Agricultural insurance in developing countries: An introduction and a case study in Tamil Nadu, India

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Abstract
Microinsurance offers poor people that lack access to mainstream financial services formal risk management instruments that may improve their situation. In the last decade many scholars have studied the possibilities to insure agricultural losses in developing countries. Traditional schemes, based on indemnification of actual losses, are thought to be infeasible in developing countries. The suggested alternative is index insurance, based on financial derivatives of the events underlying agricultural losses. However, index-based insurance is not always the appropriate solution: unacceptably high basis risk was encountered in a case study on the development of an insurance scheme to protect groundnut farmers in Tamil Nadu, India, against yield losses. Instead, a solution was found in a scheme of the traditional type.
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Preface

This thesis is written as part of the master programme in Actuarial Science at the University of Amsterdam. I conducted part of my research as a member of the product development working group of the Micro Insurance Association Netherlands (MIAN).\(^1\) MIAN is an association of volunteers active in the insurance business assisting in the development of microinsurance initiatives by providing their knowledge and experience without charge. MIAN’s ‘clients’ usually are non-governmental organizations (NGOs) in developing countries that are supported by Dutch financiers of development projects.

The product development working group has the mission to provide MIAN’s partners with technical assistance in the design of microinsurance products. The past seven months the working group’s activities mainly consisted of designing crop insurance solutions for the DHAN Foundation, a large NGO active in the southern states of India. The other members of the working group are Annette Houtekamer-van Dam, Gijs Kloek and Jan van der Sterren. During the process these persons have made important contributions to my research by discussing several issues and providing feedback on my results.

My employer Towers Perrin-Tillinghast has also supported my research by allowing me to spend part of my time at the office on the crop insurance project. I also had some very useful discussions with my colleague Henk Kriek, who made several suggestions for my research.

In order to find appropriate crop insurance solutions for DHAN I frequently had very pleasant correspondence with M. Karthikeyan, S. Balasubramanian, M. Palanisamy and M.P. Vasimalai, all active as a professional within DHAN’s organization and involved in the crop insurance program. They have provided us with the necessary information, informed us of the farmers’ needs and corrected us in case they thought the solution we suggested would not be feasible in practice.

\(^1\) www.mian.nl
Finally I am very grateful to Martijn Visser, a fellow student also highly interested in the field of microfinance, and Marjolein Dubbers, active as a microfinance professional for Cordaid, for making valuable suggestions to improve this thesis.

Jeroen Kingma
Management summary

Microinsurance

Poor people lack access to financial markets
Poor people have in common their inability to cope with income shocks. As informal risk-coping and risk management strategies often are insufficiently successful in dealing with the risks these people face, especially regarding covariant risks felt throughout communities, formal risk management instruments may improve their situation. Unfortunately, in developing countries many poor people lack access to formal financial services. This is mainly caused by the specific approach needed to serve the poor, involving large expenses.

Microinsurance offers the poor an opportunity to better manage risks
Since the 1980s initiatives to offer microfinance services have been developed, starting with small loans and later extended by other services. A relatively new microfinance instrument is microinsurance. Although the concept of microinsurance does not differ substantially from mainstream insurance, it requires special attention for the target client group’s needs. Issues that need to be carefully considered are coverage, accessibility, timing of premium collection and benefit payment, affordability and potential clients’ familiarity with insurance. A major factor for the successfulness of microinsurance programs is the delivery channel chosen to offer insurance. In the most common constructions, delivery is organized through MFIs or NGOs acting as an agent for insurance companies, or through formal mutual institutions pooling risks within communities or regions, but also other constructions are possible. Important is that in the construction chosen access to a large group of potential clients and attention for their needs are combined with sound financial management.

Microinsurance experiences so far teach valuable lessons
A landscape study performed by Roth et al (2007) shows that most microinsurance activity is employed in Asia, followed by Latin America and Africa, and that life insurance is the most popular product group. This popularity can be explained by the fact that life insurance is relatively easy to provide and highly demanded. Experiences with microinsurance programs so far show a relatively low participation rate among MFIs, where these are expected to be most suitable to participate in microinsurance
programs, as they are familiar with financial products as well as with serving the poor. Furthermore, selling group policies has proved to be most efficient, market barriers such as lack of understanding by poor people and commercial parties not recognizing the potential of microinsurance are encountered, and problems with regulation, such as activities performed outside the supervision of regulating institutions or regulation improper for microinsurance, are experienced.

**Agricultural insurance**

**Traditional schemes are thought to be infeasible in developing countries**

Agriculture plays an important role in developing countries’ economies and in their populations’ lives. As agricultural risks are common risks, losses in agricultural income are likely to occur simultaneously, and therefore may significantly impact welfare in developing countries. Agricultural insurance offers a possibility to stabilize agricultural income. Many scholars have argued that traditional agricultural insurance as present in developed countries, based on indemnification of actual losses as assessed by agricultural experts, is unsuitable for implementation in developing countries due to problems related to moral hazard, problems with finding reinsurance, and a too costly and too slow claims handling process. The measures used to overcome these problems in developed countries are infeasible in developing countries.

**Scholars suggest index-based insurance to be the solution**

In the last decade progress has been made in the search for an alternative to traditional agricultural insurance in developing countries. Several scholars claim that a solution is found in insuring the events that cause agricultural losses, instead of the agricultural losses themselves. As the main part of agricultural losses in developing countries is caused by adverse weather events, such as drought, insurance based on a well-designed weather index may provide proper compensation for losses experienced by farmers. Since a weather index, which is just a weather derivative, is a simple and objective measure, problems with moral hazard and the claims handling process are avoided. Also reinsurance is thought to be easier to obtain due to the objective nature of index-based insurance. Drawbacks are, however, an increase of basis risk and the required availability of reliable weather data for the region.
Groundnut insurance in Tamil Nadu, India

An index-based scheme results in unacceptably high basis risk

During the process of developing a mutual insurance scheme for DHAN Foundation, a large NGO active in the southern states of India, meant to protect groundnut farmers in the state of Tamil Nadu against yield losses, both traditional and index-based solutions have been considered. It turned out that it was not possible to design a simple weather index that sufficiently reduced basis risk. Despite the installation of rainfall gauges in the villages that participated in the pilot project, basis risk still remained unacceptably high due to the fact that also factors other than rainfall, like temperature, substantially influence groundnut yields.

A solution was found in a scheme of the traditional type

Instead, the scheme was designed in the traditional way, based on the assessment of actual losses. The possibility of problems with moral hazard and the claim handling process is thought to be reduced by making use of small mutual pools and by loss assessment performed by local farmers that are trusted by DHAN. The small size of the local mutual pools ensures a high degree of social control and a good knowledge of the area and the regular yield with the claim assessor, who will therefore be able to provide a good judgement of crop damage quickly.

Conclusion: local conditions determine the appropriate insurance solution

The fact that for DHAN’s groundnut insurance scheme the solution is found in a scheme of the traditional type might seem remarkable, as it seemingly contradicts many recent studies on agricultural insurance in developing countries. It shows that local conditions are of vital importance for the insurance solution that should be chosen. Although index-based insurance is thought to be most suitable in many cases, the situation for the groundnut farmers in Tamil Nadu is such that a traditional scheme turned out to be the best solution. This once again proves many authors’ view that microinsurance solutions need to be tailor-made to the local conditions and clients’ needs.
1 Introduction

By signing the United Nations Millennium Declaration\(^2\) in September 2000, the member states of the United Nations committed themselves to achieve eight Millennium Development Goals by the year 2015. One of these Millennium Development Goals is to reduce the number of people living of less than one US dollar a day by half.

One of the ways the member states try to achieve this goal to reduce poverty is by means of supporting, promoting and facilitating microfinance. Microfinance is a general term that refers to all financial services for people that have no or only limited access to mainstream financial markets. Microfinance is \textit{micro} in the sense that it typically serves the poor and therefore often involves only small amounts of money per person. The term \textit{micro} does not refer to the (potential) number of clients as still a large part of the world’s population does not have access to financial markets.

Many people associate microfinance with microcredit, the provision of small loans to poor people, which received a lot of attention in recent years in relation to the 2006 Nobel Peace Prize for its initiator, Muhammed Yunus, and his Grameen Bank. However, microfinance is much more than microcredit alone as it also includes other financial services for the poor. Such a service is microinsurance, of which the development still is in the initial stage. The current development of microinsurance is not surprising: once microcredit has enabled people to start a business that provides them with income, these people want to protect themselves against adverse events that may affect the income from their business. In the past a similar mechanism was observed in developed countries, with insurance being introduced a couple of decades after credit. As poor people are characterized by their inability to cope with income shocks, microinsurance may improve their situation.

In many developing countries the agricultural sector is of vital importance for the country’s economy and its inhabitants’ welfare. As agricultural yields often are highly variable, to a large extent caused by weather phenomena, a system of agricultural insurance in order to protect against yield losses may have a positive influence on developing countries’ economies and reduce poverty.

\(^2\) Available at http://www.un.org/millennium/declaration/ares552e.htm.
Experience with traditional agricultural insurance schemes based on loss indemnification has shown that this approach often is not suitable in developing countries. An alternative approach is based on the main determinant of agricultural losses, adverse weather scenarios. Since the beginning of this century agricultural insurance in developing countries is increasingly offered based on so-called *weather indexes*. These weather indexes basically are weather derivatives with payments in weather scenarios that are likely to affect the insured crop.

This thesis aims to be an introduction to microinsurance in general and index-based agricultural insurance in specific. Also a case study on the development of a groundnut insurance scheme offered by a large NGO in the state of Tamil Nadu, India, will be discussed. This discussion will focus on actuarial issues like the pricing of the insurance product.

Chapter 2 discusses the relationship between poverty and risk and introduces microfinance as a possibility for poor people to manage the income risks they face. The third chapter provides a discussion on microinsurance and several relevant issues regarding microinsurance, followed by a focus on agricultural insurance in chapter 4. The groundnut insurance case study is presented in chapter 5, and chapter 6 contains some concluding remarks.
2 Risk management for the poor

General consensus exists on the view that one of the main determinants of poverty is a high exposure to risk. This observation implies that poverty can be reduced by reducing risk exposure. This chapter starts with discussing the results of a number of studies on the relationship between poverty and risk. It continues with an overview of the strategies available to low-income households to manage the various risks they face. Finally, the concept of microfinance will be introduced as an extension to the list of available risk management strategies for the poor.

2.1 Poverty and risk

Before turning to the relationship between poverty and risk, we first need to find out what is actually meant by the word poverty. Wikipedia mentions three possible interpretations:

“Poverty is a condition in which a person or community is deprived of, or lacks the essentials for a minimum standard of well-being and life. Since poverty is understood in many senses, these essentials may be material resources such as food, safe drinking water, and shelter, or they may be social resources such as access to information, education, health care, social status, political power, or the opportunity to develop meaningful connections with other people in society.

Poverty may also be defined in relative terms. In this view income disparities or wealth disparities are seen as an indicator of poverty and the condition of poverty is linked to questions of scarcity and distribution of resources and power. Poverty may be defined by a government or organization for legal purposes, see Poverty Threshold.

Poverty is also a type of religious vow, a state that may be taken on voluntarily in keeping with practices of piety.” (Wikipedia, 1 April 2007, http://en.wikipedia.org/wiki/Poverty)

Poverty can thus be understood as a lack of resources to provide for life essentials and personal well-being, as a status of living below a government-defined social minimal wealth level and as a modest living standard that may be chosen out of religious or piety considerations. Throughout this thesis poverty refers to the first interpretation, and specifically to the inability to provide for materials and services essential to live a

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3 Although it is not an entirely scientific source of information, Wikipedia often provides a generally accepted view on the topics discussed and partially uses scientific sources.
decent life, like food, water, housing, health care and education. Obviously, as many of these products and services are available in exchange for money, this is closely related to monetary income. Whether a household is living in poverty is therefore often reflected by its financial situation.

Low-income households face several risks. First of all there are risks related to household members’ health, like illness, disability and death. These events often affect households in two ways: they bring costs for medical treatment, hospitalization or burial and simultaneously result in a decrease of income when one of the family members is, at least temporarily, unable to work. A second class of risk is loss of property. A savings mechanism frequently used by poor people is investing in assets, which makes a household’s savings vulnerable to theft and fire. Another risk poor households are exposed to is income risk. As resources to cope with a sudden loss of income often are not available this may immediately affect the living standard.

Almost all risks listed above do not solely apply to the poor but also to more wealthy people. What distinguishes the poor from other groups is the inability to effectively cope with these risks. In developed countries financial systems are available to put savings on a bank account and to insure against many risks. Developing countries typically lack such systems, or at least large parts of their populations do not have access to them. This implies that the poor depend on government programs and informal risk management strategies, which will be discussed later, and makes them vulnerable to risk.

As mentioned by Churchill (2006), poverty and vulnerability reinforce each other. The vulnerability to risk exposure caused by poverty leads to risk avoidance and therefore keeps poor people from undertaking more risky activities, even if these activities may generate more income and thereby reduce poverty. For example, using fertilizer increases crop yield, but poor farmers may choose not to use fertilizer because it is costly, and in case the crop is destroyed by a natural event, a larger sum of money is lost. Such income-reducing risk avoidance is often referred to as the poverty trap.

The source of risk is an important determinant of the extent of vulnerability to income shocks. A distinction can be made between individual and common risk. Individual risk refers to risks only affecting particular individuals or households within
a community. Common risks are aggregate, covariant risks simultaneously affecting all members of a community or region. Informal risk sharing mechanisms within communities tend to be more successful in dealing with individual risks, as these risks only affect some of the community members. An empirical study by Dercon (2002) shows that in practice many income risks faced by rural households in Ethiopia include both individual and common features. However, the individual part of these income risks seems to be dominant, as found by other studies.\(^4\)

In its World Development Report 2000/2001, the World Bank studies the relationship between poverty and macroeconomic downturns caused by economic crises and natural disasters. It concludes that a strong link exists between macroeconomic downturns and rising income poverty, as large adverse shocks not only affect poor people in the short run, but also undercut their ability to move out of poverty in the long run. While shocks hurt both the poor and the non-poor proportionately, their effect is much more devastating for the poor as this group lacks access to effective insurance schemes. The living standards of the poor are affected through different channels:

- a decrease of labour earnings caused by falling real wages and rising unemployment;
- a decrease of non-labour incomes due to slowing economic activity, possibly resulting in a more than average decrease of goods and services produced by poor people;
- private transfers are likely to decrease as a crisis is felt across the nation;
- assets held by the poor are exposed to inflation;
- accumulation of human, financial and physical capital slows, which weakens the ability to escape from poverty.

In developing countries agriculture plays an important role in the economy. Swiss Re (2007) mentions that, despite industrialization, the agricultural sector on average still accounts for 9% of the total GDP in emerging markets.\(^5\) For industrialized countries this figure is less than 3%. Furthermore agriculture employs 49% of the people employed

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\(^5\) The definition of emerging markets as applied by Swiss Re (2007) may differ from that of developing countries used in other studies. For example, Swiss Re (2007) includes markets like Hong Kong, Malaysia, Singapore, South Korea, Argentina, Brazil, Czech Republic, Russia, Turkey and the United Arab Emirates.
and covers 37% of total land area. The figures contained in The World Bank (2000), which refer to developing countries, are even clearer on agriculture’s importance: in 1999 agriculture accounted for 27% of GDP and 69% of the population lived in rural areas. However, according to Hess et al (2002), these figures still underestimate the importance of the agricultural sector for economic growth. As agriculture is linked to other economic sectors, its importance is multiplied. Furthermore, agriculture strongly influences the livelihood of the bulk of the population and agricultural export is a major source of foreign exchange earnings.

Agricultural earnings are largely determined by biological, climatic and financial conditions. Risks in agriculture originate from imperfect predictability of these conditions. The World Bank (2005) distinguishes five major sources of risk. The first of these risks is production risk. As agricultural production is influenced by many uncontrollable external factors, like weather, pests and diseases, agricultural production often is highly variable.

Secondly, agricultural revenues are not only determined by production but also by prices. Therefore both input and output prices, which typically are extremely volatile, are important sources of risk in agriculture. In local markets price and production risks tend to be less severe, as in these markets a higher level of production generally translates into a lower output price and vice versa. However, for markets with a larger geographical scope output prices will not be sufficiently influenced by local production to offset possible losses caused by lower production levels.

Financial risks may arise from the fact that agricultural cycles often stretch over long periods of time, and therefore it takes a long period before farmers are able to recuperate expenses. This may cause cash flow problems. In developing countries these problems typically are even more serious, as farmers lack access to credit or have to pay extremely high interest rates.

Another major risk for agricultural producers is institutional risk. This type of risk refers to unexpected changes in the regulatory and economical environment in which farmers operate. Again, this risk seems to be more serious in developing

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6 Compared to 10% in middle-income countries and 2% in high-income countries.
countries, which typically lack the political stability present in most developed countries.

Finally, The World Bank (2005) mentions operational risk factors like producer liability risk, which will increase due to the growing concern for the impact of agriculture on the environment, personal risks to the wellbeing of people who work on the farm, and asset risks.

Most of the studies on agricultural risk in developing countries mention weather risk and price risk as the most important sources of risk. The importance lies in the fact that both these risks are common risks and therefore potentially have a serious impact on local economies. According to The World Bank (1999), during the period 1983 through 1998 the prices of many commodities in the world’s poorest countries showed fluctuations to below 50 percent and above 150 percent of their averages. This uncertainty in commodity prices not only affects individual farmers, but also reflects in the economies of countries as a whole, as price volatility affects governments’ fiscal revenue, trade balance, exchange rate and creditworthiness. The importance of weather risk is best illustrated by the following quote.

"Reducing economic vulnerability to weather events in developing countries may very well be the most critical economic development challenge of the new millennium. As a proportion of GDP, natural disaster losses in developing countries are 20% greater than in industrial countries. The economies of many developing countries rely heavily on agriculture and agricultural success is directly tied to weather.” (Varangis (2002), p. 1)

### 2.2 Traditional risk management strategies

Households in developing use various strategies to deal with the income risks they face. Several authors make a clear distinction between risk management strategies and risk-coping strategies. The difference between these classifications lies in timing of the action associated to the strategy: before or after an income-affecting event has taken place. Risk management strategies refer to *ex ante* measures taken before such an event has taken place, while risk-coping strategies are *ex post* strategies dealing with the consequences of the event. Dercon (2002) discusses several of these strategies.

In developing countries risk management strategies based on income-smoothing are often used to reduce income risk ex ante. A possibility to smooth income is income diversification, using different income sources instead of only a single source. In the best case this would result in a situation with the same mean income, but with lower risk as the income sources are not perfectly correlated. Unfortunately, the general trade-off between risk and return present in financial markets also applies here in the sense that the reduction of risk associated to income diversification usually comes at the expense of a reduction in mean income. Moreover, besides reducing mean income, income diversification does not even necessarily have to reduce income risk at all. This is the case if the incomes generated from different sources that may appear to be uncorrelated in normal years, turn out to move together in times of a financial crisis felt in different sectors of the economy.

Risk-coping strategies often involve informal risk-sharing mechanisms. These risk-sharing mechanisms can have two forms. The first of these is self-insurance, individual households spreading risks over time by accumulating assets. As mentioned earlier, this strategy results in a high exposure to price risk as the income generated by selling the assets accumulated is price sensitive. Another informal risk-sharing mechanism is based on solidarity within communities. Individual members of a community affected by an income shock are temporarily supported by other community members. Basically, this is an informal form of insurance, where the unfortunate individuals experiencing a loss receive income transfers from the other members of a group. However, such mechanisms are heavily dependent on the social cohesion within a community and are only effective in reducing individual risks. Common risks are felt throughout the whole community and therefore cannot be handled within the community. For coverage of common risks people depend on safety nets provided by larger risk-sharing networks or governments.

The World Bank (2005) provides an overview of the strategies available in agriculture. Besides distinguishing between ex ante and ex post strategies, a distinction is also made between formal and informal mechanisms. Informal mechanisms involve arrangements between individuals, or households within a group, while formal mechanisms concern
market-based activities and publicly provided mechanisms. Below several strategies are listed.\textsuperscript{10}

**Informal ex ante mechanisms**
- Avoiding risk exposure
- Crop diversification
- Income diversification
- Advanced cropping techniques
- Buffer stock accumulation of crops or liquid assets
- Crop sharing with other farmers
- Informal risk pooling

**Formal ex ante mechanisms**
- Agricultural extension\textsuperscript{11}
- Pest management systems
- Infrastructure (roads, dams, irrigation)
- Contract marketing and futures contracts
- Insurance

**Informal ex post mechanisms**
- Sale of assets
- Reallocation of labour
- Mutual aid

**Formal ex post mechanisms**
- Social assistance
- Social funds
- Cash transfer

Farmers in developing countries typically are unable to apply many of the formal, market-based risk management strategies shown above due to limited access to financial markets or a lack of infrastructure. Therefore this group only has informal strategies available to manage income risk ex ante. Unfortunately, these traditional, informal risk management strategies result in a reduction of income and an increased exposure to price risk.

### 2.3 Microfinance as a solution
As poverty can be diminished by reducing risk exposure, and many of the risks poor people are exposed to could be reduced by using financial instruments available at financial markets, a legitimate question would be why the poor lack access to these financial markets. The answer to this question basically boils down to the following: providing financial services to the poor in a profitable way requires a specific tailor-made approach that is different from the current practice in traditional financial markets. The first requirement for serving the poor is a local bank office. As this requirement often is not met, a large group of people is excluded from financial services. Another

\textsuperscript{10} This list is based on table 2.1 in The World Bank (2005).
\textsuperscript{11} The term agricultural extension refers to a wide range of communication and learning activities organized for rural people by professionals from different disciplines (www.wikipedia.org).
channel the need for a specific approach is reflected through is transaction costs. The transaction costs associated to serving the poor with financial services in the traditional way are simply too large. For example, for a loan the transaction costs include costs associated to the analysis of the applicant’s creditworthiness and administration costs. These costs generally are fixed amounts per applicant that are independent of the loan amount, which makes the transaction costs for a small loan very large in relation to the loan amount, and undermines the profitability of offering the loan. This kind of problems causes the limited access for poor people to traditional financial markets.

Microfinance is a term that refers to a range of financial products specifically aimed to serve the poor. Many people confuse microfinance with microcredit, small loans for poor households to enable them to undertake a tiny business. However, microfinance also contains other financial services like savings and insurance. In the 1980s, the period in which the first microfinance initiatives were developed, these initiatives mainly consisted of microcredit services. Later developments added also other products, like microsavings and microinsurance, to the range of services. The demand for these additional services can be explained by the fact that people having their own business also need instruments to safely accumulate assets and to protect against the losses associated to certain events. The development of microinsurance initiatives was also fostered by the parties offering the loans, as they like to minimize the risk of customer default.

Typical clients of microfinance are persons that lack access to traditional financial markets, but have an opportunity to grow their own business. Often these persons are self-employed, household-based entrepreneurs, like small farmers trying to make a business with their small plot of land. Important is that these persons have a stable income. People without a stable income will only be pushed further into poverty as they will not be able to repay their loans. Microfinance therefore only works for those with the possibility to capitalize on an economic opportunity if they are provided with financial services. It can help them to establish viable businesses and reduce

12 This whole subsection heavily relies on information in the ‘Frequently Asked Questions’ section of the Microfinance Gateway (www.microfinancegateway.org).
13 Although similar initiatives have been employed earlier, the concept of microfinance as we know now dates back to the early 1980s.
vulnerability to risk, and thereby increase and stabilize income. It can also be an instrument for self-empowerment of the poor by enabling them to become economic agents. Especially women can escape from their traditional, dependent role and undertake their own economic activities.

All institutions offering financial services to the low-income market are referred to as Microfinance Institutions (MFIs). MFIs can be organizations exclusively dedicated to offering microfinance as well as organizations having microfinance as only one of their many activities. As traditional financial markets are unable to profitably offer financial services to the poor, the question rises how MFIs can be able to do so. In the end, transaction costs are still high, also for MFIs. The answer lies in the approach used by successful MFIs, which specifically fits the market served. First, by offering flexible products one takes account of clients’ specific cash flow patterns, thereby meeting their demand. Second, by effectively making use of existing local networks costs can be reduced. This does not mean that this approach manages to reduce costs towards the levels common in traditional financial markets. The costs are still substantial and therefore expense loadings are relatively high. However, microfinance clients are willing to pay these loadings as they are aware that their alternatives, like informal lending with excessive interest rates and refraining from purchasing the product, are much less attractive.

Some microfinance programs are subsidized by governments or NGOs. Although subsidies can be useful in the initial stage of a program by enabling the organization to build a strong foundation, in later stages MFIs should be able to run their business without any monetary assistance from other parties. Dependency on donor money simply is not a sustainable solution for the poor’s lack of access to financial markets.

In the 1990s commercial banks gradually became involved in the microfinance sector. This involvement was partly caused by MFIs organized as NGOs obtaining banking licenses and thereby turning into commercial banks, but also by international banks starting to participate in the market. The reason for their participation is twofold: to improve their reputation by showing their corporate social responsibility, and to achieve commercial gains. International banks mainly offer their services to large, established MFIs instead of directly to microfinance clients. However, some banks do
also sell products directly to small enterprises. Currently large international banks like ABN Amro, Barclays, Citigroup, Deutsche Bank, ING and Rabobank employ microfinance activities.\textsuperscript{14}

Recent developments, such as the designation of the year 2005 as the \textit{International Year of Microcredit} by the United Nations and the 2006 Nobel Peace Prize for Muhammed Yunus, show the enthusiasm many have for microfinance. In a video message on the launch of the International Year of Microcredit Kofi Annan, the former UN Secretary-General, mentioned the following.

"Microfinance has proved its value, in many countries, as a weapon against poverty and hunger. It can really change people’s lives for the better – especially the lives of those who need it the most."\textsuperscript{15}

Next to this enthusiasm also critique is heard. The people expressing this critique question the success of microcredit and the validity of the figures reported by some MFIs.\textsuperscript{16}

Based on the large number of potential clients in developing countries, many people believe that microfinance has the potential to become a commercially attractive market once it becomes mainstream. Others worry that once microfinance becomes more mainstream, the focus will shift towards serving only the upper class in the microfinance markets, as there is most of the money, thereby neglecting other people.

\textsuperscript{14} ING (2006a) and ING (2006b)  
\textsuperscript{16} Doorn (2007) provides a brief and clear discussion of the critique on microcredit.
3 Microinsurance

This chapter focuses on microinsurance, for which a definition will be given and several relevant issues will be brought up. It discusses the differences with commercial insurance and the various institutional options. Finally, an overview of microinsurance activities across the globe and the experiences encountered so far will be given.

3.1 What is microinsurance?

As explained in the previous chapter, microinsurance is a risk management instrument in the range of financial services for poor people that do not have access to mainstream financial markets. Churchill (2006) defines it as “the protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved”. This definition does not differ substantially from that of insurance as present in developed countries. The only difference is the target client group, low-income people, and, consequently, the amounts involved in microinsurance policies. Whether it is the most appropriate risk management tool depends upon the type of risk it is supposed to cover: it is appropriate in order to protect against infrequent large losses since pooling can diminish individual losses. However, for risks with small losses and a high frequency of occurrence, instruments like savings and emergency loans would be more appropriate.17

Churchill (2006) identifies two views on microinsurance. First of all it provides social protection for workers in the informal economy for which there are no government programs. Second, it can also be seen as commercially attractive to offer low-income people opportunities to develop their own businesses. To be successful in helping the poor and simultaneously be commercially attractive, microinsurance initiatives should find a balance between the following three competing objectives:

- coverage to meet the needs of low-income people;
- minimizing insurers’ costs;
- minimizing consumer prices.

17 Churchill (2006)
A main determinant of the success in minimizing insurers’ costs and consumer prices is whether the insurer is able to find a way to deliver insurance efficiently. In developing countries insurance markets are far from mainstream, so much attention should be paid to finding the appropriate institutional insurance delivery option that best fits the local circumstances. The institutional options most frequently observed so far are discussed in the next subsection.

To meet the other objective of microinsurance, complying with the needs of low-income people, insurers need to have a clear picture of the issues that determine the demand. Cohen and Sebstad (2006) discuss six aspects of microinsurance demand. The first of these aspects is coverage. This has to be adjusted to the needs and the financial position of the customers. As low-income households have various strategies to deal with income shocks, insurance only needs to cover the part not taken account of by other measures. Also financial reasons may underlie only partial insurance coverage, as full coverage is expensive and households may not be able to afford it.

A second issue is accessibility. Demand is clearly related to the number of people having access to the insurance program. The channel used to deliver insurance to a large extent determines accessibility.

Also timing of cash flows is an important factor. This does not only hold for the benefit payments, that need to be settled quickly as low-income households by definition are vulnerable to shocks as they lack cash reserves to deal with them, but also for premium payments. Although, as explained earlier, microfinance clients need to have a relatively stable income, rigid premium collection rules may rule out large groups of people as their income pattern may not always be compatible with the timing of premium collection. Attention for the timing of potential clients’ income flows and flexibility in premium collection therefore may increase the demand for microinsurance.

As for all products, pricing and affordability is another factor influencing the demand. Since local circumstances and the individual situation of households vary across regions, no general statement can be made on the price sensitivity of microinsurance clients. Therefore insurers have to do market research in order to obtain a clear picture of ability and willingness to pay.

A very important issue is the familiarity of people with insurance. Since many people in developing countries do not have any experience with formal insurance,
adoption of such schemes is a serious challenge. The concept of insurance therefore needs to be explained to potential clients. Most important is to ensure that people do not become disappointed by the results of the insurance scheme they bought, as bad experiences may seriously harm reputation.

Cohen and Sebstad (2006) mention the importance of tailor-made solutions. Demand studies reveal different insurance priorities for different market segments and regions. Standardized insurance products designed to attract large client groups, as available in developed countries, are not a solution to the insurance needs of poor households in developing countries.

A final issue assumed to influence the demand for microinsurance is households’ risk aversion. Based on the well-known relationship between risk aversion and risk avoiding behaviour, one would expect that more risk averse households are more likely to buy insurance products. However, an empirical study on rainfall insurance participation in rural India performed by Giné et al (2007) actually finds the opposite. A possible explanation for this result may be that it reflects households’ uncertainty about the insurance product due to their lack of experience with the concept of insurance. When a lot of uncertainty exists on the insurance product itself, the finding that more risk averse households are less likely to purchase the product is consistent with the assumed relationship between risk aversion and insurance participation.

3.2 Institutional options
For the delivery of microinsurance products several institutional options are available. This subsection discusses the three most common and some alternative options.

3.2.1 The cooperative model
In the cooperative model insurance is delivered through mutual institutions, institutions that are owned by their member-users, the policyholders. An important implication of the fact that the ownership lies with the members is that profits stay with the policyholders, instead of flowing away to shareholders. The case studies covered by

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18 This discussion of the cooperative model is based on Fischer and Qureshi (2006).
ILO’s and Munich Re Foundation’s *microinsurance compendium*\(^\text{19}\) show three varieties of mutual institutions: stand-alone mutual insurance companies, insurance as a business affiliated to a network of financial cooperatives and networks of mutual insurance associations. Fischer and Qurashi (2006) focus insurance cooperatives of the second type. For this type of cooperative there are two key components: a risk carrier that creates and underwrites insurance products and an association of cooperatives that serves as the distribution network and as a more-or-less captive market.

The range of insurance products offered to the low-income market through cooperative or mutual insurers is limited. The reason is that in general networks of cooperatives only want to offer insurance products that complement to the other financial services they provide. An example of such a product is credit life, a product that repays the outstanding debt in case the holder of the debt dies.\(^\text{20}\) Obviously, a cooperative providing credit to its customers decreases its default risk exposure by selling credit life policies to its customers.

Other problem areas for the cooperative model are the weak governance structure, possibly leading to a lack of skilled employees or managers squandering member capital in absence of appropriate control mechanisms, and a direct link between the success of the insurance program and the success of the cooperative network. Furthermore, the risks associated to insurance activities might not be properly separated from the other risks faced by the network.

Next to these problems, the cooperative model also offers advantages. First of these is the absence of the risk that the insurer fails to meet its insurance obligations, which is a direct consequence of the ownership structure with the policyholders also being the owners. Furthermore, cooperative networks often are quite large, therefore having access to large numbers of people in a variety of cultural and economical environments, and already have risk capital available for investment purposes. This available capital also limits the need for donor funding other than technical assistance. Large networks often have affiliations or alliances with other parties, which increases the accessibility of reinsurance. A last important issue is that investments directly foster

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\(^\text{19}\) *Protecting the poor. A microinsurance compendium* is a publication of the International Labour Office (ILO) in association with the Munich Re Foundation that is a collection of articles on various relevant topics on microinsurance, and is issued in 2006. Throughout this thesis references to many articles in the *microinsurance compendium* are given.

\(^\text{20}\) The credit life product is often referred to with the phrase “the debt dies with the debtor”. 

the development of the region, as the cooperative structure ensures that income returns to the community.

Fischer and Qurashi (2006) conclude that microinsurance initiatives using the cooperative model have the potential to be financially viable and to provide services to a wide variety of low-income people. In order to overcome the weaknesses they suggest to develop clear organizational and financial guidelines, enhance government arrangements and clearly distinguish risks related to the network’s insurance activities from other risks.

3.2.2 The partner-agent model

With the partner-agent model commercial insurers deliver microinsurance products through special agents that have relationships with low-income people, mostly MFIs. The difference with the cooperative model lies in the ownership structure: with the cooperative model the insurer is owned by the mutual institution, while with the partner-agent model commercial insurers are the insurer and MFIs are only used as agent.

The partner-agent model definitely has potential advantages for all groups involved. For MFIs it is the simplest, quickest and cheapest way to offer their clients risk management services outside the traditional credit and savings products without bearing too much risk. Commercial insurers also clearly benefit from the relationship with the MFI. Since an effective delivery channel is a critical component of successful microinsurance, the existing network and potential market offered by the MFI that acts as their agent substantially lowers acquisition and transaction costs. A possibility to sell group policies would make the agreement even more efficient. The advantage for low-income households is that the model ensures access to formerly inaccessible well-managed insurance products.

To benefit from the potential the partner-agent model offers, the roles and responsibilities of both parties involved need to be recorded in an agreement. Relevant issues are underwriting, staff training, premium collection and claims processing. The parties need to design a structure that is as efficient as possible in order to be able to offer affordable products. Problems may arise when MFIs regard microinsurance as

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21 This discussion on the partner-agent model is based on McCord (2006).
being of minor importance than their core business, do not have sufficient resources, or
do not have sufficiently trained staff to also deal with microinsurance.

As the commercial insurer makes use of the MFI’s network, it has to make
financial arrangements with the MFI. The three most common types of financial
arrangements between insurers and MFIs are the following. The first possibility is a
commission structure with the insurer paying commissions to the agent. Secondly,
various profit sharing mechanisms are observed and, finally, also a system of premium
mark-ups, with the agent simply adding an amount to the premium offered by the
insurer, is a possibility.

A study of experiences with the principal-agent model has identified three
factors correlated with the success of the model. These are the size of the agent’s client
base, appropriate management attitudes on the side of the agent and a positive attitude
with the agent’s field staff. A difficulty frequently encountered is establishing good
penetration rates for voluntary insurance products. Especially in India, where the
partner-agent model is frequently used due to the regulatory obligation for commercial
insurers to serve the low-income market, this is a problem.22 The saturation of MFIs
willing and able to work with insurers coupled with the relatively limited outreach of
these MFIs encourages insurers to consider other distribution channels. A good example
of an initiative based on another organizational structure is that of Tata-AIG, using local
individuals selected by NGOs as micro-agents.

McCord (2006) concludes with the remark that the partner-agent model seems to
work best when the insurance product is simple, mandatory, valuable to low-income
people and directly related to the agent’s core business. Furthermore, the agent should
recognize the benefits the product has for itself and for the clients and provide
explanation to its client via skilled field staff. The insurer should recognize that offering
microinsurance requires a different approach than its other business activities.

### 3.2.3 The community-based model

Fonteneau and Galland (2006) identify an institutional option different from the two just
discussed in the insurance schemes offered by several mutual health organizations
(MHOs) in Africa: the community-based model. Actually this model seems to be quite

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22 Section 5.2.2 provides more detailed information on India’s regulatory environment.
similar to the cooperative model in the sense that risk sharing within communities is the
basis of the model, members are both the owners and the beneficiaries and the
organization does not have a profit objective. A feature that distinguishes the
community-based model from the cooperative model is that the latter is based on
established distribution networks and insurance simply is a new service added to the set
of other financial services. The community-based model more relies on volunteer labour
and leveraging social capital to control insurance risks.

3.2.4 Alternative options

Besides the three insurance delivery models just discussed, there exist many other
possible institutional options. Important is that one should always keep in mind that
insurance for the low-income market is a high-volume, low-premium business which in
general is deeply price-sensitive. Three functions are distinguished within the insurance
structure: those of risk carrier, those of administrator and those of distributor.

Most often regulated insurance companies play the role of risk carrier. Possible
alternatives are self-insurance and making use of a so-called protected cell company
(PCC). These alternatives are often considered in case the desired microinsurance
product is simply not available. With self-insurance an unlicensed and unregulated
organization offers its own insurance product. This is often done outside the regulatory
framework. Problems that often arise with this form of risk carriage are a lack of
actuarial knowledge, resulting in poor financial performances, and an inability to
purchase reinsurance. A possible solution to these problems is establishing a protected
cell company. A PCC transacts insurance using the capital and regulatory status of a
host insurance company. The host is responsible for gains and losses, provides actuarial
expertise, helps to obtain reinsurance and receives fees in return. Requirements for this
to work are a good relationship between the host and the delivering organization and
availability of knowledge within the host. A disadvantage of the PCC-construction is
the incentive for the delivering organization to carry the risk itself if the product is
available from the host, resulting in a partner-agent model.

The administrative role in the partner-agent model is often divided between the
partner and the agent, with the agent doing the policy formation (client application,
premium collection) and the insurer verifying and paying claims. This structure might, despite serious efforts to handle claims quickly, lead to client dissatisfaction with the claims processing time. Two alternative options are using amended agency agreements, which gives the agent the responsibility to process the claims itself, and outsourcing the administration to third parties.

Traditional insurance distribution channels in developed countries are credit services, retailers, cooperatives and workers’ unions, TV/direct sales, cell phones, burial and other informal societies and worksite marketers. In developing countries the infrastructure or the level of client education might not be sufficient to implement these options. Therefore alternatives like micro-agents (working for one insurer) or independent microinsurance intermediaries (delivering products of several insurance companies) could be used. Leftley and Roth (2006) mention the following advantages of intermediaries:

- product development: more suitable to customers’ needs;
- lower transaction costs;
- effective outsourcing of the administration;
- additional channels of sale;
- staff training.

An example of a microinsurance intermediary is the Micro Insurance Agency, established by Opportunity International\(^\text{24}\) in 2005.

### 3.3 Activity and experiences

Now we have covered the theory on microinsurance, a logical continuation would be a discussion of the experiences encountered in practice. This section will provide this discussion, starting with an overview of microinsurance activities worldwide, thereby heavily relying on a recent landscape study described in Roth et al (2007).

#### 3.3.1 Microinsurance activity

As shown in figure 1 and table 1, the landscape study identifies three regions with strong microinsurance activity: Latin America, Africa and Asia, with Asia clearly being

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\(^{24}\) Opportunity International is an American NGO aiming to reduce chronic poverty in developing countries and thereby operating several microfinance programs.
the region with the largest number of policyholders. Remarkable is the lack of microinsurance in North Africa and the Middle East and the fact that, although growing fast, the number people having microinsurance is very small as compared to the total population of poor people.

Roth et al (2007) distinguish four product categories: life, health, accident & disability and property. In terms of the number of policyholders, most products concern life products, with the other product groups all being somewhat smaller. An exception is Africa, where the health category contains most of the people. A demand study performed as part of the survey reveals that poor people’s major demand is for health and life products.

Figure 1. An overview of the number of microinsurance providers across the globe (source: Roth et al (2007), map 1).

Four main types of microinsurers were identified in the landscape study. The type with the largest number of policyholders is the group of commercial insurers (38.0 million), followed by NGOs (9.8 million), mutual insurers (2.5 million) and community-based organizations (CBOs, 0.7 million). Although both types are based on risk sharing between members of communities, the distinguishing factor between mutual insurers and community-based organizations is that mutual insurers are professionally managed.

25 Microinsurance activity in Eastern Europe is to a large extent out of the survey’s scope, as the survey only considers the 100 poorest countries.
26 Crop insurance is classified as property, together with other property insurance products.
and typically are regulated. CBOs are managed by members and often operate without insurance license. Due to this non-professional character and the usually local and small scale nature of their operations the study is very likely to underestimate the number of CBOs.

<table>
<thead>
<tr>
<th>Region</th>
<th>Life</th>
<th>Health</th>
<th>Accident &amp; Disability</th>
<th>Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>7,545,057</td>
<td>445,876</td>
<td>105,000</td>
<td>600</td>
<td>8,096,533</td>
</tr>
<tr>
<td>Africa</td>
<td>2,036,141</td>
<td>3,053,778</td>
<td>1,603,000</td>
<td>1,600,000</td>
<td>8,292,919</td>
</tr>
<tr>
<td>Asia</td>
<td>54,158,332</td>
<td>31,697,038</td>
<td>39,180,058</td>
<td>34,557,434</td>
<td>159,592,862</td>
</tr>
<tr>
<td>Total</td>
<td>63,739,530</td>
<td>35,196,692</td>
<td>40,888,508</td>
<td>36,158,034</td>
<td>175,982,314</td>
</tr>
</tbody>
</table>

Table 1. The number of policyholders by product and region (source: Roth et al (2007), table 3). 27

3.3.2 Microinsurance experiences

The experiences encountered with microinsurance so far can be divided into two groups: experiences that hold for all product types and experiences that are product-specific.

Experiences relevant for all types of microinsurance products are those with delivery channels, market barriers and regulatory issues. Concerning delivery channels, the landscape study reveals that MFIs are involved in delivering microinsurance less often than expected. Based on the fact that MFIs already reach large groups of low-income people and also are familiar with offering financial services, one would expect them to be the most appropriate delivery channel for insurance products. Roth (2007) concludes that existing delivery channels often do not recognize the opportunities microinsurance offers the people they serve and instead focus on the way it may benefit themselves.

A second experience related to delivering insurance products is the effectiveness of selling group policies. Obviously, as compared to individual product, group-based delivery reduces costs significantly, often with a factor between 3 and 6. 28

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27 The actual number of policies, 78.5 million, is much lower than the total shown in the table. This is due to the fact that several policies cover risks in more than one category, and therefore are counted more than once in the table.

28 Roth (2007)
An important market barrier is the lack of understanding of financial products by poor people. This lack of understanding sometimes results in a negative attitude towards insurance products. These problems need to be overcome by taking away the negative image through providing information in a way appropriate for the target client group and successful insurance programs.

Also from the side of commercial insurers microinsurance is not completely understood and appreciated. Just like what happened with microcredit, commercial parties need to start recognizing the microinsurance market as a profitable opportunity to expand their operations.

Regulatory issues involve problems with the fact that many microinsurance activities are performed outside the supervision of regulatory institutions. Many microinsurance products are offered by unregulated insurers, which is undesirable as this increases the risk of policyholders losing their premiums and being exposed to catastrophes. Therefore efforts have to be made to regulate more microinsurance activities. However, these regulations need to take into account the specific nature of the market, as experiences with markets where microinsurance is subjected to mainstream insurance regulations show that many initiatives are hindered by excessive capital requirements and complicated documentational standards. Possible solutions to these problems are the use of reinsurance to reduce the capital required and the design of specific microinsurance regulations. Efforts on regulatory issues concerning microinsurance are made by a joint working group of the International Association of Insurance Supervisors (IAIS) and the Consultant Group to Assist the Poor (CGAP).²⁹

The experience with life insurance is that still much of the activity is in the informal sector. Good examples are community-based burial societies.³⁰ However, as the landscape survey reveals, the life insurance market is the largest microinsurance market in terms of the number of policyholders. This can be explained by the fact that life insurance is the easiest to provide form of insurance as it is highly demanded, relatively easy to price, only weakly exposed to problems related to adverse selection and moral

²⁹ For more information on their efforts so far, see IAIS (2007).
³⁰ Morduch (2004)
hazard\textsuperscript{31}, independent of local infrastructure and easy to link with other financial services. This does however not imply that there are no problems to overcome: many life insurance policies help the poor only to a limited extent. The landscape survey shows that most of the life insurance policies are short-term policies and often involve the credit life product, which mostly benefit the credit institution instead of the policyholder. Furthermore, in the cases where long-term life insurance products are offered, these are not always helpful for the policyholders because of issues like devaluations, inflation, poor returns, or loss of savings due to early termination.\textsuperscript{32}

Although health insurance, just like life insurance, is highly demanded, much more problems are encountered so far. First of all, offering health insurance does not make any sense if there is no proper local healthcare infrastructure, which typically is the case in many developing countries. Secondly, health insurance is subject to adverse selection, as unhealthy people tend to purchase health insurance more often than healthy people. Finally, something that specifically holds for developing countries is the lack of data on the costs of medical treatments, which is a serious problem as these costs can involve considerable amounts. Possible solutions to overcome this last problem are putting caps on insurance coverage and purchasing reinsurance.\textsuperscript{33}

A problem experienced across all types of property insurance schemes is controlling fraud and moral hazard.\textsuperscript{34} This problem is not specifically present in developing countries; also in developed countries people try to file false claims and tend to be less cautious after purchasing insurance coverage. Specific experiences with agricultural insurance will be discussed in the next section.

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\textsuperscript{31} Adverse selection is the phenomenon that only people exposed to high risk will purchase insurance. Moral hazard is the situation in which a policyholder changes his or her behaviour in such a way that the likelihood and/or magnitude of a loss are increased.

\textsuperscript{32} Roth (2007)

\textsuperscript{33} Morduch (2004)

\textsuperscript{34} Roth (2007)
4 Agricultural insurance for the poor

As already discussed in chapter 2, agriculture plays a vital role in the economies of developing countries. Efficiently managing agricultural risks may therefore improve these countries’ economic situation and the living standard of their citizens. As agricultural risks, of which price risk and yield risk are the most important, typically are common risks felt within whole regions, traditional community-based risk-coping and risk management strategies are often insufficient to achieve efficient risk transfers. Agricultural insurance offers a possibility to shift risks outside local communities. This chapter discusses traditional agricultural insurance schemes and their problems encountered. Also index-based insurance, a relatively new development in this field that overcomes many of the problems associated to traditional schemes, will be discussed. Throughout the whole chapter a special focus will be on crop insurance, as this is the relevant form of agricultural insurance for the case study discussed in chapter 5.

4.1 Traditional agricultural insurance

The recent decades have provided us with experiences on agricultural insurance in developed countries. From these experiences many authors conclude that the way agricultural insurance is offered in developed countries is inappropriate for developing countries. The basis of this conclusion is one common factor in these traditional agricultural insurance schemes: they are all designed as yield-based, multi-peril schemes. This means that all these schemes’ payouts are based on the loss in yield caused by an event, and that there are multiple events that may result in a payout.

These characteristics may result in situations in which the basic principles of insurance are harmed. The first of these basic principles is that the insured event should be objectively measurable and outside the insured’s influence. With yield-based agricultural insurance this is not the case. It is not possible to objectively subscribe a loss to a specific event, as the yield is influenced by many other events. Furthermore, this inability to determine the exact source of agricultural losses may also result in a situation with farmers having less incentive to take good care of their business, as the

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losses associated to this behaviour will be compensated through the insurance scheme. This problem of a change in behaviour after buying insurance is called moral hazard.

Another problem with the basic insurance principles is that agricultural losses are correlated. Insurability requires a large number of identical but independent risks. The law of large numbers\(^{36}\) then ensures that the sum of all individual losses becomes more predictable.

As with traditional agricultural insurance two basic insurance principles are violated, legitimate questions would be why these schemes are present in developed countries and why this approach cannot be implemented in developing countries. The answer to these questions lies in the fact that in developed countries systems to overcome the problems are available, and that these systems are not feasible in developing countries.

In developed countries the problem of damage assessment is handled by sending agricultural experts to farmers that claim to have a loss caused by an insured event. These experts then judge whether this indeed is the case, or that the loss, either fully or partially, is caused by other factors. This damage assessment system also is a mechanism to control for moral hazard. Although this system brings expenses associated to hiring these agricultural experts, implementation is feasible in developed countries as these countries’ agricultural sector typically contains many large scale businesses, thereby reducing the per-policy costs. In developing countries, in contrast, most agricultural businesses are small, what would lead to relatively high damage assessment costs per policy. Another problem associated to damage assessment in developing countries is that people lack financial reserves to deal with financial shocks and therefore need to receive the benefit payment quickly. Unfortunately, proper damage assessment will take some time, especially in areas with infrastructural shortcomings.

The second problem, that agricultural risks are common risks, can be addressed by reinsurance mechanisms. Insurers can buy reinsurance for the layer of risk associated to catastrophic losses in order to limit their own risk exposure. Reinsurers in their turn can diversify their portfolio geographically by offering reinsurance all over the world. This results in a portfolio of more or less independent risks, as the weather in one part

\(^{36}\) The law of large numbers is a well-known statistical law described in all standard textbooks on statistics. See for example Bain and Engelhardt (1992).
of the world can be assumed to be independent of the weather in other parts. Unfortunately insurers in developing countries have no or only limited access to reinsurance. This is due to the fact that reinsurers require that insurers comply with their standards of offering insurance, involving underwriting issues, that insurers in developing countries simply cannot meet. Reinsurers also require some minimum volume of business as reinsurance contracts involve high transaction costs. Again, this requirement is not feasible in developing countries.37

4.2 Index-based insurance solutions

In the last decade progress has been made in the search for an alternative to traditional agricultural insurance in developing countries. A solution is index-based insurance: insurance schemes in which the benefit payments are not based on actual losses but on the occurrence of a specific event. The occurrence and severity of the event are reflected by an index, and the level of this index determines the amount of the benefit payment. Basically, index-based insurance schemes are derivative financial instruments with as trigger38 the insured event. Skees (2003) distinguishes two types of indexes: yield-based and weather-based. For yield-based indexes the benefit payments are determined by the total area yield in some geographical region larger than the farm. Weather-based indexes’ payouts are determined by the occurrence of some weather event. Skees (2003) argues that weather-based indexes are usually preferred to yield-based indexes, as in developing countries the quality of historical weather data is better than the quality of yield data, and weather events, especially deficit or excess rainfall, are the major sources of crop losses in many regions.

4.2.1 Improvements and remaining challenges

As the trigger typically is an objectively and easily measurable event that cannot be influenced by individuals, index-based insurance is a way to overcome problems with

37 The World Bank (2005)
38 The trigger of a derivative is the event that determines whether or not the holder of the derivative receives a payment. For a regular European call option the trigger is the event that the value of the underlying asset is above the pre-determined strike price. In agricultural insurance the trigger usually is a specific weather event, for example deficit rainfall. In that case payments will be done if the total rainfall received in a certain period is below a certain level. An introduction in the subject of weather derivatives is given in Cao et al (2003).
damage assessment, moral hazard, the long claim handling process and high costs associated to damage assessment. Some studies also suggest that reinsurers are more willing to provide reinsurance for index-based insurance than for traditional agricultural insurance, as the benefit payments are now based on objectively measurable events. However, as we will see in section 5’s discussion on the crop insurance project in Tamil Nadu, India, also for index-based schemes access to reinsurance may still be very limited in practice.

As once indicated by the Dutch football legend Johan Cruijff\(^\text{39}\), with advantages there will always also come some disadvantages. For index-based insurance the first of these disadvantages is the fact that the events one would like to insure might not be objectively and easily measurable in developing countries, or there might not be a reliable source to provide data on it. For example, for an index that is based on a weather event, a reliable weather station needs to be present in the region of the insurance program.

Another problem with index-based insurance is basis risk. This is the risk that the benefit payments resulting from the index do not match the actual losses sustained by the people insured. There always is a possibility that the severity of an event is not large enough to result in the trigger to be hit, while this event does cause losses for some individuals. These individuals then face losses without being compensated with benefit payments. The other way around is also possible, with individuals not hurt by an event receiving benefit payments as the event was severe enough to hit the trigger. Diaz Nieto et al (2006) mention three possible sources of basis risk. First there is temporal risk, which refers to the phenomenon that during the crop cycle weather events’ impact on the crop yield may vary. A second source is spatial risk: the fact that weather events may occur locally, resulting in differences between the weather observed at the insured plot and the weather at the recording location. Finally, there is crop specific risk, which means that the sensitivity to weather events varies across crop types due to different crop characteristics.

As we have just seen, there are still several challenges to come to a successful index-based crop insurance program. Diaz Nieto et al (2006) mention some technical,

\(^{39}\) Besides his exceptional football skills and insights, Johan Cruijff has also proven to possess a clear analytical view on many other issues in life.
financial and administrative requirements that should be met for the scheme to have a positive impact on farmers’ livelihoods. Technical issues concerning the design of the index are the following:

- it should be easily understood and well defined;
- it should take account of crop sensitivity at different growth stages;
- it should take account of the relationship between soil texture and rainfall effectiveness;
- it should be crop-specific;
- it should define a protocol that reflects the actual planting date as closely as possible;
- it should ensure that the insured pays the price of spatial variation in risk;
- it should enable accurate estimation of the probability of the risk event.

For the financial and administrative system the program requires:

- reliability of the institution providing the weather data;
- transparency and absence of corruption;
- adaptation of the product to farmers’ needs;
- communication and training for farmers and field staff.

Hess et al (2002) also mention factors that determine the success of index-based agricultural insurance. However, the issues they mention are not only insurance program characteristics, but also involve issues in the broader scope of the market environment. The five key factors they highlight are:

- good weather data in key locations;
- a client profile that recognizes farmers as the ultimate end-users;
- facilitation by development organizations;
- a benign regulatory framework;
- a risk transfer mechanism into international weather markets.

In the following market-wide issues like layering of risk, involving the role of governments, local and global financial markets, and regulation will be addressed.
**4.2.2 Layering of risks and regulation**

Agricultural risks can be split into three layers in terms of frequency of occurrence and the associated loss. The bottom layer consists of high-frequency, low-severity risks. These are risks from various independent sources, occurring at least once every five years, and not having severe consequences for farmers. The middle layer includes less frequent but more severe risks, simultaneously affecting several farmers. The frequency of occurrence associated to this layer is roughly once in five to 30 years. Finally, the top layer of risks consists of truly catastrophic events, occurring at most once in twenty years, and having a very severe impact on farmers.

Several studies on the financing of agricultural risks argue that these layers should all be dealt with in a different way. The bottom layer is best to be retained by farmers and financed by other risk management strategies, as the risks in this layer involve low-severity shocks that farmers can smooth themselves.

Since the middle layer of risks includes more severe risks that cannot be dealt with by farmers without any form of risk transfer, local insurance companies should offer insurance products covering the risks in this layer. Unfortunately, as these risks often concern regionally correlated risks, local insurance companies face portfolios with a high tail risk. Therefore also for local insurance markets layering of risk should be applied. Skees et al (2005) mention two possible ways of financing the losses. The first is purchasing reinsurance at global markets. As in the past this has proven to be very difficult, as reinsurers demanded compliance with underwriting standards that simply are impossible to implement in developing countries, this requires reinsurers to develop a different approach for agricultural insurance in developing countries.

As a second possibility to assess the problem of tail risk of the insurers’ portfolios, governments should develop a regulatory structure to allow for risk pooling initiatives among insurers. When pooling is done efficiently, total reinsurance premiums related to the transfer of risk to global markets will be lower. The reinsurance benefits of the pool then could be shared between the participating insurers consistent with the

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40 Splitting up risks into different layers is a well-known risk management practice. Mahul (2005) gives a clear overview of the layers associated to agricultural risks.
41 For example, Mahul (2005) and Skees et al (2005).
profile of the risk brought in by each participant. Even more benefit could be obtained if
governments would offer a reinsurance program for the pool of insurers, as their
premium rates will most likely be significantly lower than those charged by commercial
reinsurance markets. Another advantage of a pool of portfolios with standardized index-
based insurance contracts is the possible treatment of shares in the pool as a tradable asset. The development of dynamic trading of these shares on an exchange-traded market should result in more efficient pricing.

For dealing with catastrophic events governments could play an important role as markets fail on this point. Since people tend to underestimate their exposure to risks concerning low-frequency, high-magnitude events, their willingness to pay for insurance of these risks is low. On the other hand, because datasets only have a few observations in the right tail, insurers face high ambiguity concerning the distribution of these risks, and therefore premiums for this layer of risk are high. The market response to this inequality is exclusion of catastrophe risk, leading to socially suboptimal transfers of risk. This calls for government intervention by developing a disaster response program. However, before doing so governments should carefully weigh all social costs and benefits.

Besides fostering socially optimal risk transfers by covering catastrophic losses, both at
the individual level as well as at the level of insurance companies associated within a pool, governments should also create a regulatory environment that facilitates agricultural microinsurance initiatives. First of all, this regulatory environment should be aimed to cover as many microinsurance activities as possible in order to protect policyholders against insurers’ malpractice. Secondly, regulatory requirements should be tailored to microinsurance by taking account of phenomena specifically present within this market. An example of microinsurance-specific regulation would be lowering the capital requirements, as microinsurers often are unable to meet the capital requirement for mainstream insurers, especially in their initial stage. Finally, as discussed above, governments should allow for efficient pooling agreements between insurance companies.
4.2.3 Index-based agricultural insurance in practice

Although the concept of index-based insurance was already developed in the 1920s, the first time it was actually implemented in practice was in the 1950s, when in Sweden an area-yield index scheme was introduced. A couple of developed countries followed in later decades with government schemes also based on area-yield indexes. The idea of using index-based insurance as an agricultural risk management strategy in developing countries is relatively new: first efforts date back to the late 1990s. These efforts have resulted in the first pilot schemes being introduced only a couple of years ago. The practical initiatives so far are still pilots in their initial stage, and therefore it is hard to draw conclusions on the success of index-insurance in developing countries. Instead, the discussion of the characteristics of some of the pilot projects, as provided below, is meant to give an overview of the various approaches that are chosen for implementation.

Most index insurance pilot projects concern indexes based on weather events. From all pilot projects The World Bank is involved in only one does not concern a weather-based index. The exception is an initiative in Mongolia to provide insurance against livestock mortality. As the relationship between weather events and livestock deaths was perceived to be too complex, it was decided to develop a national livestock mortality index as the basis for the benefit payments. Since agricultural losses usually are highly correlated to deficit or excess rainfall, all pilot projects using weather-based indexes I am aware of only involve precipitation measurements. However, this is not necessarily the only possibility: in her analysis of the historical performance of several index-based schemes for a particular farm in Kazakhstan, Bokusheva (2004) considers indexes also based on temperature and soil moisture as well.

The design of most indexes is based on quantitative research on the relationship between weather and agricultural yield in the specific region. However, in Diaz Nieto et al (2006) another approach is used. In order to come to a rainfall index appropriate to insure drybean farmers in Nicaragua against agricultural risks, they simulated weather

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42 The World Bank (2005) gives an overview of all pilot projects it was involved in.
43 Pilot projects with involvement of The World Bank are located in Nicaragua, Morocco, India, Ukraine, Ethiopia, Malawi, Peru and Mongolia. The World Bank also works on an initiative to establish the Global Index Insurance Facility, a global reinsurance intermediary agency to bring together the demand for and supply of reinsurance for index insurance.
and the associated crop yield using two software packages. The first software package generated weather scenarios based on a dataset of historical weather observations. These weather scenarios then were used as input for the second software package, that simulates crop yield based on weather conditions and crop characteristics.

Where many agricultural insurance schemes are either stand-alone schemes or linked to the provision of credit, Hess (2003) describes a pilot scheme that integrates several delivery and financial services in India, which I discuss in more detail as it is a good example of a tailored insurance solution specifically for small-scale farmers. The structure integrating several financial services offered by ICICI, a local commercial financial institution, aims to improve their access to credit with lower interest rates and reduce transaction costs. The design has the following four components:

- monsoon index insurance;
- risk management account;
- weather risk reinsurance;
- Smart Card.

The risk management account is a tool to mitigate basis risk. This works as follows. Half the insurance premium is transferred to the risk management account. In case in times of extreme drought losses exceed the benefits from the monsoon index insurance product, the saved amount on the risk management account can be used to cover these losses. The Smart Card can be used to withdraw funds from the account.

For the delivery of monsoon indexed crop loan insurance the following structure is designed. Through a special construction with ICICI’s agricultural agent a loan agreement is made with ICICI Bank. This loan agreement is coupled with a weather insurance policy with ICICI Lombard, ICICI’s insurance branch, resulting in a system offering a loan against an interest rate that is loaded by the insurance premium. In case of severe rainfall deficit the insurance benefits are used to lower the interest rate for that period.

The special construction with ICICI’s agricultural agent, that also has agreements with farmers, agricultural input providers and output buyers, is as follows. Before the season starts ICICI provides credit to farmers on recommendation of the agent, which the farmer receives in agricultural products to be used as cultivation input
through the agent. At the end of the season farmers supply the crop to the output buyer, and the output buyer deducts the loan amount from the sale proceeds and remits the loan to ICICI Bank. This structure results in significantly lower default rates due to the limited cash flows to farmers.
5 Mutual crop insurance solutions in Tamil Nadu, India

As part of its activities aimed to improve the development of the region, the Development of Humane Action (DHAN) Foundation, a large NGO based in the southern states of India, is currently developing two crop insurance schemes to protect farmers against agricultural losses. Technical assistance for these projects is offered by MIAN. This chapter presents the organizational approach and the technical work associated to the insurance solution for groundnut farmers in the state of Tamil Nadu, which is one of the two pilot projects. First, the DHAN Foundation is introduced and the local conditions are described.

5.1 DHAN Foundation

The DHAN Foundation is an NGO that organizes poor people in the southern states of India into self-help groups, aiming to improve the local agricultural, economical and technological environment. DHAN is active in more than 2,500 villages and has almost half a million members, with each member representing a household of on average five persons.

DHAN Foundation is involved in various types of programs. Through the Rainfed Agriculture Development Programme and the Tankfed Agriculture Development Programme it participates in the development of small scale irrigation in rural areas. Another field DHAN employs its activities in is microfinance. DHAN is a founding member of the International Network of Alternative Financial Institutions (INAFI), and takes part in many policy-making bodies on microfinance, which is done through its Kalanjiam Community Banking Programme. In the state of Tamil Nadu DHAN is currently developing crop insurance schemes to protect farmers against losses caused by rainfall deficit. Examples of other programmes are the Tata-DHAN Academy, an academy for development studies, and ICT for the Poor.

For providing the financial services, DHAN promotes self-help groups (SHGs) usually consisting of about 15 to 20 poor households. Further 15 to 20 SHGs are clustered at

44 www.dhan.org
panchayat (local government) level and about 150 to 200 SHGs in a specific geographical area are federated and registered. The federations are supported by People Mutuals, a body promoted by federations nurtured by DHAN Foundation. People Mutuals enable SHG members by providing social security to deal risks and vulnerabilities.

Mutual crop insurance pilots of rainfall indexed and yield indemnification on account of pest attack were implemented at Thirumangalam of Madurai district since 2006. It covers cotton and black gram crops grown by the farmers organised under rainfed farming development theme. This year, rainfall indexed mutual crop insurance solution is planned for the risks of chillies crop in Mudukulathur, Ramnad district, where DHAN’s tankfed agriculture development programme is implemented for restoration and conservation of small water bodies to achieve agriculture development.

Another mutual insurance pilot is at Nattarampalli of Vellore district, a location of rainfed farming development theme. The solution indemnifies farmers from loss in crop income. The loss is ascertained in individual farms by the committee of farmers and the federation professional.

5.2 Local conditions in Tamil Nadu

In order to place the crop insurance scheme described here in its context, first the local conditions need to be discussed. Issues of particular importance for crop insurance in Tamil Nadu are, obviously, the climate and India’s agricultural insurance market.

5.2.1 Climate

As shown in figure 2, Tamil Nadu is located in the south eastern part of India. The climate is dominated by the monsoon, accounting for almost all rainfall received in India. Basically there are two monsoon seasons. The period June through September is referred to as the south western monsoon period. The monsoon enters the country in the southwest by the end of May, and by the middle of July it has covered the whole of India. In comparison to other regions in India Tamil Nadu receives only a small part of its annual rainfall during this season (32% for Tamil Nadu against 75% for India as a
whole). As it is located on the eastern side of a mountain range called the Western Ghats it is considered as a rain shadow region.

At the end of September the monsoon changes its direction from southwest to northeast, which is the start of the *northeast monsoon season*. The period associated to this season is October through December. In this period Tamil Nadu and the rest of the southern peninsula receive most of its annual rainfall (48% for Tamil Nadu).  

As Tamil Nadu is bordered by the Western Ghats in the west and the Bay of Bengal is the east, within the state of Tamil Nadu climates can vary. This is reflected by figure 3, which shows level curves representing the normal total rainfall in centimetres for the south western monsoon season. In the south eastern part of India the level curves are very close to each other, indicating strong regional variation in the quantity of rainfall received.

![Figure 2. The states of India](source: www.mapsofindia.com)  
![Figure 3. A map of India with rainfall level curves](source: www.imd.ernet.in)

### 5.2.2 Crop insurance in India

As many farmers in Tamil Nadu have no other option than to rely on monsoon rainfall to fulfill their crops’ water requirement, we now turn to the possibilities for farmers to insure their crops. A distinction can be made between public and private insurance initiatives. The Indian government has tried to assess farmers’ severe weather risks with

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45 The information on Tamil Nadu’s climate is obtained from the website of the Regional Meteorological Department Chennai, www.amsschennai.gov.in.
the National Agriculture Insurance Scheme (NAIS), a crop insurance scheme offered through state-owned insurance companies. This insurance product is inbuilt as a loan component in to the crop loan of the commercial banks thus making it mandatory for the loanee farmers. The product covers only the specified crop notified by the agricultural insurance company. Payouts are based on an area yield index and eligibility for the payouts is determined based on the benchmark level of the previous five years average yield. The yield ascertained at the level of cluster of villages through crop cutting experiments is reckoned as the yield for the entire area.

NAIS’ performance is very poor. It has serious problems related to moral hazard and delay of payments. Also financial results are disappointing, with loss claim amounts systematically exceeding premium amounts.46

Since the denationalization of the Indian insurance market in 2000, the possibilities for private agricultural insurance schemes have increased.47 This is to a large extent due to the regulatory regime developed by the Insurance Regulatory and Development Authority of India (IRDA), the institution that acts as promoter as well as regulator of the Indian insurance industry. As compared to many other developing countries, the regime has two unique features. First, within this regime a special position is created for products that are in line with IRDA’s definition of microinsurance. The regime thereby recognizes the fact that microinsurance demands a specific approach. Secondly, the regulation requires insurance companies operating on the Indian market to have a proportion of their portfolio in the rural and social sector by means of setting quotas. These quotas are substantial: for life insurance companies the quota can amount up to 16% of the number of policies sold, and for insurers in other branches the quota can rise to 5% of premium income.

Although the current regulatory regime definitely shows that serious efforts have been made to develop a regulatory regime that fosters microinsurance and insurance for people in rural areas, there are also some shortcomings. Roth (2004) discusses the critique on the current regime, which basically involves two main concerns: an implicit restriction to the partner-agent model and a lack of product flexibility.

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47 For a discussion on the evolution of insurance in India see Sinha (2005).
Limitation to the partner-agent model is mainly caused by the fact that all parties offering insurance, no matter the share in the low-income market, need to comply with the same capital requirements. These requirements are infeasible for insurers that only sell low-cost microinsurance policies, and therefore only commercial insurers with microinsurance only as a part of their portfolio will be able to meet the requirements. With this implicit restriction to the partner-agent model IRDA has not adequately taken account of the scale and number of other microinsurance delivery channels based on local pooling of risks.

The lack of product flexibility is caused by IRDA’s definition of a microfinance product. This definition distinguishes two standard products, one for life insurance and one for general insurance. Products are classified as being a microinsurance product when the conditions of these standard products are met. Unfortunately, many existing microinsurance products in India fail to meet these conditions, thereby disqualifying the standard product of being standard.

5.3 Groundnut insurance scheme
Here a description of the progress regarding the development of the groundnut insurance scheme is given. Although the design almost is in its final stage, there are still some issues left to be sorted out. In the following the organizational structure, the actuarial calculations and the major risks associated to the insurance program are addressed.

5.3.1 Organizational structure
The organizational structure for the delivery of insurance is based on mutual pools organized per region or per village. The mutual structure implies that the money brought into the pool by farmers through premiums will stay in the pool. This ensures that any profits that might be made will be used to build capital for future losses and will not flow away to other parties, like what happens with commercial insurance where profits are given to shareholders through dividend payments.

The regional pools, called *uzhavar kuzhus*, typically are very small.\(^{48}\) As pools of this size are too small to smooth losses adequately, the uzhavar kuzhus are clustered

\(^{48}\) For the groundnut insurance project these uzhavar kuzhus consist of two to eight members.
into larger pools. At the top level a mutual catastrophe system between the villages and regions is organized via People Mutuals. This mutual catastrophe programme is based on risk diversification by spreading over three states. In order to protect itself against catastrophic losses People Mutuals has a risk-sharing agreement with Eureko Re.49

With respect to the policy design intensive communication has been going on between MIAN and DHAN. As DHAN also assists the farmers involved in the insurance programme with agricultural issues and therefore is in close contact with these farmers, it has provided MIAN the information on farmers’ needs, crop yields and rainfall requirement. MIAN assists DHAN with its expertise in the field of insurance by sharing ideas for insurance solutions and organizational structures, and by performing the actuarial calculations.

In first instance a scheme based on a rainfall index, as described in section 5.3.2, was designed. In order to reduce farmers’ basis risk a system of local rainfall measurements was organized by installing rainfall gauges in the insured villages. The rainfall received in these gauges was intended to be measured on a daily basis by local people, mainly older and wiser farmers, trusted by DHAN. The results of these measurements then would be communicated to DHAN and used as the basis for the determination of the benefit payments. Although the benefit payments based on the rainfall index were aimed to match farmers’ losses as closely as possible, the high premiums resulting from the actuarial calculations were judged by DHAN’s staff as being unaffordable for farmers. This led to the conclusion that an index solely based on rainfall is unable to match actual losses as experienced by farmers sufficiently well. Apparently also other factors, like temperature and sunshine, materially influence groundnut yields. Unfortunately, designing an index also including these factors would not only be extremely complicated, but also requires local daily measurements of temperature and sun activity. This requirement simply makes refinement of the index infeasible.

As an alternative to index-based insurance, as this was judged to be inappropriate for groundnut insurance in the region, a switch was made to the design of

49 Eureko Re is the reinsurance branch of the European insurance group Eureko. The involvement of Eureko Re is no coincidence, as MIAN’s activities were initiated by employees of the Dutch mutual insurer Interpolis, now part of Eureko, volunteering to help with establishing microinsurance initiatives.
a traditional mutual insurance scheme, as described in section 5.3.3. Farmers will be indemnified based on actual losses, with loss assessment done by older and wiser farmers. As many other experiences with traditional agricultural insurance have shown problems with moral hazard risk and expensive and slow loss assessment processes, several measures have been taken to address these problems. First of all, moral hazard risk will be reduced by introducing a retention, requiring farmers to pay a predetermined percentage of their loss themselves. Furthermore, the organization of the claims assessment process ensures a further reduction of moral hazard risk and time and cost efficiency. Because the uzhavar kuzhus are quite small, the claim assessor will generally have a good knowledge of the area and the regular yield, and will therefore be able to provide a good judgement of crop damage quickly. Finally, an implication of farmers owning the mutual pool is that they are very critical to what type of farmers is accepted as members of the insurance pool. This environment of social control and familiarity of colleague farmers with production circumstances will also attribute to abandoning fraud and a lack of preventive measures.

The structure of the risk-sharing agreement between People Mutuals and Eureko Re is still under consideration. In first instance one thought of a weather derivative with settlement at the end of the cropping season. In this structure People Mutuals will receive a payment in case weather conditions are such that in many of the insured villages only very little rainfall is received, while it has to pay Eureko Re under less catastrophic circumstances. In this way People Mutuals receives cover for the catastrophe risk it is exposed to. Later also a quota share mechanism was considered, which implies that Eureko Re always refunds People Mutuals a certain percentage of the benefit payments done to farmers.

5.3.2 Index insurance
The sowing period for groundnuts start mid-June and ends mid-August. The total cropping process takes approximately four months. Resulting from intensive deliberation with DHAN’s agro-economic experts, it was decided that the index should identify three crucial periods in this cropping process. The first of these periods is from 31 to 55 days after sowing, the stage in which flowering and peg formation occurs. The
other periods included in the index are the pod formation stage, between 56 and 75 days after sowing, and a part of the pod development stage, between 76 and 96 days after sowing. Table 2 shows the relationship between rainfall and the benefit payments as prescribed by the index.

<table>
<thead>
<tr>
<th>Days after sowing</th>
<th>Total rainfall (mms)</th>
<th>Benefit payment (Rs per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-55</td>
<td>0-30</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>30-60</td>
<td>1,000</td>
</tr>
<tr>
<td>56-75</td>
<td>0-30</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>30-60</td>
<td>1,000</td>
</tr>
<tr>
<td>76-95</td>
<td>0-15</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>15-30</td>
<td>600</td>
</tr>
</tbody>
</table>

Table 2. The rainfall index for groundnuts.

For the determination of the benefit payment daily rainfall below 5 millimeters is not taken into account, as this is too little for the crop to take advantage. Since daily rainfall exceeding 40 millimeters also is not useful for the crop, for the index daily rainfall is capped at 40 millimeters.

The levels of the benefit payments were chosen such that farmers are indemnified for the expenses already made for cultivation. Indemnification was meant to be done immediately after the period in which a rainfall deficit occurs. So, for example, if in the period from the 31st and 55th day after sowing in total only 40 mms of water is received in the village rain gauge, this would mean that as soon as possible after the 55th day a benefit payment of Rs. 1,000 will be done to the policyholders. Benefit payments in multiple periods are possible, although the total amount of these payments is capped at Rs. 4,000 per acre, the total cost of cultivation.

As the periods associated to the crucial cropping stages are tied to the date of sowing, each insurance policy has to be sowing date-specific. Because farmers may choose any sowing date between mid-June and mid-August, it was decided to design fourteen different policies, with subsequent policies’ sowing dates differing five days. This enabled farmers to purchase a policy closely matching the chosen sowing date. Furthermore, from the insurer’s perspective selling policies for more sowing dates brings the advantage of risk reduction through diversification. The risk of having deficit rainfall is then spread over a larger period, resulting in a diversification benefit.
The premium calculations are based on a dataset of daily rainfall measurements at the IMD Tirupathur weather station. Despite of missing measurements for some days, the dataset mainly covers the years from 1964 until 2002. The station is located at 11 to 14 kilometers from the villages insured. As this is relatively close, we think this is a sufficient justification for our assumption that the rainfall profile at the station is similar to that in the villages. This assumption is a crucial one as it allowed us to use the dataset for our calculations. Without rainfall measurements at a location with the same climatic features as at the insured location, exact premium determination based on rainfall measurements would have been very complicated.

Before actually using the dataset for our calculations we checked for a trend in rainfall. Such a trend could arise from climate change, a phenomenon observed in many places in the world that recently has been brought under the attention of many by former US vice-president Al Gore’s initiatives to increase awareness on this issue.\textsuperscript{50} A graphical analysis of the data did not show a clear trend and therefore we decided to use the complete dataset for our calculations without making any adjustments.\textsuperscript{51}

As the index is a weather derivative, calculation of premium actually boiled down to the valuation of a weather derivative and adding loadings associated to valuation uncertainties and the expenses associated to the insurance programme. Cao et al (2003) classify the existing valuation methods for weather derivatives into three categories. First of these categories is actuarial valuation, making a probabilistic assessment of the event underlying the derivative based on statistical analysis of historical data. This method is less applicable if the underlying event follows a certain trend. The second method is historical burn analysis, also called backtesting, which is no more than evaluating the derivative contract against historical data and taking the average as the estimate of its value. Although this is a very simple approach, it may also cause large pricing errors. Finally, for weather derivatives sometimes dynamic models are used. These models may use stochastic processes underlying weather phenomena and therefore usually are quite complicated.

\textsuperscript{50} His film \textit{An Inconvenient Truth} and the various \textit{Live Earth} concerts across the world were visited by many people and got much attention in the world media.

\textsuperscript{51} ‘Graphical analysis’ is a frequently used phrase that sounds more scientific than it usually is. In our case the graphical analysis was nothing more than checking whether a trend could be observed in plots showing the development of rainfall levels over time.
The approach taken for the valuation of the groundnut index insurance policies is the actuarial approach, based statistical analysis of the rainfall data received. We chose to simulate a thousand weather scenarios and to take the average of the benefit payments done in these scenarios as the fair value of a policy. For the simulation of the scenarios the total cropping period was divided into periods of five days. The simulations of the rainfall received in these periods were independent random drawings from five-day totals in the dataset. As the normal level of rainfall changes during the cropping season we chose to distinguish the rainfall measurements between months. For example, the simulated total rainfall for the period July 20 to 24 is a random drawing from all historical five-day totals in July.\footnote{As not all months have exactly 30 days, we sometimes used some days of other months in order to come to five-day totals.}

An important drawback of this approach is that it partly ignores weather dependency through time. Weather is a phenomenon that comes in periods, which implies that today’s weather to a large extent correlates with that of tomorrow and following days. In our approach, however, rainfall scenarios are simulated based on random drawings of five-day totals. Although using five-day totals implicitly takes account of short term dependencies, it completely ignores dependencies associated to periods longer than five days. Fortunately, as the historical data show that on most days no rainfall is received, this would only be problematic in case the insured event was excess rainfall instead of deficit rainfall. In that case ignoring the fact that rainfall usually comes in periods of several consecutive days would seriously underestimate the risk. Underestimation of deficit rainfall risk is much less likely, as the probability that no rainfall is received on a certain day already is quite high.

The premium levels for the policies associated to the various sowing dates are given in table 3. In order to come to these premiums, two loadings were added to the fair values. The first of these loadings is a safety loading, meant as a buffer to compensate for any losses caused by imperfections in the calculation of the policies’ fair values. As the distribution of the insurer’s losses is only based on a statistical estimation of the process that drives rainfall in practice, this distribution remains ambiguous. The safety loading was calculated using the proportional hazard transform, a statistical method with various nice properties. Appendix 1 provides more detailed information on the proportional hazard transform.
The second loading added to the fair value of the insurance policies is an expense loading. Just like any other business, insurers make expenses that they charge their clients through an expense loading. DHAN estimated their expenses to be approximately 5% of the total of the fair value and the safety loading. Since the mutual pool is not under the ambit of taxation a tax loading was not necessary.

<table>
<thead>
<tr>
<th>Sowing date</th>
<th>Fair value</th>
<th>Safety loading</th>
<th>Expense loading</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 June 2007</td>
<td>1,527</td>
<td>318</td>
<td>92</td>
<td>1,938</td>
</tr>
<tr>
<td>20 June 2007</td>
<td>1,383</td>
<td>327</td>
<td>86</td>
<td>1,796</td>
</tr>
<tr>
<td>25 June 2007</td>
<td>1,249</td>
<td>316</td>
<td>78</td>
<td>1,644</td>
</tr>
<tr>
<td>30 June 2007</td>
<td>1,143</td>
<td>319</td>
<td>73</td>
<td>1,535</td>
</tr>
<tr>
<td>5 July 2007</td>
<td>1,077</td>
<td>314</td>
<td>70</td>
<td>1,461</td>
</tr>
<tr>
<td>10 July 2007</td>
<td>989</td>
<td>309</td>
<td>65</td>
<td>1,363</td>
</tr>
<tr>
<td>15 July 2007</td>
<td>909</td>
<td>295</td>
<td>60</td>
<td>1,264</td>
</tr>
<tr>
<td>20 July 2007</td>
<td>875</td>
<td>304</td>
<td>59</td>
<td>1,238</td>
</tr>
<tr>
<td>25 July 2007</td>
<td>833</td>
<td>294</td>
<td>56</td>
<td>1,184</td>
</tr>
<tr>
<td>30 July 2007</td>
<td>837</td>
<td>300</td>
<td>57</td>
<td>1,194</td>
</tr>
<tr>
<td>4 August 2007</td>
<td>918</td>
<td>295</td>
<td>61</td>
<td>1,274</td>
</tr>
<tr>
<td>9 August 2007</td>
<td>1,024</td>
<td>315</td>
<td>67</td>
<td>1,406</td>
</tr>
<tr>
<td>14 August 2007</td>
<td>1,103</td>
<td>319</td>
<td>71</td>
<td>1,493</td>
</tr>
<tr>
<td>19 August 2007</td>
<td>1,230</td>
<td>316</td>
<td>77</td>
<td>1,623</td>
</tr>
</tbody>
</table>

Table 3. The premiums in Rs. per acre associated to all index-based groundnut insurance policies.

As shown in table 3, premium levels roughly vary between Rs. 1,100 and Rs. 2,000, depending on the sowing date chosen. This large variation in premium levels is caused by varying normal levels of rainfall over time. In the months September and October most rainfall is received. This is reflected in the premium levels, as those policies with the crucial periods most overlapping these months are the least expensive.

Despite the efforts made to design it, the index-based insurance scheme as described here has not been implemented and will not be implemented in the future. The premium levels suggest that the index does not sufficiently reflect the relationship between weather conditions and the losses as experienced by farmers. The index is judged to be overestimating drought risk, as the premiums are very high in relation to the cost of cultivation (Rs. 4,000 per acre) and farmers’ normal yield (Rs. 8,000 per acre).
5.3.3 Traditional mutual insurance

As with traditional insurance farmers will be indemnified based on actual losses, the distribution of these losses had to be estimated in order to calculate a premium. DHAN provided us with the following information on groundnut yields and the number of participants in the insurance programme.

Individual farmers experience a loss on average twice in five years. Losses range between Rs. 525 and Rs. 2,500 per acre, with an average of Rs. 1,500 per acre. Usually once in five years a moderate loss is suffered, which means below average, and once in five years farmers are confronted with a severe loss, which is above average. Individual farmers’ area of cultivation ranges from 0.25 to 4 acres, with an average of 1 acre per farmer.

In one uzhavar kuzhu between two and eight farmers participate. The average number of participants is five. Within one uzhavar kuzhu there is a high degree of yield similarity, although some differences may occur due to differences in sowing date, type of land and soil nature.

The groundnut insurance programme will operate in 60 to 80 uzhavar kuzhus. Also between uzhavar kuzhus much similarity can be observed in yields.

In order to calculate a premium per acre, the total loss over all uzhavar kuzhus was simulated a thousand times. For these simulations we had to assume distributions for the number of acres per farmer, loss amounts per acre and the number of farmers per uzhavar kuzhu. Appendix 2 provides details on these assumed distributions, which are in line with the information received from DHAN.

For each simulation three scenarios are possible. First of these is the normal scenario, where only a few farmers experience a loss. Secondly, the moderate loss scenario assumes most of the farmers to be confronted with moderate losses. Losses are the highest in the catastrophic scenario, where farmers are most likely to experience a severe loss. The exact loss probabilities for each scenario are given in table 4. The scenario design ensures similar losses are experienced within and between uzhavar kuzhus, which complies with the actual experience. Furthermore, the probabilities attached to the three scenarios, also shown in table 4, are such that on average individual farmers experience a loss approximately twice in five years. Although the
probabilities could have been chosen such that losses are experienced exactly twice in five years, DHAN’s experts assured us that the scenarios we used are more realistic.

<table>
<thead>
<tr>
<th>Scenario probability</th>
<th>Individual farmers’ loss probability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal scenario</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Moderate loss scenario</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Catastrophic scenario</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>All scenarios</td>
<td>0.57</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Table 4. Scenarios underlying traditional insurance simulations.

The thousand simulations result in a distribution for the total loss over all eighty uzhavar kuzhus. In order to determine the premium, a safety loading based on the proportional hazard transform was added to the average total loss over all uzhavar kuzhus. Next, the average total loss and the associated safety loading were calculated per acre by dividing by the number of uzhavar kuzhus, the average number of farmers per uzhavar kuzhu and the average number of acres per farmer. This resulted in a premium of Rs. 727 per acre, as shown in table 5.

This premium does not differentiate for issues like different land types, different sowing dates, differences in disease and wild animal attack vulnerability. Also the beneficial effect of summer ploughing is not reflected in the premium. How to deal with all these factors is one of the issues still left to be sorted out.

<table>
<thead>
<tr>
<th>Total</th>
<th>Average per uzhavar kuzhu</th>
<th>Average per farmer</th>
<th>Average per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average loss</td>
<td>241,141</td>
<td>3,014</td>
<td>594</td>
</tr>
<tr>
<td>Safety loading</td>
<td>44,253</td>
<td>553</td>
<td>109</td>
</tr>
<tr>
<td>Expense loading</td>
<td>14,270</td>
<td>178</td>
<td>35</td>
</tr>
<tr>
<td>Premium</td>
<td>299,663</td>
<td>3,746</td>
<td>738</td>
</tr>
</tbody>
</table>

Table 5. The premium in Rs. per acre associated to the traditional groundnut insurance scheme, assuming that there is no retention of losses.

53 We assumed the groundnut insurance program to operate in eighty uzhavar kuzhus.

54 Table 5 contains the premium levels for policies without a retention. For policies with a retention proportional to the loss one can easily derive the premium by reducing the full premium by the retention percentage.
5.4 Major risks
Recent years have shown an increasing interest in organization-broad risk management within the insurance industry. Both regulatory bodies and institutional investors more and more require companies to provide insight in their risk exposure, thereby initiating more adequate risk management. In the following I will briefly discuss some major risks DHAN faces due to its insurance activities. In order to determine the various possible sources of risk, the list with descriptions of risk types as given in a report of the International Actuarial Association (IAA) solvency working party$^{55}$ has been used as a guideline.

In IAA (2002) six risk types are distinguished. The first of these types is underwriting risk, risk associated to possible adverse scenarios concerning an organization’s insurance obligations and to policyholder behaviour. Adverse scenarios may occur due to extreme events or due to underwriting based on inadequate loss distribution estimations. Inadequate estimation of loss distributions may arise from uncertainty, but also from adverse selection or moral hazard. Risks associated to policy behaviour are related to unexpected lapses and financial options.

Two other risk classes are credit risk and market risk. The first of these classes contains all risks associated to counter-parties possibly not meeting their financial obligations, and the latter refers to the organization’s operations in financial markets.

A fourth risk type is operational risk, which can be described as the risk of losses resulting from being in business. In every organization’s activities people, processes, systems and external factors are involved, and failure of either of these may result in a loss for the organization.

The last two classes are liquidity risk and event risk. These contain the risk of losses caused by not having sufficient liquid assets available or caused by negative events outside the organization’s control.

The major risks I expect DHAN to be exposed to are underwriting risk, operational risk and reputation risk. The first reason to judge underwriting risk as being a major risk is the ambiguity of the loss distributions underlying the premium calculations. This risk is

$^{55}$ IAA (2002)
currently addressed by adding a substantial safety loading to the risk premium and thereby allowing for some degree of loss underestimation. Another possible solution may be the introduction of a system of experience rating, where multiple-year policies are written allowing for premium adjustments in case claims experience shows that the initial premiums are inadequate. Furthermore, the adequacy of the current mechanisms to avoid moral hazard should be closely monitored. Fortunately, as time passes and more historical claim data become available, insight in the actual loss distribution will be gained.

A second source of underwriting risk is the fact that the potential policyholders, most illiterate, are relatively unfamiliar with financial products in general and therefore also with the concept of insurance. This unfamiliarity may give rise to unexpected policyholder behaviour.

Various operational risks arise due to the fact that insurance is not DHAN’s core business and the organization lacks expertise on insurance issues. This lack of insurance-specific knowledge might result in suboptimal management of the insurance programs. On the other hand, experience shows that microinsurance actually requires a specific approach that fits the clients needs as closely as possible. An example of the specific approach is DHAN’s claim assessment procedure based on older and wiser farmers’ judgments. From this perspective insight in farmers’ needs is just as important as insurance-specific knowledge. In order to become more self-supportive and increase its ability to manage its insurance activities without the assistance of MIAN, DHAN needs to expand the available insurance expertise.

Part of the operational risk is caused by factors outside DHAN’s control. As India still is a developing country, with immature financial markets and a population mostly unfamiliar with financial products, the occurrence of unexpected adverse events is quite likely.

Since the people potentially participating in DHAN’s crop insurance program are unfamiliar with insurance, their willingness to participate heavily relies on trust in the organization and the system. The reputation of DHAN as organization and the insurance program therefore are of vital importance for the company’s viability. As DHAN also
operates many other development activities and has a large number of members, it will currently have a good reputation within the region it operates. However, a harmed reputation may result in a large number of people withdrawing from participation in the insurance program and other programs. DHAN therefore tries to provide potential policyholders with clear information on the concept of insurance and the crop insurance program, in order to prevent people to become disappointed with the product. Careful design of the insurance program may also reduce reputation risk.
6 Concluding remarks

Traditional agricultural insurance schemes based on indemnification of actual losses are thought to be unsuitable for implementation in developing countries due to problems like moral hazard risk, costly loss assessment, slow claim handling processes and limited access to reinsurance. Many scholars argue that index-based insurance provides a solution to offer agricultural insurance by avoiding these problems, although it comes at the cost of increased basis risk.

The design process of DHAN’s groundnut insurance scheme made clear that index-based insurance not necessarily is a proper solution in all cases. It turned out that designing a simple index that sufficiently reflected the relationship between weather and crop losses was not possible. DHAN refrained from implementing the index-based scheme as it would expose policyholders to a high level of basis risk. Instead a scheme based on loss indemnification was designed. Most of the problems associated to such a traditional scheme are addressed by making use of social control and familiarity within small local mutual pools and loss assessment by older and wiser farmers with a good knowledge of the area’s regular yield.

So, despite many scholars claiming traditional agricultural insurance to be an improper solution for crop risks in developing countries, the case study presented suggests that this does not have to be true in all cases. Of course, the scheme is still in the stage of design, but after seriously considering an index-based alternative a traditional scheme seemed the most appropriate solution. This seemingly surprising solution proves that microinsurance initiatives need a tailor-made approach. An important conclusion of this thesis is therefore that, as the local environment and the specific needs of the target group of clients may differ substantially across regions, a one-size-fits-all microinsurance solution does not exist. Insurance solutions for the poor should be designed on a case-by-case basis, always with the ultimate goal to find a structure that best fits the clients’ needs.
References


**Websites**

DHAN Foundation  www.dhan.org
India Meteorological Department  www.imd.ernet.in
IMD Regional Meteorological Department Chennai  www.amsschennai.gov.in
MapsOfIndia.com  www.mapsofindia.com
MIAN  www.mian.nl
Microfinance Gateway  www.microfinancegateway.org
United Nations  www.un.org
Wikipedia  www.wikipedia.org
Appendix 1 – Proportional Hazard Transform

In actuarial practice risk premiums based on best-estimate loss distributions are often loaded with a safety loading. This safety loading is meant to compensate for possible imperfections in the calculation of the risk premium. Imperfections may arise due to uncertainties regarding the best-estimate loss distribution underlying the calculation. There are several possible sources of uncertainty. First, the quality of the data used to determine the loss distribution may be poor. Secondly, even though high-quality data are used, these data used may not completely represent the loss generating process associated to insured risk. For example, future claiming behaviour may differ from claiming behaviour as observed in the past, thereby resulting in a different loss distribution.\(^{56}\)

There are several methods to determine an appropriate safety loading. Some well-known methods simply add a percentage to the risk premium or base the loading on the loss distribution’s standard deviation. Another method, introduced by Wang (1995), is the proportional hazard transform (PHT), which transforms the loss’ decumulative distribution function (ddf) such that probability mass is shifted to the distribution’s right tail.\(^{57}\) Mathematically the PHT \(g(.)\) of risk \(X\)’s ddf \(S_X(.)\) looks as follows:

\[
g(S_X(x)) = [S_X(x)]^r, \quad 0 \leq r \leq 1.\]

The parameter \(r\) represents the level of ambiguity regarding the loss distribution. As a lower value of \(r\) results in a stronger shift of probability mass to the distribution’s right tail, for highly ambiguous distributions a lower value of \(r\) should be chosen than for only marginally ambiguous distributions. Table 5 gives an overview of appropriate choices for \(r\) for several ambiguity levels.

The shift of probability mass towards the loss distribution’s right tail is graphically shown in figure 4. As the value of \(t\) increases, the position of the ddf of the PHT-loaded

\(^{56}\) Wang (1997)

\(^{57}\) For any value of \(x\), the ddf of a risk \(X\) evaluated in \(x\) represents \(P[X>x]\).
risk \( Y \) in \( t \), \( S_Y(t) \), clearly becomes increasingly higher than that of the ddf of the unloaded risk \( X \) in \( t \), \( S_X(t) \).

<table>
<thead>
<tr>
<th>Ambiguity level</th>
<th>Parameter ( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-ambiguous</td>
<td>0.96-1.00</td>
</tr>
<tr>
<td>Slightly ambiguous</td>
<td>0.90-0.95</td>
</tr>
<tr>
<td>Moderately ambiguous</td>
<td>0.80-0.89</td>
</tr>
<tr>
<td>Highly ambiguous</td>
<td>0.50-0.79</td>
</tr>
<tr>
<td>Extremely ambiguous</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>

Table 5. Values of \( r \) for several distribution ambiguity levels (source: Wang (1997)).

There are several properties that one would intuitively like safety loadings to have. An advantage of using the PHT method is that the resulting safety loading has all the desired properties, which is not the case for loadings determined by most other methods. For all values of \( r \) between 0 and 1, the PHT-loaded risk premium for risk \( X \), denoted by \( H_r(X) \), has following properties:\(^{58}\)

- \( E(X) \leq H_r(X) \leq \max(X) \);
- scale and translation invariant: \( H_r(aX + b) = aH_r(X) + b \) for \( a, b \geq 0 \);
- sub-additivity: \( H_r(X_1 + X_2) \leq H_r(X_1) + H_r(X_2) \);
- layer-additivity: \( H_r(X) = H_r(L_1) + H_r(L_2) + \ldots \), for \( X \) split up into the layers \( \{L_1, L_2, \ldots\} \).

For the premiums associated to the groundnut insurance scheme, we chose to use 0.75 as the value for the parameter \( r \), both for the traditional scheme and the index-based scheme. The reason to do so was that in both cases there was a high level of uncertainty regarding the loss distribution. For the traditional scheme the source of uncertainty was the limited information available regarding losses, which necessitated us to make a lot of assumptions. For the index-based scheme the uncertainty was not due to poor data quality, as we were provided with a detailed rainfall data over a long period from a reliable source, but to the distance between the location where the data were obtained and the location of the insured plots. Although this distance might seem relatively small, a similar risk profile is not completely certain as climatic conditions within Tamil Nadu are highly variable.

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\(^{58}\) Wang (1997)
Figure 4. A graphical interpretation of the PHT (source: Wang (1997), figure 1).
Appendix 2 – Distributions underlying simulations

Assumed distribution of the number of acres per farmer

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.0</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.25</td>
</tr>
<tr>
<td>Maximum</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Assumed distribution of moderate losses in Rs.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>900</td>
</tr>
<tr>
<td>Minimum</td>
<td>500</td>
</tr>
<tr>
<td>Maximum</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Assumed distribution of severe losses in Rs.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2,100</td>
</tr>
<tr>
<td>Minimum</td>
<td>1,500</td>
</tr>
<tr>
<td>Maximum</td>
<td>2,500</td>
</tr>
</tbody>
</table>
Assumed distribution of the number of farmers per uzhavar kuzhu

<table>
<thead>
<tr>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Minimum</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

![Bar chart showing the assumed distribution of the number of farmers per uzhavar kuzhu. The x-axis represents the number of farmers, ranging from 2 to 8, with the y-axis showing the probability density function (pdf). The chart visually represents the distribution with varying bar heights for different numbers of farmers.]