CHAPTER 9

New Approaches to Agricultural Insurance in Developing Economies

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Providing appropriate risk management tools for agriculture is a key challenge for agricultural development. Agricultural insurance systems play a vital role in that process: they provide structured cover against natural perils and legal entitlement for indemnification for the farming sector. As such, they serve as collateral for agricultural loans and provide a safety net for investments. Agricultural insurance systems have been successfully implemented in recent decades, though mostly in industrialized countries. All of these systems are based on public-private partnerships; only these have proved to be successful and sustainable, whereas purely private or purely state-organized systems have failed. This article illustrates why agricultural insurance systems based on public-private partnership will also lead development in developing countries and emerging markets, and elaborates upon the key components of such systems.

World agriculture is facing the challenge to provide sufficient high-quality food, raw materials, and energy to a growing world population. According to the United Nations' Food and Agriculture Organization (FAO), there is a need to increase agricultural production (food, feed, renewable primary products) globally by 1.6 percent annually until 2015 and thereafter by 1.4 percent until 2030.[2] Greater investment in agriculture will be necessary to meet this challenge.[3] Though high agricultural commodity prices are helping to finance these investments, financial institutions will also have to make a significant contribution by providing finance and risk transfer solutions.

Agriculture is confronted with a series of risks: political risks, market risks, contamination risks,[4] and natural risks.[5] No other economic activity has as large an

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[2] See BMELV (2008).

[3] The FAO report "How to Feed the World in 2050" for instance states that total average annual net investments in developing countries would have to amount to US$83 billion in order to achieve the required increase of 70 percent in food production by 2050 (FAO, 2009).

[4] Contamination due to biogenic factors (e.g. mycotoxins in cereals), chemical residues/substances or radioactivity.

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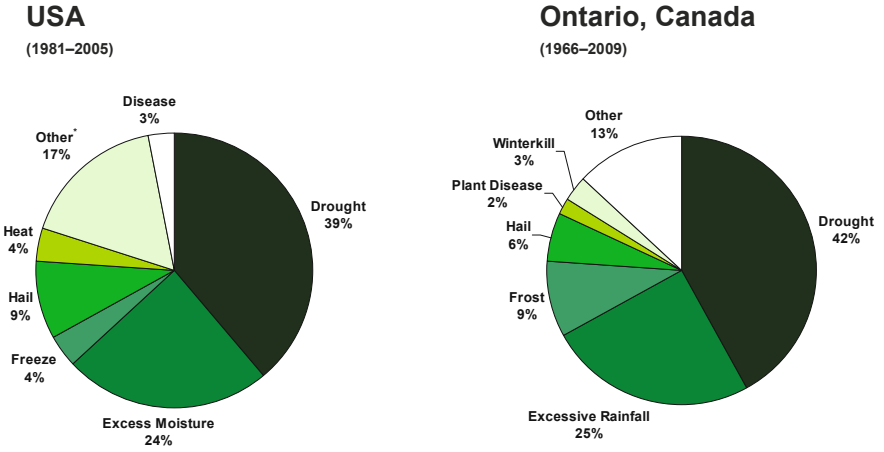
exposure to natural risks as agriculture. This is due to production being in the open air, its high dependence on sufficient and timely water supplies, and its susceptibility to pests and diseases. With appropriate management practices[6] risks can be reduced, but not eliminated.

Losses due to extreme weather events are therefore a common phenomenon, especially in crop and grassland production. The majority of these losses – estimated at 70 to 80 percent – are attributable either to lack of rain or excess of moisture (either rain or flooding). The rest is mainly due to frost, hail, and windstorm. Accurate data on crop losses caused by adverse climatic conditions are limited to countries with crop insurance systems established for decades, such as the United States or Canada (see figure 1).



* "Other" includes but is not limited to: cold wet weather, frost, wind, flood, cold winter, insects, hurricane, hot wind, irrigation failure, aflatoxin, wildlife, erosion and fire.

Fig. 1. Losses per peril in the MPCI programmes in the USA and Ontario, Canada
Sources: Rain and Hail, 2011; Agricorp, 2011

According to the projections of climate scientists, climate change can increase the variability of weather patterns in many regions; and increase the frequency and severity of extreme climate events. This implies increased frequency of heat stress, droughts, and flooding in particular, as well as modified risk of fires, and pest and pathogen outbreaks. The negative effects will be more pronounced in

5 Natural risks are climatic (e.g. drought, excessive rain, flood, hail, frost, winterkill, windstorm) and biological (e.g. diseases and pests) risks.

6 E.g. site and variety selection, crop rotation, soil preparation, fertilization, pest and disease management, sanitary measures.

low-latitude countries than in the rest of the world.[7] This puts farmers in such countries that rely heavily on the agricultural sector particularly at risk of suffering additional losses.

Smallholder farmers in developing countries are particularly vulnerable. This is due to various factors:

- Production often in more exposed areas, e.g. disadvantaged and mountain regions, marginal land;
- Shortage or lack of financial means to invest in risk-reducing measures, e.g. irrigation, drainage, frost prevention;
- Limited access to loans;
- Limited access to inputs to improve production techniques, which might have risk-reducing effects.

The livestock sector is more exposed to epizootic diseases than to climatic risks. There is a high risk of epizootic disease outbreaks being spread over a wide area and consequently causing high economic losses. Prominent examples of such outbreaks are foot and mouth disease (FMD) in the United Kingdom in 2001[8] and in South Korea in 2010–2011,[9] as well as avian influenza in Asia since 2003.[10] Though such large loss events have relatively long recurrence periods, the loss potential is huge.

In many developing economies,[11] farmers retain the risk of crop losses and epizootic diseases irrespective of the size of their farms. Their risk management mainly consists of diversifying their income sources by planting a variety of crops and breeding cattle. They have hardly any risk-transfer tools, which in turn limits the availability and range of agricultural production finance offered by banks. This situation has not changed with the development of microfinance and microinsurance[12] over the last decade. Thus, neither microfinance nor micro-insurance have made their way into the area of agricultural production. Although

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7 For more information on this topic and the impact of climate change on agriculture refer to IPCC 2007. See also IAASTD, 2009; FAO, 2009.

8 One of the worst FMD outbreaks worldwide. Animals culled: 6 million (4.9 million sheep, 0.7 million cattle, 0.4 million pigs); losses to agriculture and the food chain: €3.6 billion; government compensation for slaughtered animals and payments for disposal and clean-up costs: €2.9 billion (DEFRA, 2004).

9 The worst ever FMD outbreak in South Korea. As of 24 March 2011, 3.3 million pigs and more than 150,000 cattle had been culled (Asiaone Health, 2011).

10 These outbreaks were caused by viruses of the H5N1 subtype. As of June 2007, 62 countries around the world had reported H5N1 in birds. During these H5N1 outbreaks more than 250 million birds were destroyed or died and the direct economic costs for affected countries exceeded €8.8 billion (WHO, FAO, both undated).

11 Developing economies comprise emerging markets and developing countries.

12 Microfinance/microinsurance is defined as finance/insurance designed for low-income people/businesses not served by typical social or commercial insurance schemes.

this is not surprising, many people are unaware of the fact because rural microfinance/insurance is normally aimed at rural households and not crop or livestock production specifically. Therefore, the development of sustainable risk management systems and tools – one of them being agricultural insurance – will be a key topic in future agricultural development strategies as well as in climate change mitigation strategies.

1 Ex-ante Versus Ex-post Risk Management Solutions

After major agricultural losses in a country, it is common practice to try to release funds to farmers in the form of disaster payments. These payments are made either by the national government or by international organizations like the World Food Program (WFP). The shortcomings of these ex-post payments are:

- Inaccurate distribution of the money, thus either over- or under-compensating the real loss;
- Long process to release and distribute funds, as a result of which the relief often comes late, so that farmers might miss the following crop season and, if worse comes to worst, lose their assets;
- Not accepted as collateral by lending institutions such as rural banks;

Ex-post payments are subject to political considerations. Often they are not driven by impartial criteria but are heavily dependent on external circumstances such as the timing of an election or political and international factors.

Due to these shortcomings, many governments, farmers' associations, financial institutions, and international organizations are nowadays reviewing their risk management approach, looking for ex-ante rather than ex-post risk management solutions in agriculture. These ex-ante solutions consist of:

- Agricultural insurance systems:
  They have the advantage that the farmer has a legal entitlement to indemnification in cases clearly defined in the policy wording. Furthermore, payments are made quickly, improving liquidity in times of financial difficulty. Structural and operational aspects of these systems will be discussed in detail in the following sections.
- Fund solutions:
  - State-run funds
    Nowadays state-run funds are found mainly in the livestock sector to cover the value of the stock in the event of government slaughter orders. In former times these funds were set up also to cover crop losses due to extraordinary climatic conditions, e.g. in France, Greece, Israel.

      Participation in these funds is obligatory. They are normally financed at least partly by the farmers through levies, either by a surcharge on agricultural sales or by a levy per head in the case of livestock. The

remainder is financed by the state, either by annual co-financing or in case of an event by subsequent payment where an event has occurred.[13]

In the livestock sector these funds are a very important and successful tool to cover the value of livestock in the event of epidemic diseases. Epidemic diseases are mainly controlled by government slaughter order on the affected and the surrounding farms.[14]

However in the crop sector, state funds have proved ill-suited due to difficulty in assessing the real crop losses, leading to either over- or under-indemnification. Another major problem has been late payment and depletion of funds after big loss events. As a result, fund solutions are often replaced by crop insurance systems.

- Privately run funds:
  These are set up to cover specific production sectors against selected perils, often in form of mutuals. Participation is optional. Typical examples are the Potatopol and Avipol in the Netherlands.[15]

- Combination of insurance and fund solutions:
  In the livestock sector, where fund solutions play a vital role in managing losses caused by epidemic diseases, the base cover provided by the fund should be enhanced by insurance cover for natural perils. In more developed economies, where a national epizootic disease control system and legislation is in place, business interruption covers can also be integrated. These covers indemnify if in the course of an epidemic disease outbreak a farm lies in a quarantine zone established by public authorities for a protracted period.[16]

In the case of crop insurance, a combination of insurance and fund solutions might be considered for the starting phase, especially where there is a high degree of uncertainty as to insurable risks and lack of data are a real constraint. Natural risks for which sufficient data or loss experience is available are classified as insurable and are covered by the insurance system. All other risks will be covered by a state fund. There has to be a strong link between insurance cover and fund cover: only

[13] See Gabber, 2007, for a detailed comparison of the national compensation systems for epizootic diseases in the European Union.

[14] Public authorities in the European Union for instance might order culling within a radius of three kilometer around the outbreak (quarantine zone) and a surveillance zone of, for example, 10 or 20 km radius in which for a certain period of time no livestock and no livestock products (e.g. milk) can be moved. The size of the surveillance zone depends on the characteristics of the epizootic disease.

[15] Potatopol covers only the diseases ringrot, brownrot, and Potato spindle tuber viroid (PSTVd) in potatoes. For more information see Potatopol, 2011.
Avipol covers only the diseases salmonellae, mycoplasma gallisepticum (MG) and "schrikziekte" in poultry production. For more information see Avipol, 2011.

[16] Normally defined as a certain number of days after establishing the quarantine zone (see also table 1).

policyholders and participants in the crop insurance system are entitled to indemnification for non-insurable risks under the fund cover. The fund could be financed, for example, by an additional premium for participation in the fund cover claimed under the insurance scheme.[17] In the course of the development of the insurance system, more and more risks are covered by insurance and the fund can be dissolved gradually.

Drivers of ex-ante risk management solutions are often governments or governmental institutions that wish to avoid a supplementary budget in the event of disaster payments and see a structured risk management approach as an important component of their agricultural development strategies. However, the farming sector too – depending on the extent to which it is organized – might be a driver or at least a strong supporter as it is confronted with limited access to agricultural finance because without risk transfer solutions they often cannot provide the security required for loans. This is the reason for financial institutions, and in particular agricultural and rural banks, often being strong advocates of agricultural insurance systems.

In the insurance industry, the drivers are often specialized agricultural insurance companies and reinsurers with a strategic agricultural focus – but only if certain structural requirements are achievable.[6] Multiline insurance companies – though having a potential commercial interest – can sometimes be indifferent or reluctant, as their traditional business model in non-agricultural lines differs considerably from the business models needed in agricultural insurance.[18] Furthermore, not many insurance companies have a rural strategic focus and a network in rural areas.

2 First Considerations When Setting Up Agricultural Insurance: System Approach Before Product Approach

In the discussion on agricultural insurance in developing economies it is misleading to look for the solution first at product level. With an insurance product alone – either an index insurance product or an indemnity-based insurance product – the problem of lacking access to appropriate risk management tools in agriculture cannot be solved. This is why all the proposals for index insurance over the last few years have not solved the problem of a lack of risk management tools in developing economies. This is not necessarily due to the type of product, but to the failure to implement the appropriate framework that any insurance product needs. In other words, a system approach has to be pursued first, before determining which insurance product is appropriate. Such a system approach creates a suitable legal, institutional, and organizational framework in which insurance products and other risk management tools can function efficiently.

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17 Portugal, for instance, has adopted this.

18 See section “SystemAgro: Framework and Structural Aspects of Agricultural Insurance Systems”.

A successful and sustainable agricultural insurance system consists of three major components:

- Framework and structural aspects;
- Operational aspects;
- Innovation.

Only if these three elements are all present and implemented as effectively as possible will the system achieve a high acceptance level among the stakeholders, financial stability, and sustainability.

3 SystemAgro: Framework and Structural Aspects of Agricultural Insurance Systems

The framework and the structural aspects of sustainable agricultural insurance systems have been compiled systematically by Munich Re under the name of SystemAgro.[19] The key features and key success factors are:

- Ability to respond to the heterogenic structures in the agricultural production sector (e.g. large-scale, medium-sized and smallholder farms as well as different production sectors) and provide individual insurance solutions to each of them. Sustainable production methods and use of best-available production techniques are prerequisites of insurance. Cooperation with extension services might be beneficial;
- Agricultural insurance systems to be organized and financed as public-private partnerships between the state, farmers, and the insurance industry.[20] The role of these stakeholders is as follows:
    - State: legal and regulatory framework, definition of agricultural insurance as a part of national agricultural policy, agricultural insurance law, co-

[19] For more information: www.munichre.com/systemagro.

[20] Traditionally, agricultural insurance was organized either privately by insurance companies without state involvement or by the state alone. State-run systems were very common in the socialist countries (e.g. Soviet Union, China, Mongolia, German Democratic Republic) until 1990, often organized as obligatory insurance (Wildermuth, 1998). By contrast, privately organized systems prevailed in nations with a market economy. However, until 1980 even the United States had a state run agricultural insurance system that was subsequently reformed into a public-private partnership system. As either purely privately or purely state-run systems have proved to be ill-suited if comprehensive multi-peril insurance is required in these cases, public-private partnership models are at the forefront of developments. Privately organized insurance is prevailing only in those countries in which single peril insurance, e.g. hail insurance, predominates.

financing of the risk premium and administrative costs, risk carrier for catastrophe losses, supervision of the system. To guarantee the long-term stability of the system, cross-party agreement on these elements is essential. Premium subsidies and state reinsurance for catastrophe losses contribute to keeping insurance terms affordable for the farmer, thus facilitating high market penetration and the stability of the programmed;

In developing countries, where state institutions sometimes have insufficient resources, some of these tasks might be assumed by international organizations. At the national level, the ministry of agriculture and the treasury generally intervene;

- Farmers: financing part of the risk transfer by paying an insurance premium, retaining part of the risk in the form of a deductible or with index products as a basis risk. Applying site-specific and sustainable production methods and techniques in order to minimize production risks;
- Insurance/reinsurance industry: risk carrier, marketing and administration of insurance policies, portfolio management and product development, loss adjustment. Especially in developing economies, where direct insurance companies are often short of risk capital, reinsurance arrangements are essential to maintain the solvency margins of insurance companies at an adequate level. Besides the much-needed risk capital, reinsurers operating globally also contribute expertise and international experience in setting up and managing agricultural insurance systems.

- Joint market approach by all insurance providers and risk carriers, e.g. in form of a coinsurance pool. In such a pool, all of the crop risks of one country or even several (smaller) countries are combined, thus creating a better spread of risk. This joint market approach includes market-wide uniform insurance terms and conditions that are technically sound and – if appropriate historical data is available – actuarially calculated. These uniform terms and conditions are approved by the state and then have to be applied by all insurance providers. This is an important factor in guaranteeing the sustainability of the system;
- Centralized technical entity run by the insurance industry, which bundles the technical expertise, maintains an extensive database, and carries out the loss adjustment;[21]
- Integrate financial institutions as well as agricultural input, output, and extension service providers (including cooperatives) in order to promote and market the insurance products cost-effectively.[22]

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[21] See section on "Operational Aspects of Agricultural Insurance Systems: Loss Management and Loss adjustment/administration."

[22] See section on "Operational Aspects of Agricultural Insurance Systems – Distribution".

4 Operational Aspects of Agricultural Insurance Systems

If the above-mentioned framework of an agricultural insurance system has been put in place, then a wide range of operational aspects has to be addressed. As mentioned above these tasks are best carried out by a centralized technical entity. This is also the best approach to combining the expertise and experience available nationally. Nevertheless, especially in developing countries, such qualified staff are often scarce, making this one of the most critical and limiting factors, especially in the start-up phase. To alleviate these limitations, it is advisable to establish international cooperation agreements with countries that have established agricultural insurance systems or with Managing General Agencies (MGAs) that operate the systems.

5 Insurance Products and the Overestimated Potential of Weather Trigger Policies

Agricultural insurance systems require a range of appropriate insurance products to cover the various production sectors (e.g. crop, grassland, livestock) and crop types prevailing nationally. It is important for products to be customized to the development stage of the national agricultural sector and to the structural differences (e.g. large, medium-sized and small farms and their differences in revenue). Different products with their underlying concepts are described in Table 1. If several risks are covered, it is important that they be insured as a package; this means that individual risks cannot be chosen by the insured. Each product described has advantages and disadvantages. Therefore, insurance products have to be selected taking into consideration the risk and production characteristics prevailing in a country and the needs of the farmers and the banking sector.

Despite this, in the last few years the discussion on crop insurance in developing economies has been focused on index insurance based on meteorological triggers (weather trigger policies). These insurance products were promoted as *the* solution. Many international organizations and non-governmental institutions promoting microinsurance have adopted this position. The fact that an insurance product alone cannot be the solution[23] and also that the insurance product had considerable shortcomings was overlooked:

- These policies pay out if a specific meteorological value, e.g. precipitation, is not achieved or is exceeded in a specific period of time – irrespective of the actual yield. The problem is that there is a relatively low correlation (as low as 60 percent) between the trigger and the actually harvested yield. This leaves a considerable basis risk with the individual farmer for the specific risk.

[23] See section "First Considerations When Setting up Agricultural Insurance: System Approach Before Product Approach."

Another reason for basis risk is the fact that the product covers only one or – at best – two natural hazards.

The above-mentioned basis risk has resulted in situations where the farmers have suffered considerable crop losses without the policy indemnifying – a situation that is disastrous both for the farmer and for the insurance industry because of the loss of confidence and acceptance among farmers and state representatives.

- There are stringent requirements for the infrastructure. Weather stations have to cover the entire geographical area, be closely meshed, and tamper proof. These requirements are often not met, which decreases the accuracy and increases the basis risk.
- These policies are difficult for the clients to understand, especially smallholder farmers, because the real mechanism of the cover is difficult to follow. Thus smallholder farmers are normally not acquainted with, for instance, how many millimeters of rainfall they would need for a decent crop.
- Consequently, demand by farmers for meteorological trigger policies has generally been much lower than anticipated by the promoters.

This does not mean that these products might not play a role in risk transfer for the agricultural sector. However, except for grassland, where index products have proved to be successful at farm level,[24] the potential for covers based on meteorological triggers is more at aggregate level than at individual-farmer level. Instead of covering the individual farmer, the cover should apply at aggregate level, for example covering a crop credit portfolio or the portfolio of a cooperative. Under these circumstances, the basis risk can be absorbed by the aggregating body. The problem of how to distribute indemnification in the event of losses to the individual lenders or cooperative members still has to be solved, for example by providing them with individual covers. In any case, aggregate covers should address this problem and define clear procedures and obligations to indemnify the individuals.

For covers at farm level in the special circumstances of developing economies, area yield index insurance, for instance, might be an attractive solution. It is also suitable for smallholder farmers. A prerequisite is that the production potentials at the different locations in the region be homogeneous because a certain percentage (e.g. 70 percent or 80 percent) of a regional average yield of a specified crop (mainly annual crops, such as cereals) is covered independently of the individual yield on the farm. If the actual regional yield is below the covered yield, an indemnification is paid out according to the shortfall (difference between actual and covered yield). Traditionally the actual regional yield was the yield recorded by the public authorities after the harvest. The period for collecting this data is rela-

[24] For more information on insurance products offered in Canada and the United States see AFSC, 2011 and RMA, 2011.

tively long, resulting in considerable delays for payouts. The following alternatives might be feasible in the near future:

- Assessing the yield on random sampled plots out of a universal set of insured plots in the defined region;
- Remote-sensing technology (cf. section on "Innovation")

In the case of developed production systems and conditions and for medium-sized and large farms, the following insurance products should be considered:

- Yield guarantee insurance to cover annual crops such as cereals and oleiferous and root crops. There are two alternative ways of setting the guarantee level: a percentage (normally around 70 percent) either of a regional average yield or of an individual production history at the insured's location. The period under consideration should be five to ten years. In order to avoid anti-selection all plots cultivated with the same crop have to be insured.

Damage-based insurance products, especially for specialty crops such as vine grapes, fruit, and vegetables. As the drought exposure of these crops is normally limited, covers with only selected perils[25] are feasible. Fruit and vegetables produced for developed national or international markets require not only quantity cover but also quality cover.

6 Portfolio Management and Underwriting

Portfolio management and underwriting are key elements for the operation of agricultural insurance systems. Staff with a high level of expertise and experience are required. Experience and knowledge are of utmost importance, as reliable historical data are scarce, making decisions based on uncertain criteria more the rule than the exception.

In the start-up phase of an agricultural insurance system, special attention should be paid to building up a balanced portfolio spread over different production regions, production sectors, and crop types. It is advisable is to start with the major crops in the most important production regions and leave specialty crops and areas that are difficult to access for a later development stage.

International organizations and NGOs, however, often use another approach: pilot projects focusing on selected crops in specific regions. This is understandable from the perspective of the donors as these pilot projects can be launched with a limited budget and financed for a specific period only. However, scaling up these pilot

[25] E.g. fire, hail, frost. However, if several perils are insured, then only as a package, not selectively. Also all plots cultivated with the same crop have to be insured.

projects to programs at national level covering major crops in all important production regions have often failed. Generally speaking, this approach is not advisable.

Underwriting agricultural risks is a challenge, mainly due to the lack of reliable historic and exposure data, and previous experience with agricultural insurance. Rates – for indemnity-based or yield guarantee products normally calculated with historical loss data – often cannot be calculated on a actuarial basis, so that they then have to be derived from exposure data or from exposure comparison with similar regions in other countries or with other crops. The uncertainty involved, however, is considerable and can best be managed by having a sizeable and diversified portfolio.

It is of utmost importance to take into account the advances made in weather forecasting and meteorology in general in the underwriting of agricultural risks. There are two aspects:

- In recent years, weather forecasts have improved considerably and the periods for which reliable forecasts are available have increased and will continue to do so. In order to prevent selective buying of insurance, the underwriting has to be adjusted, for example by extending waiting periods[26] for risks such as frost, excessive rain, and flood, and by bringing forward sales closing dates;[27]
- **E**l **N**iño/**S**outhern **O**scillation (ENSO) research has made significant progress in the last decade, leading to statistical correlations between the ENSO phase and regional impacts.[28] Due to these correlations and improved seasonal climate forecasts, some climate patterns can be predicted with some confidence for certain geographical areas.[29]

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[26] The waiting period is the period between policy inception and the date cover begins.

[27] Sales closing dates are the dates after which insurance cover is no longer available. Sales closing dates are essential for all policies covering drought.

[28] The most commonly used index is the Southern Oscillation Index (SOI); others are the NOAA‘s Oceanic Niño Index (ONI) of and the Japan Meteorological Agency index (JMA).

[29] El Niño-phase, December to February:

- Australia: below-normal rainfall across much of the country, in particular the northern, the west and the north east. Increased risk of drought;
- South America: above-normal precipitation in Ecuador and parts of Peru, with increased risk of excessive rain and flooding; below-normal rainfall in large areas of Colombia, northern Brazil, and Chile;
- Africa: below-normal rainfall probabilities in large parts of southern Africa.

La Niña-phase, December to February:

As a consequence, the likelihood of demand for insurance being influenced by the relevant forecasts is increasing considerably. In order to avoid anti-selection and to guarantee a balanced portfolio over time for the insurers, multi-year direct insurance arrangements will gain in importance in countries where ENSO-related impacts are strong.

7 Distribution

Cost-effective distribution of agricultural insurance products is a challenge due to the spread of clients over a large geographical area and hence the problems in accessing them cost-effectively. This situation is aggravated if insured assets have a relatively low value, as for instance in the case of smallholding farmers. This challenge is independent of the insurance products offered.

In industrialized countries, distribution is dominated by direct insurance brokers and agents. In developing economies, such distribution is often too costly and therefore other distribution channels prevail. The most important channels are currently rural and agricultural banks, which have good regional distribution networks and established links to farmers through their credit business. It obviously makes sense also to use these structures for agricultural insurance purposes, either by offering agricultural finance and insurance as a package as the preferred option or on an option combining it, for example, with reduced interest rates as an incentive.

However, other possible distribution channels have also unexploited potential, particularly input and output marketing services (e.g. elevators or storehouse, agricultural traders), extension services, cooperatives, and microfinance institutions. There are synergies that should be used in order to provide cost-effective delivery of agricultural insurance to different target groups.

As agricultural insurance is service intensive, it is questionable whether alternative distribution approaches, for example via Internet and mobile phone networks, will be successful.[30]

- Australia: above normal rainfall across much of the country, most notably in eastern and northern regions. Increased risk of damage from heavy precipitation and flash floods. Reduced risk of drought;
- South America: dryer-than-normal weather conditions in western central Argentina and in eastern Brazil. Risk of drought is increased in those regions. Above-normal rainfall in South America's regions north of the Equator, but also in Patagonia and southern Chile. Hence the risk of flooding and landslides is increased;
- Africa: above-normal rainfall probabilities in large parts of southern Africa. Increased risk of flooding.

(Faust, 2011).

[30] These technologies however could be used for premium collection or claims payments (see section "Administration and Data Management").

8 Loss Management and Loss Adjustment

Quality insurance requires the timely payout of claims in order to guarantee liquidity for the farmers. To achieve this, efficient loss management processes have to be in place.

Furthermore, in most cases a loss adjustment network is necessary. This is essential for all insurance products requiring an in-field loss assessment (see Table 1) or – in the case of livestock insurance – a loss verification. Only certain index products, for example those based on meteorological triggers, can function without them, though qualified personnel available at regional level is also necessary for the maintenance and supervision of weather stations.

The backbone of a high-quality loss adjustment network is the personnel who have to have specific agronomic, loss assessment, and insurance expertise.[31] It is common practice to have specialist loss adjusters for certain crops and even insured perils. In order to work in a consistent and verifiable manner, loss adjusters need meticulously designed adjustment methodologies and procedures.[32] In case of direct loss insurance best practice is for these methodologies to be derived from crop-specific, scientific field experiments with simulated damage to the crop. Loss adjustment is cost-intensive. Modern technology and future advances will however contribute to lower costs and lead to new applications and processes.[33]

9 Administration and Data Management

Appropriate IT systems are the backbone of an efficient administration comprising inter alia policy issue, premium collection, loss payments, data management, and interface with regional branch offices and governmental entities. These systems have been developed in several countries in the last decade, taking into consideration the specific requirements of agricultural insurance and national characteristics. It might be more cost-effective to use them under licensing agreements than to develop them from scratch again. In any case, it is of the utmost importance that the system used has a properly designed database that permits the collection and storage of all-important underwriting and loss data. Over time, such a database develops into an invaluable asset, which enables product development, underwriting, and rate calculations to be performed on a technically sound basis.

In order to reduce administration work, it would be beneficial to use official data from governmental institutions on individual farmers and their crop growing areas and production.

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[31] This service is normally provided by freelance professionals on a fee basis. Regional coordinators of the network managing the in-field adjusters work either freelance or on contract.

[32] For an example of such guidelines, see MAPA.

[33] See section “Innovation: The Driving Force in all Development Phases”.

10 Innovation: The Driving Force in All Development Phases

Successful agricultural insurance systems are subject to constant change, especially in the operational area. Though the structural components, once established, are relatively stable, they also need to be adapted or refined from time to time.

Agricultural insurance systems develop over years and decades from:

- Selected production sectors to all important sectors;
- Selected risks via all climatic risks to all climatic and natural risks;
- Non-individualized insurance products (e.g. index products) to individualized insurance products;
- Dominant crop types, mainly grain and oleiferous crops, via all crops with quantity cover to all crops, including specialty crops with quality covers.

Innovation is essential in order to enhance agricultural insurance systems, adapt them continuously to the needs of a changing farming sector and increase efficiency. Underwriting, product development, and loss adjustment are particular target areas for innovation.

Technology plays an important role in innovation. Key technologies leading future development will be:

- Georeference and Geographical Information Systems (GIS):
  Collecting georeferenced data of insured plots and processing them with GIS will be essential in future for underwriting, loss adjustment, accumulation control, portfolio management, rate calculation and the application of remote-sensing technology;
- Remote-sensing technology:[34]
  Nowadays remote-sensing technology for agricultural applications is developing rapidly: plot identification, yield estimations, and assessment of loss events and vegetation status are only examples of activities that will enhance crop insurance and other risk management tools.

  A key factor will be to identify correctly the crop type and then to determine yields accurately with remote-sensing technology. It can be assumed that this will be achieved first and in the near future with cereals, oleiferous; and tuber crops for regional yields; this technology can then be used to determine the actual regional yield for area-yield products. In a next step, reliable yield determination on individual plots might be possible.

[34] Remote-sensing uses aerial sensor technology to detect and classify objects on the Earth. It records information from the ultraviolet, visible, infrared, and microwave regions of the electromagnetic spectrum with equipment such as cameras, scanners, lasers, and linear arrays. This equipment is located on aircraft or spacecraft (e.g. satellites). Visual and digital image procession is used to analyze the information obtained. (ISU).

If that is the case, then individual yield-based covers will also be feasible for smallholding farming.

Furthermore, insurance products using remotely-sensed vegetation indices will further gain in importance, especially for covering extensive farming such as grassland.

Remote-sensing technology will also play a major role in assessing large loss events,[35] supporting loss adjustment coordination and activities as well as national or international food and disaster aid.

- Automatic yield-recording
  Combines and harvesters equipped with automatic yield recording combined with GIS are already a widespread technology in many parts of the world. For insurance applications, it is essential for the yields and the corresponding georeferenced plots to be recorded in a tamper-proof and fraud-resistant manner. Only then can they be used as reliable yield declarations by insureds. Further improvements in automatic yield-recording technology and reliable data transfer will enhance the application of this technology to yield guarantee products and will contribute to improving the accuracy of yield determination and to reducing loss adjustment expenses.[36]

11 Current Status and Outlook

Agricultural insurance systems have been developed over the last decade in several emerging economies. It is estimated that in 2010 emerging economies contributed €2,500 million, or 20 percent, to the estimated worldwide agricultural insurance premium pool of some €12,500 million.[37] The vast majority of the premiums, an estimated 93 percent, are allocated to crop insurance. Key features of selected systems in place are described in Table 2, all of them organized in the framework of public-private partnerships. These systems are nowadays an important risk management tool for farmers. However, market penetration is still unsatisfactory and further attempts to increase it, for example by product development and structural improvements, need to be made. This process will be enhanced by new and more accurate technology.

It is to be expected that additional countries will follow these examples and develop their own agricultural insurance systems adapted to the specific characteris-

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[35] For instance, inundations can be monitored relatively accurately by means of radar remote sensing; yield losses can be estimated by monitoring the duration of the inundation in specific areas.

[36] This technology will benefit primarily large and medium-sized farms that harvest mechanically. However, it is also used by contract harvesters who also harvest on smaller farms.

[37] 48 percent of this figure is attributable to crop insurance in the United States.

tics and needs of their agricultural sector. Their endeavors will benefit from the experience gained worldwide in the last few decades in setting up and managing agricultural insurance systems, leading to their being developed more rapidly and cost-effectively in the future.

Exchange Rates

€ 1 corresponds to 1.3687 US$, 2.2806 BRL, 0.85434 GBP, 61.9428 INR, 16.5109 Mex Peso, 9.0098 RMB.

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