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Drought insurance for agricultural development and food security in dryland areas

Peter B. R. Hazell · Ulrich Hess

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Abstract This paper reviews the potential role for and experience with index based insurance for managing drought risks in agriculture and rural areas in the dry areas of developing countries. It argues that while index insurance is not a panacea for risk management, it could make important, market-based contributions in catalyzing sustainable safety nets and promoting agricultural growth. And though the private sector should be the main supplier, there are still important enabling and facilitating roles that need to be played by the public sector.

Keywords Drought management · Agricultural risk management · Disaster risk management · Index insurance · Dry areas · Agricultural insurance · Food security

Introduction

The Earth's drylands as defined by the United Nations Convention to Combat Desertification (UNCCD) cover nearly 40% of the Earth's surface and are home to some 1.2 billion people, most of whom live in the developing world and are poor and food insecure.[1] High levels of climate risk, especially drought, have always been a defining characteristic of these areas and the agricultural and pastoral societies that inhabit them have developed extensive but robust farming systems that enable them to survive many weather shocks. Difficulties arise in that these extensive farming systems are increasingly inadequate for meeting the rising livelihood expectations of local populations, and because the level of wealth accumulated in these societies is often inadequate to protect against severe economic and human losses in major drought periods. These problems are becoming more challenging as continued population growth adds to the pressure on available land and water resources, and as climate change adds to the risk of more frequent and prolonged droughts.

To address these problems, many governments have intervened in dry areas with various forms of drought assistance. By buffering losses during droughts, it is hoped not only to alleviate human suffering but also to protect assets, especially livestock, and to encourage farmers to invest in agricultural intensification to raise living standards. However, many of these interventions are encouraging farming practices that could increase both the extent of future drought losses and the dependence of local people on government assistance. They are also costly to governments and use resources that could otherwise be spent for broader development purposes. A combination of the high cost of public interventions and new developments in the international financial and insurance markets, has led to much interest today in using market assisted approaches to risk management, including weather index insurance. This

P. B. R. Hazell (✉)
School of Oriental and African Studies, London University,
London, UK
e-mail: p.hazell@cgiar.org

P. B. R. Hazell
Centre for Environmental Policy, Imperial College London,
London, UK

U. Hess
World Bank,
Washington, DC, USA
e-mail: uhess@worldbank.org

[1] Drylands are defined by the UNCCD to include arid, semi-arid and dry sub-humid ecosystems characterized by low and irregular rainfall and high evapo-transpiration that are subject to cyclical droughts.

paper reviews past experience with drought assistance policies and explores the potential for using weather based insurance to provide a better alternative. The paper concludes that while weather index insurance is not the panacea that some enthusiasts suggest, it does show promise and that there are situations where it may be able to make a useful contribution.

The problem with climate risk in dryland areas

Climate risk poses two major problems for farmers in dryland areas. First, the high level of agricultural production risk poses a threat to household income, food security and debt repayment each season. Second, severe droughts typically cause losses for many farmers at the same time, undermining the ability of local communities and financial institutions to help out.

Farm households and rural communities in dryland areas pursue a number of well honed strategies for managing risk. For example, to reduce their exposure to risk, farmers often spread their bets by growing a mix of crops and crop varieties, staggering crop planting dates, spreading crops amongst fields that have different risk exposures in the landscape, and keeping livestock. These techniques can help reduce the chance of a major production loss in any one season. Many farm households also engage in off-farm employment, or have a small non-farm business of their own, and these help reduce their dependence on farm income. To cope with the losses that do occur, farmers carry food stocks, savings, and other assets (e.g. livestock and jewelry) that can be consumed or sold in times of need. They may also borrow credit and engage in temporary off farm employment.

Communities provide another layer of protection against risk. Religious funds, credit groups, and kin-support networks provide means through which individuals can help each other in times of need on a reciprocal basis (e.g. Sommerfeld et al. 2002). Sharecropping contracts also emerged in many societies as a way of sharing risks between landlords and tenants (Otsuka and Hayami 1993). In pastoral areas, reciprocal arrangements between spatially dispersed communities enable mobile or transhumant grazing practices that reduce the risk of having insufficient forage in any one location (McCarthy et al. 1999).

Studies of traditional methods of risk management show they are surprisingly effective in handling most climate risk, and have helped farm families and rural communities survive for countless generations in many drought prone areas (e.g. Walker and Jodha 1986; Sarris and Christiansen 2007). But they are not without their costs and limitations. Diversification strategies prevent farmers from specializing in their most profitable alternatives, essentially trading off higher income to reduce risk exposure. Studies of drought-prone areas in India and Burkina Faso suggest that farmers may sacrifice 12–15% of average income to reduce risk (Gautam et al. 1994; Sakurai and Reardon 1997). Farmers may also be less willing to invest in agricultural intensification if this is more risky, leading to additional long term sacrifices in living standards.

Traditional risk management arrangements frequently fail to provide an adequate safety net for the poor. With few assets, poor people have limited options for coping with serious income losses. They are also more exposed to food price increases that may follow local production or market shortfalls, and they are more exposed to any contraction in local employment and wages. There is a growing literature showing that repeated income shocks and asset losses can conspire to keep poor households trapped in poverty. Credit, which might offer a viable pathway out of poverty, is also much less likely to be available to the poor (Carter and Barrett 2006).

Perhaps the greatest weakness of traditional risk management in dryland areas is its limited ability to manage catastrophic droughts that impact on most farmers within a region at the same time. The highly covariate nature of these losses makes them especially difficult to manage. Community support networks cannot cope when everybody needs help at the same time. Credit also becomes scarce when everybody is seeking to borrow and few have money to lend. Local markets for crops, feed and livestock also work against farmers when all are trying to trade the same way at the same time. For example, because many farmers try to sell livestock in drought years they force animal prices down, and then when they try to restock in post-drought years, prices rocket. Local food prices can also spike when regional shortages arise, and many farmers may lose important assets (e.g. livestock) that make subsequent recovery slow and difficult. Covariate risks are also a problem for financial institutions and input suppliers, since they can be faced with widespread defaulting on loans and unpaid bills.

Studies of the impact of droughts in Ethiopia, (Webb and von Braun 1994), Eastern India (Pandey et al. 2007) and South India (Hazell and Ramasamy 1991) provide dramatic evidence of the failure of traditional risk management arrangements. All show that in percentage terms, income losses can far exceed initial production losses because of a collapse in local agricultural employment and wages, nonfarm income and asset prices. Most households in drought hit areas suffer consumption shocks with the impact being most severe for the poor. In pastoral areas, droughts can also lead to liquidation of a significant share of the total livestock in the absence of other sources of feed. Widespread inability to repay bank loans in drought years has also contributed to lower levels of lending for agriculture in dryland areas, which in turn has slowed agricultural development.

Lessons from past policy interventions

Recognizing the limitations of traditional risk management, many governments have intervened in dryland areas with a range of risk management programs for farmers and herders, including crop insurance, credit forgiveness, livestock feed subsidies, and emergency relief. We review some of these experiences below.

Crop insurance

Crop insurance has often appealed to policy makers as an instrument of choice for helping farmers and agricultural banks manage climate risks like drought, but the experience has generally not been favorable (Hazell et al. 1986; Hazell 1992; Wright and Hewitt 1994; Glauber 2004). Publicly provided crop insurance has, with few exceptions, depended on large subsidies from government, and even then its performance has been plagued by the moral hazard problems associated with many sources of yield loss, by high administration costs, by political interference, and by the difficulties of maintaining the managerial and financial integrity of the insurer when government underwrites all losses. Livestock insurance that compensates for loss of animals or reduced productivity because of drought has rarely been offered, especially for herders in traditional pastoral systems. There are good reasons for this: opportunities for fraud and moral hazard are high with little opportunity for on-farm inspection of management practices or loss assessments when the animals are on the move.

Public crop insurance programs became hugely expensive to governments and most of the programs in developing countries were phased out in the 1990s or redesigned as partnerships with the private sector. In a recent review, Mahul and Stutley (2010) found some improvement in the financial performance of crop insurance schemes though most still depend heavily on government subsidies.

Feed subsidies

In the West Asia and North Africa (WANA) region, feed subsidy programs have been widely used to provide supplementary feed to safeguard livestock in drought years, with the predominant expenditure going for subsidies toward the costs and distribution of concentrates and other feeds, especially barley (Hazell et al. 2003).[2] These programs have been quite successful in protecting livestock numbers and production during droughts, but they have also encouraged unsustainable farming practices and have benefited large herders rather than small. In particular, they have:

- Accelerated rangeland degradation in the long term by undermining the traditional process of adjusting flock size to inter-annual climatic variations. Herd sizes have increased sharply since the introduction of feed subsidies, and grazing practices have changed so that many of the animals no longer leave the rangeland areas during the dry season but have their feed and water trucked in. This practice leads to overgrazing during the dry season, reduces the natural seeding of annual pasture species, disturbs the soil, and contributes to wind erosion, particularly in areas near water and feed supply points.
- Led to high government procurement prices for barley and this has encouraged the mechanized encroachment of barley cultivation onto rangeland areas where it causes serious soil erosion and cannot be sustained.
- Because the subsidies are typically administered on an animal or per hectare basis, large herders and cereal farmers have captured most of the payments, aggravating income inequalities in dryland areas.

Although typically introduced as a relief measure during severe droughts, once established, feed subsidies have tended to become permanent and expensive to governments. Total costs became high and they were scaled back in most WANA countries as part of market liberalization programs.

Relief programs

Many governments have found it necessary to provide direct disaster assistance to relieve the problems of rural areas stricken with catastrophic losses caused by drought. For many small, risk prone countries, such government assistance can represent a significant percentage of national income when the disaster is large. This cost detracts from the resources available for agricultural development, and increases a country's dependence on donor assistance. These costs may escalate in the future as population densities increase in vulnerable areas and as global climate change increases the frequency and severity of severe droughts.

Relief programs are driven by humanitarian rather than development agendas and their primary value is in saving lives and protecting and rebuilding assets and livelihoods. However, they have run into a number of problems[3]:

- It is difficult to target relief aid to the truly needy under emergency conditions and large leakages to others are common.

[2] Other components of public assistance include subsidies for wells and water provision, transport of livestock, and debt forgiveness, but feed subsidies have typically dominated public relief budgets.

[3] See, for example, Grosh et al. (2008).

- Relief can distort incentives for development; e.g. food aid can depress local prices for farmers.
- By the time an emergency has been declared and a relief effort funded and launched, the assistance often arrives too late to be effective.
- Once disaster assistance has been institutionalized and people know they can count on it, it may inadvertently worsen future problems by encouraging people to increase their exposure to potential losses and become increasingly dependent on government assistance. For example, compensation for crop or livestock losses in drought prone areas encourages farmers to grow more of the compensated crops or livestock even when they are more vulnerable to drought than alternative land uses.[4]

Weather index insurance

Given the high cost and limited effectiveness of many past public interventions, there is much interest today in exploring marketed assisted alternatives for managing drought risk. Recent institutional, market and technology advances have also increased the range of policy options available for assisting farmers and rural communities manage drought risk. One of the most promising approaches is weather index insurance, which can be used in two ways. One is to provide farmers with a form of insurance that can aid them in managing drought risk in their farm businesses. Another is to provide a market based approach to underwriting public and NGO drought relief programs.

The essential principle of weather index insurance is that contracts are written against specific perils or events like droughts which are defined and recorded at regional levels, usually at a local weather station (World Bank 2005). If an insured event occurs then all those who bought the insurance would automatically receive a payment. To serve as drought insurance for farmers or relief agencies, the index should be defined against weather events that are highly correlated (on the downside) with the yields of major crops grown by farmers in the region, or with major livestock losses. For example, an insured event might be that rainfall during a critical period of the growing season and recorded at a local weather station, falls 70% or more below normal.

Weather index insurance for farmers

Weather index insurance for farmers is tied to local weather stations and all the farmers pegged to the same station are offered the same contract terms per unit of insurance. That is, they pay the same premium rate and, once an event has triggered a payment, receive the same rate of payment, and their total payments and indemnities would be that rate multiplied by the value of the insurance coverage purchased. Payouts for index insurance can be structured in a variety of ways, the simplest being a zero/one contract (once the threshold is crossed, the payment rate is 100%), or a layered payment schedule (e.g., a one third payment rate as different thresholds are crossed).

Using weather index insurance in this way has a number of attractive features for insuring farmers:

- Because buyers in a region pay the same premium and receive the same indemnity per unit of insurance, it avoids perverse incentive problems such as moral hazard and adverse selection.[5] A farmer with regional index insurance possesses the same economic incentives to produce a profitable a crop as the uninsured farmer.
- It can be inexpensive to administer, since there are no on-farm inspections, and no individual loss assessments. It uses only data on a single regional index, and this can be based on data that is available and generally reliable.
- The insurance could in principle be sold to anyone. Purchasers need not be farmers, and the insurance could be attractive to anybody in the region whose income is correlated with the insured event, including agricultural traders and processors, input suppliers, banks, shopkeepers, and agricultural labourers.

From the farmers' perspective, weather insurance could play a useful role if it protects their productive assets and income in drought years. But a greater payoff from index insurance lies with its potential to unlock access to credit, new technologies and modern inputs, which together can lead to game changing increases in farm productivity and income. This has the potential to lift poor households out of

[4] Any subsidized risk management aid can have similar effects. Subsidies on any input (e.g. fertilizer) can encourage over use of that input in terms of the balance between the economic value of the additional production and the cost to the tax payer. In this case the "overuse of the input" is the adoption of farming practices and livelihood strategies that lead to a growing dependence on government assistance.

[5] This assumes that the insurance contracts are set up on an actuarially fair basis for each weather station. A compelling advantage of index insurance is that all the information needed to write actuarially fair contracts exists, unlike typical insurance contracts written at the farm level. Of course, if the insurer doesn't follow basic pricing principles, or makes payments that are tied to individual farm rather than area outcomes, then moral hazard and adverse selection problems may arise.

poverty traps (Carter and Barrett 2006) as well as promote farm business growth for the better off. This could happen because banks and private input suppliers are more willing to provide access to credit and extension advice to farmers who insure their loans with index products. For this to work, it is necessary that there be a formal link between the insurance and credit arrangements—such as a formal pledge of the insurance payout to the lender—so that the lender has assured access to part or all of the insurance payout in the event of a default caused by an insured risk. One arrangement is for the insurance to be packaged with a loan, enabling the bank to collect directly from the insurer. Alternatively, the farmer could have a contractual arrangement with a marketing agent such as a contract farming operator who could deduct the value of the insurance payout from the farmer's sales and repay the lender.

Experience

The past 5 years have seen many weather index insurance programmes launched around the world, many on a pilot basis, and involving a diverse range of actors including governments, multinational agencies, private insurers, international reinsurers, relief agencies, non-governmental organizations, banks, input suppliers, food marketing companies, and farmer organizations. A recent study (International Fund for Agricultural Development and the World Food Programme 2010) compiled data on 30 ongoing index insurance programs for farmers of which 21 were based on regional rainfall indices. These 21 schemes had a total insured value of about $1 billion in 2008/9 and reaching some 1.3 million farmers.[6] About 60% of the total coverage was written in OECD countries, mostly the US, and the rest was written in developing countries, mostly India (Hess 2003).

Although it is still early to evaluate most of these programs, the review cited above reinforces a number of important lessons that have already been identified in the literature.

Minimize basis risk Basis risk can be a serious deterrent to farmers' demand for weather index products. This is the problem that arises if an individual suffers a loss but is not paid because the major event triggering a payment for the region has not occurred. For example, an individual farmer with rainfall insurance could lose her crop to drought, but not receive an indemnity if the drought is not widespread and recorded at the local weather station.

Basis risk arises because the insurance is tied to weather events measured at a higher scale than the individual farm, so an obvious remedy is to increase the number and dispersion of weather stations to more accurately capture the spatial diversity of farming conditions. Technological advances are rapidly reducing the cost of adding secure weather stations,[7] and in some countries private firms now offer weather station services for a fee (e.g. India). Greater problems are that additional weather stations add to the cost of developing and marketing insurance contracts, and new weather stations come without site specific historical records. This latter problem has led to interest in new types of indices that can be assessed remotely with satellites, such as cloud cover or soil moisture content for a chosen region during critical agricultural periods, and which can be triangulated against existing weather data stations in order to generate a "synthetic" historical data set for the new weather station. This kind of data is becoming increasingly available and may prove the wave of the future.

Another approach to reducing basis risk is to invest in agro-meteorological research to identify weather indices that minimize basis risk for as many households as possible in a region given the available weather data. Recent developments in crop-weather modelling, as well as participatory approaches to the design of insurance contracts, have demonstrated potential for matching seasonal weather events more precisely with yield failures for local crops (Hellmuth et al. 2009). In the US and Canada, biophysical models are used to estimate rangeland productivity given observed rainfall outcomes, and insurance contracts are indexed to the model predictions (IFAD and WFP 2010). Given panel household data, it is also possible to model the relationships between weather events and household incomes rather than yields, leading to even more relevant indices with low basis risk for insuring household welfare (Lybbert et al. 2010). But the cost of this kind of "designer" research can be high and the indices that follow may prove too site specific to scale up.

Another way is to limit the insurance to the kinds of low frequency, high impact weather risks that affect most people in a region at the same time. Individual losses are then much more likely to be highly correlated with the insured weather station event (Giné et al. 2007). This approach may work best for insurance that is being written for relief agencies, but it can also work for farm insurance as long as it is accepted that alternative types of arrangements may be needed to help households manage more frequent and less covariate risks.

Yet another approach is to develop indices that do not require local weather data at all but which correlate highly with drought losses for many farmers. For example, Mude et al (2010) have developed a remotely sensed vegetation

[6] See Table 3 in IFAD and WFP (2010).

[7] A good low-cost weather station with automatic capabilities costs about US$2,000. They cost even less in India.

index to insure livestock losses in pastoral areas in Northern Kenya, while Mongolia has recently launched a livestock insurance programme in which the index is a county-level livestock mortality rate measured through an annual livestock census (Hellmuth et al. 2009).These kinds of indices look promising, but one limitation is that they are endogenous with aggregate farmer behaviour. In other words, the actuarial risks could change over time with changes in land use or technology uptake, as well as with climate change, making premium setting and reinsurance more challenging than with a weather index.

Focus on a real value proposition for the insured Many farmers have proved reluctant to buy weather index insurance even when available. Yet studies in drought prone areas have shown that most farmers are risk averse and behave as if they would be willing to pay 12–20% above the pure risk cost for an insurance product that has low basis risk (Gautam et al. 1994; Sakurai and Reardon 1997; Binswanger 1980; Binswanger and Sillers 1983; McCarthy 2003; Lybbert et al. 2010). One reason for the discrepancy between hypothetical and actual demand is that farmers often do not understand how index insurance works and hence are reluctant to buy it. Studies of the uptake of index insurance show that socio-economic factors like education and initial level of wealth are important determinants (Giné et al. 2008; Lybbert et al. 2010). Basis risk and the availability of alternative ways of handling the same risk are also important reasons, as illustrated by the difficulty of selling index insurance when it must compete with heavily subsidized crop yield insurance.

On the other hand, demand seems to have been stronger in programmes where the insurance catalyzes access to credit, technology, or new markets that lead to significant additional income. A good example is a privately run programme in India in which PepsiCo offers weather based insurance to its potato out-growers; the insurance is linked to the credit and inputs that are already offered to contract farmers to secure supplies from poor smallholders (IFAD and WFP 2010). It is noticeable that of the 21 rainfall insurance programmes for farmers reviewed by IFAD and WFP (2010), 13 were tied to credit and/or access to modern inputs. Moreover, only 3 of these tied programmes were subsidized, compared to 7 of the 8 programmes that were not tied to credit or inputs.

Develop efficient and credible delivery channels Insurers rarely have their own rural distribution networks and typically must rely on intermediaries to sell and transact the insurance with farmers. These intermediaries need to be efficient providers, and available and responsive to farmers' needs. They also need to be trusted, as must the insurance company itself. Ongoing programmes are successfully using microfinance institutions, banks, fertilizer distributors and marketing agents as intermediaries.

Provide adequate and early training of all implementation actors Index-based insurance programmes that include initial training and an overall approach to capacity development have a clear advantage compared to those that do not. By training farmers in the use of index insurance as a risk reducing investment, more realistic expectation about payments can be achieved, as well as an increased familiarization with the nature of the product. New experimental approaches in which farmers participate in structured games are proving useful for educational purposes as well as for research purposes (Lybbert et al. 2010).

Access international risk transfer markets The highly covariate nature of the payouts for weather index insurance poses a challenge to the insurer. The insurer can hedge part of this risk by diversifying its portfolio to include indices and sites that are not highly and positively correlated, an approach that works best in large countries. Most often it is also necessary to sell part of the risk in the international financial or reinsurance markets. One of the key drivers of index insurance today is the growing depth and diversity of these markets for absorbing some kinds of natural disaster risk (Skees 1999, 2000). Reinsurance support is essential for attracting private insurers and scaling-up. Of the 21 rainfall insurance programmes for farmers reviewed by IFAD and WFP (2010), 13 are reinsured internationally. So far there is little indication that the recent global financial crisis has reduced the availability of reinsurance capital for natural risk. Reinsurance premium rates increased in 2008 but fresh capital inflows into catastrophe insurance markets should remain strong given that the underlying weather based risks are uncorrelated with the risks in financial markets, offering an important avenue for investors to reduce portfolio risk (Kunreuther and Michel-Kerjan 2009; Guy Carpenter 2008).

Weather index insurance for disaster relief agencies

Weather index insurance is being used by some disaster relief agencies to improve their capacity to respond to droughts. As relief agencies typically have broad regional or national mandates, basis risk is less of a problem for this kind of insurance since the primary purpose is to insure their aggregate liability. The index can be defined as a weighted average of readings from multiple weather stations that cover the region or country in which the agency works. There is also greater scope for using remote sensing data at these levels of aggregation. Marketing and distribution problems are also simpler because this kind of insurance is heavily if not fully subsidised by governments and donors, and there are just a few large scale buyers.

The main advantage of index insurance for relief purposes is that it can provide timely and assured access to funds in the event of an insured catastrophe. Studies show that the earlier relief arrives after a shock, the greater its effectiveness in cushioning adverse welfare impacts, avoiding the distress sale of assets and speeding up recovery (e.g. Dercon et al. 2005). By selecting a weather-based index that is an early or lead indicator of an emerging crisis, an insurer can make quick payments to relief agencies and households, avoiding the usual delays incurred when relief agencies must first appeal for donations from governments and donors before they can take action (Linneroth-Bayer et al. 2005; Chantarat et al. 2007).

These benefits might be amplified if disaster relief agencies were to distribute insurance vouchers to households in advance of a catastrophe, since households could then quickly convert the vouchers into cash at local shops or banks to meet discretionary needs in an emergency. The use of vouchers would also enable disaster relief to be targeted in advance to the more vulnerable households. As the voucher distribution would be undertaken annually, there is ample opportunity to develop appropriate targeting procedures, avoiding the more chaotic allocations and associated leakages that can arise when relief in the form of cash and kind must be hastily distributed during an emergency (Hess et al. 2009).

Using insurance for disaster relief purposes also has implications for the way relief is funded. Instead of ad-hoc fund raising after emergencies, the financial needs of relief agencies are annualized into an insurance premium. Governments and donors then face a predictable annual contribution that can be easier to budget (Chantarat et al. 2007).

Experience

Mexico has been successful in using weather index insurance to improve public relief efforts in the event of drought (IFAD and WFP 2010). Initially piloted in 2002 and managed by a government owned insurer (AGROASEMEX), the insurance is sold to federal and state agencies to underwrite their financing of the activities of a national relief programme (the Programa de Atención a Contingencias Climatológicas (PACC)). The insurance does two things. First, it provides an alternative way of funding an established relief programme in the event of a drought and transfers part of the risk to the international market. Second, it has enabled the relief programme to be put on a more rational ex ante basis that is targeted to the most vulnerable smallholder farmers. The target group is known in advance and payments from the federal relief fund to the states are now made based on local rainfall indices that correlate highly with the yields of the major food crops grown. Since the insurance substitutes for public relief funds, it is fully subsidized by the federal and state governments. So far, the farmers have not been involved in buying any insurance and do not receive contracts or vouchers, so from their perspective the insurance payments are de facto indistinguishable from the relief aid they previously received in drought years.[8] The programme has grown steadily since 2002, and in 2010 had an insured value of $628 million with a total premium of $81 million, potentially benefiting approximately 3.2 million low income farmers on 8 million hectares in 30 out of 33 states in Mexico.[9] PACC covers 77% of eligible smallholder landholdings. An impact evaluation is ongoing that should provide useful insights into whether the new programme is proving more cost effective, better targeted and faster in delivering aid than the previous system of direct government grants in drought years.

Ethiopia and Malawi have both piloted programmes to transfer part of the national cost of drought relief to the international insurance market (Hellmuth et al. 2009). In Ethiopia, the pilot programme was set up for the 2006 season by the Government and the World Food Programme. A national drought index was developed based on readings from weather stations across the country and a crop-water balance model. An historical simulation showed that the index had an 80% correlation with the number of food aid recipients from 1994 to 2004 suggesting that it tracks drought losses well. The programme was internationally reinsured in the first year to recover up to $7.1 million in the event of a severe drought. The first year's premium of $930,000 was paid by USAID on behalf of the Ethiopian Government. Good rainfall that year meant that no payments were received. Following this pilot the Government and WFP introduced subnational drought indices as part of

[8] Fuchs and Wolff claim that the "automatically insured farmers get informed about their coverage status through state officials." They assume therefore that the farmers are weather index insured and that the WII creates disincentives to invest in (i) other non-insured crops leading to potential overspecialization and mono-cultures and (ii) irrigation systems because only rain-fed farmers are insured. (Fuchs and Wolff 2011) These arguments hinge on the assumption that farmers actually feel they are *insured*. In fact, an external evaluation of the programme (Mexican Ministry of Agriculture 2009) finds only that those farmers that have received payouts "incorporated" those payouts into their production decisions. General awareness of the existence of the insurance coverage and even more so individual perception of being "insured" are not known and are probably low.

[9] Victor Celaya del Toro in a presentation to the World Bank titled "Programa de Atencion a Contingencias Climatologicas—Seguro Agropecuario, Mexico DF, June 2010.

a risk management framework including a better early warning system based on risk software (known as LEAP, for Livelihoods, Early Assessment, and Protection) (Hess et al. 2006; Hess and Im 2007). In 2008 the World Bank approved a US$60 million drought index contingent grant to support that framework. In 2010 the Bank added another contingent grant of US$50 million, and the UK's Department for International Development (DFID) and USAID together added US$110 million, all earmarked for distribution if the weather indices indicate a drought. Thus donors replaced the insurance market by providing drought relief funds ex-ante to be triggered by an agreed and objective drought stress trigger. Timely delivery of the cash to additional distressed households is assured by the national safety net programme that already transfers cash and food to around 7 million people. The shift from reinsurance to a contingent loan arrangement can be explained as follows. The Government preferred a contingent grant to an insurance policy because it was cheaper, while donors find it easier to justify to their parliaments relief disbursements that are made after an emergency has occurred rather than before as is the case with insurance.

A similar programme was piloted in Malawi in 2008 with an insured value of $5 million, sponsored by the Government, the World Bank and DFID. DFID paid the insurance premium (Hess and Syroka 2005; Syroka and Nucifora 2010). In this case any insurance payout received because of drought in combination with a call option on South African Maize guarantee the availability of a certain amount of emergency maize in Malawi. A side effect of this weather and price "insurance" is to de facto cap the price of maize in the country, relying on the market to pass on the benefits to vulnerable households. In Malawi the delivery of the insurance benefits to farmers is uncertain and depends on Government emergency relief programmes, because there is no safety net in place that could be scaled up to additional beneficiaries.

The challenge of climate change

Climate change is expected to increase both the frequency and severity of droughts in many dryland areas, and this will be compounded by greater uncertainty about the levels of risk involved. Adapting to these changes may in some cases require major changes in farming systems and livelihood strategies, or even relocation for some people. More widely, it will reduce the effectiveness of traditional risk avoidance and coping mechanisms at household and community levels, increasing the need for greater public assistance in coping with catastrophic drought events. Under these circumstances, drought insurance ought to become an even more attractive aid, though its costs will also increase. This is because insurers will need to increase premium rates on a periodic basis to reflect higher payout levels, and they will need to add an additional premium charge to hedge against remaining uncertainties about the changing nature of drought risk.

Weather index insurance can be adapted to climate change and this will require:

- Adjusting the types of insurance offered in different regions to reflect changes in growing conditions and risk. Priced correctly, older products may become too expensive for farmers, while new products will be needed as farmers adapt their land use patterns and choice of technologies.
- Adjusting premium rates on a regular basis to reflect changing risks.
- Adapting to more pronounced cyclical weather patterns by, for example, moving towards longer term (multi-season) contract arrangements.
- Adapting to the emergence of more available and accurate seasonal weather forecast data. This may require establishing earlier sell by dates or adjusting premium rates to better match the purchase date with the availability of season specific forecasts.

However, increasing the cost of voluntary insurance will be difficult without the aid of subsidies. The additional cost of drought insurance with climate change compared to pre-change levels can be seen as a direct measure of the cost of climate change to the farmers concerned. Seen in this light, there may be a valid argument for subsidizing this additional cost using climate change adaptation funds set up by governments and donors, particularly in areas with high incidence of poverty.

Role of government

Although private insurers are actively engaged in most of the weather index insurance programmes studied by Hellmuth et al. (2009) and IFAD and WFP (2010), they have rarely initiated programmes. Instead, governments, multinational agencies such as the World Bank and WFP, and non-governmental organizations like Oxfam have played the crucial initiating role. This suggests there may be important public roles that need to be met, without which the private insurance sector faces high set-up costs and barriers to entry. There is also a first mover problem: the high initial investment costs in research and development of index insurance products might not be recouped given the ease with which competitors can replicate such products if they prove profitable to sell. Private insurers may be particularly wary of this issue; unlike public insurers, they are not subsidized and may miss the opportunities that public insurers have as early movers.

If index insurance is to scale up, governments and donors must intervene more actively by playing important enabling and facilitating roles (Hess et al. 2002; World Bank 2005, 2010[10]). These roles are discussed below.

Build weather station infrastructure and data systems Weather index insurance is not commercially feasible without a reliable weather station infrastructure, and these must be sufficiently dense to avoid excessive basis risk. Beyond the physical presence of weather stations, there is need to collect, maintain, and archive data and to make it available on a timely basis in relation to insured events. Ideally, these data would be placed in the public domain and, because they have multiple uses, made freely available to all, including those with commercial interests wishing to develop innovative weather insurance products. Increasing the availability of weather stations and data is an important need in many developing countries. Private firms can be contracted for this purpose, but they will need to be paid by the public sector if the data are to be freely available.

Support agro-meteorological research leading to product design One of the challenges associated with private-sector development of new financial products is the ease with which they can be replicated by others. This free-rider problem discourages companies from making initial investments in new product development, especially in underdeveloped markets. Thus, some level of government and/or donor support for product development is justified. These investments should be targeted at feasibility studies and pilot tests of new products with the involvement of local private-sector partners.

Provide an enabling legal and regulatory environment Establishing a legal and regulatory environment for enforcing contracts that both buyer and seller can trust is a fundamental prerequisite for index insurance. Additionally, laws and regulations need to be consistent with international standards to improve the chances of insurers gaining access to global markets for risk transfer. Unfortunately, in many countries, regulations are simply not in place to accommodate the development and use of weather insurance products. Human capacity building and technical assistance are essential for preparing the legal and regulatory environment to govern index insurance programs.

Educate farmers about the value of insurance To increase the likelihood that information is presented in a balanced way, and that sufficient investments are made in a broader educational effort for untested insurance products, public funds from governments and/or donors may be required. While private insurers will invest in marketing their products, they are unlikely to invest at socially optimum levels in educating farmers more generally about the appropriate role of insurance.

Facilitate initial access to reinsurance Until a sufficient volume of business is established to attract global reinsurers, extreme losses for the insurance pool may initially need to be underwritten by government and/or donors, perhaps through risk pooling or contingent loan arrangements. For example, the World Bank, DFID and USAID have provided a contingent grant arrangement to the Ethiopian Government to reinsure its drought relief insurance programme.

Should drought insurance be subsidised? Sustained subsidies are inevitable when insuring disaster relief agencies. Arguments for subsidizing insurance for farmers are trickier. The evidence in this paper suggests that farmers may be willing to pay the full cost of unsubsidized weather insurance if it is linked to a value proposition that enables them to access credit and new productivity-enhancing technologies or high-value markets that can significantly raise incomes. There may be good arguments for subsidizing insurance for poor farmers, especially if this helps them to graduate from more costly types of safety net programmes. But such subsidies should be carefully targeted and monitored. Subsidies might also be warranted to kick-start insurance markets for non-poor farmers, for example, by offsetting some of the initial set-up, administration and reinsurance costs. Such subsidies will be less distorting if made directly to the insurer to offset administration and development costs rather than subsidizing the premium rates paid by farmers. There should also be an explicit exit strategy. Finally, subsidies might be warranted as part of a strategy to assist farmers adapt to climate change, where the subsidy is set to cover the difference in the premium rate between pre- and post-climate change scenarios.

Support impact studies to systematically learn Impact studies are needed to ensure effective learning from programme investments and to attract and maintain the support of donors and governments. Over time the insurance must be seen to generate real benefits, and impact studies need to be undertaken to make this case. In the case of farm insurance, the insurance should contribute to farm income growth by, for example, enhancing access to credit and technologies. In the case of disaster relief insurance, it will need to be shown that the insurance is protecting lives, assets and consumption during catastrophic droughts. Impact pathways need to extend well beyond demonstrating a demand for uptake of insurance, and also show how the insurance has impacted risk management behaviour, the choice of land use

[10] See chapter 2, Reducing human vulnerability: Helping people help themselves, p87–124.

and technologies, and ultimately incomes, poverty and vulnerability.

None of the insurance programmes reviewed by IFAD and WFP (2010) has been subjected to a rigorous impact assessment. A few studies examine farmers' uptake of index insurance when linked to credit and technology packages and of the socio-economic determinants of that demand (Giné et al. 2008; Giné and Yang 2008), but no ex post impact studies exist to show how insurance has changed farmers' livelihood strategies and incomes or how protecting lives and assets has enabled people to avoid or escape poverty. It will be important to build more long-term Monitor & Evaluation components into future index-based weather programmes.

Conclusions

Drought has long been an important constraint to food security and agricultural development in the dryland areas, and there is already an existing deficit in the institutional and policy arrangements for managing droughts. Moreover, many past interventions have encouraged farming practices that increase both the extent of future drought losses and the dependence of local people on government assistance. They have also proved costly to governments. Climate change seems likely to add to these problems if the frequency and severity of droughts increase.

Weather based index insurance shows promise as a more efficient and market based instrument for managing drought risk in dryland areas, but one that is still at an early stage of development. Recent years have seen the launch of a wide range of index-based weather insurance programmes around the world, many on a pilot basis. Some initial results are encouraging and show that index-based weather insurance can work though it is unlikely to be a widespread panacea. There has been limited spontaneous development by the private sector, and initiation has depended on governments or international agencies, such as the World Bank. This reluctance by the private sector is related to the high basis risk associated with too few weather stations; problems associated with barriers to entry and set-up costs; the need for marketing intermediaries to link farmers with insurers; and the fact that many risk management products are simply too expensive for smallholders to afford unless it catalyzes access to credit, technology, or new markets that can help generate significant additional income.

There is a need for further product and institutional innovation, as well as for a stronger public sector role in helping to launch new programmes in countries where the potential is greatest. In particular, governments need to create more enabling regulatory environments, set up additional weather stations, and provide a first line of reinsurance. The case for these kinds of public investments and support will need to be strengthened through good Monitor & Evaluation systems that demonstrate, over the longer term, the ex post economic and social benefits of such insurance products.

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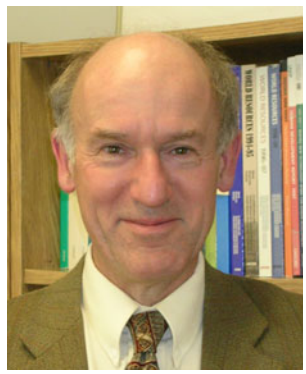

Peter Hazell has devoted most of his career to research and advisory work on policy issues related to agricultural development. Initially trained as an agriculturalist in England, he completed his Ph. D. in agricultural economics at Cornell University in 1970. From 1972 to 2005 he held various research and management positions at the Bank and the International Food Policy Research Institute (IFPRI). After retiring from IFPRI he became a Visiting Professor at Imperial College at Wye and a Professorial Research Associate at the School of Oriental and African Studies (SOAS), University of London.

Ulrich Hess is Senior Economist working on innovative financing, particularly climate finance at the World Bank's Concessional Finance and Global Partnerships Vice Presidency. He was seconded to the World Food Progamme (WFP) as Chief of Risk Reduction and Disaster Mitigation Policy from February 2006 to October 2009 where he managed the Disaster Risk Reduction Unit and produced WFP's new disaster risk reduction strategy, as well as innovative risk financing instruments in China, Ethiopia and other countries. Before that he worked in Bank's Ghana country unit and in various IFC units and the Agricultural and Rural Development Department in the Bank. He started the World Bank Group's work on weather risk management, for example assisting successful weather risk financing initiatives in India in 2003 and Malawi and Ethiopia in 2005 and 2007 as well as Caribbean in 2004. Prior to joining the World Bank as a Young Professional in 1998, Mr. Hess worked in management and development consulting. Mr. Hess holds a Master in Economics degree from Bocconi University, Milan and a Master in Political Science degree from Freie Universität, Berlin. He also studied at Institut d'Etudes Politiques de Paris and Yale Law School.