on average. While there need not always be a direct correlation between landholding and poverty, it is likely that a significant proportion of such households are below the poverty line. Further, the vast majority of farmers grow rainfed crops and are therefore particularly vulnerable to the vagaries of the weather. More than 20 percent of the total farmland, estimated at 165 million hectares in 2004, was affected by natural disasters on average over the period 1979–2004. The major cause of loss is drought, followed by flood. In 2004, it is estimated that China’s farmers and economy lost close to $18 billion worth of crop value due to natural disasters. In this context, agricultural risk management products such as insurance are of critical importance, particularly for the small and marginal farmers.

2. The agricultural insurance market in China is extremely small. In 2005, the national agricultural insurance premium volume was $91 million, representing a mere 0.6 percent of the total Chinese non-life insurance premiums. Various management models of agricultural insurance are being piloted in China. The models range from specialized mutual insurance companies with local government subsidies, to foreign commercial insurance companies with no public subsidies. These pilots are currently under implementation in several provinces: Heilongjiang, Xinjiang, Jiangsu, Shanghai, Jilin, Xinjiang, Zhejiang, Sichuan, and Hainan.

3. The government of China (GoC) recognizes the importance of revitalizing the agricultural insurance industry to better meet the needs of farmers throughout China. Under the 11th Five-Year Plan (FYP) and various other government policy documents, the Chinese government has reiterated its commitment to agricultural and rural development. In early 2007, the Ministry of Finance (MoF) approved a new set of pilots in the following provinces: Jiangsu, Jilin, Xinjiang, Hunan, Sichuan, and Inner Mongolia. The ministry has allocated a budget of RMB1 billion ($125 million), equivalent to that allocated by the selected provincial governments. The RMB 2 billion ($250 million) subsidy program aims to finance 50 percent of the agricultural insurance premiums in the selected provinces.

4. In that context, the challenge for policymakers is how to develop agricultural insurance that will be accessible by small farmers at an acceptable cost. Multiple-peril crop insurance (MPCI) products have been overemphasized in China. MPCI products are extremely challenging to design and administer in a cost-effective fashion, particularly in countries dominated by small farm households. World experience for MPCI has demonstrated that these programs either pay very high administrative costs or the products have extremely poor actuarial performance. Given the costly nature of developing MPCI products, most countries chose to subsidize these products. For example, if China followed the path of the United States in product design and subsidies, the total cost could approach $10 billion.
5. The report explains why agricultural insurance is expensive to deliver to small farm households. This backdrop, coupled with the detailed risk assessment in four provinces, leads to a key finding that China should put more resources in developing products that are more suited to an agricultural economy that is dominated by small farm households. In particular, named-peril and index-based crop insurance products could be developed for less cost than MPCI products. The report discusses the important role of government in supporting the legal and regulatory environment, access to data for new product development, risk sharing, and broader education of all stakeholders about the benefits of agricultural insurance. It also explains why this form of subsidy could provide improved incentives versus a direct subsidy for farmer premium.

6. In this regard, the government, through its MoF, requested the World Bank to conduct a comprehensive assessment of its agricultural insurance industry and provide recommendations for its future development.

**Objectives and Methodology**

7. The objectives of the study were agreed upon through extensive consultation with central and provincial government authorities, insurance companies, agricultural insurance policyholders, farmers, and other stakeholders throughout different parts of the country. The study intended to assist the government of China in the development of a forward-looking strategy for promoting access to agriculture insurance for small farmers.

8. An operational framework for the development of agricultural insurance was developed. It clearly identifies the key operational functions of the insurance companies with consideration of the multiple stakeholders:

   - Product delivery and product development are key functions. Named-peril and index-based insurance products should be key products if small farmers are to be served in a cost-effective fashion. Furthermore, bank and financial intermediaries should be involved in selling agriculture insurance to further reduce delivery costs.
   - Technical assistance should be national in scope in order to take advantage of the learning that takes place in many different regions of China. While the central government can be involved, it is more appropriate to try to create a service entity using, for instance, the Insurance Association of China. This entity could sell services to all firms and bring the knowledge, data, software, and other services together in a much more cost-effective fashion than insurance companies performing these services on their own.
   - The insurance regulatory service deserves a special function. In this case, only one primary entity is involved in facilitating that activity—CIRC.
   - The financing of agricultural excess losses should be based on a public-private partnership involving both central and provincial governments as well as international reinsurers.
9. The study focused its analysis of the industry on the following four target provinces: Hainan, Heilongjiang, Shanghai\(^1\), and Xinjiang. These target provinces were selected based on their spatial coverage of China, the differing agro-ecological conditions, the divergent agricultural risk profiles, and varying experiences with both government- and non-government-supported agricultural insurance.

10. The study was divided into three successive phases: Phase 1 focused on agricultural-, weather-, and insurance-data collection at both the national and provincial levels. This data collection was coordinated mainly by the provincial finance bureaus and CIRC offices, in close collaboration with the relevant line bureaus and insurance companies. Phase 2 focused on the detailed technical analysis of the data collected by a multidisciplinary team of economists, insurance and financial sector specialists, legal and regulatory specialists, and researchers. Phase 3 presented the draft report and findings for discussion with all relevant stakeholders, namely central government agencies, provincial line bureaus, insurance companies, and representatives of the reinsurance industry, among others, to gain feedback before finalizing the report.

**Key Challenges Facing the Agricultural Insurance Industry in China**

11. **National agricultural insurance uptake is low.** In 2005, the agricultural insurance premium volume approximated RMB729 million ($91.1 million)—less than 0.6 percent of national non-life insurance. On the supply side, agricultural insurance is only available in a few provinces. On the demand side, the majority of Chinese farmers lack awareness and education related to insurance in general and crop and livestock insurance in particular.

12. **Pilot crop insurance initiatives, as currently designed, are not geared toward small farmers.** The current crop insurance products, as well as the new pilot insurance products, are designed mainly for farmers insured in former military reclamation areas, and where individual-grower crop MPCI programs are feasible. This is because of the unique features of the reclamation areas, large farm structure, and the organization of agriculture. These MPCI products are not well suited to wide-scale replication with small farmers outside the reclamation areas.

13. **China’s crop risk profile shows great differences in risk across crops and geographic areas.** Risk exposure for small and geographically concentrated crop-insurance companies can be high because of the high level of covariate risk such as droughts, floods, and typhoons. However, pooling agricultural risks across the country can significantly reduce the peak risk exposures.

14. **Insurers have limited financial capacity to deal with catastrophic losses.** Domestic insurers are exposed to catastrophe risks and have limited opportunity to diversify their portfolios.

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\(^1\) It should be noted that Shanghai is a municipality and not a province, but in this report, the phrase ”pilot provinces” includes Shanghai for the sake of simplicity.
15. **Agricultural insurance products offered by the insurance industry are limited.** Crop insurance products currently available are mainly MPCI products, which present numerous challenges for the insurance industry to develop successfully and are not fully appropriate to meet the insurance needs of the agriculture sector.

16. **Agricultural risk assessment capacity is inadequate.** The risk assessment conducted under this study shows that domestic insurers tend to underestimate the underlying crop yield risks and therefore may under price their products.

17. **Domestic insurers have limited access to technical services and international agricultural insurance expertise.** Provincial insurers have limited access to technical insurance services in specialized areas such as product design, ratemaking, underwriting, and loss adjustment.

18. **Government support is not geared to providing insurers with incentives to improve their operations and expand their services to small farmers.** Public support to agriculture insurance is mainly through direct premium subsidies. This does not create incentives for agricultural insurers to provide better services to existing insured farmers or to offer new products tailored to small farmers.

19. **The legal and regulatory framework for agricultural insurance is ambiguous.** The present insurance law includes no specific provisions for agricultural insurance, therefore insurers operate without a clear legal framework.

**Lessons from International Experience in Agricultural Insurance**

20. Agricultural insurance is challenging under any circumstances. It is even more challenging when farm units are small, markets are not well-developed, regulations are unclear, and data and information are limited. International experience has been mixed for many types of agricultural insurance. Governments have become increasingly involved in agricultural insurance, in some cases as a direct insurance provider, in others via public-private partnerships.

21. Central to the development of a sound and sustainable agricultural insurance program, is the application of sound actuarial principles to determine the cost of agricultural insurance (that is, insurance premium). It is therefore important that any agricultural insurance program takes into account the pure cost of risk (expected annual loss), the operating costs (that is, delivery costs, loss adjustment costs, and so on) and the reserve load (that is, cost of holding reserves or cost of reinsurance).

22. The cost of insurance can greatly vary across different product designs. The benefits and limitations of three types of insurance products can be considered:
   - **Named-peril insurance:** Named-peril insurance products (for example, hail) have been the first crop insurance products offered in many countries. The cost of offering named-peril insurance is significantly less than the cost of offering multiple-peril insurance, because (1) it is easier to conduct risk assessment for a single named peril than for multiple perils; (2) risk classification is easier, so the
potential for adverse selection is greatly reduced; and (3) the loss-adjustment costs are usually lower.

- **Multiple-Peril Crop Insurance (MPCI):** MPCI is an attractive product in cases where the damage to crops is complex (for example, many perils interacting, such as rainfall and disease). Furthermore, it provides a guarantee to the farmer of an indemnity if the actual realized yield is less than an agreed percentage of the average yield established for the farm. Despite the advantages of MPCI to the farmer, individual-farmer MPCI has proved to be highly problematical for insurers, because it is very expensive to administer and farmers (and especially smallholders) are usually unwilling to pay premiums that are sufficient to cover the insurer’s cost of providing MPCI. Thus, all MPCI programs (except in South Africa) have large premium and/or administrative subsidies paid for by government.

- **Index-based insurance:** Because index insurance indemnities are based on the realized value of a predetermined index rather than farm-level losses, the operating costs of providing index insurance are less than the operating costs of indemnity-based insurance. It offers (1) limited moral hazard, because the farmer cannot influence the likelihood or magnitude of an indemnity; (2) no farm-level loss adjustment; and (3) a simpler enrollment process, since there is no need to establish and verify average farm-level yield.

23. Even when these best practices are followed, the cost of delivering and loss adjusting MPCI policies will likely be excessive for smallholders. There are several ways for the government to provide subsidies that reduce the costs of providing various types of crop insurance—for example, through the development of risk market infrastructure.

24. **Legal and Regulatory Framework:** Among the most important functions for government in facilitating agricultural insurance markets is the establishment of an enabling legal and regulatory framework. Agricultural insurance is a special class of insurance business that has characteristics that are somewhat different from other classes of general insurance, such as automobile or property and casualty insurance. It is important for the insurance law and the regulatory system to account for these differences. For example, index insurance creates some unique legal and regulatory challenges, since indemnities are not based on the actual loss incurred. Thus, even when strong legal and regulatory systems are in place, it is likely that modifications will be required.

25. **Enhancing Data and Information Systems:** To develop any crop insurance product, insurers require reliable, impartial data on agricultural production. Because much of the data required for crop insurance has public-good characteristics, it is unlikely to be collected, cleaned, and archived by private sector companies. Therefore, the government should provide this kind of data. Crop insurance companies in China currently make extensive use of the National Bureau of Statistics (NBS) data on hectares planted and production of various crops, as well as the data on hectares covered by, and affected by, various natural disasters. Further government investments in collecting, cleaning, and archiving relevant data—as well as ensuring that this type of data is easily available to insurance companies—could further stimulate the development of the agricultural insurance market in China.
26. **Public Awareness and Capacity Building.** Government should be actively engaged in public awareness and capacity building during the early stages of crop insurance market development. Very often crop insurance, or even general insurance, is not very well understood by rural farmers, and therefore these kinds of efforts are critical to ensure that farmers understand the advantages and disadvantages of different crop insurance products.

27. **Catastrophe Reinsurance and Risk Sharing.** Crop insurance is highly subject to spatially covariate risks, such as drought or extreme temperatures. This implies that, in any given year, indemnities can be very high relative to premiums collected. Insurers must have access to large amounts of ready capital to pay these indemnities. Reinsurance is the most common means that insurers use to gain access to additional financial capacity. However, reinsurance can be expensive. Governments often provide subsidized reinsurance for MPCI policies. In the United States, the federal government provides a highly subsidized reinsurance contract for insurance companies that sell MPCI policies. In Spain, the consortium of insurance companies is mainly reinsured by the public reinsurance company Consorcio de Compensacion de Seguro.

28. To date, the experience on weather-index insurance is limited. However, it is likely less costly to obtain private sector reinsurance on index insurance products than on MPCI. Some weather variables are less spatially covariate than MPCI losses. More important, however, is that, compared to MPCI, index insurance products are simple, transparent, and less susceptible to adverse selection and moral hazard problems. This reduces the reinsurers cost of due diligence so they can provide reinsurance on index insurance at more favorable terms than reinsurance on MPCI.

29. **Public Subsidies.** In almost all MPCI insurance programs (including those in China), the government subsidizes the premium cost to farmers. By way of contrast, government premium subsidies have rarely been applied to named-peril insurance products such as hail insurance. This is because the costs of providing named-peril insurance are low enough that farmers can afford to pay the premium. Premium subsidies may make MPCI more affordable for farmers, but they do not address the underlying high costs of providing MPCI (that is, adverse selection, moral hazard, and high loss adjustment, delivery, administration, and reinsurance costs). Furthermore, for a fully scaled-up MPCI insurance program, public sector premium subsidies can be prohibitively costly. In 2006, the U.S. government paid $2.7 billion in crop insurance premium subsidies despite numerous studies documenting widespread adverse selection and moral hazard problems with the MPCI program in the United States. If China adopted a similar program, the annual cost of the subsidy program to the government could be as high as $10 billion.

30. Premium subsidies can also create perverse behavioral incentives. Premium subsidies are typically calculated as a percentage of the commercial premium (for example, a subsidy might be equal to 50 percent of the commercial premium). Farmers producing the most risky crops or producing in the highest risk areas, who should be charged the highest premiums, get more subsidies (in value terms). Government premium
subsidies can also encourage farmers to produce a high-valued but risky crop in a region that is not well-suited to produce that crop, thus assuring greater losses in the future.

31. If governments wish to provide crop insurance subsidies, it is likely far better to focus those subsidies on developing risk market infrastructure, such as the items mentioned earlier (that is, product development, catastrophic risk financing, an appropriate legal and regulatory framework, high-quality data, public awareness, capacity building, and so on).

Principal Recommendations

Product Development

32. **One size does not fit all.** No single product solution will meet China’s needs, due to the very wide range of climatic and farming conditions. A variety of appropriate crop insurance products is required in each province. As a result, a mix of existing crop insurance products and index products is recommended, to allow for the expansion of crop insurance. A structure whereby products are developed within each province will increase the likelihood that tailored agricultural insurance products will be developed to match the great diversity of agriculture in China.

33. **New crop insurance products should be specifically developed for small farmers.** These products should offer effective and affordable insurance to small farmers and should focus first on the financing of catastrophic losses.

34. **Insurers should perform a formal portfolio risk assessment.** Insurers should conduct a formal assessment of the catastrophic risk exposure of their portfolio of insurance business. This would allow them to identify peak exposures in their portfolio, rebalance their portfolio, and structure cost-effective risk financing strategies (including risk retention, pooling, and reinsurance purchasing), leading to an increased capacity to sustain catastrophic losses.

35. **Agricultural insurance rate making techniques should be revisited in the light of international best practice.** Insurers must consider using actuarially sound rating techniques consistent with international best practice and with Chinese conditions.

Risk Financing Strategy

36. **The government should contribute in the financing of losses that cannot be transferred to the private market at acceptable costs.** The government should focus on catastrophic losses, acting as reinsurers of last resort, when the financial resources of the domestic insurance industry are scarce and access to international reinsurance markets is limited.

37. **Fostering commercial agricultural reinsurance capacity.** The provincial and central governments should further promote access to agriculture insurance to local reinsurers (for example, China Re) and international reinsurers in order to increase commercial agricultural reinsurance capacity.
38. **The role of the central government and provincial governments in the financing of catastrophic risks in agriculture should be clarified.** If the central government wishes to offer a subsidy to local insurance companies, the central government could offer free stop-loss reinsurance at an agreed proportional level above certain extreme levels, to the provincial government or the provincial insurance companies. The central government could also sell stop-loss reinsurance for the remaining portion. The provincial government could buy this stop-loss reinsurance for its local insurers.

**Institutional Capacity Building and Technical Assistance**

39. **A technical support unit should be established as a central agricultural insurance service provider.** This unit should have support from the central government and linkages to the provincial governments, insurers, and reinsurers. This center of expertise would provide market services for a fee to support rapid development and scaling up of agricultural insurance.

**Legal and Regulatory Framework**

40. **An appropriate legal and regulatory framework should be developed to support agricultural insurance.** Although there are some differences between agricultural insurance and other forms of general insurance, the principles governing the regulation and supervision of general insurance, and insurance contracts, are largely applicable to agricultural insurance. Given the considerable overlap, it is recommended that the Insurance Law be applicable to agricultural insurance, but allow different provisions to be made for agricultural insurance, where appropriate, through regulations made under the Insurance Law.

**Government Support and Public Subsidies**

41. **The objectives of public intervention should be clarified.** If the policy objective is to increase the incomes of rural households or to create a safety-net program that assures some minimum level of income for farm households, agricultural insurance is not a cost-effective instrument. These types of social policies involve direct transfers of wealth from the government to rural households. Agriculture insurance can be an effective risk-management tool but is not an effective tool for transferring wealth to economically disadvantaged rural households.

42. **The Government should facilitate the pooling of agricultural risks.** Provincial agricultural coinsurance pools, like those established in Hainan and Zhejiang, should be supported by the provincial governments to help local companies reduce their risk exposure.

43. **Ongoing pilot initiatives on agricultural insurance should be better coordinated.** The central government, through the MoF, and the provincial governments, through their finance bureaus, are piloting a series of agricultural insurance initiatives.
These pilots should be better coordinated and be implemented as part of a national policy framework for the development of agriculture insurance.

44. **A public subsidy program should be developed to create incentives for agricultural insurers to expand their services to small farmers.** Public support should focus on the development of risk market infrastructure and public goods that will give agricultural insurers incentives to offer affordable and effective insurance to farmers, particularly small farmers.

45. **Targeted premium subsidies could support marginal farmers as a social tool.** Premium subsidies could be targeted to marginal farmers under a social program. However, they should be combined with the promotion of risk-mitigation activities (for example, drought resistance seed, and so on).

46. **Government reinsurance should complement private reinsurance.** Public subsidies for reinsurance should be made available for risk layers that cannot be transferred to the reinsurance market at acceptable costs or for which reinsurance capacity is unavailable. This is usually the case for top (catastrophic) layers, where the government could act as a reinsurer of last resort.
## Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AAL</td>
<td>Average Annual Loss</td>
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<td>China Re</td>
<td>China Reinsurance Company</td>
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<td>CIRC</td>
<td>China Insurance Regulatory Commission</td>
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<tr>
<td>CPC</td>
<td>Communist Party of China</td>
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<tr>
<td>CUPIC</td>
<td>China United Property Insurance Company</td>
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<td>EASRD</td>
<td>East Asia Sustainable Rural Development</td>
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<td>FMD</td>
<td>Foot and Mouth Disease</td>
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<tr>
<td>FPDSN</td>
<td>Finance and Private Sector Development, Financial Markets for Social Safety net</td>
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<td>FYP</td>
<td>Five-Year Plan</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GNPI</td>
<td>Gross Net Premium Income</td>
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<td>GoC</td>
<td>Government of China</td>
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<tr>
<td>GRC</td>
<td>Group Risk Plan</td>
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<tr>
<td>HRG</td>
<td>Heilongjiang Reclamation Group</td>
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<tr>
<td>IAHI</td>
<td>International Association of Hail Insurers</td>
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<td>IAIS</td>
<td>International Association of Insurance Supervisors</td>
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<td>MoF</td>
<td>Ministry of Finance</td>
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<td>MPCI</td>
<td>Multiple-Peril Crop Insurance</td>
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<td>NBS</td>
<td>National Bureau of Statistics</td>
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<td>PICC</td>
<td>People Insurance Company of China</td>
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<td>PML</td>
<td>Probable Maximum Loss</td>
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<td>SAIC</td>
<td>Sunlight Mutual Agricultural Insurance Company</td>
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<td>XPCC</td>
<td>Xinjiang People’s Construction Corps</td>
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<td>TSU</td>
<td>Technical Support Unit</td>
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Chapter 1: Introduction

1.1. China is the world's most populous country and one of the largest producers and consumers of agricultural products. It produced crops and livestock valued at $366 billion in 2004, about 50 percent more than the U.S. total. Despite limited supplies of land, water, and other natural resources, China grows most of its own food and is a major exporter of many agricultural commodities. China ranks No. 1 in the world in paddy rice production with over 40 percent more production than India, which ranks No. 2. Importantly, China also ranks No. 1 in the world in fresh vegetable production with four times more production than India, which again ranks No. 2. China is also the largest wheat-producing country in the world. In total, China ranks No. 1 in the world in the production of 45 agricultural commodities (FAO, 2005).

1.2. Agriculture policy reforms in 1978 transferred land use and crop- and yield-ownership rights from farm collectives to individual households. Most planting and other production and marketing decisions became the responsibility of households. Since that time, the trends in agricultural productivity have been quite impressive.

1.3. When estimating the value lost per year relative to the total crop value, a distinct trend can be identified (Figure 1.1). The average value has gone from about 7 percent in 1980 to about 8 percent in 2002. This could be caused by a number of factors. For example, more marginal land that is also more vulnerable to natural disaster has been brought into production over the last years. This somewhat troublesome trend has been confirmed by several stakeholders (including insurance companies).

Figure 1.1: Trend in Losses for Crops in China, 1980 to 2002

![Figure 1.1: Trend in Losses for Crops in China, 1980 to 2002](image)

Source: Authors’ calculations from China Statistical Yearbook 2005.

1.4. Compared to other industries, agriculture’s long production cycle makes rural households particularly vulnerable to natural disasters. More than 20 percent of the total
farmland, estimated at 165 million hectares in 2004, was affected by natural disasters over the period 1979–2004 (Figure 1.2). The major cause of loss is drought, followed by flood. The average annual loss of grain output caused by natural disasters in China in 2004 was estimated at about 5 percent, roughly 25 million tons, which is more than 70 percent of the Chinese grain imported in the same year.

**Figure 1.2: Farmland Affected by Natural Disasters in China***

*Percentage of total farmland.

1.5. Access to formal risk financing instruments, such as insurance, can help Chinese farmers transfer excessive losses to a third party (such as an insurance company), thus stabilizing household income, facilitating their access to credit, and ultimately enhancing their livelihoods. Thus, risk management is essentially the responsibility of individual farmers and their extended households. When disasters occur, local government often provides short-term immediate relief, but systemic challenges remain.

1.6. In 1998, China established a “National Natural Disaster Reduction Plan” to try to address the challenges associated with ad hoc and postevent relief, particularly the efficiency and effectiveness thereof. This also led to the establishment of a center in the Ministry of Civil Affairs known as the National Disaster Reduction Center, among others. Despite these developments, limited success has been observed in efforts to better coordinate response mechanisms at different government levels, particularly for individual farmers and their households. Agricultural insurance, not surprisingly, was widely supported by government at all levels as a major policy initiative to address this issue.

1.7. The 11th Five-Year Plan (FYP) highlights the shift in government focus to rural and agricultural development. The plan outlines major financial and policy support to improve rural households’ standard of living through changes such as the elimination of agriculture taxes and additional investment in rural infrastructure. In particular, a policy
1.8. Between 1982 and 2002, 24 percent of all hectares had losses of 10 percent or greater across China. Over half of the losses come from drought, and another 28 percent come from flood. Hail losses account for another 10 percent, and frost and freeze losses are about 6 percent (Figure 1.3)

Figure 1.3: Share of all Losses by Cause of Loss, Using 2004 Crop Values

![Figure 1.3: Share of all Losses by Cause of Loss, Using 2004 Crop Values](image)

Source: Authors’ calculations from China Statistical Yearbook 2005.

Box 1.1: State Council’s Opinion on Developing Agricultural Insurance

The State Council of China has expressed opinions on the development of an agricultural insurance model that suits Chinese conditions (“No.1 Document”). The central and local governments, insurance companies, dragon-head companies, and farmers are encouraged to play active roles. Agricultural insurance legislation should be developed to encourage farmers’ participation and facilitate coordination among stakeholders.

The No.1 document also recommends shifting from the current model of postdisaster relief to a new model based on agricultural risk prevention and subsidized insurance. An agricultural reinsurance program, with fiscal support from the central and local governments, should be promoted to facilitate risk diversification and risk transfer.

Various forms of agricultural insurance organizations, such as mutual insurance, should be developed. Insurance companies should get technical assistance to develop low-cost products and easy-to-understand policies. Delivery channels suitable for agricultural insurance should be explored.

Source: State Council of China.

1.9. GoC recognizes the importance of revitalizing the agricultural insurance industry and has undertaken a series of pilot projects to test different models of insurance. These pilots are currently under implementation in several provinces: Heilongjiang, Xinjiang,
Jiangsu, Shanghai, Jilin, Xinjiang, Zhejiang, Sichuan, and Hainan. CIRC has also approved the launch of specialized agricultural insurance companies in Shanghai, Jilin, and Heilongjiang provinces.

1.10. Five management models of agricultural insurance are being piloted in China. The models range from specialized mutual insurance companies with local government subsidies to foreign commercial insurance companies. Wide variations in cropping and livestock farming systems, across different climatic regions of the country, pose significant challenges to the design, development, and policy support of agricultural insurance products. These variations also offer opportunities for risk diversification.

1.11. In this context, the MoF requested the World Bank to conduct a comprehensive assessment of the agricultural insurance industry in China and provide recommendations for its future development. This work aims to provide an overall framework for the development of market-based agricultural insurance. It relies on the following components:

- **Agricultural risk assessment.** Agricultural risks faced by farmers and herders are identified and quantified, based on risk layering, (that is, decomposition between low-frequency/high-severity losses, such as droughts or cyclones, and high-frequency/low-severity losses). This assessment is instrumental in developing appropriate risk-financing strategies for provincial and national governments and insurance companies.

- **Technical, financial, and operational review of insurance companies.** The current insurance practices (insurance products, reinsurance, underwriting, loss assessment, financial statements, and so on) are reviewed and discussed based on international experience.

- **Options for public-private partnership in the financing of agricultural risks.** The role of the government and the private insurance sector in the financing of agricultural risks is discussed, with a particular focus on the financing of natural disasters in agriculture.

- **Institutional capacity building.** This entails support from the government in creating an economic and legal environment that facilitates the emergence of a competitive insurance market and provides farmers with the incentives to engage in risk-financing strategies. It includes efficient data-management systems, appropriate regulatory and legal framework, effective information and education programs, and the development of national and provincial technical expertise.

1.12. Ideally, a demand assessment for insurance, and more generally risk-management strategies, would have been helpful in acquiring a more comprehensive overview of the situation. However, given the magnitude and complexity of an examination of the structural and institutional issues surrounding the industry, it was determined that a cursory overview of demand be undertaken, and majority emphasis be placed on policy aspects.

1.13. The highly technical and specialized nature of the proposed work required numerous experts in the fields of agricultural risk management, insurance, and economics. The Bank is among the few international institutions, and maybe the only one, with
internal expertise in this area, and which can bring together both public and private sectors and provide the required technical recommendations and guidance for this work.

1.14. The report consists of five chapters, starting with this introduction. Chapter 2 provides a review and a diagnosis of the current agricultural insurance industry in China and lays out the key challenges. Chapter 3 presents guiding principles in the design of an agricultural insurance program, based on international experience. Chapter 4 discusses options and recommendations for the future development of agricultural insurance in China. Chapter 5 presents conclusions and suggestions. The report ends with six technical annexes, provided for reference purposes. Stand-alone documents for each of the five insurance companies involved in agricultural insurance are also included.
Chapter 2: Agricultural Insurance in China: Review and Diagnosis

2.1. This chapter provides a review of the current agricultural insurance market in China. It first presents the agricultural insurance pilots and lists some key challenges that will have to be overcome to make agricultural insurance successful in China. It then offers a detailed risk assessment in selected provinces and highlights the benefits of risk pooling among crops, risks, and provinces. Finally, it provides a technical and operational assessment of the agricultural insurance and reinsurance markets in China.

Agricultural Insurance in China: Context

Government Policy

2.2. Growing concerns over income inequality and equitable economic growth have shaped the government’s rural development agenda. Although agriculture’s contribution to the gross domestic product (GDP) and employment represents a declining share of the economy and population, the industry still employs 45 percent of the total population and remains a key sector in China’s development. In 2005, the per capita income ratio between urban citizens and rural residents was estimated at 3.2 to 1. Recognizing the importance of improving rural incomes and decreasing income disparity, the government has issued policy priorities that underscore its concern. Influential decrees—such as the No. 1 document issued by the Communist Party of China (CPC) Central Committee in January 2003—explicitly focused on improving rural incomes and reducing inequality. This marked a significant shift in the focus of the No. 1 document to rural development. The Fifth Plenum of the 16th CPC passed the 11th FYP in October 2005. The government’s rural-development policy until 2011 is summed up in the slogans, “building a new socialist countryside” and “extracting less, putting more back in.” Specific initiatives include increased investment in rural infrastructure and agriculture technology, reducing the tax burden, and improving public services. The FYP and the No. 1 documents from 2003–2007 are leading policy reforms to improve rural development (Box 2.1).

2.3. One important change in policy toward rural areas and agricultural development was the rural fees and tax reform introduced in 2001 to reduce peasant burden. This reform marks a significant shift in attitude, as it removed a 2,000-year-old agricultural tax. In 2003, China’s National Bureau of Statistics reported agricultural tax revenue, specialty crop revenue, and herding tax revenue of RMB 42.7 billion ($5 billion). The estimated reduction in financial burden on peasants is as high as 40-50 percent nationwide. The World Bank (2006) Rural Public Finance Report discusses the details and impacts of the rural fee reduction and agricultural tax reform.

2.4. In addition to the plan to eliminate agricultural taxes, in 2004 the central government announced direct subsidies to farmers for grain production. Direct agricultural subsidies from the center are provided primarily to grain farmers, based on
the number of acres planted. In Heilongjiang and Shanghai, farmers are given subsidies through Bank of China branches. In Shanghai, farmers can receive a debit card to obtain their subsidy. In the first year of this subsidy program, the MoF allocated RMB 11.6 billion ($1.5 billion) in direct grain subsidies, with the majority of this subsidy, RMB 10.3 billion ($1.3 billion), going to 13 major grain-producing provinces (Jilin, Liaoning, Hebei, Henan, Shandong, Jiangsu, Anhui, Hunan, Hubei, Sichuan, Jiangxi, and Inner Mongolia Autonomous Region). The net increase in income per family is estimated to be approximately RMB 75 ($9.4). Central government subsidies are often supplemented with provincial funds, resulting in different levels of subsidies across provinces. In Heilongjiang, improved soybean- and corn-seed subsidies were RMB 10 per mu, and RMB 15 per mu for rice. The total subsidy per household was approximately RMB 55. In 2006, MoF increased the subsidy by allocating RMB 14.2 billion ($1.8 billion) in direct grain subsidies to 30 provinces and autonomous regions. Other agricultural subsidies include support for seeds and machinery.

2.5. The reform and development of agricultural insurance represents an important example of the government’s commitment to rural development. Agricultural insurance in China first began in the 1950s but was abandoned toward the latter part of that decade and was not reintroduced until 1982. During the 1980s and 1990s the state-owned People’s Insurance Company of China (PICC) was the main crop, livestock, forestry, and aquaculture insurer, operating at a national level in the major agriculture provinces of China. In addition, two provincial-level agricultural insurance programs were initiated by the military during this period. One was in Xinjiang Province, the Xinjiang Production and Construction Corps Agricultural Insurance Company (today privatized as China United Property Insurance Company, or CUPIC), and the second was in Heilongjiang Province, the Heilongjiang Reclamation Group (HRG). The agricultural insurance division of the later was privatized in 2004 to form Sunlight Mutual Agricultural Insurance Company (SAIC). Until 2003, these three companies were the only players in the Chinese agricultural insurance market.

Box 2.1: Agriculture and Rural Development Policy Reforms

| Rural Fee and Agricultural Tax Reform: | Rural Fee Reform was launched in 2000 and rolled out from 2002 to 2004. As a second step in rural fee reform, the phased removal of agricultural taxes was announced to take place over five years, beginning in 2004. In 2006, the effort to remove agricultural taxes and fees was launched nationwide. According to official estimates, the central government allocated RMB 108 billion ($13.5 billion) in 2006 for transfers to provinces and autonomous regions to support local government operations. |
| Direct Subsidies: | Direct payments to grain farmers started in 2004, based on historical area planted. Direct subsidies are designed to prevent |

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2 Ministry of Finance.
3 1 mu = 1/15 hectare.
leakage for overhead expenses transferred, bypassing some layers of government. Subsidies are also provided for high-quality seeds and machinery.

**Land Tenure Rights:** According to the Rural Land Contract Law of 2003, land tenure rights are supported for 30 years. This is designed to prevent nonagriculture or corrupt appropriation of farmland and to facilitate the transfer of temporary usage rights.

**Rural Infrastructure:** This reform increased investment to improve irrigation, roads, and access to electricity. Total investment in public-good construction (including roads, irrigation, drinking water, schools, and so on) increased from an average 77 RMB per capita to 217 RMB per capita from 2000 to 2004.\(^5\)

**Financial Institutions:** The new Postal Savings Bank, offering both credit and savings services, opened in March 2007. Agricultural lending has increased significantly. Rural Credit Cooperatives’ agricultural loan balance increased by 48 percent from 2001 to 2005.

Source: [http://english.gov.cn/special/rd_rr.htm](http://english.gov.cn/special/rd_rr.htm), USDA ERS

### Agricultural Insurance Pilots

2.6. The agricultural insurance market in China is extremely small. In 2005, the national agricultural insurance premium volume was RMB 729 million (about $91.1 million) representing a mere 0.6 percent of the total Chinese non-life insurance premiums of RMB 123 billion ($15.4 billion). This represents a decline from the peak year, 1992, when agricultural insurance premiums reached RMB 817 million ($102.1 million). The split of 2005 premium volume is shown in Figure 2.1.

\(^5\) For additional details, please see World Bank 2006. Rural Public Finance Report.
2.7. Under the 11th FYP, the Chinese government reiterated its commitment to agricultural and rural development. Within this framework, the government is actively promoting the development of agricultural insurance through a variety of models and different support mechanisms. Since 2004, CIRC has approved the formation of four specialist agricultural insurance companies:

- **Sunlight Mutual Agricultural Insurance Company** (SAIC) in Heilongjiang. SAIC is the first mutual insurer to receive CIRC approval in China. SAIC is a regional agricultural insurer, primarily involved in underwriting traditional MPCI and backed by premium subsidy support from the provincial government;

- **Anxin Agricultural Insurance Company** (formerly a PICC regional branch) is a regional insurer underwriting both crop and livestock in Shanghai Municipality. Anxin is China’s largest insurer of epidemic disease cover for livestock and poultry, and the company receives a high level of local municipality government financial support in the form of premiums subsidies and catastrophe excess-of-loss protection for crops and livestock;

- **Anhua Agricultural Insurance Company** in Jilin Province is a commercial company formed by seven local enterprises, with initial capital of RMB 200 million ($25 million). In 2005, Anhua insured six pilot programs for corn, tobacco, strawberries, dairy cattle, pigs, and poultry. This program attracts high levels of premium subsidies from government;

- The French insurer **Groupama** was granted a license to commence offering agricultural farm-package insurance products to farmers in Sichuan Province in 2005.

2.8. In addition, the local governments in several provinces work closely with PICC (China’s largest property insurer, with two-thirds of the property premium) and CUPIC (fourth-largest property insurer in China, with 8 percent market share) to develop and pilot a series of new public-private crop and livestock products and programs.
2.9. CUPIC (China United) has commenced underwriting agriculture in several other provinces of China since 2003. In Huai’an City, Jiangsu Province, CUPIC implemented a pilot project for rice, wheat, and barley insurance in 2003. In 2004, aquaculture insurance and personal accident insurance were added to the program, which is being implemented in 10 counties and districts of Huai’an. The local finance bureau is providing 50 percent premium subsidies. CUPIC is involved in a livestock insurance project in Sichuan and tobacco-leaf insurance in Chongqing. CUPIC, along with PICC, has the potential to develop agricultural insurance at a national level throughout China.

2.10. PICC currently has nine new pilot agricultural insurance projects either under development or in implementation. In 2006, a PICC-led agricultural coinsurance pool was launched in Zhejiang Province to underwrite crops, forestry, livestock, poultry, and aquaculture, supported by premium subsidies. This is the first program in China in which the government, through the local finance bureau, is providing formal catastrophe reinsurance protection to the pool co-insurers for losses between 200 percent and 500 percent loss ratio. In addition, international reinsurers are providing layered stop-loss treaty protection to the pool on their net retentions. In Hainan Province, PICC, CIRC, and the finance bureau are finalizing plans for the early-2007 launch of pilot insurance programs for banana, rubber, pigs, and local fishermen—programs closely modeled on the Zhejiang public-private model, with government providing a combination of premium subsidy support and catastrophe reinsurance protection.

2.11. Suzhou City, in Jiangsu Province, represents another pilot agricultural insurance project that started in 2006. PICC won the tender on this government-commissioned pilot project to provide insurance for rice, seedlings, swine, fish farming, and poultry. For rice insurance, a priority for the city government, the premium subsidy is 60 percent (20 percent from the city government and 40 percent from the county or district government). By August 2006, a total of 250,000 mu of crops had been insured, with total insured value of RMB 166 million ($20.8 million) and RMB 2.49 million ($310,000) in premium. It is estimated that the premium received from rice insurance alone will amount to RMB 7 million ($875,000) in 2006.

2.12. Early in 2007, the MoF approved a new set of pilots in the following provinces: Jiangsu, Jilin, Xinjiang, Hunan, Sichuan, and Inner Mongolia. MoF allocated a budget of RMB 1 billion ($125 million), matched by the same amount from the selected provincial governments. The RMB 2 billion ($250 million) subsidy program aims to finance 50 percent of the agricultural insurance premiums. This budget allocation comes in addition to RMB 700 million ($87.5 million) already allocated by CIRC.

**Challenges in Developing Agricultural Insurance**

2.13. China is facing key challenges in the development of agricultural insurance. These challenges are also faced by other countries that want to promote market-based agricultural insurance as part of their agricultural policy. These challenges can be overcome over time through an appropriate agricultural risk-management framework, relying on a strong public-private partnership.
2.14. **Low national agricultural insurance uptake.** Penetration of agricultural insurance in China is low. On the supply side, agricultural insurance is available in only a few provinces. Its history is dominated by prior agricultural insurance activities that were heavily influenced by public sector interventions.

2.15. **Insurance is mostly in developed farming sectors, which are not representative of most of Chinese agriculture.** The majority (64 percent) of the present insurance premium is derived from farmers insured in reclamation areas of HRG and Xinjiang People’s Construction Corps (XPCC), which offer special advantages to an insurer, such as low costs for insurance delivery and loss adjustment. The challenge for insurers is to find products and operational and distribution solutions that can be scaled up.

2.16. **Lack of national framework for agricultural insurance.** The development of agricultural insurance activity is strongly decentralized, with diverse business models, products, and linkages in each province. Although this approach has many benefits, such as promoting local initiative, adaptation, and activity, it provides limited opportunity for central exchange of technology and best practice. In addition, the roles of the central government and provincial governments in the development and implementation of agriculture are not clearly defined.

2.17. **Lack of appropriate legal and regulatory framework for agricultural insurance.** Current insurance law makes no provision for agricultural insurance; hence insurers operate without a firm legal framework.

2.18. **Low insurance awareness and education.** The majority of Chinese farmers lack awareness and education regarding insurance in general and crop and livestock insurance in particular.

2.19. **Insurers have limited financial capacity.** Domestic insurers are exposed to catastrophe risks and have only limited opportunity to diversify their portfolios. In mitigation of this constraint, several Chinese insurers have been successful, through reinsurance brokers, in attracting the interest of international reinsurers. However, the current reinsurance protections are not geared toward catastrophic losses, thus potentially exposing some of the insurers to bankruptcy. In some cases, however, the provincial government is acting as a reinsurance of last resort, covering excess losses where these exceed the reinsurance limits.

2.20. **Agricultural insurance products.** A key product offered at present is individual-grower MPCI, which is enabled by the close linkages to HRG and XPCC. International experience shows that this product has many shortfalls. Further, the history of PICC underwriting at the time of highest expansion in China was based on MPCI. Named-peril crop insurance is also offered in China on a limited basis.

2.21. **Data availability.** Agricultural insurance is data-reliant. Availability of quality, long-term time-series data on crop production and yield is a challenge in developing adapted crop insurance products. Data on hectares planted and tons produced of various
commodities are available at the township level, state-farm level, or team level, although issues on data quality and consistency have been identified.

2.22. **Limited access to technical services.** Provincial insurers have limited access to technical insurance services in specialist areas such as product design, ratemaking, underwriting, loss adjustment, and so on.

2.23. **Lack of exposure to international agricultural insurance technology.** Chinese insurers have had little contact with the international insurance and reinsurance community, to share experiences in program and product design, and for technology transfer.

**Risk Assessment**

*Data and Methodology*

2.24. China has great differences in risk across crops and geographic areas. Two types of data are used to emphasize these differences. The first is data on tons produced and hectares planted for major crops in selected pilot counties and state farms in the four study provinces and municipalities (Heilongjiang, Xinjiang, Shanghai, Hainan). The second is cause-of-loss data for all provinces in China.

2.25. Using the first data set, township- or team-level annual yield per hectare is calculated for selected crops in three of the four study provinces. In Shanghai, county- or district-level yield data are used. Statistical procedures are used to adjust the annual yields for trends in productivity. These trend-adjusted yield data allow for evaluation of yield loss relative to the expected yield and can be used to compare yield risk for different crops in different regions. A limitation of these data is that they are for large units. Such aggregate data underestimate the yield risks that are present for household farm units.

2.26. The second data set is provincial-level data on hectares impacted by various causes of loss. These data are grouped into three categories: (1) sown hectares with 0–10 percent damage; (2) sown hectares with 10–30 percent damage; and (3) sown hectares with 30 percent or greater damage. Statistical procedures were developed (see Technical Annex 3) to estimate the annual loss by estimating the equivalent hectares with a total yield loss relative to the total hectares sown. Given difficulties of estimating losses for the group with less than 10 percent damage, the annual average losses for these data are estimated at the 10 percent level or higher.

2.27. A risk assessment begins by estimating the probability that losses of various magnitudes will occur. This is the basis for developing insurance premium rates. Insurers also diversify their risk exposure across different agricultural enterprises and geographic regions to reduce the probability of financial ruin. Thus, a complete risk assessment must also examine the characteristics of a portfolio of insurance products.

2.28. For each of the four provinces or municipalities, pilot counties or state farms were targeted for risk assessment. Between 15 and 20 years of yield data were obtained and
analyzed for these counties and farms. Yield-data analysis forms the only basis for the risk assessment of individual crops. The cause-of-loss data are used to conduct provincial risk assessment that is not crop-specific. In addition, supplementary information was obtained through discussions with agricultural experts in each of the provinces and municipalities. No risk data on livestock mortality were available, so the risk assessment focuses exclusively on crop yield risk.

2.29. The available yield data are generally at the township level for counties and at the team level for state farms. Due to aggregation bias, a risk assessment based on aggregate data will systematically underestimate risk at lower levels of aggregation. One can simulate a multiple-peril insurance policy by estimating yield losses relative to the insured yield. For example, if a 30 percent deductible is used, the insured yield is 70 percent of the expected yield. An insurance indemnity would be paid only when the realized yield is at least 30 percent less than the expected yield. The annual insurance loss can be estimated as the yield loss divided by the insured yield. For example, if the expected rice yield is 5 tons per hectare and the MPCI policy has a 30 percent deductible, the policy would pay an indemnity when the realized rice yield on the insured unit was less than 3.5 tons per hectare. For all cases presented in this analysis, it is also assumed that a complete payment would be made if the yield were equal to zero. Thus, if the yield were 1.75 tons, the annual insurance loss would be 50 percent.

2.30. If there is a time series of annual yields, then a time series of annual insurance losses can be simulated for any design of MPCI program. The average annual loss is the simple average of a long time series of annual loss estimates. This is the starting point for premium-rate calculations.

2.31. The risk assessment presented in this report is performed to explore relative risk exposure and volatility. This allows for some insights into relative risk differences across crops and regions. It also allows for the building of portfolios and the demonstration of how contingent capital requirements change as risks are spread across crops and regions. The analysis presented here is solely for the purpose of demonstrating risk assessment principles and providing some general sense of relative risk differences across crops and regions. As a consequence, insurance companies or other decision makers should not take the quantitative estimates as guaranteed. The township- and team-level yield data do not provide a sufficient basis for measuring yield losses caused by specific perils, or losses at the farm level. Thus, the risk assessment is for all perils. However, this should not be misinterpreted as an endorsement of MPCI.

**Provincial Crop Risk Profile**

**Heilongjiang**

2.32. The primary crops produced in Heilongjiang are rice, soybeans, and maize. Drought is the primary peril for non-irrigated crops, particularly maize and soybeans produced in the central and southern parts of the province. Other perils are flood and waterlogging, hail, disease, late frost in spring, early frost in autumn and cold summer temperatures. Statistical analysis of the cause-of-loss data suggests that over half of lost
hectares are from drought and about one-third are from flooding events. Hail and frost account for about 6 percent each of all causes of loss.

2.33. Table 2.1 presents yield loss exposure for soybeans, maize, and rice in the six pilot counties and farms in Heilongjiang. The first row shows the average annual loss. Subsequent rows show probable maximum losses (PMLs) for various return periods. Thus, the PML for a 10-year return period is the maximum loss that would be expected to occur during a 10-year period. For soybeans, the average annual loss is 11 percent. Losses of up to 30 percent would be expected in 1 out of every 10 years. For rice, the average annual loss is 21 percent and in 1 out of every 10 years, the expected average losses would be 39 percent. An extreme 1-in-100-year event would be expected to generate average losses of 42 percent for soybeans and 56 percent for rice. The values that appear under the heading “all crops” come from the cause-of-loss data risk assessment. This should be considered the most ideal portfolio possible, because it represents all crops blended together into a perfectly spread portfolio across the province. Even in this case, up to 22 percent of the total crop value of the province can be lost in the extreme case of 1-in-100-year risk assessment.

<table>
<thead>
<tr>
<th></th>
<th>Soybean</th>
<th>Maize</th>
<th>Rice</th>
<th>All Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Loss</td>
<td>11%</td>
<td>10%</td>
<td>21%</td>
<td>10%</td>
</tr>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>30%</td>
<td>24%</td>
<td>39%</td>
<td>15%</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>34%</td>
<td>32%</td>
<td>45%</td>
<td>17%</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>42%</td>
<td>45%</td>
<td>56%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Note: Estimates for specific crops are based on township and team yield data; estimates for all crops are based on cause-of-loss data.

Source: Authors’ calculations from Heilongjiang finance bureau.

Xinjiang

2.34. Xinjiang has an arid climate. The northern part of the province receives some rainfall in the spring, but the southern part receives very little rainfall. Much of the crop production is irrigated. Snowmelt from the mountains is the primary source of irrigation water. The primary field crop produced in Xinjiang is cotton, though significant quantities of wheat and maize are also produced.

2.35. One of the primary crop perils in Xinjiang is dry, hot winds that desiccate crops. These winds sometimes carry sand that also damages crops. Other perils include inadequate irrigation water, cold summer temperatures, hail, disease, early frost in autumn, late frost in spring, and occasional flooding. Statistical analysis of the cause-of-loss data suggests that nearly half of lost hectares is from drought and about one-quarter is from hail events. Flooding and frost or freeze account for about 12 percent each of all causes of loss.
2.36. Table 2.2 presents yield risk exposure for cotton, wheat, and maize in the five pilot counties and farms in Xinjiang. Wheat and maize produced in Xinjiang have lower yield loss exposure than the same crops produced in Heilongjiang. Cotton production in Xinjiang is much riskier than either wheat or maize production. An extreme 1-in-100-year event would be expected to generate average cotton yield losses of 45 percent. Even more striking perhaps is the finding that even a 1-in-10-year event would generate average cotton yield losses of 33 percent. The “all crops” column suggests that Xinjiang could have a significantly better spread of risk than Heilongjiang, with the “perfectly diversified portfolio” that is represented by the cause-of-loss data. In this case, the extreme loss is about 9 percent of the province crop value. By comparison, the value for Heilongjiang was 22 percent. However, a caution should be added, because the cause-of-loss data likely do not capture wind damage, which is an important factor in Xinjiang.

Table 2.2: Xinjiang Yield Loss Exposure

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Maize</th>
<th>Cotton</th>
<th>All Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Loss</td>
<td>8%</td>
<td>8%</td>
<td>13%</td>
<td>3%</td>
</tr>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>14%</td>
<td>18%</td>
<td>33%</td>
<td>7%</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>15%</td>
<td>22%</td>
<td>37%</td>
<td>8%</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>18%</td>
<td>28%</td>
<td>45%</td>
<td>9%</td>
</tr>
</tbody>
</table>

*Note: Estimates for specific crops are based on township and team yield data; estimates for all crops are based on cause-of-loss data.*

*Source: Authors’ calculations from Xinjiang finance bureau.*

Shanghai

2.37. Shanghai Municipality is located at the mouth of the Yangtze River in southeastern China. It contains 3 counties and 17 urban districts. Crops produced in Shanghai include rice, wheat, rapeseed, melons, and a variety of vegetables and tree fruit. Vegetables are produced both in fields and in greenhouses.

2.38. Typhoon is the primary peril affecting crop production in Shanghai. Typhoons generally occur between June and September. Crop losses are caused by wind damage, flooding, waterlogging, hail, drought, and frost or freeze. Typhoon winds can also damage greenhouses. Other perils include prolonged periods of extremely high or low temperatures. Statistical analysis of the cause-of-loss data suggests that nearly half of lost hectares is from floods and about one-quarter is from frost or freeze events. Hail and drought account for about 12 percent each of all causes of loss.

2.39. Yield data were available only at the county or district level (rather than the township level as in other provinces). Table 2.3 presents yield risk exposure for grain and rapeseed in the three pilot counties or districts in Shanghai. Infrequent but catastrophic events may be either underrepresented or overrepresented in the available yield data. Rapeseed is quite risky with a 1-in-100-year PML of 65 percent. Although the “all crops” column suggests that a perfectly spread portfolio could have a significantly reduced maximum exposure, significant care should be taken when interpreting the results for
Shanghai. The cause-of-loss data reflect only the lost hectares relative to the total hectares. If the crops that are lost are heavily weighted to high-value crops, such an aggregate analysis will underestimate the loss exposure.

Table 2.3: Shanghai Yield Loss Exposure

<table>
<thead>
<tr>
<th></th>
<th>Grain</th>
<th>Rapeseed</th>
<th>All Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Loss</td>
<td>3%</td>
<td>13%</td>
<td>2%</td>
</tr>
<tr>
<td>Probable Maximum Loss (10 year return)</td>
<td>9%</td>
<td>33%</td>
<td>5%</td>
</tr>
<tr>
<td>Probable Maximum Loss (20 year return)</td>
<td>18%</td>
<td>50%</td>
<td>10%</td>
</tr>
<tr>
<td>Probable Maximum Loss (100 year return)</td>
<td>23%</td>
<td>65%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Note: Estimates for specific crops are based on county and district yield data; estimates for all crops are based on cause-of-loss data

Source: Authors’ calculations from Shanghai finance bureau.

Hainan

2.40. Hainan Province is an island in the South China Sea off the coast of Guangdong Province. Much of the island has a tropical climate. Colder temperatures and higher rainfall occur in higher elevations—primarily in the central and southeastern parts of the island. Major crop commodities produced in Hainan include rubber, banana, rice, coconut palm, oil palm, betel palm, pepper, sisal hemp, lemon grass, cashew, cocoa, wheat, sweet potato, cassava, taro, maize, Chinese sorghum, millet, beans, sugarcane, peanut, sesame, tea, pineapple, litchi, longan, plantain, citrus, mango, watermelon, parambola, and jackfruit. In addition, more than 120 kinds of vegetables are grown.

2.41. Typhoon is the primary peril affecting crop production in Hainan. Typhoons generally occur between May and November, with a peak in August and September. Crop losses are caused by wind damage, flooding, and waterlogging. On average, there are 3.1 typhoon landings on the island per year, and if tropical depression is included the figures increase to 7.7 per year. Typhoons cause major losses approximately every 5 years. In 2005, Typhoon Dawai hit Hainan causing more damage than any typhoon in the past 30 years. Agricultural losses were estimated at RMB 8 billion ($1 billion). Drought also can cause crop losses in Hainan. Statistical analysis of the cause-of-loss data suggests that about one-third of lost hectares is from drought and about one-third from flooding. Typhoon cause-of-loss data are only available for a limited number of years. However, between 2000 and 2003, 22 percent of hectares planted had at least 10 percent loss due to typhoon.

2.42. The risk assessment focuses on banana production in Ledong County (located in southwestern Hainan) and rubber production for Nongken Farm. Rubber is produced primarily in the higher elevations in the central and southeastern parts of Hainan. It is important to note that these data only reflect yield loss for bananas and rubber. They do not reflect the value of damage of the rubber or banana trees.

2.43. Yield risk exposure for banana and rubber is presented in Table 2.4. The 1-in-10-year yield PML for bananas is 23 percent; for rubber it is 18 percent. However, the 1-in-
100-year yield PML is the same for rubber and for bananas. Given the limited years of available yield data and the catastrophic nature of typhoon risk, it was not possible to assess PMLs with a 100-year return period (additional data can be found in the technical annexes). The “all crops” values again reflect the potential for significant risk reduction with the perfectly diversified portfolio of crops that would be spread equally across the province. In this case, the maximum exposure can be reduced to 17 percent, or less than half of the yield loss exposure for the two crops separately.

Table 2.4: Hainan Yield Loss Exposure

<table>
<thead>
<tr>
<th></th>
<th>Banana</th>
<th>Rubber</th>
<th>All Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Loss</td>
<td>10%</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>23%</td>
<td>18%</td>
<td>11%</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>29%</td>
<td>28%</td>
<td>14%</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

n.a. = not applicable.

*Note:* Estimates for specific crops are based on township and team yield data; estimates for all crops are based on cause-of-loss data.

*Source:* Authors’ calculations from Hainan finance bureau.

**Risk Assessment Profile of All Provinces**

2.44. The cause-of-loss data are used for all provinces to provide a more complete picture of the great diversity of risks across China. First, the average annual losses are mapped in Figure 2.2. This demonstrates that the northcentral and northeastern provinces are the most risky in China. The southern provinces appear to be the least risky and the east central provinces are in the mid-risk range. Figure 2.3 provides some perspective on how these average annual losses may vary across regions and for different levels of deductible. The 10 percent deductible is presented only for purposes of comparison. Under no circumstances should one sell MPCI with only a 10 percent deductible.
Figure 2.2: Mapping of Expected Annual Average Loss for MPCI

*Note:* Mainland China.

*Source:* Authors’ calculations from China Statistical Yearbook 2005.

Figure 2.3: Differential Average Annual Losses—Relative Risk and Deductibles

<table>
<thead>
<tr>
<th>Low-Risk Areas</th>
<th>Medium-Risk Areas</th>
<th>High-Risk Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Low-Risk Areas Chart" /></td>
<td><img src="image2" alt="Medium-Risk Areas Chart" /></td>
<td><img src="image3" alt="High-Risk Areas Chart" /></td>
</tr>
</tbody>
</table>

*Source:* Authors’ calculations from China Statistical Yearbook 2005.
2.45. The average annual loss values are only the beginning point for developing premium rates. Many other cost aspects must also be considered. Thus, even for the low-risk areas, the beginning point for developing premium rates would be close to 8 percent, with a 10 percent deductible. The fully loaded rate would be much greater. Even with a 30 percent deductible, the average annual loss estimates for the high-risk areas is extremely high (about 8 percent).

2.46. Table 2.5 presents more detail about the share of causes of loss for the different provinces. The table also arrays the provinces by their share of total crop value in China in 2004. For example, Shandong has more than 10 percent of the total crop value in 2004 (RMB 185 billion). As Figure 2.2 illustrates, the relative risk is quite variable across China. The underlying values in the map range from an annual average loss estimate of more than 14 percent to as low as about 2 percent. These estimates provide an opportunity to develop a hypothetical national program. To gain perspective on the magnitude of the numbers, assume that MPCI was sold throughout China, with purchases totaling 10 percent of all crop value. China’s crop value in 2004 was RMB 1,780 billion ($223 billion). At participation rates of 10 percent, the sum insured would be RMB 178 billion ($22 billion). Given rudimentary estimates of premium rates that may be charged for a properly designed MPCI program, the premium generated from RMB 178 billion of sum insured would be approximately RMB 13.7 billion (using a weighted average premium rate of 7.3 percent).

2.47. To supplement the information in Table 2.5, maps of the various causes of loss are presented in Technical Annex 3. These data are considered generally acceptable, with the exception of typhoons. Again, typhoon data were available for only a few years. To give some national perspective, from 1982 to 2004, 24 percent of all hectares sown faced some losses where there were at least 10 percent losses or more. Nearly 17 percent of all hectares were impacted at this level by drought, 8 percent by floods, 3 percent by hail, and nearly 2 percent by freeze. Typhoon data were less reliable and are not reported in Table 2.5. When taking the weighted average of the causes of loss and the crop value matrix, drought accounts for 52 percent of all losses, flood 28 percent, hail 10 percent, and frost or freeze about 6 percent. The residual (4 percent) is for the typhoon data that are available. In reality, this value is likely greater than 4 percent.
Table 2.5: Market Share of Crop Value in China with Share of Cause of Loss

<table>
<thead>
<tr>
<th>Province</th>
<th>Market Share</th>
<th>Percent of Average Annual Loss by Cause of Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drought</td>
<td>Floods</td>
</tr>
<tr>
<td>Shandong</td>
<td>10.4%</td>
<td>71%</td>
</tr>
<tr>
<td>Henan</td>
<td>8.8%</td>
<td>63%</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>6.9%</td>
<td>36%</td>
</tr>
<tr>
<td>Hebei</td>
<td>6.3%</td>
<td>72%</td>
</tr>
<tr>
<td>Sichuan</td>
<td>5.4%</td>
<td>52%</td>
</tr>
<tr>
<td>Guangdong</td>
<td>5.3%</td>
<td>33%</td>
</tr>
<tr>
<td>Hunan</td>
<td>5.1%</td>
<td>43%</td>
</tr>
<tr>
<td>Hebei</td>
<td>4.8%</td>
<td>45%</td>
</tr>
<tr>
<td>Anhui</td>
<td>4.6%</td>
<td>41%</td>
</tr>
<tr>
<td>Guangxi</td>
<td>3.4%</td>
<td>53%</td>
</tr>
<tr>
<td>Heilongjiang</td>
<td>3.4%</td>
<td>53%</td>
</tr>
<tr>
<td>Liaoning</td>
<td>3.4%</td>
<td>68%</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>3.3%</td>
<td>26%</td>
</tr>
<tr>
<td>Fujian</td>
<td>2.9%</td>
<td>32%</td>
</tr>
<tr>
<td>Yunnan</td>
<td>2.9%</td>
<td>50%</td>
</tr>
<tr>
<td>Xinjiang</td>
<td>2.8%</td>
<td>49%</td>
</tr>
<tr>
<td>Jiangxi</td>
<td>2.7%</td>
<td>36%</td>
</tr>
<tr>
<td>Jilin</td>
<td>2.7%</td>
<td>59%</td>
</tr>
<tr>
<td>Shaanxi</td>
<td>2.3%</td>
<td>71%</td>
</tr>
<tr>
<td>Inner Mongolia</td>
<td>2.3%</td>
<td>74%</td>
</tr>
<tr>
<td>Gansu</td>
<td>1.8%</td>
<td>72%</td>
</tr>
<tr>
<td>Guizhou</td>
<td>1.8%</td>
<td>51%</td>
</tr>
<tr>
<td>Shanxi</td>
<td>1.6%</td>
<td>80%</td>
</tr>
<tr>
<td>Hainan</td>
<td>0.9%</td>
<td>37%</td>
</tr>
<tr>
<td>Shanghai</td>
<td>0.6%</td>
<td>12%</td>
</tr>
<tr>
<td>Tianjin</td>
<td>0.5%</td>
<td>72%</td>
</tr>
<tr>
<td>Beijing</td>
<td>0.5%</td>
<td>69%</td>
</tr>
<tr>
<td>Ningxia</td>
<td>0.4%</td>
<td>71%</td>
</tr>
<tr>
<td>Qinghai</td>
<td>0.2%</td>
<td>63%</td>
</tr>
<tr>
<td>Tibet</td>
<td>0.1%</td>
<td>58%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from China Statistical Yearbook 2005.

**Portfolio Analysis**

2.48. To further illustrate some important concepts of risk assessment and insurability, a hypothetical insurance company is assumed for each province. The insurance company starts with a very limited market and then expands to a well-diversified market within the province. Eventually, the case of an insurance company having a diversified market across multiple provinces is considered. A more detailed discussion of the findings can be found in Technical Annex 2 and Technical Annex 3.

2.49. For simplicity, it is assumed that the insurance company can operate at zero profits over the long term, and that there are no other costs associated with selling these services. These assumptions simplify the analysis and allow for a conservative estimate of loss ratios. Thus, given a time series of annual insurance losses, a time series of pure loss ratios can be estimated as:

20
\[
\text{Loss Ratio}_t = \frac{\text{Insured Loss}}{\left(\frac{1}{T} \sum_{s=1}^{T} \text{Insured Loss}_s\right)}
\]

where \( t \) indicates a given year and \( T \) is the number of years available. With the time series of loss ratios, it is now possible to determine the probability of various extreme loss ratios. Also any number of crops and regions can be blended to generate loss ratios for various insurance portfolios. Within the portfolios, the correlations in the empirical data are maintained. Thus, adding new crops or regions to an existing portfolio will reduce the risk and probability of ruin, if yield losses for the new crop or region are not highly correlated with those of the existing portfolio. Results are presented using loss ratio PMLs.

2.50. The loss ratios presented here are calculated assuming that crop insurance was purchased by each township or team (county and district for Shanghai) in the pilot regions with no deductible. It is important to note that it is not suggested that crop insurance policies be sold with no deductible. This assumption is used because the available yield data are not at the level of the farm household but rather are aggregated at the township or team level. Using aggregate data reduces the yield variability relative to that which would be experienced at the level of the farm household. Based on international experience, the loss ratios from assuming no deductible with aggregate yield data are expected be roughly equivalent to loss ratios from using standard 20–30 percent deductibles with farm-household-level yield data.

**Heilongjiang**

2.51. Table 2.6 presents insurance loss ratio exposure for a hypothetical insurance company in Heilongjiang. Notice that the more risky crops, in terms of Average annual loss (AAL), do not necessarily generate the largest loss ratio PMLs. For example, while yield loss PMLs are larger for rice than for soybeans, the opposite is true for loss ratio PMLs. Large rice yield losses are fairly common. Thus, the average annual loss is quite high. For soybeans, large yield losses are less common than for rice; thus, the average annual loss for soybeans is much lower. But when large soybean yield losses do occur, they generate large loss ratios because the premium rate (estimated as the weighted average annual loss) is relatively low.

2.52. Loss ratio PMLs are valuable for insurance companies because they demonstrate the insurer’s exposure to extreme loss events. To maintain financial solvency over the long term, insurers should have reinsurance and/or sufficient financial reserves to pay indemnities from at least a 1-in-100-year loss event. These findings suggest that if the hypothetical insurance company were insuring only soybeans, it should have the capacity to pay indemnities in excess of four times the amount of premium collected. If the insurance company were insuring only maize, it should have the capacity to pay indemnities that are in excess of five times the amount of premium collected.

2.53. Crop insurance companies typically do not insure only one crop. Insuring multiple crops provides for diversification, since underwriting losses for one crop might be offset by underwriting gains for another crop. The last column in Table 2.6 shows loss ratio PMLs for a portfolio that consists of soybean, maize, and rice insurance policies. In these
six counties or farms (and considering only these three crops), soybeans account for 45 percent of the expected value of production, maize 39 percent, and rice 16 percent. In total for the province (and again considering only these three crops), rice is approximately 45 percent of the expected value of production, soybeans 37 percent, and maize 18 percent. Thus, relative to the province as a whole, the six pilot counties and farms have more soybeans and maize but less rice. Even so, the portfolio clearly demonstrates how diversifying across crops reduces loss ratio PMLs.

Table 2.6: Heilongjiang Township- and Team-Level Insurance Loss Ratio Exposure

<table>
<thead>
<tr>
<th></th>
<th>Soybean</th>
<th>Maize</th>
<th>Rice</th>
<th>Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>2.7</td>
<td>2.6</td>
<td>2.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>3.1</td>
<td>3.7</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>3.7</td>
<td>4.8</td>
<td>3.5</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations, from Heilongjiang finance bureau.

2.54. When the cause-of-loss data are used to develop a perfectly diversified portfolio for the hypothetical insurance company, the PML for the 100-year return value declines as expected—from 3.4 to 2.2. The 10-year return goes to 1.5, as compared to 2.2 (in Table 2.6). It is unlikely that any insurance company would have such a perfectly balanced portfolio. Thus, these values represent a lower boundary on PML for even the most successful uptake of insurance across crops throughout Heilongjiang.

Xinjiang

2.55. Table 2.7 presents insurance loss ratio exposure for a hypothetical Xinjiang insurance company with loss ratios calculated as described earlier. In these five pilot counties and farms, cotton accounts for 84 percent of the expected value of production, wheat 9 percent, and maize 7 percent. In total for the province, cotton accounts for 64 percent of the expected value of production, wheat 23 percent, and maize 13 percent. Thus, relative to the province as a whole, there is more cotton and less wheat and maize in the five pilot counties and farms. Even so, the insurance portfolio that includes some wheat and maize reduces the loss ratio PMLs relative to insuring cotton alone. Despite the fact that cotton accounts for 84 percent of the portfolio, the 1-in-100-year PML for the portfolio is 3.6 relative to 4.0 for cotton alone.

Table 2.7: Xinjiang Insurance Township- and Team-Level Loss Ratio Exposure

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Maize</th>
<th>Cotton</th>
<th>Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>2.0</td>
<td>2.2</td>
<td>3.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>2.3</td>
<td>2.8</td>
<td>3.3</td>
<td>3.0</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>2.7</td>
<td>3.7</td>
<td>4.0</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations, from Xinjiang finance bureau.
When the cause-of-loss data are used to create a perfectly diversified portfolio for the hypothetical insurance company, the PML for the 100-year return value declines from 3.6 (in Table 2.7) to 2.2. The 10-year return loss ratio goes from 2.7 to 1.7. Although it is unlikely that any insurance company would have such a perfectly balanced portfolio, these values represent a lower bound for even the most aggressive and successful marketing campaign across crops throughout Xinjiang.

### Shanghai

Table 2.8 presents insurance loss ratio exposure for a hypothetical Shanghai insurance company, with loss ratios calculated as described earlier. Since grain is an aggregate category that contains different crops, it was not possible to calculate a portfolio based on value of production. The catastrophic nature of typhoon risk is revealed in these loss ratio PMLs. The Shanghai yield loss PMLs are roughly similar to those for Heilongjiang. However, the loss ratio PMLs for Shanghai are significantly higher—especially for extreme 1-in-100-year events. These data suggest that, due to the catastrophic nature of typhoon risk, crop insurers in Shanghai should have the capacity to pay indemnities of between 6 and 9 times the amount of premiums collected.

**Table 2.8: Shanghai Township- and Team-Level Insurance Loss Ratio Exposure**

<table>
<thead>
<tr>
<th></th>
<th>Grain</th>
<th>Rapeseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>3.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>6.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>8.7</td>
<td>5.7</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations, from Shanghai finance bureau.*

### Hainan

Table 2.9 presents insurance loss ratio exposure for a hypothetical Hainan insurance company. The loss ratio PMLs for bananas are larger than those for rubber. The portfolio is weighted to reflect the relative value of production for these two crops in Hainan (74 percent rubber and 26 percent banana). Despite the fact that rubber dominates the portfolio and banana and rubber losses are highly correlated at 74 percent, the portfolio generates significant reduction in loss ratio exposure—especially for 1-in-100-year loss events.

**Table 2.9: Hainan Insurance Loss Ratio Exposure**

<table>
<thead>
<tr>
<th></th>
<th>Banana</th>
<th>Rubber</th>
<th>Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>2.8</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>3.5</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>4.5</td>
<td>3.9</td>
<td>2.6</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations, from Hainan finance bureau.*
2.59. When the cause-of-loss data are used to develop a new portfolio for our hypothetical insurance company, the PML for the 100-year return value declines as expected—from 2.6 (in Table 2.9) to 2.0. This value (2.0) is very likely lower than the actual number, given that the typhoon risks are not adequately reflected in the cause of loss data.

**Pooling Benefits Among Provinces**

2.60. To what extent can risk across China be pooled to improve the position of a hypothetical insurance company? This question is investigated in a model wherein three of the four provinces (Heilongjiang, Xinjiang and Hainan) are pooled into a single insurance company. Because of the limited amount of crop production, Shanghai is not included. The annual risk measures for the cause-of-loss data are used to create the insurance portfolio. A key insight into the potential pooling effect comes from examining the correlation of the annual risk measures from 1980 to 2004 for the four provinces that compose this study. For example, the correlation between Hainan, Heilongjiang, and Xinjiang is quite low. This is to be expected, because totally different weather events impact these three provinces. By using the 2004 crop values of these three provinces, a portfolio can be developed that reflects the relative risk, the relative weights of the crop values, and the correlation.

2.61. The effect of pooling these three provinces is presented in Table 2.10. The pooled portfolio is obviously less risky. The PML for the 100-year return period is 2.0, compared to 2.3 for the least risky province in the set. When pooling across these provinces, the risk for Xinjiang and Hainan are reduced more than for Heilongjiang. In part this is because Heilongjiang accounts for the largest percentage of the crop value (44 percent of the total among these four provinces).

<table>
<thead>
<tr>
<th></th>
<th>Xinjiang</th>
<th>Heilongjiang</th>
<th>Hainan</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Maximum Loss (10-year return)</td>
<td>1.8</td>
<td>1.5</td>
<td>1.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Probable Maximum Loss (20-year return)</td>
<td>2.0</td>
<td>1.7</td>
<td>2.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Probable Maximum Loss (100-year return)</td>
<td>2.3</td>
<td>2.3</td>
<td>2.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations, from China Statistical Yearbook 2005.*

**Conclusion**

2.62. Results in this section support concerns regarding the risk exposure of new insurance companies. The concept of PML provides a basis for comparison, and for understanding how diversification lowers risk exposure. For example, companies having limited markets within a province can have a loss ratio PML in excess of 3 or 4. This implies that indemnities can exceed 3- or 4-times the premium in bad years. This is likely the position of many of the emerging crop insurance companies in China. As companies diversify across crops and spread out over the province, the loss exposure can be reduced by 50 percent or more. Finally, the analysis demonstrates that having a crop insurance
company with business in multiple provinces provides even more diversification opportunities. More fundamentally, this type of analysis demonstrates that national pooling of risks can have benefits.

2.63. Figure 2.3 provides a summary of the 1-in-100-year PMLs for various portfolios, based on the findings presented in this section. As expected, PMLs decline as an insurer moves from a limited set of offerings to a more diversified set of offerings, even if the diversified set is still restricted to the province. If the insurer could create a portfolio that includes Heilongjiang, Xinjiang, and Hainan, the PMLs would decline further. The lowest PMLs are achieved with a national pool. The relative positions of the risk measures and the PMLs are likely good indicators of the risk profile for China crop agriculture. There are significant differences between (1) a portfolio of three crops in select areas, and (2) something that may represent a well-diversified portfolio of crops that are spread equally across the province. The latter type of portfolio would be extremely difficult to obtain, since purchases of crop insurance are rarely evenly distributed. Placing the three provinces into a portfolio has some obvious advantages, as does a national pool of risk.

Figure 2.3: Relative Position of Various Insurance Portfolios (1-in-100-Year PML)

Source: Authors’ calculations, from China Statistical Yearbook 2005.

2.64. The risk assessment also provides insights into the potential size and risk exposure of a national agricultural insurance program in China. This analysis will be extended in Chapter 4, as policy options are considered. The major point is that, even with relatively modest participation levels, the sum insured can be very high. At a 10 percent participation level, sum insured can exceed RMB 178 billion ($22.2 billion). The national average premium rate for a multiple-peril crop insurance program would likely approach 8 percent. Thus, premiums of RMB 14 billion ($1.8 billion) may be possible, once participation at 10 percent is achieved. However, the cost of such expansion must be carefully considered. The risk exposure of this type of expansion is also critical for policy makers.
2.65. Some important themes emerge from the risk assessment: (1) If an insurer tries to develop MPCI products, the risks are quite high and premium rates must reflect the differences in risk by crop and region (price discrimination). (2) Risk exposure for small and geographically concentrated crop insurance companies can be high, and risk exposure for even a well-diversified book of crop insurance business within a single province is still relatively high. (3) Pooling risk across provinces or across the nation can reduce risk exposure significantly.

Technical and Operational Assessment

Agricultural Insurance Market

2.66. Under the 11th FYP, the Chinese government is promoting a system of decentralized agricultural insurance development in each province, usually through a single insurance company. The proliferation of different institutional and structural models in each province (for example, SAIC in Heilongjiang, the new 2006 PICC-led commercial company coinsurance pools in Zhejiang Province, and the proposed PICC-led pool for crops and livestock in Hainan) suggests that future government policy and support to agricultural insurance should continue to be tailored to individual provinces.

2.67. In several instances the provincial governments through their finance bureaus are providing financial support to the agricultural insurers in the form of up-front premium subsidies and catastrophe reinsurance protection (Table 2.11). Agricultural crop and livestock premium subsidies are very new in China, and with the exception of Shanghai where the government has offered premium subsidies on mandatory epidemic disease cover since the mid-1990s, the premium subsidies now offered by insurers have been introduced only in the past two years. Policy makers justify the provision of premium subsidies as a means of promoting the adoption of agricultural insurance: (1) Subsidies enable small farmers to afford coverage at the high premium rates charged for MPCI (7.5–10.0 percent for crops). (2) From an insurer’s viewpoint, subsidies are important to permit it to charge actuarially sound rates. Another significant development in China since 2006 has been local governments’ decision in Zhejiang and Hainan Provinces to budget for and provide formal catastrophe reinsurance protection, as opposed to the more ad hoc disaster compensation funding provisions that have operated in most other provinces in the past.

2.68. National and provincial governments need to study carefully the financial implications of premium subsidy support as their provincial agricultural insurance programs expand, to avoid the huge economic costs of the highly subsidized mature agricultural insurance programs in countries such as the United States, Canada, Spain, Mexico, and India. (See Technical Annex 1.)

6 PICC, which traditionally underwrote crop and livestock insurance in most provinces, had by 2005 significantly reduced its operations due to a combination of poor results and changed priorities under its public listing. The only other company that is currently underwriting in several provinces is CUPIC, with headquarters in Xinjiang Province.
Table 2.11: Government Financial Support to Agricultural Insurance in China, 2006

<table>
<thead>
<tr>
<th>Province/Municipality</th>
<th>Insurance Company</th>
<th>Premium Subsidies</th>
<th>Premium Subsidy Level</th>
<th>Government Disaster Compensation</th>
<th>Formal Government Reinsurance for Insurers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heilongjiang</td>
<td>Sunlight</td>
<td>Yes</td>
<td>35%</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Xinjiang</td>
<td>CUPIC</td>
<td>No</td>
<td>none</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Xinjiang</td>
<td>PICC</td>
<td>No</td>
<td>none</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>CUPIC</td>
<td>Yes</td>
<td>50%</td>
<td>Unknown</td>
<td>No</td>
</tr>
<tr>
<td>Shanghai</td>
<td>Anxin</td>
<td>Yes</td>
<td>40% - 50%</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Jilin</td>
<td>An Hua</td>
<td>Yes</td>
<td>33% - 100%</td>
<td>Unknown</td>
<td>Proposed for 2006</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>PICC Pool</td>
<td>Yes</td>
<td>35% - 50%</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hainan</td>
<td>PICC Pool</td>
<td>Yes</td>
<td>20% - 30%</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>PICC</td>
<td>Yes</td>
<td>20% - 50%</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Source: Authors, from provincial finance bureaus.

**Insurance Products**

2.69. The wide range of crop insurance products and policies is offered by the insurers in each province largely reflects the geographical variation in catastrophe risk exposures.

2.70. The most common form of crop insurance in China is MPCI, which acts as a loss-of-yield guarantee against all climatic perils, including the catastrophe perils of drought and flood, and uncontrollable pests and diseases. Comprehensive MPCI, including drought, is extensively underwritten by SAIC in Heilongjiang Province and by CUPIC in Xinjiang Province. Other companies that underwrite MPCI loss-of-yield policies include PICC in Xinjiang Province and Anxin in Shanghai Province, but in these cases the companies specifically exclude drought.

2.71. In Hainan Province, typhoon is the key catastrophe exposure, and PICC has traditionally offered coverage against the single peril of wind under a conventional damage-based insurance and indemnity policy. Anxin and PICC also offer named-peril damage-based indemnity policies in some crops and in specialist greenhouse insurance cover. Also, several companies offer basic fire cover in forestry (standing timber).

2.72. Some drawbacks of the MPCI programs currently underwritten in China include:

- Insured yields are set on the basis of township-level average yields or, in the reclamation areas, regimental farm-level average yields, yet losses are adjusted and indemnified on the basis of actual yield at the individual farmer or field level. This leads to potential adverse selection problems.
• On most of the MPCI policies reviewed, a simple sum insured is established for each crop on the basis of the input costs of production, and this is offered to each grower. Thus, an insured yield is not established for each insured farmer at the time of policy inception. In the event of loss, yield shortfall or loss is usually calculated by comparing the township or regimental farm three- to five-year average yield with the actual yield for the affected farmers’ fields and then converting this into a percentage yield loss. A percentage deductible is then applied to the calculated percentage yield loss, and the net loss is applied to the sum insured, to calculate the value of the indemnity due to the insured.

• In most cases a 20 percent yield deductible is applied to losses. However, CUPIC uses a 20 percent qualifying franchise, and if this is exceeded, losses are indemnified in full from the ground up. Qualifying franchises may not be appropriate on MPCI yield-shortfall policies. Furthermore, there may be a need to introduce much higher deductible and rate options in areas where yields exhibit high variability. For example, for individual-grower MPCI in the United States, deductible levels vary from a minimum of 20 percent (80 percent coverage level) up to a maximum of 50 percent (50 percent coverage levels).

• Crop sums insured are set at extremely low levels, often representing no more than 30–40 percent of the costs of production. This is due to the following constraints: (1) low profitability of agriculture and thus farmer’s resistance to paying higher premiums for a higher sum insured, and equally important, (2) insurers’ concern over the catastrophe potential of crop insurance and lack of willingness to offer higher levels of indemnity for crops. This practice is termed “low sum insured, low premium, and low indemnity” in China.

2.73. Livestock insurance is a relatively minor class, generating about RMB 55 million premiums ($6.9 million), or less than 8 percent of total 2005 agricultural insurance premiums of RMB 729 million ($91.1 million). Several companies—including Anxin in Shanghai, CUPIC in Xinjiang, SAIC in Heilongjiang, and PICC Xinjiang—are underwriting individual-animal livestock policies for cattle, pigs, and sheep and goats. Anxin also offers poultry and aquaculture insurance. Anxin is the only company that currently underwrites livestock on a large scale, and in this case under an agreement with the Shanghai Municipality government it is offering compulsory epidemic disease cover and government slaughter for all commercial cattle, pig, and poultry farms in the municipality. Anxin’s average rates for epidemic disease cover are about 1 percent for poultry and pigs and 2 percent for dairy cattle. Although Anxin reports an average loss ratio of only 54 percent over the past six years, this result is a reflection of the fact that there have been no major disease outbreaks during this period and the catastrophe loading for epidemic disease outbreak is inadequate. Therefore, the rates may not be technically sustainable. The Anxin livestock program is not formally reinsured, but Anxin has an agreement with the municipality government to compensate catastrophe losses arising out of any epidemic disease outbreak in livestock (Box 2.2). CUPIC also underwrites livestock insurance.

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7 For government slaughter order, Anxin only indemnifies losses that are not otherwise compensated by government. This may take the form of top-up compensation for the difference between the market value of the animal and the government payment.

8 Anxin is currently reviewing its livestock products and may amend them to bring them into line with international standards.
livestock epidemic diseases and government slaughter order, but in this case charges much higher average rates of about 6 percent.

2.74. It appears that neither Anxin nor CUPIC has conducted any formal modeling of its epidemic disease exposures. In Shanghai, Anxin currently writes a livestock portfolio of about RMB 3.1 billion ($388 million), and in the event of a major epidemic disease, international experience from neighboring countries such as Malaysia and Thailand has shown that it is possible to incur huge financial losses. Although it is accepted that livestock sanitation and vaccination standards are extremely high in Shanghai Municipality, it is not inconceivable that under an epidemic disease outbreak Anxin could lose 10–20 percent of its insured livestock through enforced culling. This would represent a major loss of $39–78 million. It is not known how readily the municipality government could compensate Anxin for such high losses.

Box 2.2: Economic Implications of Epidemic Disease in Livestock

*Taiwan, China 1997.* Foot and mouth disease outbreak in pigs: Failure to identify the initial outbreak, intentional contamination of herds by pig owners, and absence of a proper vaccination program led to the national herd being infected, and to the culling (obligatory government slaughter) of more than 3.8 million head of pigs in an attempt to stamp out the disease. The estimated cost of this outbreak was $6.9 billion.

*Malaysia 1999.* The Malaysian swine (pig) industry was devastated by a previously unknown and highly contagious virus named *nipah virus*. To stamp out the disease, culling was ordered by government on a total of 829 farms, and a total of 1.07 million pigs were eradicated, or 45 percent of the national swine herd. The direct losses to the Malaysian swine industry were estimated at RMB 1.1 billion ($300 million), and upwards of 1 million upstream and downstream jobs in the industry were lost or affected.


**Risk Assessment and Rate Making**

2.75. Although it was not possible to conduct a detailed review of the risk analysis and rating methodologies adopted by the insurance companies, it appears that most companies are currently offering single rates for each crop type, with little or no differentiation according to regional risk exposure and results. Average 2005 rates are reported in Table 2.12, and are reviewed in detail in the individual company reports. SAIC and CUPIC are charging high average rates of about 8 percent for their crop MPCI programs. The other companies, which do not insure drought, charged much lower average rates of between 2.1 percent (Anxin) and 4.2 percent (PICC Hainan) on their crop programs in 2005. For livestock, PICC Xinjiang and SAIC charged average rates of 3.6–3.9 percent for individual-animal mortality cover, which specifically excludes diseases and government slaughter. Conversely, in 2005 Anxin charged an average rate of 1.1 percent on its livestock epidemic-disease policy.
Table 2.12: Average Premium Rates, 2005

<table>
<thead>
<tr>
<th>Province</th>
<th>Heilongjiang</th>
<th>Xinjiang</th>
<th>Xinjiang</th>
<th>Shanghai</th>
<th>Hainan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>SAIC</td>
<td>CUPIC</td>
<td>PICC</td>
<td>Anxin</td>
<td>PICC</td>
</tr>
<tr>
<td>Average rates crops</td>
<td>7.9%</td>
<td>8.1%</td>
<td>3.4%</td>
<td>2.1%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Average Rates Livestock</td>
<td>3.9%</td>
<td>5.7%</td>
<td>3.6%</td>
<td>1.1%</td>
<td>n.a.</td>
</tr>
<tr>
<td>Overall Average Rate</td>
<td>7.9%</td>
<td>7.8%</td>
<td>3.4%</td>
<td>1.6%</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

n.a. = not applicable.

*Note:* Rates are prior to any premium subsidy available to the farmer.

*Source:* Information provided by insurance companies.

2.76. Although some companies are adjusting their rates on an actuarial basis, in general rates are inadequate to cover the long-term average claims and to generate adequate levels of return on equity. There is also a need for a formal review of the terms and conditions of the insurance contracts, such as deductible level and coinsurance levels.\(^9\)

2.77. Few companies are currently conducting modeling of their catastrophe exposures in order to build a suitable loading into their original gross premium rates and to assist in decisions concerning their risk retention and reinsurance requirements. There is a major need for the insurers to address this issue.

**Distribution Channels**

2.78. The distribution and marketing channels for agricultural insurance vary widely from province to province. In Heilongjiang and Xinjiang reclamation areas, crop insurance is provided by SAIC and CUPIC, respectively, on an automatic (compulsory) basis for all the farms in the reclamation areas. In Hainan, PICC has traditionally marketed crop insurance cover only to large state farms. Elsewhere PICC has marketed cover to the local township governments, as opposed to individual farm households. In Shanghai, Anxin has an agreement with local government to provide subsidized insurance to all rice growers and also to all commercial cattle, pig, and poultry enterprises. Features common to all of these programs in the past include the following: (1) most sales have been made to collective organizations as opposed to individual households, (2) the local entity has been responsible for providing insurance schedules to the insurer, and (3) the local entity has been responsible for providing to the insurer the premium due for all farmers in the command area.

2.79. The challenge for the development of agriculture insurance for small farmers will be to scale up the distribution of agricultural insurance at reasonable cost, and on a voluntary basis as required by law, to very large numbers of individual household farms. Providing agricultural insurance for small farmers has always been a challenge.

\(^9\) For example, in the damage-based policies, coinsurances on the amount of loss should be replaced by conventional deductibles.
worldwide, because the administrative costs in traditional MPCI programs (underwriting costs, monitoring, loss adjustment costs, and so on) represent a fixed cost that can be disproportionate compared to the low sums insured of small farmers. Innovative products, such as index-based insurance products, and alternative delivery channels (for example, through farmers organizations, rural banks input providers) may reduce the operating costs and thus make agricultural insurance affordable and effective to small farmers. (See Chapter 3.)

**Loss Assessment**

2.80. Given the preponderance of MPCI cover in China, most loss assessment relies on yield-based loss assessment at the time of crop maturity. Loss assessment is conducted at the individual-farmer or field level. Loss assessment procedures vary according to whether the loss is a total loss or partial loss:

- Total losses generally require a single visit to verify the cause of loss and to measure the damaged area. The standard procedure is to indemnify total losses against a preagreed indemnity scale that relates to the growth stage and the actual costs, or a proportion of the actual costs, invested in the crop at the time of loss.

- Partial losses generally require two separate loss-assessment visits, one at the time of inspection to verify the insured cause(s) of loss, and then a second visit at crop maturity to conduct in-field sample measurement of the actual yield in the affected plot or field and to compare this with the insured yield to estimate the percentage yield loss or shortfall. Individual-farmer and field assessment is very time consuming.

2.81. Currently yield-based loss assessment is provided at highly subsidized cost, either by the farmers and the management of the reclamation groups, or by the agricultural technicians from the county or township agricultural services centers. SAIC and CUPIC staff reported that they actively participated in loss assessment, but in the cases of Anxin and PICC their function appears to be restricted to spot checks and auditing of the assessments provided to them by local authorities.

**Agricultural Insurance Operating Costs**

2.82. Individual farmer and livestock producer insurance is often expensive to administer, and this problem applies especially to crop MPCI with its dependence on in-field yield-based loss assessment.

2.83. Table 2.13 provides a summary of selected companies’ 2005 operating expenses, expressed as a percentage of total agricultural insurance premiums. There are two distinct expenditure patterns. SAIC and CUPIC write the largest agricultural insurance portfolios,

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10 In Heilongjiang, loss assessment is extremely intensive and involves a “4-tier” system under which farmers and local staff at the local insurance cooperative branch level conduct the original assessment. The loss is then inspected and audited separately by staff from the Insurance Cooperative, then the branch office, and finally SAIC’s headquarters adjuster signs-off on the claim before it can be settled.
with premiums in excess of RMB 200 million ($25 million), and they enjoy economies of scale. The two companies work very closely with the management and staff of the HRG and XPCC farms, who mainly provide their field-inspection and loss-assessment services free of charge. SAIC and HRG have total operating costs of less than 20 percent of premium, of which 10–12 percent is allocated to internal operating expenses and 5–7 percent is allocated to external costs, including risk-prevention measures and handling charges. 11

2.84. Conversely, the other commercial companies, including PICC, Anxin, and Anhua, face much higher operating expenses, which average 25–30 percent of premium. Of this, an average of about 20 percent represents their internal operating costs. Anhua is a start-up operation with relatively small premium volume and currently high overheads. PICC and Anxin, however, are well-established companies that are incurring extremely high operating costs in spite of receiving major assistance from the village townships and agricultural service centers in administering their programs, in premium collection and in loss assessment.

Table 2.13: Agricultural Insurance Company Operating Expenses, 2005*

<table>
<thead>
<tr>
<th>Province</th>
<th>Heilongjiang</th>
<th>Xinjiang</th>
<th>Xinjiang</th>
<th>Shanghai</th>
<th>Hainan</th>
<th>Jilin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>SAIC</td>
<td>CUPIC</td>
<td>PICC</td>
<td>Anxin</td>
<td>PICC</td>
<td>Anhua</td>
</tr>
<tr>
<td>Total 2005 Premium (RMB Million)</td>
<td>219.8</td>
<td>248.4</td>
<td>30.9</td>
<td>74.8</td>
<td>3.1</td>
<td>27.4</td>
</tr>
<tr>
<td>Total Operating Expenses</td>
<td>15%</td>
<td>19%</td>
<td>28%</td>
<td>28%</td>
<td>36%</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Percentage of premium.

Source: Individual company reports.

**Profitability**

2.85. Table 2.14 reports the long-term average loss ratios for the five companies at completion of the 2005 season. With the high levels of operating expenses, only one company, CUPIC, has consistently generated profits over time. For most of the companies, livestock results are better than those for crops, which have historically been underrated or have had deductibles set too low.

2.86. In general terms, and based on international norms, these companies should set target loss ratios of no more than 60–65 percent, particularly if in the future they intend to seek proportional (quota share) reinsurance support from international reinsurers.

11 The risk prevention measures center on antihail cloud-seeding programs using radar-controlled cannons and rockets. SAIC and CUPIC cover the operating costs of these programs.
Table 2.14: Crop and Livestock Insurance Results, 2005*

<table>
<thead>
<tr>
<th>Province</th>
<th>Heilongjiang</th>
<th>Xinjiang</th>
<th>Xinjiang</th>
<th>Shanghai</th>
<th>Hainan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>SAIC</td>
<td>CUPIC</td>
<td>PICC</td>
<td>Anxin</td>
<td>PICC</td>
</tr>
<tr>
<td>No years experience</td>
<td>13</td>
<td>20</td>
<td>10</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Crop loss Ratio</td>
<td>90%</td>
<td>73%</td>
<td>70%</td>
<td>86%</td>
<td>77%</td>
</tr>
<tr>
<td>Livestock Loss ratio</td>
<td>61%</td>
<td>63%</td>
<td>67%</td>
<td>54%</td>
<td>n.a.</td>
</tr>
<tr>
<td>Overall Loss Ratio</td>
<td>90%</td>
<td>73%</td>
<td>70%</td>
<td>74%</td>
<td>77%</td>
</tr>
</tbody>
</table>

n.a. = not applicable.

*Long-term average loss ratio.

Source: Individual company reports

**Agricultural Reinsurance Market**

2.87. Prior to 2002, the Chinese reinsurance market was closed to foreign competition, and the market was controlled by the state-owned China Reinsurance Company (ChinaRe). ChinaRe was founded in March 1999 from the former PICCRe. Until 2002, ChinaRe enjoyed a monopoly of the domestic reinsurance market, and it prospered from the 20 percent compulsory cession of direct insurers’ premiums, which in 2001 accounted for approximately 94 percent of ChinaRe’s premium income. Post-WTO membership, the 20 percent compulsory cession requirement has been gradually phased out, reducing to 15 percent in 2003, 10 percent in 2004, 5 percent in 2005, and final abolishment in 2006. Local insurance companies are now free to cede business to ChinaRe as they wish. In 2004, ChinaRe’s reinsurance premium income amounted to RMB 20.0 billion ($2.5 billion), of which 29.9 percent was composed of commercial reinsurance premiums. In 2004, total assets amounted to RMB 26.4 billion ($3.3 billion), or an increase of 7.5 percent over 2003.12

2.88. SwissRe and MunichRe were given approval to apply for full branch licenses in July 2002, thus ending ChinaRe’s monopoly, and since 2003 both of these international reinsurers have been granted full national reinsurance branch licenses, permitting them to write reinsurance business throughout China. At the end of 2005, there were six locally licensed professional reinsurers in China: ChinaRe, PICC Property & Casualty Re, China Life Re, MunichRe, SwissRe, and General CologneRe.13

2.89. The compulsory cessions to ChinaRe were phased out in December 2005 and replaced by a series of new regulations, beginning December 1, 2005, which require that any direct insurance company wishing to place facultative or treaty reinsurances must first offer at least 50 percent of the reinsurance to at least two of the locally licensed

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13 Other reinsurers who have sought branch approval for branch licenses in Shanghai or Beijing include Transatlantic Re, Employers Re, and Lloyd’s.
reinsurers\textsuperscript{14} (as listed above). Any balance on the company’s retention and the local reinsurance acceptance can be reinsured to reinsurers outside of China.

**Chinese Agricultural Reinsurance Arrangements Prior to 2004**

2.90. During the 1980s and 1990s, PICC, SAIC, CUPIC, and Anxin implemented their agricultural insurance programs without any formal reinsurance protection. In the case of PICC, agricultural underwriting losses incurred at a provincial level were absorbed by the Property and Casualty division, under which agriculture falls.\textsuperscript{15}

2.91. In Heilongjiang Province, in the years 1993–2004, prior to the formation of SAIC, there was no formal reinsurance program, and in years of catastrophe losses that exceeded the mutual’s premiums and claims reserves, the following mechanisms were applied: (1) the mutual adjusted down the claims for all farmers on a pro rata basis and/or (2) provincial government stepped in with disaster relief payments for the excess losses.\textsuperscript{16}

2.92. In Xinjiang, CUPIC has operated for 20 years without external financial and reinsurance support. The company’s internal risk-management measures applicable to its agricultural insurance business include:

- In the event of severe disasters, if the premium of the year is insufficient to cover claims, it will be supplemented by risk funds accumulated from past years;
- If this is still insufficient, 30 percent of CUPIC’s profits from commercial P&C business in that year can be allocated to pay for the agricultural insurance losses;
- Finally, if this is still insufficient, funds will be financed by the XPCC farms and regiments to aid the affected farmers (CUPIC has established an agricultural risk fund with XPCC in which the premium shall be reserved at the ratio of 3:7 between XPCC and the company.);

2.93. According to CUPIC, during its 20 years of operation, underwriting losses (claims in excess of premiums) were experienced in 4 years, 1986, 1989, 1999, and 2001, and underwriting profits were generated in 15 years. The company also reports that up to the end of 2005 approximately RMB 100 million ($12.5 million) of risk funds have been accumulated to pay for catastrophe losses.

\textsuperscript{14} Willis November 2005 – Issue 10, International Alert Reinsurance Rules Tighten in China.
\textsuperscript{15} According to PICC Xinjiang, PICC Group also operates an internal reinsurance program for losses arising out of a single event that exceeded RMB 10 million. It is understood that this cover is applicable to Property & Casualty business.
\textsuperscript{16} According to Sunlight, the provincial government compensated excess losses on three occasions in the 11-year period, namely 1994, severe waterlogging; 1998, flooding; 2002, low temperature and frost losses. The total excess-of-loss payments amounted to RMB 280 million.
New Reinsurance Arrangements Since 2004

2.94. The agricultural reinsurance market has been opened up since 2004, and several companies are now involved in the purchase of international stop-loss reinsurance or coreinsurance arrangements with local government. International Crop Stop Loss Reinsurance Treaty protection has been purchased by SAIC and by Anxin on their crop portfolios in 2005 and 2006. In both cases these local insurers buy very small layers of stop-loss reinsurance equivalent to approximately 50 percent in excess of 90 percent GNPI. This level of stop-loss cover is unlikely to be adequate to protect against the catastrophe PML exposures (drought and flood in the case of SAIC; typhoon in the case of Anxin) on their crop programs, and they therefore remain very exposed to major losses. It is understood, however, that provincial governments will continue to provide ad hoc (ex post) compensation for losses in excess of their stop-loss reinsurance limits.

2.95. The livestock reinsurance market is much more restricted than the crop reinsurance market in terms of specialist leaders and following market capacity providers. Currently, neither SAIC or Anxin is purchasing international reinsurance on its livestock program. The SAIC livestock policy is a standard individual-animal accident-and-mortality product, which is likely to attract reinsurance support if required. Anxin, however, underwrites livestock epidemic-diseases as well as government slaughter order, and it is highly unlikely that international reinsurers will accept to reinsure these perils at all, or only with major restrictions.

2.96. In Zhejiang Province, the new 2006 PICC-led agricultural coinsurance pool is also buying international stop-loss reinsurance protection on its combined crop, livestock, forestry, and aquaculture portfolio, in this case for losses in excess of 100 percent up to 200 percent GNPI, and which is part of a carefully structured and layered reinsurance program involving both private and public sector reinsurance.

2.97. CIRC has been promoting pool coinsurance programs led by PICC in several provinces—in Zhejiang since 2006, and in Hainan, which is planned for 2007, under which the local provincial governments and financial bureaus have agreed to provide reinsurance protection under a coreinsurance arrangement for losses in excess of 200 percent GNPI up to 500 percent GNPI. In these provinces, government has accepted 50–67 percent share on the reinsurance programs. In Zhejiang it is understood that, by agreement of CIRC, government and the PICC-led coinsurance pool, losses will be capped at 500 percent loss ratio. In Hainan, government’s liability is capped at 500 percent loss ratio, and liability for losses in excess of 500 percent loss ratio will revert to the pool coinsurers. This public-private risk financing represents a very significant development in the Chinese agricultural insurance and reinsurance market in 2006 and merits further analysis on a province-by-province basis.

2.98. Full details of the public and private international stop-loss reinsurance arrangements are presented in Technical Annex 6.

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17 Government reinsurance protection is provided free of charge.
Chapter 3: Guiding Principles Drawn from International Experience

3.1. Agricultural insurance is challenging under any circumstances. It is even more challenging when farm units are small, markets are not well-developed, regulations are unclear, and data and information are lacking. International experience has been mixed for many types of agricultural insurance. Governments have become increasingly involved in agricultural insurance—in some cases as a direct provider of the insurance, in others, via a public-private partnership. These cases generally involve relatively heavy premium subsidies that neglect to address some of the underlying issues that are critical to a properly designed agricultural insurance program. Technical Annex 1 provides an overview of some of these country experiences. Although it is beyond the scope of this document to review these cases in detail, it is useful to draw from them and attempt to develop guiding principles that may assist policy makers and those involved with the emerging agricultural insurance market in China.

Agricultural Insurance Products: Overview

3.2. Much of the global agricultural insurance premium is generated in North America (58 percent) and Western Europe (28 percent). Asia accounts for about 4 percent and Latin America 3 percent. The rest of the world constitutes the remaining 6 percent. Worldwide, most agricultural insurance is for crops—representing 71 percent of the global premium for agricultural insurance (hail crop insurance is 22 percent, and MPCI is 49 percent). Only about 12 percent of global premium is for livestock (not including sporting or companion animals). This chapter focuses exclusively on various types of crop insurance products.

3.3. Most agricultural insurance is traditional insurance that pays an indemnity when the farm household incurs a loss. To pay indemnities, the insurance provider must make estimates of the loss incurred for each farm that makes a claim. There are two dominant types of crop insurance: Named-peril and multiple-peril. Named-peril insurance involves assessing losses that occur due to a specific peril. Hail insurance is the most common form of named-peril insurance. For well over 100 years, hail insurance has been available in a number of countries (mostly in North America and Europe). Once loss adjustors are properly trained, hail damage is easily identifiable, and special procedures have been developed to make field assessments of the degree of damage. Furthermore, hail losses are typically localized rather than widespread. For these reasons, hail insurance has been offered in most countries in the private sector without government subsidies. Named-peril crop insurance can also be offered on other perils, such as freeze or windstorm. The loss-adjustment process attempts to estimate the specific damage created by the insured peril. These estimates are done on a percentage basis. The percentage of damage (minus any deductible) is multiplied by the sum insured to calculate the indemnity.

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3.4. Drought is rarely covered under traditional named-peril insurance. It is nearly impossible to isolate how much loss of yield is due to drought versus other factors, potentially including bad management. These issues become even more problematic when offering yield-based multiple-peril crop insurance. If one is insuring for multiple perils, it is very difficult to first identify the “set of perils” that may have created the losses and then perform a loss assessment that attempts to separate the actual loss by peril. It is often difficult to tell whether the loss was due to a weather event or to poor management practices.

3.5. Agricultural index insurance products are now offered in several countries. These products pay indemnities based not on farm-level yield shortfalls but rather on realizations of an index that is highly correlated with farm-level yield shortfalls. An example is area-yield-index insurance, which pays indemnities based on estimates of the area yield. A threshold is established that is less than the expected county yield (for example, 80 percent of the expected county yield). Indemnities are paid whenever the realized area average yield (for example, county average yield) is less than the threshold. These products date to the 1950s, with products offered in Sweden. Some regions in Canada have offered such products since 1977. Since 1992, area-yield-index insurance (called the Group Risk Plan, or GRP) has been included among the various agricultural insurance products available to U.S. farmers.  

3.6. India also has a long-standing national crop insurance program that is based on area yields, with its first area-yield insurance program introduced in 1985. In fact, if one considers only the number of farmers insured, India has the largest crop insurance program in the world, with about 18 million farmers in 2005. The Indian area-yield insurance program is delivered directly with farm loans, even including provisions to add a premium charge to the loan and make the payment to the bank to pay all or part of the loan. Although suitable for small farm households, the Indian program has had numerous problems. The program has mixed social and market goals, and the actuarial performance is quite poor (average loss ratios exceed 400 percent). Since it takes time to develop the area yields, payments can be delayed to the extent that the insurance is not useful for the next crop season. To address these issues, the government of India has proposed to move to an actuarial regime for crop insurance. Premiums would be charged on a commercial basis and government’s support, where necessary, would provide up-front premium subsidies (though not for commercial or horticultural crops) differentiated by the economic category of farmer. This will help address the issue of delayed indemnity payments to farmers, since government contribution, which currently leads to considerable delays in settlements, would be made up-front. Such a sound financial and actuarial approach will also result in introducing more discipline to the Indian crop insurance program and more efficient targeting of subsidies for poorer farmers. The World Bank is currently helping the government of India to move to this proposed actuarially sound regime.

3.7. Weather-index insurance is another type of index insurance. This product pays indemnities based on realizations of some weather variable (for example, rainfall or

temperature) measured at a local weather station. The insurance can be structured so that it pays whenever rainfall or temperature is so high or so low that it is likely to cause crop yield losses. Weather-index insurance is currently being tested on a pilot basis in several countries, including India, Mexico, and Malawi.

3.8. For both area-yield-index insurance and weather-index insurance, there is no need for farm-level loss adjustment. This and other factors associated with these products make them significantly less costly to deliver. These products can offer a sound basis for an agricultural insurance program. However, they require accurate, consistent, and secure measures of the underlying index (weather variable or area yield). Also, since indemnities are based on the realized value of the index rather than on the policyholder’s actual losses, it is possible that the insurance payout does not exactly match the actual loss (basis risk).

Box 3.1: Summary Various Types of Agricultural Insurance Products

<table>
<thead>
<tr>
<th>Traditional Crop Insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Damage-based indemnity insurance</strong> (named-peril crop insurance) is crop insurance wherein the insurance claim is calculated by measuring the percentage damage in the field, soon after the damage occurs. The percentage damage measured in the field, less a deductible expressed as a percentage, is applied to the preagreed sum insured. The sum insured may be based on production costs, or on the expected revenue. Where damage cannot be measured accurately immediately after the loss, the assessment may be deferred until later in the crop season. Damage-based indemnity insurance is best known for hail, but it is also used for other named-peril insurance products (such as frost and excessive rainfall).</td>
</tr>
</tbody>
</table>

| Yield-based crop insurance (multiple-peril crop insurance, MPCI) is insurance wherein an insured yield (for example, tonnes per hectare) is established as a percentage of the historical average yield of the insured farmer. The insured yield is typically 50–70 percent of the average yield on the farm. If the realized yield is less than the insured yield, an indemnity is paid equal to the difference between the actual yield and the insured yield, multiplied by a preagreed value of sum insured per unit of yield. Yield-based crop insurance typically protects against multiple perils, meaning that it covers many different causes of yield loss. This is because it is generally difficult to determine the exact cause of loss. |

<table>
<thead>
<tr>
<th>Index Crop Insurance</th>
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<tbody>
<tr>
<td><strong>Area-yield-index Insurance</strong> is insurance wherein the indemnity is based on the realized average yield of an area, such as a county or district. The insured yield is established as a percentage of the average yield for the area. An indemnity is paid if the realized yield for the area is less than the insured yield, regardless of the actual yield on a policyholder’s farm. This type of index insurance requires historical area-yield data.</td>
</tr>
</tbody>
</table>

| Weather-index insurance is insurance wherein the indemnity is based on realization of a specific weather parameter measured over a prespecified period of time at a particular weather station. The insurance can be structured to protect against index realizations that are either so high or so low that they are expected to cause crop losses. For example, the insurance can be structured to protect against either too much rainfall or too little. An indemnity is paid whenever the realized value of the index exceeds a prespecified... |
threshold (for example, when protecting against too much rainfall) or when the index is less than the threshold (for instance, when protecting against too little rainfall). The indemnity is calculated based on a preagreed sum insured per unit of the index.

**Traditional Livestock Insurance**

*Mortality insurance* for individual animals is the basic traditional product for insuring livestock. It is very costly for an insurer to provide insurance for individual animals, especially where herd size is small. Premiums are set based on normal mortality rates within the permitted age range, plus risk and administrative margins, and are generally quite expensive. Further, since mortality is influenced to a considerable extent by management, the product suffers from antiselection by the highest-risk farmers.

*Herd insurance* is a variation on individual-animal mortality cover, for larger herds. A deductible is introduced, in which a certain number animals, or a percentage of the animals, must be lost before an indemnity is paid.

*Epidemic-disease insurance* is offered in only a few countries, most notably Germany. Insurance of government ordered slaughter or quarantine is normally excluded. Epidemic-disease insurance carries major and infrequent catastrophic claims exposures necessitating a high reliance on reinsurance for risk transfer. Due to the difficulties of modeling epidemic-disease spread and financial exposures, it is difficult to develop this type of insurance and to obtain support from international reinsurers.

**Index Livestock Insurance**

*Index insurance for livestock* has been applied for mortality in Mongolia, where there is a high incidence of livestock losses due to extreme weather, and for some pasture and rangeland products in Canada and the United States.

*Source:* Individual company reports.

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**Cost of Agricultural Insurance**

3.9. The cost of agricultural insurance (that is, agricultural insurance premium) is decomposed and analyzed from the standard cost equation below. It explains how these cost components vary across different agricultural insurance products, different legal and regulatory environments, and different agricultural structures (large-scale versus small-scale agriculture).

\[
\text{Insurance Premium} = \text{Expected Annual Loss} + \text{Expense Loads} + \text{Cost of Capital}
\]

**Expected Annual Loss**

3.10. If insurance is not priced according to the underlying risk, it is doomed to failure. Thus, a critical function for any insurer is to estimate the cost of the risk being insured. This is done through a risk assessment. If the insurance product has been in existence for many years, historical loss costs (indemnities or sums insured) can sometimes be used to estimate the cost of the risk. However, historical loss-cost data may not be adequate for estimating future indemnities, if the insurance product covers losses from extreme but
infrequent events such as devastating typhoons. For new insurance products, historical loss-cost data will not be available. Thus, actuaries will attempt to use other data sources (for example, historical yield data, weather data, and so on) to simulate what the loss cost would have been had the insurance product been sold in previous years.

3.11. A sound risk assessment relies on a quantitative analysis, as shown in Chapter 2 and in Technical Annex 2. However, insurance companies will always supplement such quantitative analysis with expert judgment. This is particularly true when the insurance product insures against losses from highly infrequent but potentially catastrophic loss events. The following are some of the primary questions that are addressed in a risk assessment:

- Are there one or more natural perils that are known to directly undermine the welfare of farm households, or that impede the delivery of critical services to rural areas? Events likely to meet this condition include well-defined extreme weather events such as droughts, excessive rainfall, floods, freezes, excessive temperatures, deficit sunlight, and so on.
- How frequently do losses occur? For any insurance to be successful, extreme loss events must occur frequently enough to be recognized by individuals as a significant risk. However, they should not occur too frequently, or else premium rates would be prohibitively high. As a rule, major loss events should occur at least once every 15 years, but not more than once every 7 years.
- When loss events occur, what is the magnitude of loss? Will the loss event cause severe economic distress for farm household?
- How spatially correlated are agricultural production losses? Are losses generally localized or are they widespread over a large area?

**Expense Loads**

3.12. A number of expense factors must be carefully addressed. Each of these factors adds to the expense of developing and implementing an effective and sustainable agricultural insurance program. Understanding these cost factors also provides significant insight into *guiding principles* for developing agricultural insurance

**Cost of Information to Control Antiselection**

3.13. Data and information are critical to any agricultural insurance program. As was just discussed, quality data are required to conduct a risk assessment. Data are also needed to conduct risk classification of potential policyholders. An insurer will attempt to classify potential policyholders according to their risk exposure and charge higher (lower) premium rates to those whose agricultural production is more (less) risky. Such classification requires information on the risk exposure of the potential policyholder relative to other agricultural producers. To understand why this is important, suppose that the insurer is not able to accurately classify potential policyholders according to their risk exposure. Those who have been misclassified to their benefit (that is, charged premium rates that underestimate the true cost of their risk) will be more inclined to purchase insurance. Those who have been misclassified to their detriment (that is, charged premium rates that overestimate the true cost of their risk) will be less inclined to purchase insurance. The pool of insurance purchasers will then consist disproportionately
of those who have been misclassified to their benefit. As a result, the insurer will pay larger indemnities than had been anticipated. The high level of indemnities will cause the insurer to increase premiums in subsequent years. However, this only compounds the problem, since only those persons who have been most severely misclassified to their benefit will choose to purchase the insurance at the higher premium. This phenomenon, known as “adverse selection” will eventually destroy an insurance market and can only be corrected with more and better information with which to conduct risk classification. If there is no risk classification and policyholders are all charged the same premium rate, severe anti-selection problems will almost always emerge.

3.14. Often it is very difficult to conduct farm-level risk classification because information on farm-level yields or losses is not available. Comprehensive local data on weather or area crop yields are also often difficult to obtain, unless such data have been systematically organized and archived in useable formats. Without these data, it is very difficult for an insurer to even determine which crops or regions of the country are relatively more prone to losses—much less conduct farm-level risk classification. Public investments in quality data are often needed to facilitate development of agricultural insurance.

Cost of Monitoring to Control Moral Hazard

3.15. Moral hazard occurs when, as a result of purchasing insurance, individuals change their behavior in ways that increase the likelihood or the magnitude of losses. Moral hazard can be something as simple as irrigating less or using less pesticide as a result of having purchased crop insurance. It can also be a deliberate attempt to defraud the insurer and collect more indemnity than is really due. Insurers attempt to control moral hazard in part through product designs that include deductibles and coinsurance. These designs ensure that the policyholder shares in any losses, so there is less incentive to engage in riskier behavior. Insurers also attempt to monitor the behavior of policyholders to make sure that they use widely accepted best management practices and do not use production practices that are expressly forbidden by the insurance policy.

Cost of Loss Adjustment

3.16. When an insured loss occurs, the magnitude of the loss must be calculated to determine the amount of indemnity due the policyholder. For named-peril and multiple-peril crop insurance products, this requires that a trained loss adjuster visit the farm, determine whether the loss occurred due to an insured peril, and, if so, estimate the magnitude of yield loss. The cost of loss adjustment can be quite high. For MPCI, this is especially true when a high proportion of policyholders experience a loss due to a widespread event such as a drought. Since loss adjustment must be conducted for each insured farm, the cost of loss adjustment also increases greatly when a large percentage of the policyholders are smallholders.

3.17. The cost of loss adjustment is much lower for index insurance products because there is no need for farm-level estimates of loss. Indemnities are based solely on the realized value of the index relative to the threshold. Once the realized value of the index is determined, indemnities can be calculated without ever visiting the insured farm.
Cost of Delivery

3.18. The cost of selling crop insurance policies can also be quite high. Trained sales staff must travel to remote rural areas, meet with farm-level decision makers to explain the insurance policies, obtain signatures on sales contracts, and eventually collect premiums. As with loss adjustment, the cost of delivery is much higher when a large percentage of the policyholders are smallholders. The cost of delivery is also higher for more complex insurance products like MPCI, as compared to more simple products like named-peril or index insurance.

3.19. Sometimes the cost of delivery can be reduced if crop insurers can form relationships with organizations such as input suppliers or lenders who already have sales staff in the countryside. Also farmer mutuals or cooperatives can sometimes serve as an important insurance distribution channel. An example of a linkage to lending is provided by the Philippines Crop Insurance Organization. The majority of farmers insured are recipients of a supervised credit program. The French agricultural mutual insurance program Groupama has been involved in similar practices for well over 100 years. Groupama is now operating in parts of China. In India, farmers taking loans from state-supported lenders are forced to purchase crop insurance that is packaged with the loan. Premiums are collected by the lender. Any insurance indemnity is applied first to paying the loan balance. If the indemnity exceeds the loan balance, the difference is put into a bank account for the policyholder.

3.20. In a well-developed insurance market, insurance sales agents often also sell various types of farm supplies and production inputs. They use point-of-sale laptop computers for entering relevant information and can often issue insurance policies while meeting with the farmer. This reduces the number of trips that sales agents must make to remote rural areas to meet with farmers. Obviously, a sophisticated information technology system is required to support such efforts. Similar systems have been developed in India by Basix, a rural services organization that has developed index insurance products for small-scale farmers (Box 3.1).

3.21. Where a crop is grown for export or for processing, and a single export or processing channel exists, it may be possible to provide crop insurance in an automated way to all contracted farmers. An example is Windward Island Crop Insurance Ltd, a company protecting banana growers on four Caribbean islands against hurricane and localized wind damage. Another example is Mauritius Sugar Insurance Fund Board, which provides protection for sugar growers against a variety of perils, but particularly cyclone and rain. Linkages to cotton processors could perhaps offer similar opportunities in China.

Administrative Costs

3.22. In addition to information, monitoring, loss adjustment, and delivery costs, there are other costs of administration associated with selling and servicing insurance products. These include everything from the cost of skilled actuarial, underwriting, legal, and

management information system personnel to the cost of maintaining computers, vehicles, buildings, and so forth.

**Product Development Costs**

3.23. Developing new agricultural insurance products is an expensive activity that involves product design and actuarial pricing. The insurer would expect some kind of fixed-mover advantage capable of generating excess returns for a period in order to recover the sunk development losses incurred earlier.

**Cost of Capital**

3.24. The third major component of cost for any viable insurance company is the cost of ready access to capital. Companies writing agricultural insurance must consider making a reasonable rate of return on the risk capital. Economic capital is also required to reduce the probability of ruin. Insurers must have access to sufficient capital to pay in full all indemnities that have a high probability (for example, 99 percent) of occurring in a given year. A thorough risk assessment must also provide some indication of how large the insurer’s loss ratio could be in any given year. This is often referred to as the loss ratio PML. The larger the loss ratio PML, the more the insurer will need access to ready sources of capital. The amount of contingent capital required can be particularly high for multiple-peril policies that cover spatially covariate perils. For example, a widespread drought can generate massive losses in a single year. By selling insurance for different crops or in different regions, an insurer can diversify its portfolio of insurance policies. Such diversification reduces the insurer’s loss ratio PML, and thus the insurer’s contingent capital needs.

3.25. When insurance is regulated according to international standards, having proof of sufficient access to contingent capital is a requirement. Some of the necessary capital may come from the insurer’s accumulated reserves. However, taxation and regulatory structures often make it cost-prohibitive for insurers to accumulate large reserves. Further, an extreme loss event could occur before sufficient reserves are accumulated. Thus, most insurers purchase access to contingent capital through reinsurance. The larger the loss ratio PML, the higher will be the insurer’s cost of obtaining sufficient access to contingent capital.

**Product Development**

3.26. For any proposed insurance product, the insurer must ask whether the cost of risk can be accurately estimated. The insurer must also consider how the costs of information, monitoring, loss adjustment, delivery, administration, and access to contingent capital vary across different product designs. These questions are explored by focusing on named-peril crop insurance, multiple-peril crop insurance, and index insurance.

**Named-Peril Insurance**

3.27. The cost of offering named-peril insurance is significantly less than the cost of offering multiple-peril insurance. It is easier to conduct risk assessment for a single
named peril than for multiple perils. Risk classification is easier for a named peril than for multiple perils, so the potential for adverse selection is greatly reduced. It is much easier to monitor for moral hazard with named-peril insurance than with yield-based multiple-peril insurance. For most named-peril insurance products, it is fairly easy to determine whether the yield loss was due to the insured peril. The cost of ready access to capital is also much lower for named-peril insurance, since the perils insured (such as hail) tend to be localized rather than spatially covariate. For these reasons, named-peril insurance products have been the first crop insurance products offered in many countries.

3.28. Named-peril hail insurance is an extremely well-established product in most developed countries with temperate climates, where hail is normally a significant hazard. The risk assessment presented in Chapter 2 demonstrates that hail risk is a significant hazard in many parts of China. There is a substantial body of hail insurance experience in the international insurance and reinsurance marketplace, and among associations of insurers. It is a major class of insurance throughout Europe (for example, Germany, Spain, France, Italy, Poland, and Eastern Europe), Canada and the United States, South America (for example, Argentina, Chile, and Brazil), and Australia and New Zealand. The viability of hail insurance can be attributed to several features:

- It can be sold as a commodity product, requiring only limited skills from sales agents;
- It is a standardized and simple policy, with variations only in the loss-adjustment processes, which are adapted to each crop type and growth stage;
- Field-loss adjustment can be carried out by persons who have received basic training but are not necessarily agricultural specialists;
- Hail (and associated wind) is a clearly identified peril occurring with sudden onset and causing physical damage to crops;
- Hail is a localized (rather than spatially covariate) risk;
- Farmers generally cannot affect the extent of losses due to hail.

3.29. Other named-peril crop insurance products are sometimes offered, often as a supplement to a hail insurance policy. Examples are hail and spring frost on grapes; hail, wind, and frost on field crops; and hail and excess rain on tomatoes grown for processing. These supplemental perils are often more technically difficult for the insurer to underwrite than hail alone but are still considered feasible.

**Multiple-Peril Crop Insurance**

3.30. Multiple peril crop insurance was first developed in the United States by the government, and the United States and Canada remain the only countries where MPCI is widely adopted. The yield-based approach to loss measurement is attractive to farmers, and to financing institutions lending to farmers, because it captures all causes of yield variation. It provides a guarantee of an indemnity to the farmer if the actual realized yield is less than an agreed percentage of the average yield established for the farm. MPCI is an attractive product where the damage to crops is complex (for example, many perils interacting, such as rainfall and disease), and for drought, which develops gradually over a crop season.
3.31. Despite the advantages of MPCI, individual-farmer MPCI has proved highly problematical for insurers. Key difficulties associated with MPCI have been extensively documented and can be summarized as follows:

- Because it protects against multiple perils, the cost of risk for MPCI is higher than for named-peril insurance.
- MPCI tends to be highly susceptible to antiselection. A great deal of information is required to classify the risk exposure of potential policyholders. Generally, the insured farmer knows much more about his or her real risk exposure than the insurer does. Those who perceive that they have been misclassified to their benefit (that is, charged a premium rate that underestimates the true cost of the risk exposure) will tend to purchase insurance, while those who have been misclassified to their detriment will not.
- MPCI tends to be highly susceptible to moral hazard. It is practically impossible for the insurer to monitor the behavior of all policyholders. Thus, it is often difficult to know whether yield losses were the result of some unavoidable peril or just poor management.
- Loss adjustment is difficult and costly. Highly skilled loss adjusters must try to determine whether the yield loss was due to an insured peril and, if so, the magnitude of the loss.
- Delivery costs are quite high. The farmer must provide historical data on hectares planted and tons produced. The sales agent must be able to verify these data based on objective third-party sources.
- MPCI is data intensive, requires highly skilled underwriters, and involves monitoring of policyholder behavior. Thus, the administrative costs are quite high.
- Among the perils typically covered by MPCI are spatially covariate perils such as drought. This implies that loss ratios in any given year can be extremely high, so the insurer must have access to large amounts of contingent capital. Obtaining access to this contingent capital can be extremely expensive.

3.32. Considering each of these cost components makes it clear why providing MPCI is very expensive. In addition, the information, monitoring, loss adjustment, delivery, and administrative costs of MPCI generally do not vary much with the size of the policy. Thus, the cost of providing MPCI insurance to smallholders is even more expensive. International experience has shown that farmers (and especially smallholders) are unwilling to pay premiums that are sufficient to cover the insurer’s cost of providing MPCI. Thus, most MPCI programs have large premium and/or administrative subsidies paid by government.

3.33. It is important to note that currently in China most MPCI is being sold by insurance companies that service large state farms, such as the HRG and the XPCC. This is noteworthy because the state farms, through their highly developed local infrastructure support, effectively pay much of the costs associated with controlling antiselection and moral hazard, loss adjustment, delivery, and administration, and (in some cases) even provide access to contingent capital. In other words, the state farm implicitly subsidizes the insurer. In contrast, insurers who attempt to sell MPCI in areas outside of state farms must bear all of these costs. Thus, it is not surprising that PICC has been largely unsuccessful in its efforts to sell MPCI to farmers who are not part of state farms.
Index Insurance

3.34. Because index insurance indemnities are based on the realized value of the index rather than farm-level losses, the costs of providing index insurance are much less than the costs of providing MPCI. In general, index insurance (either area-yield-index insurance or weather-index insurance) has the following cost advantages relative to MPCI:21

- Since indemnities are based on the realized value of the index rather than farm-level losses, there is no need to classify individual policyholders according to their risk exposure. Further, there is little reason to believe that the farmer has any better information than the insurer regarding the risk of the underlying index (such as area yields, rainfall, or temperature). Thus, there is little potential for anti-selection;
- Since indemnities are not based on farm-level losses, the farmer cannot influence the likelihood or magnitude of an indemnity. Thus, there is no need to monitor for moral hazard.
- Since indemnities are not based on farm-level losses, there is no need for farm-level loss adjustment. This greatly reduces the cost of providing index insurance relative to the cost of providing MPCI. It also creates opportunities to insure crop or livestock enterprises that might otherwise be uninsurable.
- Although extension and farmer education remain essential for index products, the actual delivery cost is reduced relative to MPCI. The enrollment process is less complex, since there is no need to establish and verify an average farm-level yield. As a result, the product can be sold by less-skilled personnel.
- Although there are administrative costs associated with any insurance product, the simplicity of index insurance products greatly reduces administrative costs relative to those associated with MPCI.

3.35. Basis risk is the most important disadvantage of index insurance. Basis risk refers to variability in the relationship between the value of the index and losses experienced on the farm. With index insurance it is possible for the farmer to experience a loss and yet not receive an indemnity. It is also possible that the farmer may receive an indemnity and yet not experience a loss. These events are possible because the indemnity is based solely on the realized value of the index. If the index and farm-level yields are highly correlated, basis risk should be very small. If the index and farm-level yields are not highly correlated, basis risk may be quite high, suggesting that the index insurance may not be appropriate for that farm. Basis risk occurs due to spatial variation in weather variables (particularly where there are local microclimates) as well as differences in management practices, soil quality, or crop varieties. Careful insurance product design can reduce (but not eliminate) basis risk. In particular, it is important that the index reflect spatially correlated loss events such as drought or extreme temperatures. Index insurance should be designed to assure that farmers will receive some payments during the very worst years. Technical Annex 5 provides more detail about how to make index insurance operational and also how to mitigate the problem of basis risk. Localized perils such as hail or frost (which may also be affected by topography) are not well-suited to index insurance.

21 See Technical Annex 5 for a detailed discussion of index-based insurance.
3.36. The cost of capital for index insurance is likely higher than for named-peril insurance, because index insurance products, by design, protect against spatially covariate losses such as drought. However, it is likely less than for MPCI, because reinsurers recognize that index insurance products are much less susceptible to adverse selection and moral hazard than MPCI policies. Further, because index insurance is simpler and more transparent than MPCI, it is less costly for reinsurers to assess the risk that they are assuming when they reinsure index insurance policies. An insurer that is selling index insurance products can also reduce the cost of access to ready capital by diversifying across different index insurance products or index insurance products offered in different geographic regions (for example, different provinces).

3.37. In practice, it is often more feasible to develop weather-index insurance than area-yield-index insurance. This is because the meteorological bureaus in many countries have long time-series of accurate, consistent, and secure weather data for various weather stations across the country. It is far less common to find long time-series of accurate, consistent, and secure measures of area average yield. Both India and Mexico have introduced forms of weather-index insurance.

3.38. In any discussion of area-yield-index insurance, it is important to clarify a common point of confusion. With area-yield-index insurance, area-yield data are used both to establish the yield guarantee and to adjust losses. A common mistake in MPCI insurance programs is to use area average yields to establish the yield guarantee but then adjust losses based on farm-level yields. This practice is inherently flawed, since it effectively provides more (less) insurance protection to those whose expected yields are less (greater) than the area average yield. The result will be antiselection where those with the lowest (highest) expected yields will be most (least) inclined to purchase insurance. Some agricultural insurance programs in China are currently using this flawed method of establishing MPCI yield guarantees.

3.39. In conclusion, both named-peril crop insurance and index insurance are easier to develop and less costly to operate than is MPCI. The information, monitoring, loss-adjustment, delivery, and administrative costs of MPCI are very high—especially if the insurer is selling to smallholders. To cover these costs, insurers must charge premiums that often exceed amounts that farmers are willing and able to pay. Thus, it seems reasonable that any insurer wishing to enter the agricultural insurance market should first offer named-peril or index insurance products. There is a logical sequence of insurance products that should be introduced. Ideally, insurers would offer MPCI only after they have gained experience with named-peril or index insurance products and only after careful consideration of how they can minimize information, monitoring, loss-adjustment, delivery, and administrative costs.

Government Role in Developing Risk-Market Infrastructure

3.40. In many countries, governments do not consider that insurance markets can play a role in coping with exposure to weather risks. Instead, following an extreme weather event they tend to focus on the provision of government aid. The expectation of postdisaster government aid reduces the demand for agricultural insurance. It is therefore
important that governments focus on those areas in which their resources can be most efficiently utilized. Careful consideration of the various cost components has implications for the appropriate roles of government in facilitating the development of crop insurance. Far too often, governments have chosen direct premium subsidies as their primary role. Government efforts at providing the proper environment for risk markets can be more significant. Given the nature of the risk, governments can facilitate risk financing in a fashion that will “crowd in” more market development. Furthermore, there are some important public-good roles for government to play in data management, product development, and capacity building with an agricultural insurance industry. International experience has demonstrated that governments do not properly separate the social function from the market function for agricultural insurance, thus generating a program that is attractive neither for farmers nor for insurance companies.

**Legal and Regulatory Framework**

3.41. One of the most important functions for government in facilitating agricultural insurance markets is the establishment of an appropriate legal and regulatory framework. This requires not just the enactment of appropriate laws and regulations, but also encouraging and, where appropriate, putting in place the necessary legal and regulatory infrastructure.

3.42. There are two principal elements of the legal framework: The laws necessary to enable the proper regulation of insurance business; and the laws that govern the contractual relationship between the parties.

3.43. The laws that govern the contractual relationship between the parties may—and in civil-law countries such as China, will—be codified in legislation enacted by Parliament. Sometimes, as in China, one law covers both the contractual relationship between the parties and the regulation of insurance business. Although the law governing the contractual relationship may need to be adjusted to some extent for agricultural insurance, particularly with respect to index-based insurance, the principles generally applicable to insurance contracts should also apply to agricultural insurance.

3.44. International standards for the regulation of mainstream insurance business, as promulgated by the International Association of Insurance Supervisors (IAIS), are reasonably well developed. However, standards continue to evolve, and in some areas, such as the regulation of microinsurance, standards have not yet been developed. This is an important consideration, since agricultural insurance when sold to small farmers may well be classified as microinsurance.

3.45. Furthermore, agricultural insurance is a special class of insurance business that has characteristics that differ somewhat from other classes of general insurance, such as automobile or property-and-casualty insurance. Some of the well-established regulatory standards applicable to general insurance may not be fully appropriate to agricultural insurance. It is important that the Insurance Law and the regulatory system account for these differences. An example would be minimum capital requirements. As indicated earlier, MPCI and index insurance are highly exposed to spatially covariate losses. Thus,
for these products, regulators need to make sure that insurers have access to sufficient
capital to cover loss ratios that can be much higher than would be expected in other lines
of insurance.

3.46. Index insurance also creates some unique legal and regulatory challenges. Since
indemnities are not based on the actual loss incurred, index insurance differs considerably
from traditional insurance products. Thus, even when strong legal and regulatory systems
are in place, it is likely that modifications will be required to accommodate index
insurance contracts. This is discussed further in Technical Annex 4.

3.47. A number of countries have well-established agricultural insurance programs (for
example, the United States, Canada, Spain, India, and Mexico). However, these programs
are established under specific legislation that is not necessarily appropriate for a country,
such as China, that is considering the development of a general agricultural insurance law.
Reference has also been made in this report to Mongolia, which has established a
program to pilot-test index-based livestock insurance. For purposes of the pilot, the
regulatory challenges have been addressed through the design of the pilot program. Work
on developing an appropriate regulatory framework for the rollout of the program on a
national basis has not yet commenced.

3.48. In other country cases of agricultural insurance, the legislation is usually product
specific rather than of general application. For example, last year the Grand National
Assembly of Turkey enacted a new Law on Agricultural Insurance. However, despite the
broad title, the law is actually limited to the establishment and operation of an
agricultural insurance pool. Thus, although there is international experience and
precedent for developing a legal framework for specific types of agricultural insurance
programs, very little work has been completed on the development of regulatory
frameworks tailored to general agricultural insurance.

3.49. The government also has a role to play in the development of a court system that
enables the regulator to take legal action against insurers, if necessary, with respect to
regulatory breaches, and the parties, whether insurers or policyholders, to enforce their
rights under the contract. Particularly in countries where the insurance market is not well
understood, the principles of insurance law may not be well-understood by judges. If
erroneous judgments are made, this may also erode confidence, resulting in a reluctance
on the part of insurers to sell insurance and on the part of the public to purchase it.
Although applicable to all insurance products, there is a greater potential for such
judgments to do damage with respect to agricultural insurance, particularly given the
diversity of possible products, the differences between agricultural insurance and other
classes of insurance, and the fact that it is likely to be purchased by small farmers who
are unlikely to have a sophisticated knowledge of insurance products. An adequate
procedure for arbitration is also important at the local level, to allow smaller policyholder
disputes to be settled.
Enhancing Data and Information Systems

3.50. Data and information are critical to insurance provision. In particular, data are absolutely necessary for any quantitative assessment of the cost of the risk. To develop any crop insurance product, insurers require historical data on the types of crops produced in an area, the hectares planted for each crop, and the tons produced. To offer named-peril insurance products, insurers need region-specific data from which to develop a probability distribution of losses caused by the named peril. To offer weather-index insurance products, insurers need data (normally daily data) on various weather variables from a number of meteorological stations. They also need historical crop-yield data so they can determine which weather variables, measured over which time periods, are most closely correlated with crop-yield losses. To offer area-yield-index insurance, insurers need crop- and region-specific historical data on area average yields. MPCI requires historical farm-level yield data from which to establish average yields. As indicated earlier, the other data and information requirements needed to control adverse selection and moral hazard make MPCI the most data-intensive of the crop insurance products discussed here.

3.51. Much of the body of data required for crop insurance has public-good characteristics. Thus, it is unlikely to be collected, cleaned, and archived by private sector companies. Governments generally must provide data on hectares planted and production for various crops, yield losses due to natural disasters, and weather variables measured at various locations. Crop insurance companies in China currently make extensive use of National Bureau of Statistics data on hectares planted and production of various crops, as well as the data on hectares covered by, and affected by, various natural disasters. Further government investments in collecting, cleaning, and archiving relevant data, as well as making these data easily available to insurance companies, could further stimulate the development of crop insurance markets in China.

Education and Capacity Building

3.52. In the early stages of crop insurance market development, it is important that farmers be educated about crop insurance. If insurance is not commonly available in the countryside, general education about insurance and risk management will likely be necessary. As the market develops and various crop insurance products are offered, it is important that potential insurance purchasers fully understand the advantages and disadvantages of the different crop insurance products. Although insurers will provide some information as part of their sales efforts, farmers also need balanced information from an objective source. Thus, it is important that governments invest resources in educating farmers about the advantages and disadvantages of various insurance products. This is particularly true if index insurance policies are offered. Even though index insurance generally has lower premiums than MPCI, farmers need to understand that it is possible to experience a yield loss and yet receive no indemnity from an index insurance product.

3.53. When insurance companies begin offering new lines of insurance such as agricultural insurance, they often need capacity-building opportunities to develop expertise within the company. Even after the insurance products have become well–
established, there is a need for continuing education and training of insurance professionals. In some countries, these activities are conducted by industry associations (such as National Crop Insurance Services, NCIS, in the United States and International Association of Hail Insurers, IAHI, in Europe). Governments can facilitate capacity building by directly providing education and training opportunities or by encouraging industry associations to provide these opportunities. Regardless of who provides it, it is important that capacity building reflect internationally recognized best practices for providing agricultural insurance.

Research and Development

3.54. One of the challenges associated with private sector development of new insurance products is the ease with which the new products can be copied and replicated by others. This “free rider” problem prevents most companies from making the initial investment in new product development, especially in underdeveloped markets. Thus, some level of government support for product development may be justified. These investments should be targeted toward feasibility studies and pilot tests of new products, with the involvement of local private sector partners. Every attempt should be made to assure that the knowledge and technology for new product development will be passed on to the private sector insurance companies as soon as possible.

Catastrophe Risk Sharing

3.55. Both MPCI and index insurance are highly subject to spatially covariate risks such as drought or extreme temperatures. This implies that, in any given year, indemnities can be very high relative to premiums collected. Insurers must have access to large amounts of ready capital to pay these indemnities. Reinsurance is the most common means that insurers use to gain access to large amounts of capital.

3.56. Non-proportional reinsurance treaties make payments to insurers whenever loss ratios exceed some predetermined level. These reinsurance payments provide the capital that insurers need to pay indemnities to policyholders. Reinsurance is offered by large international firms that pool risks into a portfolio that contains different lines of insurance offered in different regions of the world. However, reinsurance can be expensive. Any reinsurer will want to know the details of how an agricultural insurance program is being implemented. Obtaining this information is often referred to as due diligence. Due diligence requires significant time and resources and is typically an investment undertaken by the reinsurer and by reinsurance brokers. The reinsurer will normally only make such an investment in anticipation of adequate future business volume. Any agricultural insurance development in China must address the need for large amounts of contingent capital due to the potential for very large loss ratios.

3.57. Because they are subject to spatially covariate risks, the cost of reinsurance is much higher for MPCI and index insurance than for named-peril insurance. For this reason, governments often provide subsidized reinsurance for MPCI policies. In the United States, the federal government provides a highly subsidized reinsurance contract for insurance companies that sell MPCI policies. In Spain, the consortium of insurance
companies is mainly reinsured by the public reinsurance company Consorcio de Compensacion de Seguro.

3.58. To date, the experience on weather-index insurance is limited. However, it is likely less costly to obtain private sector reinsurance on index insurance products than on MPCI. Some weather variables are less spatially covariate than MPCI losses. More important, however, is that compared to MPCI, index insurance products are simple, transparent, and less susceptible to adverse selection and moral hazard. This reduces the reinsurers cost of due diligence, allowing them to provide reinsurance on index insurance at more favorable terms than they can offer for reinsurance on MPCI.

**Public Subsidies**

3.59. In almost all MPCI insurance programs (including those in China) the government subsidizes the premium cost to farmers. By way of contrast, government premium subsidies have rarely been applied to named-peril insurance products such as hail insurance. This is because the costs of providing named-peril insurance are low enough that farmers can afford to pay the premium.

3.60. Premium subsidies make MPCI more affordable for farmers, but they do not address the underlying high costs of providing MPCI. MPCI is expensive because of adverse selection, moral hazard, and high loss-adjustment, delivery, administration, and reinsurance costs. Premium subsidies make MPCI more affordable for farmers, but for a fully scaled-up MPCI insurance program, the costs of these subsidies can be astounding. In 2006, the U.S. government paid $2.7 billion in crop insurance premium subsidies—and the crop sector in the United States is significantly smaller than in China. In addition to these premium subsidies, the United States also subsidizes the delivery and reinsurance costs for MPCI. But premium subsidies do not address any of the underlying problems with MPCI. For example, numerous studies have documented widespread adverse selection and moral hazard problems with the MPCI program in the United States. Premium subsidies simply mask these problems by making MPCI more affordable for farmers.

3.61. Premium subsidies can also create perverse behavioral incentives. Premium subsidies are typically calculated as a percentage of the unsubsidized premium (for example, a subsidy equal to 50 percent of the unsubsidized premium). But if proper risk classification is being done, farmers producing the most risky crops or producing in the highest risk areas should be charged the highest premiums. Thus, when the percentage premium subsidy is applied, the largest premium subsidies will be paid to the highest risk farmers. So the government is disproportionately subsidizing those who choose to produce the riskiest crops or produce in the riskiest areas. As a result, government premium subsidies can encourage farmers to produce a high-valued but risky crop in a region that is not well-suited to production of that crop. If there is no loss, the farmers benefit by earning higher returns. If there is a loss, the farmers are protected by highly subsidized insurance. Many experts now believe that in certain regions of the United States farmers choose to produce specific crops based largely on MPCI premium
3.62. If governments wish to provide crop insurance subsidies, it is likely far better to focus those subsidies on developing risk-market infrastructure, such as the items mentioned above. This may also include some level of subsidy for catastrophic-risk financing, as more fully developed below. Government investments in establishing an appropriate legal and regulatory framework reduce the cost of administering crop insurance programs. Government investments in providing data and information can reduce the cost of risk assessment, risk classification, and monitoring. Government investments in education and capacity building can reduce the cost of delivering crop insurance products, since better informed potential buyers of insurance are more likely to make the purchase. Government investments in research and product development can lead to new and improved insurance products, such as index insurance, which can be offered at lower cost.

3.63. Governments may also want to subsidize crop insurers’ access to contingent capital—particularly, for low-probability, high-consequence events. Evidence suggests that those at risk tend to ignore the probability of the most extreme and infrequent loss events. But insurers do not ignore these events and must consider the probability of such catastrophic losses in setting premiums. This creates a gap between what buyers are willing to pay and what sellers are willing to accept for protection against very infrequent but catastrophic losses.

3.64. Some provincial governments in China are implicitly subsidizing crop insurers’ access to contingent capital by recapitalizing the companies following excessive losses. The problem with this practice is that there is likely moral hazard in the relationship between the provincial government and the insurance company. The provincial government cannot effectively monitor the activities of the insurance company to make sure that the company is following best management practices. If central or provincial governments want to subsidize crop insurers’ access to contingent capital for extreme loss events, there are several ways that this can be structured without undermining incentives for insurance companies to use best management practices.

Box 3.2: Public Insurance

The government may have limited comparative advantage to reduce risk, compared to the private insurance industry. The risk-aggregation function, through the law of large numbers, performs well with a relatively small sample when individual risks are independent. In this context, the government’s size and scope is not required for the risk aggregation function to perform well.

Insurers control adverse selection by segregating the individual risks. Low insurance premiums are offered to low-risk producers, while higher premiums are charged to high-risk producers as a signal of their true risk exposure. The insurance industry thus plays a central role in discovering the true cost of risk. However, segregation is often viewed as socially unacceptable, because it does not meet some social and solidarity objectives. As a consequence, public insurance is likely to engage low efforts to control adverse selection through risk-pool segregation and to offer some average premium to all parties.
Under voluntary insurance, this absence of segregation leads to the death spiral of adverse selection. In this case, compulsory insurance may be viewed as a solution to adverse selection, because it forces low-risk producers to stay in the insurance pool. However, this is not a risk-reducing effect but a wealth-redistribution effect from the low-risk agents, who overpay their premiums, to the high-risk agents, who underpay their premiums.

The ex ante control of moral hazard is based on risk sharing through coinsurance and deductibles, and exclusions on insurance coverage. This limited coverage is usually inconsistent with the government’s willingness to offer farmers universal coverage against all sources of risk. As in the case of adverse selection, social objectives may prevent the government from efficiently controlling moral hazard problems.

However, the government can have a comparative advantage to absorb catastrophic losses that are beyond the financial capacity of the insurance industry, because it is able to spread these losses across generations and to implement the solidarity principle through an appropriate wealth-transfer mechanism.

Source: Authors.

Conclusion

3.65. International experience has demonstrated that the cost of providing MPCI is very high relative to named-peril insurance or index insurance. This is particularly true in countries such as China where a large proportion of farmers are smallholders. Among the primary guiding principles that can be gleaned from international experience is the compelling need to carefully consider the development process of agricultural insurance. Starting with named-peril or index insurance is quite logical, given the contrast in the cost of these products versus that of MPCI.

3.66. Given the implicit subsidies provided, it may be financially feasible for insurers to continue providing MPCI to state farms. However, the potential for offering MPCI outside of state farms, especially for smallholders, may be quite limited. Regardless, if MPCI is offered, it is important that certain best practices be followed. Among these best practices for MPCI are the following:

- Risk classification should be implemented. Ideally, risk classification would occur at the level of the policyholder. However, at the very least, it must reflect differences in risk for different crops (and varieties), different regions, different production practices (such as irrigated versus nonirrigated production), and different soil types. If all producers are offered coverage at the same premium rate, anti-selection will almost certainly develop.

- Premium rates should reflect farmers’ risk exposure.

- Appropriate deductibles and/or coinsurance should be applied to reduce the potential for moral hazard. In addition, insurers should implement monitoring procedures to make sure that policyholders are following best management practices.

- The yield guarantee should be established at the level that loss adjustment will be conducted. If the loss adjustment is at the level of the farm household, then the yield guarantee should also be established at that level. If the loss adjustment is at
a village level, then the yield guarantee should also be established at that level. A common mistake in MPCI programs is to use area average yields to establish the yield guarantee, but then adjust losses based on yields at the farm household level. This practice is inherently flawed since it effectively provides more (less) insurance protection to those whose expected yields are less (greater) than the area average yield.

- Regulators should ensure that insurers have access to sufficient amounts of ready capital. MPCI loss ratios can be much higher than those for other lines of insurance—especially when there is potential for spatially covariate losses caused by events such as drought or typhoon. Capital requirements should be based on a thorough risk assessment that determines loss ratio PMLs.

3.67. Even when these best practices are followed, the cost of delivering and loss-adjusting MPCI policies will likely be excessive for smallholder agriculture. There are several ways for the government to provide subsidies that reduce the costs of providing various types of crop insurance through the development of risk-market infrastructure. Among these are government investments in: (1) establishing an appropriate legal and regulatory framework; (2) providing data and information; (3) education and capacity building; (4) research and product development; and (5) providing contingent capital for infrequent but catastrophic loss events. However, direct premium subsidies for the existing MPCI products simply mask the high cost of providing MPCI, without addressing the underlying causes. Even more troublesome, they can generate incentives for farmers to actually take on more risk.
Chapter 4: Developing Agricultural Insurance: Options and Recommendations

4.1. The recommendations in this chapter are predicated on an assumption that the government of China wishes to devote some financial resources to expanding agricultural insurance services to the extent possible. Furthermore, the contention of this evaluation is that, given the great diversity of agriculture in China, it is suggested that agricultural insurance products be developed within the local context. This means that both the central and provincial governments will likely be involved in the further development of agricultural insurance in China. These recommendations are based on the agricultural insurance policy framework developed by World Bank (Gurenko and Mahul 2004, Mahul 2005) and adapted to the Chinese context.

4.2. China has a growing agricultural sector and a keen desire to seek policy options that will increase incomes for the many lower-income households involved in agriculture and other related economic activities. However, fundamental questions can be raised regarding the relative costs versus benefits of using agricultural insurance to achieve this goal. It is possible to give insights into the potential costs of supporting agricultural insurance, given the current trends in China. Chapter 3 describes the various cost components for providing agricultural insurance in the light of international experience. That presentation makes clear that it will be quite expensive to deliver MPCI to the many small-farm households that dominate Chinese agriculture. Chapter 2 documents the various pilot programs that are already developing MPCI programs in China. If increasing the incomes of rural households is the ultimate policy objective, then policy makers and analysts in China need to seriously consider whether agricultural insurance is the right tool to achieve this objective. There are likely other policy tools that are better suited to improving the incomes of rural households.

4.3. Premium subsidies are generally provided for MPCI. Although these subsidies are being provided on a limited basis and mostly by provincial governments, it is important to assess the potential cost of premium subsidies for a scaled-up MPCI program in China. It is possible to provide these estimates using the macro-risk model developed in Chapter 2. (See also Technical Annex 3.) Four items are needed to estimate the cost of premium subsidies for a scaled-up MPCI program: (1) the value of crop production in China; (2) the assumed percentage of the crop value that would be insured; (3) the rate of premium subsidy; and (4) countrywide average premium rates. In 2004, China produced crops valued at approximately RMB 1,780 billion ($222.5 billion)—or almost double the value of all crops produced in the United States. To develop an initial estimate, assume that 10 percent of the crop value, or RMB 178 billion ($22.2 billion), would be insured under the scaled-up MPCI program. If the premium subsidy is 50 percent and the average premium rate is 8 percent (from the risk assessment in Chapter 2), the cost of the premium subsidy would be more than RMB 7 billion ($875 million).

4.4. What if China were to adopt an MPCI program similar to that in the United States? In 2006, roughly 50 percent of the total crop value in the United States was
insured. The average premium rate was 9 percent, and the average premium subsidy was 59 percent. Applying these percentages to the RMB 1,780 billion crop value in China implies that the cost of the premium subsidy would be RMB 47 billion ($5.9 billion). The United States also has subsidies for delivery cost (about 22 percent of premium) and risk sharing (about 15 percent of premium). If China extended its program to include something similar, the additional subsidy cost would be RMB 30 billion ($3.8 billion) for a program that insured 50 percent of the value of crop production. It seems highly unlikely that China wants to spend RMB 77 billion ($9.6 billion) per year on crop insurance subsidies. These cost comparisons are also likely a low-end estimate, because the size of U.S. farms are much larger than those in China. This means that the delivery cost in China would be significantly higher. Of further concern, it is unlikely that an expanded MPCI program in China will be effective in protecting small farmers. Finally, it is also important to note that, thus far, the United States has very little livestock insurance. In contrast, some provinces in China are expanding sales of livestock insurance. Insuring livestock will further increase these cost estimates.

4.5. These estimates of subsidy costs are offered to help inform the policy dialogue in China. They also motivate the recommendations that are presented below. These recommendations are based on knowledge of the Chinese agricultural insurance market, knowledge of international experience and the various cost components of providing agricultural insurance, and the belief that the Chinese government wants to support diverse product development for agricultural insurance by putting limited government resources to the highest and best use.

4.6. It is recommended that, rather than adopting a single choice for risk financing, the government of China may wish to facilitate each of the choices in some fashion. At some level of aggregation, risk financing should be facilitated by pooling of agricultural insurance risks. However, as will be developed further, high transaction costs will likely impede any national pooling of agricultural insurance risks. The central government and the provincial governments play important roles in supporting the development of agricultural insurance.

4.7. A common problem with many agricultural insurance programs is the lack of clarity regarding the objectives of public intervention. This lack of clarity creates considerable inefficiencies. If the policy objective is to increase the incomes of rural households or to create a social safety net that assures some minimum level of income for farm households, agricultural insurance is a very blunt and inefficient instrument. Generally, these types of social policies involve direct transfers of wealth from the government to rural households. Insurance can be an effective risk-management tool, but it is generally not an effective tool for transferring wealth to economically disadvantaged rural households. Again, this is especially true for smallholders, due to the high cost of risk classification, monitoring, loss adjustment, delivery, and administration for agricultural insurance. Insurance should be market-based and oriented toward profitable businesses that can afford to pay actuarially sound premiums. For these farm businesses, agricultural insurance can provide protection against insurable natural perils.
Agricultural Risk Financing

4.8. Risk assessment is critical to understanding the PML and then ex ante risk financing to assure that adequate capital is organized to cover the worst-case scenario. The focus of this section is on how to finance the risk where losses exceed premium income and the ability of the agricultural insurer to borrow or use insurance reserves to finance these losses.

4.9. Figure 4.1 provides general guidance regarding who should pay for different levels of risk. This figure represents the estimates for the loss ratio for Shanxi province from the risk assessment in Technical Annex 3. The hypothetical insurance company should be in a good position to retain lower levels of loss via insurance premiums. Given this figure, the lower losses that are occurring about 35 percent of time will have loss ratios where losses are less than 75 percent of the premium. The agricultural insurer generally should organize credit or insurance reserves for the next layer of losses, where losses are 75—110 percent of premiums. Beyond 110 percent of premium, it is likely that reinsurance or other forms of risk transfer should be organized. Finally, for the most extreme losses (likely something less than 1-in-25 years and, in this case, about 200 percent of premium income), the government may serve as the reinsurer of last resort, paying for the most extreme and infrequent levels of catastrophic loss. Diversification of the sales of insurance across crops and regions, and increasing premium rates, are mechanisms that can be used to change the frequency of losses that exceed premium income.

Figure 4.1: Risk Layering

Source: Authors.

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22 Loss ratios referred to in this chapter in relation to layers of risk financing are intended to reflect typical “gross” premiums of insurance companies, which include an allowance for overhead and other costs (see Chapter 3). The data presented in Figure 4.1 reflect indicative pure loss ratios, that is, premiums prior to allowing for such costs.
4.10. Figure 4.2 illustrates the financing structure in a different format than that presented in figure 4.1.

**Figure 4.2: Financing the Different Layers of Risk**

<table>
<thead>
<tr>
<th>Loss Ratio</th>
<th>Financing Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>200% loss ratio and above</td>
<td>Government pays for losses</td>
</tr>
<tr>
<td>110–200% loss ratio</td>
<td>Reinsurance and/or other alternative risk transfer solutions pay losses</td>
</tr>
<tr>
<td>75–110% loss ratio</td>
<td>Credit and/or reserves pay losses</td>
</tr>
<tr>
<td>0–75% loss ratio</td>
<td>Premiums pay losses</td>
</tr>
</tbody>
</table>

*Source: Authors.*

4.11. Since losses over 110 percent of premium income should be infrequent for a well-developed and well-priced agricultural insurance portfolio, this is a common level for many reinsurers to offer stop-loss\(^{23}\) coverage. However, for many agricultural insurers in China, it seems that these types of losses are going to be relatively frequent until they can scale up their business and increase the premium rates that they are charging. Still, estimating these layers of loss is subject to large differences among insurance underwriters and global reinsurers. There is some level of ambiguity regarding the most extreme losses as well. Added to this ambiguity is the need for any global reinsurer to understand the nature of the insurance business prior to being willing to actually absorb significant amounts of these risks. This type of due diligence adds to the cost of reinsurance premiums as well. Thus, the cost of transferring the most infrequent and extreme events can be five- to ten-times the expected annual average loss for those events. Additionally, as has already been demonstrated in China, the agricultural insurers are less likely to purchase this type of insurance because of a common tendency to underestimate the exposure to catastrophic risks.

4.12. There are many alternatives for dealing with risk financing of the upper layers of losses. Generally, the choices fall into four categories (not mutually exclusive):

- Risk transfer via traditional reinsurance in the global markets;
- Risk transfer by government provision of reinsurance;
- Risk transfer via other mechanisms that will be referred to as macro-indexes;
- Agricultural insurance pooling.

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\(^{23}\) “Stop loss” coverage is the type of non-proportional (excess of loss) reinsurance normally used for protection of agricultural portfolios, in layers where the excess point and limit are defined in terms of the loss ratio.
Traditional Reinsurance

4.13. International reinsurers are demonstrating a keen interest in China. (See Technical Annex 6.) Nonetheless, this is a recent phenomenon, and it is too early to know how significant this activity may become in the future. It is a new experience for both Chinese agricultural insurance companies and global reinsurers. At this point, the reinsurers are likely testing the new markets that are emerging. Furthermore, the layer of risk that they are taking is not the extreme risk. These layers are often for 50 percent above 90 percent of premium income. (See Technical Annex 6.) In Figure 4.1, this would be for layers between 90 percent and 140 percent of the loss ratios appearing on the horizontal axis. The risk assessment presented in Chapter 2 suggests that across individual provinces the loss ratio PML values are considerably in excess of 140 percent of premium income. This seems to be true for almost any localized agricultural insurance company operating in China. It also appears likely that a major reason that some agricultural insurers are not purchasing reinsurance for extreme layers is an explicit or implicit understanding that the central provincial government will recapitalize the insurer in the event of large losses.

4.14. International reinsurers will bring the discipline needed to the emerging market for agricultural insurance in China. These reinsurers also have much international experience that could be useful for agricultural insurers in China. These are important contributions. However, there are concerns. International reinsurers will provide significant amounts of reinsurance only if China’s agricultural insurance products are transparent and reflect internationally recognized best practices. Furthermore, reinsurers will want to see that China’s legal and regulatory systems are adequate to facilitate agricultural insurance markets. Finally, international reinsurance markets tend to be cyclical. If reinsurers experience large losses in a particular market (for example, agricultural insurance in China) they generally respond by reducing the amount of reinsurance they are willing to offer in that market and/or significantly increasing reinsurance premiums.

Other Forms of Risk Transfer

4.15. Innovative alternative risk-transfer products have been developed recently by capital markets. These include macroindex insurance, catastrophe bonds, catastrophe options, and contingent debt. Global reinsurers are experimenting with some of these instruments. Given the experimental nature of these alternatives, they should not be considered as a core element of any plan for agricultural insurance in China. However, they have some potential and could be considered on an experimental basis for agricultural insurance in China.

4.16. Although many of these risk transfer instruments may best be left to the market, it may also be useful for the central government to facilitate agricultural insurance by selling macroindex reinsurance products to agricultural insurance companies. For example, the government could sell a province- or subprovince-level area-yield reinsurance based on National Bureau of Statistics crop-yield estimates for individual crops. The central government would be selling these macroinsurance products and pooling the risk at a national level. The advantage of this approach, in comparison to a government-provided stop-loss, is that the central government would not need to perform
any due diligence on each of the insurance companies. The central government could simply put these instruments up for sale, and the insurance companies would have to sort out how to use them to transfer their catastrophic risk. Another advantage of having the central government sell such macroindex reinsurance is that the central government would be pooling the risk at a national level. The diversification benefits of such pooling could reduce the premiums charged to agricultural insurers for the index reinsurance. If interest in index reinsurance develops, the government may consider offering the reinsurance only for extreme thresholds and allow global reinsurers to offer index reinsurance for thresholds closer to expected values.

4.17. For these types of macroindex instruments to provide effective reinsurance protection, the agricultural insurance companies would need to understand the nature of their risk exposure and, in particular, what events are likely to create extreme insurance losses. The appropriate index might be based on a weather event such as cumulative rainfall over a period or an area yield. It might also be based on the cause-of-loss data at the province or subprovince level. Agricultural insurers would need to determine exactly which index is most closely correlated with their insurance losses. Even, if insurance companies do not purchase index reinsurance, it would likely be insightful for them to determine which indexes would provide the best reinsurance protection. This type of risk assessment would allow them to better understand what events are likely to cause extreme insurance losses. In short, simply considering macroindex reinsurance alternatives would likely enhance the knowledge of various stakeholders. Thus, there is an inherent value to simply allowing the market to develop these products, even if there are no purchases in the short term. The other advantage in having some central-government entity working to develop and offer macroindex insurance instruments in the market is that these types of indexes could be used for other purposes beyond risk transfer for agricultural insurance companies. For example, in some cases they could be used by provincial and local governments for ex ante contingent financing of government costs associated with extreme catastrophic weather events. There is some precedent for such an approach with the fondos of Mexico. (See Technical Annex 1.)

4.18. The macroindex instruments can be based on a wide range of indexes. Among these are indexes based on satellite images, as have been used to provide reinsurance for pasture and rangeland in both Canada (province of Alberta) and Spain (see Technical Annex 1). Generally, the amount of risk transferred with these innovative instruments must be large enough for the premium income to be sufficient to cover the fixed cost of developing the instrument. Thus, the use of these alternatives in the near future is probably limited.

**Government Provision of Reinsurance**

4.19. An alternative to direct premium subsidies is for the government to play a more direct role in risk financing. This type of activity is now occurring, and in some cases there is a significant structure to the activity. (See Technical Annex 6.) For example, in Zhejiang and Hainan, government reinsurance is offered on a coinsurance basis for losses in excess of 200 percent up to 500 percent loss ratio, and then the local government assumes 100 percent liability for catastrophe losses above a 500 percent loss ratio. It is
not recommended to depend solely on the provincial government to finance catastrophe losses. Given the value of risk pooling across provinces, the central government or some central business entity could potentially perform these services more efficiently. Of course, the government must proceed carefully in how it chooses to do this.

4.20. A structured, government-provided, stop-loss reinsurance would be superior to ad hoc recapitalization of insurance companies following large losses. The current limited use of commercial reinsurance by agricultural insurers in China may be partially due to an expectation that the province insurance company will be recapitalized by the either the provincial or the central government, should large losses occur. For agricultural insurers, uncertainty regarding government recapitalization is not desirable. Such uncertainty can result in serious mistakes and potential failure to have proper financing organized. More structure and transparency is recommended. This would help facilitate more development of agricultural insurance as well as assure that needed capital is actually available for even the most extreme losses. There have also been previous instances where farmers had to be paid on a pro rata basis when extreme losses occurred and the insurer could not pay the full indemnity due to inadequate access to capital. Such experiences will undermine farmer confidence in agricultural insurance.

4.21. Another advantage to having government assume a clear role in offering stop-loss reinsurance for agricultural insurance companies is that global reinsurers would be in a better position to know precisely how much reinsurance they should provide. This could result in an increase in their role of providing protection against extreme losses. Nonetheless, there is a delicate balance between what the government can do for risk financing and how much these actions may crowd out the global reinsurance market. Once again, an objective should be to use the government so as to expand agricultural insurance while crowding in the global reinsurance market.

4.22. Either the central or provincial government could offer stop-loss reinsurance for agricultural insurance companies. It is also possible that both levels of government could be involved. For example, the central government could offer a proportional stop-loss for losses beyond 200 percent of gross insurance premium. If the proportion were 50 percent, then it would be up to provincial or local governments to determine whether they were going to offer the other 50 percent or require the insurance companies to seek global reinsurance for this catastrophic risk. In either case, there would be clarity, and such actions would send a clear message that this is the extent of government support for agricultural insurance—the government is not going to recapitalize insurance companies that fail to obtain adequate access to contingent capital. These structures would also more clearly guarantee that policyholders would receive the full indemnity due, even following extreme loss events.

4.23. The central government could offer the stop-loss reinsurance either at no cost to the insurance companies or with some insurance premium-rating principles applied. Focusing on the extreme risk levels does give better incentives for insurance companies to design appropriate products and perform the needed underwriting to control moral hazard and adverse selection. However, fixing the stop loss at the same levels for every region would generate larger government transfers for higher-risk regions than for lower-risk regions if the stop-loss reinsurance were offered at no cost. One of the aggregate
analyses that are performed assumes that the central government provides stop-loss reinsurance for each province at 150 percent (Technical Annex 3). This means that all indemnities greater than 150 percent of premium collected would be paid by the government. If 10 percent of the crop value were insured, the estimated annual cost for this type of stop-loss reinsurance would be around RMB 550 million ($68.8 million). However, in the event of extreme losses, the cost could exceed RMB 3 billion ($375 million). The value of the stop-loss reinsurance would vary across provinces from just under 1 percent of the total premium for the lowest-risk province to more than 20 percent for the highest-risk province. This occurs because the loss ratio PMLs are quite different across the various provinces (Technical Annex 3). Some careful consideration of classifying the risk and thresholds for a government-provided stop loss is needed. For example, a target that the threshold should not trigger more often than 1 in 25 years may be reasonable.

4.24. The most direct way to deal with the differential benefits of the stop-loss reinsurance would be for the central government to charge the insurance companies a reinsurance premium based on findings from a risk assessment of each insurance company. The central government would effectively be creating a national risk pool. Furthermore, the central government should be able to charge a lower premium than an international reinsurer for this layer of risk. Alternatively, if the stop-loss reinsurance is provided at no premium cost, the level of the stop loss could be varied in an attempt to equalize the benefits across insurance companies. Those operating in lower-risk provinces would receive reinsurance with a lower stop loss, while those operating in higher-risk provinces would receive reinsurance with a higher stop loss. Regardless, the government-provided stop loss would be a direct benefit to the agricultural insurance companies, because it will limit their maximum loss exposure and reduce the amount of commercial reinsurance that the companies need to purchase. This should, in turn, reduce the premium that agricultural insurance companies would need to charge farm households.

**Insurance Pooling**

4.25. The value of scaling up agricultural insurance was demonstrated in Chapter 2 by showing how much the PML might decline as an insurance company creates a larger insurance business within the same province and across multiple provinces. If this cannot be done by a single insurance company, it may be possible to create a pool of insurance companies that would have the same effect of lowering the aggregate PML. This would allow the pool of insurance companies to retain part of the agricultural risk within the country. An insurance pool could both improve the risk profile of the participating companies and serve as a vehicle for further collaboration on technical assistance and capacity building. The pool could approach the global reinsurance market with a greater volume of business and obtain reinsurance on the aggregate results after pooling.

4.26. Agricultural insurance pools could insulate this line of business, thus protecting the other lines of business against agricultural catastrophic losses. This “ring fencing” is particularly important, since the non-life insurance market in China is under development and its growth should not be jeopardized by excessive agricultural losses.
4.27. The problem with creating a pool is that each insurance company must fully trust the business practices of all participating members. This would require that each company perform due diligence on the other companies. Reinsurers are likely in a much stronger position to perform this activity on a company-by-company basis. The same effect can more easily be achieved by having the central government provide stop-loss reinsurance at the most catastrophic levels. A pooling arrangement would be unlikely to emerge with MPCI, given all of the management challenges of making sure that MPCI is implemented in a proper fashion for each participating insurance company. However, a national or regional pool among participating insurance companies in China may be more practical for select index insurance products, since they are less prone to the dual problems of adverse selection and moral hazard.

4.28. CIRC has been promoting coinsurance pools in several provinces, including Zhejiang (since 2006) and Hainan (planned for 2007). Under these programs, the provincial governments provide reinsurance protection against catastrophic losses. PICC and CUPIC are already providing insurance in several provinces, and benefiting from pooling of risks.

Agricultural Risk Financing Options for China

4.29. It is recommended that the central government experiment with a number of the approaches outlined above. It must be strongly emphasized that a combination of approaches will serve the goal of supporting agricultural insurance better than any single approach. One clear role for the central government is to continue to assure that the legal and regulatory environment is in good order to encourage global reinsurers to enter into risk-financing arrangements with Chinese agricultural insurance companies.

4.30. There are many variations that can be presented for blending the approaches to risk financing. While it is premature to recommend any particular blending of the approaches, the following options could be considered:

- Central government could offer free stop-loss reinsurance at a 50 percent proportion above certain extreme levels. The stop-loss levels would be different, based on the relative risk of the province, and the reinsurance would be offered free. This would be the central government’s subsidy contribution to agricultural insurance.
- Central government offers a fully priced stop loss for the other 50 percent proportional value or leaves it to the provincial or local government to facilitate reinsurance protection for the remaining 50 percent. In other words, the decision to provide more subsidies by paying for the other 50 percent of the stop-loss layer offered by the central government would be left to the provincial governments.
- Central government could also offer macro-index reinsurance products to fill the gap that is left by the base stop loss. These macro-index reinsurance products should have better pricing than traditional reinsurance, and they could be purchased for other layers of risk as well.
- Global reinsurers would continue to fill in the gaps with reinsurance at the lower levels of stop loss.
4.31. This type of structure would modify what was presented in Figure 4.2 to what is presented in Figure 4.3. In this example, the stop loss for the central government would begin at 200 percent of the losses above gross premium income. For 50 percent of these losses, the central government would provide the reinsurance for free as their contribution for subsidy. For the other 50 percent of these losses, the central government would either sell the stop-loss reinsurance to the agricultural insurance company or to the provincial government, which would then offer that portion of the stop loss for free to the insurance company. This could be the subsidy level for the provincial insurance company. These types of subsidies would be less distorting than a flat premium subsidy, since the insurance company would have to pay more attention to the product designs and underwriting risks, given that they would depend on a global reinsurer to provide reinsurance for the layer of risk below the central government stop-loss threshold.

Figure 4.3: One Model for Joint Sharing of Catastrophic Financing*

<table>
<thead>
<tr>
<th>Loss Ratio</th>
<th>Central Government Action</th>
<th>Central Government Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>200% loss ratio and above</td>
<td>Central government pays for 50% of catastrophic losses</td>
<td>Central government sells reinsurance on the other 50% of catastrophic losses to either the insurance companies or the provincial government if they wish to add subsidies</td>
</tr>
<tr>
<td>110-200% loss ratio</td>
<td>Reinsurance and/or other alternative risk transfer solutions pay losses</td>
<td></td>
</tr>
<tr>
<td>75-110% loss ratio</td>
<td>Credit and/or reserves pay losses</td>
<td></td>
</tr>
<tr>
<td>0-75% loss ratio</td>
<td>Premiums pay losses</td>
<td></td>
</tr>
</tbody>
</table>

*Cost shared between the central government and either the provincial insurance company or the provincial government.

Source: Authors.

4.32. This type of structure would facilitate many of the recommendations discussed in this report. First, this structure clearly facilitates a role for the central government to pool and price extreme risk while leaving product development to the agricultural insurance companies. Second, the central government or some national market entity would be offering either some extreme reinsurance or macroindex reinsurance products for sale, and this activity would serve as the mechanism for pooling risk at lower transaction costs than many other pooling alternatives. Third, provinces and local government can both facilitate more subsidies to the local insurance companies and finance these offerings by purchasing the macroindex insurance or the stop loss from the central government. Finally, as long as the stop-loss offerings are at relatively high levels, these activities should leave plenty of room for global reinsurers to enter the market and provide reinsurance protection for lower stop-loss levels.
Product Development

4.33. The crop insurance products currently offered in China include MPCI and named-peril crop insurance (traditional products). There is at present strong interest in index insurance in China.

4.34. The selection of a suitable product for any given circumstance depends on multiple factors: the nature and complexity of the risk(s) to be insured; the costs of risk classification and monitoring; the costs of loss adjustment and delivery (related to farm size); the technology level of farmers; the potential for linkages in product distribution and marketing; skills and training required by the insurer and distributor to support the product; and many other surrounding factors.

4.35. No single product solution will meet China’s needs, due to the very wide range of climatic and farming conditions that exist throughout China. A variety of appropriate crop insurance products is required in each province. Further, no “retail” insurance product exists at present to insure certain complex risks, such as flood or typhoon. There is a need to segment those risks for which catastrophe disaster management, outside the scope of insurance, is needed, and those risks which can be taken on by the insurance sector. Within this framework, the government may want to assist the insurance sector in the areas of product development and capacity building. Specifically, the roles of crop insurance products in China are the following.

4.36. **MPCI insurance** is a viable option only for those areas where it is currently in use, which are restricted to the HRG, XPCC, or other similar circumstances. These are special situations, because, through their highly developed local infrastructure support, these state farms effectively pay much of the costs associated with controlling antiselection and moral hazard, and loss-adjustment, delivery, and administration costs. In some cases, state farms even provide insurers with access to contingent capital. In contrast, the experience of the PICC indicates that, absent such implicit subsidies, MPCI is likely not viable, especially for smallholders. This is consistent with international experience, which has shown that MPCI cannot be successful unless heavily subsidized. MPCI is unlikely to be a viable insurance product for most farming areas in China.

4.37. **Named-peril crop insurance** employs simplified systems of loss adjustment, involving measurement of percentage damage, soon after the loss has occurred. Objective procedures can be developed that allow loss adjustment to be carried out by competent persons who do not always need to be agronomists. Named-peril crop insurance holds a very important place in China’s future product mix, to address sudden-onset hazards, such as hail and frost. The main advantage of named-peril crop insurance is that it can address those hazards, particularly hail but also frost and excess rain, which may be localized in occurrence, and which would carry a high basis risk from a weather index product. However, traditional named-peril crop insurance is not well-suited to insuring against drought.

4.38. **Weather-index insurance** offers some promise as a micro-level (individual farmer) product, but only for selected hazards. The product suffers from a very important drawback of basis risk, which limits the scope of its application. Weather-index insurance
will not be effective if crop losses are localized or not clearly correlated with a specific weather variable. Also, it is difficult to construct effective weather-index insurance if losses occur due to complex interactions between multiple weather variables. For these reasons, it is recommended that the primary focus of micro-level index insurance development in China should be for drought in rainfed crops. Further, China can build on international efforts to develop agricultural index insurance. These efforts have focused primarily on rainfall-deficit-index insurance. Although this drought product is not applicable to irrigated agriculture, there remain many areas of rainfed production throughout China where drought is a significant peril. A second focus of weather-index product development could be for specific crop types and specific time windows during the growth cycles of vulnerable crops, including prolonged cold conditions in crops such as cotton. Weather-index insurance has many of the same cost advantages as named-peril crop insurance, and is a highly flexible product. Where weather-index insurance is feasible and basis risk is acceptably low, it should be encouraged, because it can allow faster scaling up, due to its well documented simplicity of marketing and loss adjustment. It is important to note that, in spite of the interest in this product, index insurance has only targeted applications and does not provide a panacea to all crop insurance needs in China.

4.39. **Area-yield-index insurance** is a product most suited to those crop and hazard combinations where a peril, or series of more complex perils, simultaneously affects a crop in a particular region. These conditions are most likely to be found in de-scale and uniform crop production systems, such as in rice production and in field-scale crops such as cereals and oilseeds, or cotton. The product allows all perils to be insured. However, the availability of quality historical yield statistics is a prerequisite to area-yield-index insurance, and this is a constraint in China. Data on a local scale would require careful assessment on a case-by-case basis, to determine the integrity of the data and lack of prior biases.

4.40. Internationally, it should be noted that index insurance is a new concept and still highly developmental. Global crop insurance premium is estimated at approximately $6.5 billion, and weather-index insurance or area-yield insurance forms only a negligible proportion of this total.

4.41. The following priorities are suggested as a framework for crop insurance product development:

- A mix of existing crop insurance products and index products is needed to allow the expansion of crop insurance;
- Great care should be taken in considering expansion of MPCI products beyond the special situations where they are currently in place;
- Named-peril crop insurance should be an important priority product, particularly for hail insurance and other sudden-onset hazards such as frost and excess rain;
- Index insurance should be prioritized to address drought in rainfed crops, and as a second priority can be developed for specific weather exposures. It has only a limited range of applications but, because of its advantages, it should be developed wherever its main constraint of basis risk can be overcome. Although Chinese companies have been successful in accessing reinsurance to date, index products are expected to open up further access to capacity in the future.
4.41. Considerable gaps remain in finding solutions to China’s need for crop insurance products at the micro level (for sale to individual farmers). These gaps are mainly associated with flood and typhoon exposure. Further research into future insurance products for flood could be foreseen. This would require the categorization of China’s flood exposure both by province and catchment basin, and by flood type (inundation, flash flood, typhoon-originated flood, coastal flood), working with existing specialists in hydrological institutions. Research is in progress internationally to find possible solutions to allow risk transfer from major flood risks. In the case of typhoons, very large differences are found in damage due to variable wind, flood, and waterlogging associated with typhoons. Thus, basis risk would be quite high for a micro-level typhoon index-insurance product. Although typhoons are being indexed at a macro scale, and derivatives developed to address other areas of property insurance, this does not provide a product to address localized damage caused by typhoon. Further research, building on international initiatives, can also be foreseen for China to participate in finding typhoon products adapted to agriculture.

4.42. In common with most countries, the uptake of livestock insurance is very low in China. Currently, agricultural insurance companies are offering two very contrasting individual-animal products. PICC and SAIC are offering basic animal accident-and-mortality cover against natural perils. Conversely, in Shanghai Municipality, the cattle, pig, and poultry sectors are insured on a mandatory basis against epidemic disease and government slaughter order, and the insurer operates compensation on behalf of the municipal government authorities. CUPIC is also offering comprehensive livestock insurance, including epidemic disease and government slaughter order.

4.43. Substantial scaling up of the existing individual-animal insurance product is unlikely to be attractive to either clients or insurers. A fundamental difficulty exists in insuring farmers who have only a small number of livestock per household, and where mortality is highly dependent on the management of the livestock by the individual farmer. Further, it becomes very difficult to structure such a product to differentiate between routine mortality, for which insurance is not appropriate, and catastrophe cover. In short, the costs of providing individual-animal insurance are likely to be excessive.

4.44. For livestock farms with large-scale production units (notably pigs and poultry, but also dairy cattle and herders), the option of herd-based deductibles for mortality insurance should be explored further. The introduction of a herd-based deductible (expressed either in terms of a number of head of animals per event, or as a percentage of herd total sum insured per event) at a level which is designed to eliminate normal frictional losses (that is, small claims) can allow insurers to offer much lower premium rates and to convert the product into a catastrophe-only insurance.

4.45. It should be noted that internationally livestock epidemic-disease insurance in the private sector is very restricted, which reflects the difficulty of managing this risk and associated catastrophe exposure. Commercial insurers and reinsurers are reluctant to consider such risks without clear understanding of the likely financial exposures from disease outbreak. Further, government slaughter order is specifically excluded in almost all international livestock insurance and reinsurance programs. Decisions surrounding
government slaughter order to control the spread of epidemic disease are complex: governments rely on animal health departments to advise whether culling (slaughter order) is the most effective measure to control further outbreak and spread of the disease, or whether compulsory vaccination of all animals in the neighboring areas to the outbreak would be more effective. Here, experience has shown that the livestock industry is often resistant to vaccination, since it automatically leads to a ban on the export of meat and livestock products, and they prefer compulsory slaughter, especially where compensation levels for culled animals are high. In view of the conflicting interests, livestock underwriters are naturally reluctant to assume open-ended liability for government slaughter order.

Operational and Technical Assistance

4.46. The future development of agricultural insurance in China will likely be strongly decentralized, building on the strengths of the provincial insurers. Furthermore, there are strong provincial organizations, specializing in agronomy, animal husbandry, meteorology, hydrology, and statistics, which are well-placed to service the technical requirements of the agricultural insurers. In each province, there is a strong base to develop risk-management solutions and insurance products that are adapted to local needs. However, there is a common need in all provinces for wider access to technical and operational assistance, to support capacity development within the agricultural insurance companies. In particular, there is a common demand for access to international experience in agricultural insurance to allow knowledge transfers regarding best practices. This would, no doubt, facilitate the development of agricultural insurance solutions for China.

4.47. A central service, a technical support unit (TSU), should be established in China to provide specialist services to agricultural insurance companies. This unit should have support from the central government and linkages to the provincial governments, insurers, and reinsurers. It would have the following objectives:

- To create a center of expertise within China, able to support rapid development and scaling up of agricultural insurance in each province and nationally.
- To establish a core staff, able to provide technical support to agricultural insurers, principally in the specific areas of product identification, product design, and product pricing, and in modeling catastrophe risk exposures for risk-financing and rate-making purposes.
- To create a centralized data base for China—of agricultural crop, livestock, forestry, and aquaculture production and yield statistics, production damage loss data and animal mortality statistics, and meteorological data—with the purpose of making this data available to agricultural insurance practitioners to assist them in the design and rating of new products and policies.
- To create linkages, centrally and for the provinces, to international agricultural insurance organizations and associations, in order to promote exchange of

24 The debate over culling or vaccination was a major political issue in the 2001 foot and mouth disease (FMD) outbreak in the United Kingdom, and farmers successfully lobbied against vaccination. There is also evidence that some farmers deliberately infected their herd with FMD to obtain the above-average-market-price compensation paid by the government for culling.
expertise through sharing of information and written materials, and through exchange of technical staff.

- To establish training courses, course materials, and operational manuals.

4.48. External support for the TSU would come from both (1) international agricultural insurance organizations and associations, and (2) specialist consultants. In view of the shortage of consultants specializing in international agricultural insurance, the linkages with international agricultural insurers and associations may provide the best method to facilitate the exchange of operational technical experience, and may provide staff capable of supporting training courses.

4.49. The intended use of the TSU would be primarily to promote technical support services, rather than policy framework or reinsurance needs of agricultural insurers. Reinsurance relationships are developing in the private market, which is a strong benefit for agricultural insurers. Although reinsurers may be willing to provide some specific advice on subjects such as pricing and product design, most reinsurers are not set up to provide the comprehensive technical support needed in China. Commercial relationships with reinsurers would therefore be bilateral with agricultural insurers, but the TSU would also promote contact with those reinsurers willing and able to support the common objectives for the industry provided by the TSU. Reinsurers would be invited to contribute to training courses and to facilitate contact with international agricultural insurers with whom they have existing relationships.

4.50. Although the proposed focus of the TSU, noted above, is product identification, product design, and product pricing, the TSU would also be concerned with operational support, especially in the design of field-level loss-adjustment procedures, and in advising on distribution linkages. These latter functions are integral to product identification and design in planning the feasibility of any agricultural insurance program.

4.51. The TSU should establish a central database of information relevant to its activities. The database would include insurance statistics; official government statistics on crop, livestock, forestry, and aquaculture production, production risk, and losses; and meteorological data. It would also establish a library of reference materials to support its activities.

4.52. The TSU could be housed in an insurance environment. Options could be within the Insurance Association of China. The TSU should be free from any commercial interests, and able to serve any client company. Housing the TSU in an existing organization would allow the sharing of overhead services and reduce the need for separate infrastructure and cost.

4.53. A manager would be appointed to spearhead the development of the TSU. This is a key position, since the initial development of an effective TSU will be dependent on the skills of this person. The manager would report to a small board, to provide direction. He

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25 The specialist international agricultural reinsurance brokers, including Aon, Guy Carpenter, Benfield, and Willis, are best placed to assist Chinese insurers in the design and placing of structured reinsurance solutions.
or she would be responsible for establishing linkages with the provincial insurers, reinsurers, consultants, and international organizations, including agricultural insurers. Staffing (in terms of number of persons and requisite skills) for the TSU would need to be determined following consultation with CIRC and interested parties. However, it is anticipated that such a TSU could consist of approximately five specialists, reporting to the manager: a crop product design specialist; a livestock product design specialist; a pricing and risk modeling specialist; a training and extension specialist; and a data management specialist.

4.54. International technical assistance would be necessary, especially during the implementation phase of the TSU. The existence of the TSU should not preclude any provincial insurer’s establishing its own relationships, bilaterally, with either agricultural insurance organizations, or consultants. The market in China will best expand if private sector activity is permitted to proliferate. However, there should be a strong interest among all parties to acknowledge the need, and the benefits, of a centralized TSU.

4.55. Financing of the TSU could be through the central government for core overheads. The budget for specific services could be through charging client provincial insurance companies, which would be free to make appropriate budget arrangements with provincial authorities to co-finance. Further, the TSU could seek international support from the World Bank, or other donors, for start-up assistance.

**Legal and Regulatory Framework**

4.56. China currently has an Insurance Law that serves the dual purposes of governing the contractual relationship between the parties to an insurance contract and providing a framework for the regulation and supervision of insurance business and insurance intermediaries by CIRC. The Insurance Law, enacted in 1995, is supplemented by a large number of insurance regulations that have been issued by CIRC. These regulations establish more detailed regulatory requirements for insurers and insurance intermediaries.26

**Scope and Extent of Proposed Agricultural Insurance Law**

4.57. The 1995 Insurance Law is being reviewed, and it is likely that this review will result in a significant revision of the Law. However, it is understood that agricultural insurance is not included in the revision exercise. This is perhaps because Article 149 of the Insurance Law states that agricultural insurance shall be provided for separately by other laws and administrative regulations, and it is understood from CIRC that it is anticipated that the revised Insurance Law will continue to contain this provision.

4.58. It is also understood that, as part of its commitment to the development of agricultural insurance, the government of China will be considering the development of

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26 It is beyond the scope of this project to undertake a full review of the Insurance Law and all of the regulations that have been promulgated by CIRC; and no regulations were provided, although some are available in English translation on the CIRC Web site. However, some detailed observations and comments on the Insurance Law are contained in Technical Annex 4.
an appropriate legal and regulatory framework. This may include the development of a new Agricultural Insurance Law and Regulations as envisaged by the new Insurance Law.\(^\text{27}\)

4.59. An agricultural insurance law is often enacted for one or more specific purposes, such as to provide for subsidies, to establish an insurance pool, or to establish a specific program such as the U.S. Group Risk Plan. It is usual for insurers who are subject to these specific agricultural insurance laws to also remain subject to the general insurance law. This may well be the intention of the China government. However, the wording of Article 149 of the Insurance Law of 1995 appears, in translation, to envisage a wholly separate Agricultural Insurance Law that will apply to agricultural insurance in the place of the Insurance Law, rather than as a supplement to it, and this also seems to be the perception of some insurers. There is, therefore, at the very least, confusion as to the meaning of Article 149.

4.60. Although there are some differences between agricultural insurance and other forms of general insurance, the principles governing the regulation and supervision of general insurance, and insurance contracts, are largely applicable to agricultural insurance. Given the considerable overlap, there is a strong argument for clarifying that the Insurance Law is applicable to agricultural insurance, but enabling different provisions to be made for agricultural insurance, where appropriate, through regulations made under the Insurance Law or, if considered necessary, through the proposed agricultural insurance law. Given that this would require some amendment to the Insurance Law, and in particular Article 149, it is recommended that the overarching objectives of the proposed agricultural insurance law should be considered as part of, or concurrent with, the more general review of the Insurance Law now taking place.

4.61. There are no clear international precedents for a general agricultural insurance law. Therefore, if the central government decides that such a law is necessary or desirable, it would be important to tailor that law to the policy goals of the Chinese government. It would likely be unwise to turn to any other country for model agricultural insurance legislation, because such legislation simply does not exist.

**Policy Objectives**

4.62. Where there is a need for legislation, governments are often tempted to treat the development of policy and the development of legislation as part of the same process. This approach is not recommended with respect to agricultural insurance. The purpose of legislation is to give effect to and implement policy. It may be premature to commence drafting legislation until policy has been determined. A significant number of policy options have been presented in this report. The government should therefore consider whether it is ready to develop agricultural insurance legislation at this stage. If the Insurance Law were to be amended to enable regulations to make specific provision for agricultural insurance where necessary, there would not be an urgent need for specific agricultural insurance legislation, which would provide time for the policy issues to be thoroughly explored and investigated before the drafting process commences.

\(^{27}\) No information concerning the intended scope of the proposed new agricultural insurance law has been provided.
**Framework and Legislation**

4.63. Governments are often inclined to prepare detailed legislation in an attempt to provide for all circumstances and contingencies. However, detailed legislation quickly becomes out of date and needs to be brought back to Parliament for amendment as circumstances change. As discussed in Technical Annex 4, the current Insurance Law contains a number of detailed provisions that are no longer appropriate. In most countries, it is a difficult and time-consuming process to amend primary legislation. Parliamentary time has to be allocated, often long in advance, and with competing demands for that time. This deprives the legal framework of flexibility. It would therefore be better for the proposed agricultural insurance law to be developed as framework legislation that sets out the overarching principles, the details being contained in supporting regulations issued by CIRC as the regulator.

4.64. This approach will enable the regulatory framework to be adapted more quickly. This is particularly important for the following reasons:

- As discussed in Chapter 3, international standards can be expected to evolve further, particularly with respect to microinsurance and index-based insurance. It is important that the regulatory framework can be adapted reasonably quickly to accommodate those changes.

- Given the agricultural diversity in China, it is likely that a number of different agricultural insurance products may need to be developed over time. If the proposed agricultural insurance law is detailed, there is a risk that the development of new products not currently envisaged may require the amending of the Law.

- As the agricultural insurance market matures, the regulatory regime will need to be adjusted.

4.65. Great care should be taken to draft laws and regulations that are clear and that can be understood, not just by the courts but also by the insurance industry and insured policyholders. A lack of certainty may lead to differing expectations between insurers and policyholders on critical issues such as the liability to pay claims. A lack of certainty will lead to a loss of confidence the market and to a reduction in demand for agricultural insurance.

**Index-Based Insurance**

4.66. The Insurance Law does not specifically provide for index-based insurance. Index-based insurance has certain special characteristics that present legal and regulatory challenges that differ from those presented by traditional agricultural insurance. In particular, it is a fundamental and universal principle of insurance law that an insurance payment is made to indemnify or compensate for loss. In most jurisdictions, the insured must have an insurable interest in the property insured. The payment made under an
index-based insurance policy is dependant upon the underlying index. To that extent
index-based insurance is indistinguishable from a derivative. However, there must be a
reasonable correlation between the index and the loss sustained by the insured for an
index-based product to be classified as an insurance product. However, the correlation
between the index and the insured’s loss can never be perfect, and the payment under an
index-based insurance contract cannot therefore properly be classified as an indemnity.

4.67. Article 2 of the Insurance Law, in the English translation, provides that “insurance
. . . means a commercial insurance whereby . . . the insurer bears a liability to indemnify
for property damage or losses caused by occurrence of possible accidents that are agreed
upon in the contract.” This article, if the translation is accurate, could be interpreted as
creating a legal impediment to index-based insurance. Furthermore, the Insurance Law
contains a number of articles that, although not necessarily a legal obstacle to index-
based insurance, if interpreted strictly could make it impracticable. These are discussed

4.68. It is therefore recommended that the central government should include a study of
the legal and regulatory issues and challenges raised by index-based insurance in the
current review of the Insurance Law.

Operational Framework

4.69. The key operational functions of the insurance company with consideration of the
multiple stakeholders are summarized in Figure 4.4. It brings all of the stakeholders and
their facilitation of important functions for the insurance company into one picture so that
everyone can see the role of the different stakeholders in making crop insurance more
accessible to small farmers:

a) Product delivery and product development are key functions. Named-peril and
index-based insurance products should be key products if small farmers are to be
served in a cost effective fashion. Further, bank and financial intermediaries
should be involved in selling agriculture insurance to further reduce delivery costs.

b) Technical assistance should be national in scope in order to take advantage of the
learning that takes place in many different regions of China. While the central
government can be involved, it is more appropriate to try to create a service entity
using, for instance, the Insurance Association of China. This entity could sell
services to all firms and bring the knowledge, data, software, and other services
together in a much more cost-effective fashion than could insurance companies
performing these services on their own.

c) The insurance regulatory service deserves a special function. In this case, only
one primary entity is involved in facilitating that activity—China Regulatory
Insurance Commission.

d) Risk financing is where this chapter begins and where it ends. The chapter
introduces multiple ideas about how to assure that extreme losses can be paid.
These ideas involve both central and provincial governments as well as
international reinsurers.
Figure 4.4: Operational Functions of Insurance Company—Multiple Stakeholders

Source: Authors.
Chapter 5: Summary Conclusions

5.1. This chapter summarizes the key outcomes and conclusions on the technical, financial, and operational review of the existing agricultural insurance programs in China. It aims to provide suggestions, based on international best practice, that the central government and provincial governments as well as insurance companies could consider using to make agricultural insurance more attractive to small farmers, so as to increase the agricultural insurance penetration and to develop financially viable insurance programs without relying on heavy government subsidies.

Conclusions

5.2. The government of China (GoC) is working on the development of agricultural insurance through a series of provincial pilot initiatives. The GoC has reiterated its commitment to agricultural and rural developed in the 11th Five-Year Plan. In particular, GoC recognizes the importance of revitalizing the agricultural insurance industry and has undertaken a series of pilot projects to test different models of insurance. These pilots are currently under implementation in several provinces: Heilongjiang, Xinjiang, Jiangsu, Shanghai, Jilin, Xinjiang, Zhejiang, Sichuan, and Hainan. The China Regulatory Insurance Commission (CIRC) has also approved the launch of specialized agricultural insurance companies in Shanghai, Jilin, and Heilongjiang provinces. The Ministry of Finance has recently approved a budget of RMB 1 billion ($250 million) for the financing of a premium subsidy program in selected provinces: Jiangsu, Jilin, Xinjiang, Hunan, Sichuan, and Inner Mongolia. The Ministry of Agriculture is also considering the financing of its own set of pilots.

5.3. China is facing key challenges in the development of agricultural insurance. These challenges, similar to those faced by many other countries that want to promote agriculture market-based insurance, are summarized below.

5.4. National agricultural insurance uptake is low. In 2005, the agricultural insurance premium volume approximated RMB 729 million ($91.1 million), that is less than 0.5 percent of the estimated potential agricultural insurance premium from a nationwide MPCI program, and about 0.6 percent of national non-life insurance. On the supply side, agricultural insurance is available in only a few provinces. The history is dominated by prior agricultural insurance activities, which were heavily influenced by public sector interventions. On the demand side, the majority of Chinese farmers lack awareness and education related to insurance in general and crop and livestock insurance in particular.

5.5. Pilot crop insurance initiatives, as currently designed, are not geared toward small farmers. The current crop insurance products as well as the new pilot insurance products are mainly designed for farmers insured in former military reclamation areas, and where individual-grower crop MPCI programs are feasible because of the unique features of the reclamation areas, large farm structure, and the organization of agriculture.
These MPCI products are not well-suited to wide-scale replication with small farmers outside the reclamation areas.

5.6. **China’s crop risk profile shows great differences in risk across crops and geographic areas, but drought remains the principal cause of crop yield losses in most provinces.** Risk exposure for small and geographically concentrated crop insurance companies can be high, and it can still remain high for a well-diversified book of crop insurance business within a single province because of the high level of covariate risk, such as droughts, floods, and typhoons. However, pooling agricultural risks across the country can significantly reduce the peak risk exposures.

5.7. **Insurers have limited financial capacity to deal with catastrophic losses.** Domestic insurers are exposed to catastrophe risks and have limited opportunity to diversify their portfolios. Several Chinese agricultural insurers are involved in the purchase of international reinsurance and coreinsurance arrangements with local governments. However, the level of private reinsurance cover does not seem to be adequate to protect against catastrophic losses.

5.8. **Crop insurance products currently available are mainly multiple-peril crop insurance products (MPCI).** A key product offered at present is MPCI, which is enabled by the linkages to reclamation groups. Named-peril crop insurance is also offered in China on a limited basis.

5.9. **Livestock insurance is a minor class of the agricultural insurance business.** Several companies underwrite individual livestock policies for cattle, pigs, sheep and goats, poultry, and aquaculture, but the premium volume is less than 8 percent of total 2005 agricultural insurance premiums volume.

5.10. **MPCI products are under priced and do not allow for price differentiation.** It was not possible to conduct a detailed review of the risk analysis and rating methodologies adopted by the insurance companies, but it appears that most companies are currently offering single rates for each crop type, with little or no differentiation according to regional risk exposure and results. In addition, the risk assessment conducted under this study shows that domestic insurers tend to underestimate the underlying crop yield risks and therefore may under price their products. A fundamental best practice of agricultural insurance involves risk classification and differential premium rates based on those risk classes. Further difficulties arise from the use of individual-farmer yield assessment against area-based insured yields, giving rise to anti-selection.

5.11. **Domestic insurers have limited access to technical services and international agricultural insurance expertise.** Provincial insurers have limited access to technical insurance services in specialist areas such as product design, ratemaking, underwriting, loss adjustment, and the like. Chinese insurers have had little contact with the international insurance and reinsurance community, little opportunity to share experiences in program and product design, or for technology transfer.
5.12. **Crop insurance products such as MPCI are generally subsidized.** The provincial governments provide financial support to the agricultural insurers in the form of up-front premium subsidies and/or catastrophe reinsurance protection. The central government has recently approved a RMB 1 billion ($125 million) premium subsidy program for selected provinces.

5.13. **Public support is not geared to provide insurers with incentives to improve their operations and expand their services to small farmers.** Public support to agriculture insurance is mainly through direct premium subsidies. This does not create incentives for agricultural insurers to provide better services to existing insured farmers or to offer new products tailored to small farmers.

5.14. **Premium subsidies, as currently allocated, may not foster the development of agriculture insurance among small farms.** The budgets allocated by the central and provincial governments for agricultural insurance mainly focus on premium subsidies. These subsidies may be captured mainly by large insured farms and do not benefit small uninsured farmers.

5.15. **There is currently no legal and regulatory framework for agricultural insurance.** The present insurance law includes no specific provisions for agricultural insurance; hence, insurers operate without a firm legal framework. The Insurance Law is currently being reviewed, but agricultural insurance does not seem to be included in the revision exercise.

**Key Challenges Facing Agricultural Insurance Industry in China**

5.16. These challenges, which are also faced by many other countries, can be overcome over time through an appropriate agriculture risk-management framework relying on a strong partnership between the central government, the provincial governments, and the insurance companies. This public-private partnership is based on three pillars: agricultural insurance product development; agricultural risk financing; institutional capacity building.

*Agricultural Insurance Product Development*

5.17. **No size fits all.** No single product solution will meet China’s needs, due to the very wide range of climatic and farming conditions. A variety of appropriate crop insurance products is required in each province. As a result, a mix of existing crop insurance products and index products is recommended to allow for the expansion of crop insurance. A structure whereby products are developed within each province will increase the likelihood that tailored agricultural insurance products will be developed to match the great diversity of agriculture in China.

5.18. **MPCI is unlikely to be a viable insurance product for small farmers in China.** International experience has highlighted several drawbacks with individual MPCI, including the absence of farmer-level-yield time series, leading to the common practice of establishing yields on district average yields, thus generating adverse selection. MPCI
may be a viable option only for those areas where the operating costs can be supported by highly developed local infrastructure, such as the Heilongjiang Reclamation Group and Xinjiang Production and Construction Corps.

5.19. **New crop insurance products should be specifically developed for small farmers.** These products should offer effective and affordable insurance to small farmers and should focus first on the financing of catastrophic losses.

- **Named-peril crop insurance** employs simplified systems of loss adjustment, involving measurement of percentage damage soon after the loss has occurred. This type of product could cover sudden-onset hazards such as hail, frost, and excess rainfall at a competitive price.

- **Weather-index insurance** offers some promise, but only for selected hazards such as drought. Weather index insurance is effective only when basis risk (that is, potential mismatch between actual losses and indemnities) can be minimized. It is also very difficult to design an effective weather-index insurance product if losses are caused by a complex interaction among multiple weather variables. For these reasons, the primary focus should be for drought in rainfed crops. A second focus could be for specific crop types and specific time windows during the growth cycles of vulnerable crops, including prolonged cold conditions for cotton.

- **Area-yield-index insurance** should be investigated. It is a product most suited to those crop and hazard combinations where a peril, or series of more complex perils, simultaneously affects a crop in a particular region. These conditions are most likely to be found in wide-scale and uniform crop production systems, such as in rice production and in field-scale crops such as cereals and oilseeds, or cotton. The product allows all perils to be insured. However, the availability of quality historical-yield statistics is a prerequisite to area-yield-index insurance.

5.20. **Livestock insurance products and services should be studied in the light of international best practice.** Specific issues that require particular attention include: (1) the provision of epidemic-disease cover and government slaughter order, which are usually excluded by international reinsurers; (2) herd-based covers and deductibles for larger livestock-production units (cattle, pigs, and poultry); (3) rates and deductibles set at actuarially sound levels.

5.21. **Agricultural insurance solutions should be province-based.** Given that risks, crops, and farming practices are mainly province-specific, agriculture insurance solutions should be developed by and adapted to each province. Provincial governments and local insurers should play a central role in fostering innovative agriculture insurance programs.

5.22. **Insurers should perform a formal portfolio risk assessment.** Insurers should conduct a formal assessment of the catastrophic risk exposure of their portfolio of insurance business. This would allow them to identify peak exposures in their portfolio, to rebalance their portfolio, and to structure cost-effective risk-financing strategies (including risk retention and reinsurance purchasing), leading to an increased capacity to sustain catastrophic losses.

5.23. **Agricultural insurance ratemaking techniques should be revisited in the light of international best practice.** Insurers could consider using actuarially sound rating
techniques consistent with international best practice and with Chinese conditions. The methodology should be designed to achieve actuarially sound premium rates that are stable yet reflective of regional differences and responsive to changes in risk over time.

**Agricultural Risk Financing**

5.24. **Fostering commercial agricultural reinsurance capacity.** The provincial and central governments should further promote access to agriculture insurance for local reinsurers (such as China Re) and international reinsurers in order to increase commercial agricultural reinsurance capacity.

5.25. **The government should contribute to the financing of losses that cannot be transferred to the private market at acceptable costs.** The government should focus on catastrophic losses, acting as reinsurers of last resort, when the financial resources of the domestic insurance industry are scarce and the access to international reinsurance markets is limited. This risk-transfer arrangement should allow insurance companies to build up reserves and to retain larger layers of risk over time. The resulting risk exposure of the government should be adequately financed through an appropriate country risk-financing strategy including, for example, reserve funds and contingent debt facilities provided by international institutions such as the World Bank.

5.26. **The role of the central government and provincial governments in the financing of catastrophic risks in agriculture should be clarified.** If the central government wishes to offer a subsidy to local insurance companies, it could offer free stop-loss reinsurance at an agreed proportional level above certain extreme levels (based on the relative risk of the province) to the provincial government or the provincial insurance companies. The central government could also sell stop-loss reinsurance for the remaining proportion. The provincial government could buy this stop loss reinsurance for local insurers. This would be the provincial government subsidy contribution to agricultural insurance. The most direct reinsurance stop loss would be based on the book of business for the local insurance companies or an indemnity-based policy, which could be supplemented with an index-based (macro-index insurance) form of reinsurance. Finally, if the central government does not want to offer a subsidy, it can still perform a useful risk pooling function by selling the entire level of stop-loss reinsurance to either the provincial government or the local insurance companies at a fair premium.

**Institutional Capacity Building**

5.27. **A technical support unit (TSU) should be established as a central agricultural insurance service provider.** This unit should have support from the central government and linkages to the provincial governments, insurers, and reinsurers. This center of expertise would provide market services, for a fee, to support rapid development and scaling up of agricultural insurance in each province and nationally. It would provide technical support and training in the specific areas of product identification, product design, risk assessment, and product pricing.
A centralized agricultural database for China should be created. This database would include agricultural crop, livestock, forestry, and aquaculture product and yield statistics; production-damage loss data and animal mortality statistics; and meteorological data—with the purpose of making such data available to agricultural insurance companies.

Government Support and Public Subsidies

The objectives of the public intervention should be clarified. If the policy objective is to increase the incomes of rural households or to create a safety-net program that assures some minimum level of income for farm households, agricultural insurance is not a cost-effective instrument. These types of social policies involve direct transfers of wealth from the government to rural households. Agriculture insurance can be an effective risk-management tool, but it is not an effective tool for transferring wealth to economically disadvantaged rural households.

Ongoing pilot initiatives on agriculture insurance should be better coordinated. The central government, through the Ministry of Finance, and the provincial governments, through their finance bureaus, are piloting a series of agriculture insurance initiatives. These pilots should be better coordinated and be implemented as part of a national policy framework for the development of agriculture insurance.

A public subsidy program should be developed to create incentives for agricultural insurers to expand their services to small farmers. Public support should focus on the development of risk-market infrastructure and public goods that will give agricultural insurers incentives to offer affordable and effective insurance to farmers, and particularly small farmers. This may include the support of a TSU, development of a centralized agricultural database, development of new delivery channels to reach small farmers, development of promotional and educational programs, and so on. Financial incentives, such as direct premium subsidies, could be targeted to small farmers as part of a social program, but they should not support unsustainable farming activities.

Targeted premium subsidies could support marginal farmers as a social tool. Premium subsidies could be targeted to marginal farmers under a social program. They should be combined with the promotion of risk-mitigation activities (such as drought-resistance seed, and so on).

Government reinsurance should complement private reinsurance. Public subsidies for reinsurance should be made available for risk layers that cannot be transferred to the reinsurance market at acceptable costs, or for which reinsurance capacity is unavailable. This is usually the case for top (catastrophic) layers, where the government could act as a reinsurer of last resort.

The government should facilitate the pooling of agricultural risks. Provincial agricultural coinsurance pools, such as those established in Hainan and Zhejiang, should be supported by the provincial governments to help local companies reduce their risk exposure. A national agricultural insurance pool, promoted by the central government,
could help insurers and provincial governments to further reduce their risks. However, these insurance pools should be designed to ensure that cross-subsidization is kept to a minimum and remains negligible compared to the benefits provided by the pooled portfolios.

5.35. **National and provincial governments should study carefully the financial implications of any public support as provincial agricultural insurance programs expand.** This is to avoid huge fiscal costs of highly subsidized mature agricultural insurance programs, such as those in the United States, Canada, or Spain. It is estimated that if China were to adopt a U.S.-like MPCI program, the total cost of crop insurance subsidies would exceed $9 billion per year.

5.36. **An appropriate legal and regulatory framework should be developed to support agricultural insurance.** Although there are some differences between agricultural insurance and other forms of general insurance, the principles governing the regulation and supervision of general insurance, and insurance contracts, are largely applicable to agricultural insurance. Given the considerable overlap, it is recommended that the Insurance Law be applicable to agricultural insurance, but that it allow for different provisions to be made for agricultural insurance, where appropriate, through regulations—under the Insurance Law or, if necessary, through the proposed agricultural insurance law. The legal and regulatory framework should also allow index-based products, such as weather-index products, to be classified as insurance products when there is a reasonable correlation between the index and the insured’s loss, and when the principle of insurable interest is met.
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weather insurance, which covers catastrophic weather events or the extreme tail of the probability distribution of weather events for a region or country. See also Index Insurance.

**Drought**

One of the most commonly requested peril covers by farmers, but it is also one of the most difficult perils to insure because of problems of definition, isolation, and measurement of effects on crop production. In contrast to most weather perils, drought is a progressive phenomenon, in terms of an accumulating soil moisture deficit for plant growth, and its impact on crop production and yields is often extremely difficult to predict, then measure and isolate from other noninsured causes.

**Due Diligence**

The responsibility of an external reviewer to perform an investigation of risk associated with a potential client, considered prudent and necessary for an adequate assessment of that client’s level of risk. The process associated with “due diligence” in insurance includes underwriting, contract design, rate making, and adverse selection and moral hazard controls.

**Endogenous Market Factor**

A factor occurring within the market which impacts market transactions, such as fluctuations in local supply or demand or political instability within a country.

**Ex ante Risk Mechanism**

Action taken prior to a potential risk event. Making preparations before a disaster helps avoid inefficient, quick-response coping decisions. If ex ante strategies are not in place, resort will be to short-term coping strategies that have no significant benefit in the long run.

**Ex post Risk Mechanism**

Risk-management strategies that are developed in reaction to an event, without prior planning. Although ex post strategies have a role to play in a risk-management program, risk-management mechanisms can be more effective when introduced ex ante.

**Exposure**

The amount (sum insured), exposed to the insured peril(s) at any one time. In crop insurance, exposure may increase, then decrease, during the coverage period, following the growth stages of the crop from planting to completion of harvest.

**Exogenous Market Factor**

A factor occurring outside the market which impacts transactions within the market, such as a shift in the global demand for a commodity.

**Financial Intermediary**

An institution (such as an insurance company, bank, or microfinance institution) that serves as a middle man or acts as a go-between for sellers and buyers of financial services such as credit or insurance.

**Financial Risk**

Risk that income will not reach expected levels, or the invested value in a crop will be lost due to adverse changes in weather and price. Many agricultural production cycles stretch over long periods of time, and farmers must anticipate expenses that can only be recouped once the product is marketed, leading to cash-flow problems that can be made even more severe by a lack of
access to credit, or the high cost of borrowing in rural areas.

**Fondo**

According to Mexican laws, fondos are nonprofit organizations constituted by the farmers as civil associations without the need to provide any capital endowment, except their willingness to associate among themselves. From a risk-financing perspective, fondos pool crop-yield risks from farmers with similar risk profiles.

**Franchise**

An amount of loss which has to be reached before the insurer will pay a claim, and once this threshold is met, the insurer has to pay the claim in full. For example, a farmer insures his crop for $1,000 with a franchise of $100. If the claim is for $99, then this is borne by the farmer. If the claim is for $101, however, then the whole amount of the $101 is paid by the insurer.

**Gross Net Premium Income**

Gross written premium of a primary insurer, minus cancellations, refunds, and reinsurance premium paid to other reinsurers.

**Guaranteed Yield**

The expected physical yield of a crop stated in the insurance policy, against which actual yields will be compared when adjusting any losses.

**Hazard**

A physical or moral feature that increases the potential for a loss arising from an insured peril or that may influence the degree of damage.

**High-Probability Low-Consequence Events**

High-probability, low-consequence risks are frequent risks that cause mild to moderate damage. Insurance products for high-frequency, low-consequence losses are seldom offered, because the transaction costs associated with frequent loss adjustment makes the insurance cost prohibitive for most potential purchasers. These high transaction costs are in part due to information asymmetries that cause the problems of moral hazard and adverse selection. See also Moral Hazard and Adverse Selection.

**In-Between Risk**

Agricultural production risks, such as natural disasters, that lack sufficient spatial correlation to be effectively hedged using exchange-traded futures or options instruments. At the same time, they are generally not perfectly spatially independent, and therefore traditional insurance markets cannot cover these risks. Skees and Barnett (1999) refer to these risks as “in-between” risks. Because of their unique characteristics, in-between risks require more innovative instruments.

**Indemnity**

The amount payable by the insurer to the insured, in the form of cash, repair, replacement, or reinstatement in the event of an insured loss. This amount is measured by the extent of the insured’s pecuniary loss. It is set at a figure equal to but not more than the actual value of the subject matter insured just before the loss, subject to the adequacy of the sum insured. For many crops, this means that an escalating indemnity level is
established as the growing season progresses.

**Independent Risk**
Risks such as automobile accidents, fire, or illness that generally occur independently across households. Such statistical independence allows effective risk pooling across entities in the same insurance pool, making insurance possible. For independent risks, the law of large numbers suggests that, on average, the insurance indemnity paid to claimants in a particular year can be offset by the premiums received from clients who did not experience indemnifiable losses. See also Risk Pooling.

**Index Insurance**
Index insurance makes indemnity payments based not on an assessment of the policyholder’s individual loss, but rather on measures of an index that is assumed to proxy actual losses. Two types of agricultural index insurance products are those based on area yields, where the area is some unit of geographical aggregation larger than the farm, and those based on measurable weather events. See also Weather-Index Insurance.

**Informational Constraint**
Limited access to or availability of reliable data can be a significant constraint to the development and performance of risk transfer markets.

**Institutional Risk**
Institutional or regulatory risk is generated by unexpected changes in regulations, especially in import and export regimes, and influences producers’ activities and their farm profits.

**Insurability**
The conditions that determine the viability of insurance as a method of managing a particular risk.

**Insurable Interest**
An insurance policy is valid only if the insured is related to the subject matter insured in such a way that he or she will benefit from its survival, suffer from loss or damage caused to it, or may incur liability in respect of it.

**Insurance**
A financial mechanism that aims to reduce the uncertainty of loss by pooling a large number of uncertainties so that the burden of loss is distributed. Generally, each policyholder pays a contribution to a fund in the form of a premium, commensurate with the risk he introduces. The insurer uses these funds to pay the losses (indemnities) suffered by any of the insured.

**Insurance Agent**
The person who solicits, negotiates, or implements insurance contracts on behalf of the insurer.

**Insurance Broker**
The person who represents the insured in finding an insurer or insurers for a risk and negotiating the terms of the insurance contract. A broker may also act as an agent (that is, for the insurer) for the purposes of delivering a policy to the insured and collecting premium from the insured.

**Insurance Policy**
A formal document (including all clauses, riders, and endorsements) that expresses the terms, exceptions, and
conditions of the contract of insurance between the insurer and the insured. It is not the contract itself but evidence of the contract.

**Insured Peril**
The cause of loss stated in the policy, which on its occurrence entitles the insured to make a claim.

**Layer**
The term used to define a range of potential loss that is covered by insurance. For example, an insurance contract may pay indemnities only for losses within a specified range of magnitude. See also Risk Layering.

**Livestock Risk**
The risk of death, injury, or disease to livestock.

**Loss Adjustment**
Determination of the extent of damage resulting from occurrence of an insured peril, and settlement of the claim. Loss adjustment is carried out by the appointed loss adjuster who works on behalf of the insurer.

**Loss Ratio**
The proportion of claims paid (or payable) to premium earned. A loss ratio is usually calculated for each class of business in which an insurer participates. Analysis of loss ratios can be useful in assessing risks and designing appropriate insurance structures.

**Low-Probability High-Consequence Events**
Low-probability, high-consequence risks are events that occur infrequently yet cause substantial damage. Decision makers, including agricultural producers, tend to underestimate their exposure to low-probability, high-consequence losses, because people forget the severity of the loss experienced during infrequent extreme weather events. Thus, an insurance product that protects against these losses is frequently discounted or ignored altogether by producers trying to determine the value of an insurance contract.

**Macro Level**
The economic level at which countries and large donor agencies working with these countries experience risk of weather-induced humanitarian crisis or economic instability caused by price volatility.

**Market Failure**
The inability of a market to provide certain goods at the optimal level because market prices are not equal to the social opportunity costs of resources. The high cost of financing catastrophic disaster risk prohibits most private insurance companies from covering this risk, resulting in market failure.

**Market Risk**
Input and output price volatility are important sources of market risk in agriculture. Prices of agricultural commodities are extremely volatile as a result of both endogenous and exogenous market shocks, and some commodities experience shocks more frequently than others do.

**Meso Level**
The economic level at which banks, microfinance institutions, producers, traders, processors, and input providers experience risk due to the vagaries of weather and price.
| **Micro Level** | The economic level at which individual farm households experience risks due to shocks such as adverse weather events, price fluctuations, or disease. |
| **Microclimate** | The climates of localized areas, which may differ considerably from the climate of the general region. These climate variations are caused by geographical differences in elevation and exposure. |
| **Moral Hazard** | In insurance, moral hazard refers to the problems generated when the insured’s behavior can influence the extent of damage that qualifies for insurance payouts. Examples of moral hazard are carelessness, fraudulent claims, and irresponsibility. |
| **Nonproportional Treaty Reinsurance** | An agreement whereby the reinsurer agrees to pay all losses that exceed a specified limit arising from an insured portfolio of business. The limit is set by the reinsurer and may be monetary (for example, excess of loss) or a percentage (for example, stop loss). The rates charged by the reinsurer are calculated independently of the original rates for the insurance charged to the insured. |
| **Personal Risk** | The risk to an individual of personal injury or harm. |
| **Premium** | The monetary sum payable by the insured to the insurers for the period (or term) of insurance granted by the policy.  

\[
\text{Premium} = \text{premium rate} \times \text{amount of insurance}
\]

Also, the cost of an option contract—paid by the buyer to the seller. |
<p>| <strong>Premium Rate</strong> | The price per unit of insurance. Normally expressed as a percentage of the sum insured. |
| <strong>Probable Maximum Loss</strong> | The largest loss believed to be possible for a certain type of business in a defined return period, such as 1 in 100 years, or 1 in 250 years. |
| <strong>Proportional Treaty Reinsurance</strong> | An agreement whereby the insurer agrees to cede and the reinsurer agrees to accept a proportional share of all reinsurances offered within the limits of the treaty, as specified on the slip. Limits can be monetary, geographical, by branch, class of business, and so forth. The reinsurer has no choice of which risks to accept or decline; he is obliged to accept all good and bad risks that fall within the scope of the treaty. |
| <strong>Quota Share Treaty Reinsurance</strong> | An agreement whereby the ceding company is bound to cede and the reinsurer is bound to accept a fixed proportion of every risk accepted by the ceding company. The reinsurer shares proportionally in all losses and receives the same proportion of all premiums as the insurer, less commission. A quota share often specifies a monetary limit over which the reinsurer will not accept to be committed on any one risk—for example, 70 percent each and every risk, not to exceed $700,000 any one risk. |</p>
<table>
<thead>
<tr>
<th><strong>Rapid-Onset Shock</strong></th>
<th>A sudden large shock, such as a flood, hurricane, frost, freeze, excess heat, high wind speed, storm, or commodity price shock. Rapid-onset events are easier to identify than slow-onset shocks, and their impact can be easier to determine.</th>
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<tbody>
<tr>
<td><strong>Rate On Line</strong></td>
<td>A rate of premium for a reinsurance which, if applied to the reinsurer's liability, will result in an annual premium sufficient to meet expected losses over a number of years.</td>
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<tr>
<td><strong>Regulatory Risk</strong></td>
<td>Institutional or regulatory risk is generated by unexpected changes in regulations, especially in import and export regimes, and influences producers’ activities and their farm profits.</td>
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<tr>
<td><strong>Reinsurance</strong></td>
<td>When the total exposure of a risk or group of risks presents the potential for losses beyond the limit that is prudent for an insurance company to carry, the insurance company may purchase reinsurance (that is, insurance of the insurance). Reinsurance has many advantages, including (1) leveling the results of the insurance company over a period of time; (2) limiting the exposure of individual risks and restricting losses paid out by the insurance company; (3) possibly increasing an insurance company’s solvency margin (percent of capital and reserves to net premium income), hence the company’s financial strength; and (iv) enabling the reinsurer to participate in the profits of the insurance company, but also to contribute to the losses, the net result being a more stable loss ratio over the period of insurance.</td>
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<td><strong>Risk Aggregation</strong></td>
<td>The process of creating a risk-sharing arrangement that gathers together or pools risks, thereby reducing transaction costs and giving small households or other participants a stronger bargaining position.</td>
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<tr>
<td><strong>Risk Assessment</strong></td>
<td>The qualitative and quantitative evaluation of risk. The process includes describing potential adverse effects, evaluating the magnitude of each risk, estimating potential exposure to the risk, estimating the range of likely effects given the likely exposures, and describing uncertainties.</td>
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<tr>
<td><strong>Risk Management</strong></td>
<td>Care to maintain income and avoid or reduce loss or damage to a property resulting from undesirable events. Risk management involves identifying, analyzing, and quantifying risks and taking appropriate measures to prevent or minimize losses. Risk management may involve physical mechanisms, such as spraying a crop against aphids, using hail netting, or planting windbreaks. It can also involve financial mechanisms such as hedging, insurance, and self-insurance (carrying sufficient financial reserves so that a loss can be sustained without endangering the immediate viability of the enterprise in the event of a loss).</td>
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<tr>
<td><strong>Risk Mitigation</strong></td>
<td>Actions taken to reduce the probability or impact of a risk event, or to reduce exposure risk events.</td>
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Risk Retention  
Risk retention is the process whereby a party retains the financial responsibility for loss in the event of a shock.

Risk Transfer  
Risk transfer is the process of shifting the burden of financial loss or responsibility for risk financing to another party, through insurance, reinsurance, legislation, or other means.

Risk Coping  
Strategies employed to cope with a shock after its occurrence. Some examples of risk-coping strategies include the sale of assets, seeking additional sources of employment, and social assistance.

Risk Financing  
The process of managing risk and the consequences of residual risk through products such as insurance contracts, CAT bonds, reinsurance, or options.

Risk Layering  
The process of separating risk into tiers that allow for more efficient financing and management of risks. High-probability, low-consequence events may be retained by households to a certain extent. The market insurance layer is characterized by the ability of the market to manage risks through insurance or other contracts. Low-probability, high-consequence events characterize the market-failure layer, and at this layer of risk, government intervention may be necessary to offset the high losses.

Risk Pooling  
The aggregation of individual risks for the purpose of managing the consequences of independent risks. Risk pooling is based on the law of large numbers. In insurance terms, the law of large numbers demonstrates that pooling large numbers of roughly homogenous, independent exposure units can yield a mean average consistent with actual outcomes. Thus, pooling risks allow an accurate prediction of future losses and helps determine premium rates.

Shock  
An unexpected traumatic event such as death in the family or loss of land and livestock, which can be caused by catastrophic weather events or other unexpected phenomenon. Price shocks occur when the price of a commodity changes dramatically due to changes in local or global supply and demand, affecting the livelihood of households dependent on this commodity, for either income or caloric intake. Economic shocks can occur at the micro, meso, and macro levels and can have long-term consequences for the economic well-being of actors at each level.

Slow Onset Shock  
A shock that unfolds slowly, such as drought; it starts unnoticed, and its impact is difficult to assess or may not be recognized until high losses are realized.

Social Safety Net  
Various services, usually provided by the government, designed to prevent individuals or households from falling below a certain level of poverty. Such services include free or subsidized health care, child care, housing, welfare, and so on.
**Stop Loss**
This term, usually applied to reinsurance business, refers to a policy that covers claims once they have exceeded a certain amount. A policy with a stop-loss provision is a non-proportional type of reinsurance, where the reinsurer agrees to pay the reinsured for losses that exceed a specified limit, arising from any risk or any one event. For example, a reinsurer may agree to pay claims of $200,000 in excess of $100,000. If the claims are more than $300,000, the reinsured (that is, the insurer) will have to bear the remainder of the claims or make additional financing arrangements to cover the remaining risk exposure.

**Subsidy**
A direct or indirect benefit granted by a government for the production or distribution (including export) of a good or to supplement other services. Generally, subsidies are thought to be production- and trade-distorting and to cause rent-seeking behavior, resulting in an inefficient use of resources.

**Transaction Costs**
Transaction costs are the financial costs or effort required to engage in business transactions, including the cost or time spent obtaining information. Transaction costs of insurance include those associated with underwriting, contract design, rate making, adverse selection, and moral hazard.

**Underwrite**
To select or rate risks for insurance purposes.

**Weather-Index Insurance**
Contingent claims contracts for which payouts are determined by an objective weather parameter (such as rainfall levels, temperature, or soil moisture) that is highly correlated with farm-level yields or revenue outcomes. See also Index Insurance.

**Yield Risk**
Unique to agricultural producers; like most other entrepreneurs, agricultural producers cannot predict the amount of output that the production process will yield, due to external factors such as weather, pests, and diseases.