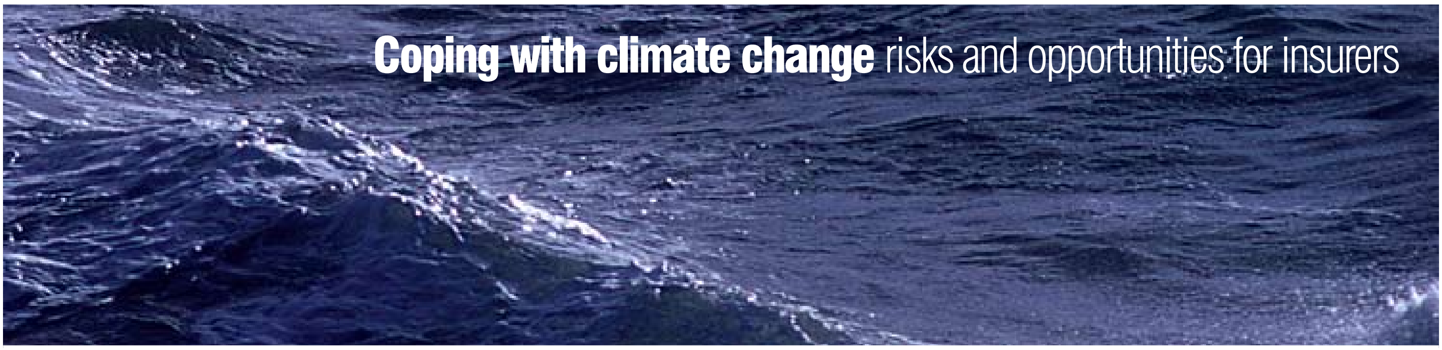


Chapter 13

Farming and forestry

13.1 Introduction

The agricultural and forestry industries make a significant contribution to the UK and global economy and these industries account for substantial amounts of land-use. In the UK agriculture contributes 1.4% of GDP and occupies 75% of total land area[1]. In some African countries it is up to 70% of GDP[2].

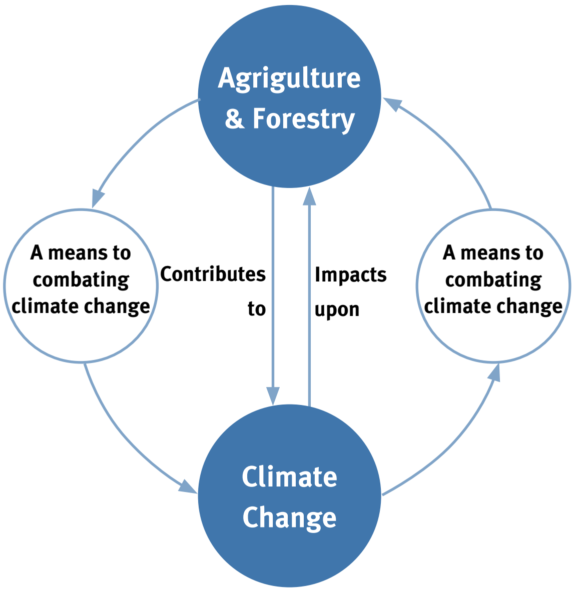
This chapter will analyse the effects that climate change will have on these industries at both a UK and global level, particularly in developing countries, and the implications for the insurance industry. This will include an overview of the different relationships between agriculture and climate change and the resulting effects. Globally, agriculture is an important contributor to global warming. Conventionally the term agricultural insurance is restricted to crops, livestock, forestry and aquaculture, but here we use the broader definition of "insurable risks relating to these activities".

Climate change presents many challenges to agriculture and forestry as well as a number of opportunities. Historically, the agricultural industry has experienced major changes such as technological advancement allowing increased productivity but reduced labour intensity, increased usage of fertilisers, globalisation, diversification into new activities and various phases of governmental intervention. These factors are continuing unabated. Climate change is now a further challenge that needs to be addressed, along with issues like GMO's, biodiversity, and concerns for consumer health. Private market insurance has played a limited role in the sector, for several reasons: the potential for widespread catastrophe, government intervention, and the likelihood of moral hazard. However, new sources of capital, and novel risk transfer products may alter that.

13.2 Relationship between farming and forestry and climate change

When analysing the relationship between climate change and the agricultural and forestry industries there are three key factors:
a. The impact that climate change is having upon agriculture and forestry.
b. The effects that both the agricultural and forestry industries are having upon the climate.
c. The use of agriculture and forestry to combat climate change.

Figure 1:



These relationships are illustrated by Figure 1 and each will be discussed in turn throughout the course of this chapter.

13.3 Impact of climate change on farming and forestry

The impact of climate change will vary depending on geographical regions. This section considers the impact of climate change from a global and UK perspective. The UK experiences relatively smaller variations and as such the effects are more limited than in North America, for example. Figure 2 summarises the main factors and the impact that they have on the agricultural and forestry industries.

1 Climate Change & Agriculture in the United Kingdom, DEFRA

2 IPCC Working Group II, Fourth Assessment Report

Figure 2: Impacts of climate change upon agriculture and forestry

Factor	Beneficial Effects	Detrimental Effects
Increased Carbon Dioxide Levels	• Higher yields for certain crops (e.g. vegetables, wheat). • Exploration risk (e.g. unexpected, temperature and flow rate). • Increased growth in forests.	• Reduced yields for certain crops and certain areas, e.g.rice yields in central China. • Reduction in timber quality & possible nutrient imbalance.
Warmer Temperatures	• Scope for new crop types in certain areas. • Longer growing seasons.	• Damage to crops which are sensitive to warm temperatures. • Reduced fertility of animals and crops. • Greater use of refrigeration in storage and transportation leading to higher costs. • Softer winter ground conditions. • Increased heat stress in animals. • Increased occurrence of pests & diseases, including exotic ones. • More frequent and severe fires.
Changing Rainfall		• Increased precipitation in winter months lead to waterlogging & flooding problems. • Lower rainfall in summer months likely to lead to droughts and water shortages causing damage to crops/forests.
Weather Extremes		• Significant damage to land and property, e.g. caused by increasingly intense windstorms & heavy isolated thunderstorms creating flash floods. • Reduced yields and increased costs.
Rising Sea Levels		• Coastal erosion and flooding. • Loss of agricultural land.

Global examples of recent extreme weather events include:

– The unexpected heat wave across Europe in 2003 which led to severe wildfires in France, Portugal and Spain. This affected large areas of forestry and property and resulted in approximate losses of $12bn[3]. It was reported that huge areas of forest covering 5% of the country's surface area were destroyed in Portugal as a result of the heat wave[4].

– The extreme flooding experienced in Europe in 2002 was estimated to have cost €13bn to repair damage to land and property[5].

– In January 2005, windstorm 'Gudrun' swept across Sweden. Approximately half of the damage costs (€2bn) related to commercial forestry with only €0.2bn of this being insured. In total, 46,000 hectares of forestry were destroyed, the equivalent of 10 years worth of fellings[6].

Increased carbon dioxide levels

Carbon dioxide levels have risen noticeably over time and continue to do so at a significant rate. This can have a beneficial impact upon the growth of some crops. The increased carbon dioxide concentrations in the atmosphere trigger photosynthesis leading to the possibility of increased crop yields. This has been found to have a greater effect on crops such as vegetables and wheat. Crops such as maize do not appear to benefit from increased carbon dioxide levels.

In terms of forestry, increased carbon dioxide levels do generally bring about an increased growth rate but at the cost of a reduction in timber quality and the potential for nutrient imbalances.

The occurrence of higher yields though does rely upon a number of other factors including; having a sufficient water supply, use of fertilisers and adequate control of pests and diseases.

[3] Financial Risks of Climate Change, June 2005 – Summary Report, Association of British Insurers

[4] Climate Change and the Financial Sector – An Agenda for Action, June 2005, Allianz Group & WWF

[5] Climate Change and the Financial Sector – An Agenda for Action, June 2005, Allianz Group & WWF

[6] Financial Risks of Climate Change, June 2005 – Summary Report, Association of British Insurers

In the UK the effects of increased carbon dioxide levels are likely to be beneficial overall. However, in other parts of the world the benefits of increases in carbon dioxide levels will be more regional. In Asia, for example, rice yields in North West Japan and wheat yields in North East China will increase. However, reduced yields will be experienced in South East Japan and central China[7].

Temperatures

The change in temperatures that climate change is bringing has a wide range of effects. The impact of the change in temperatures upon crops is variable. Some benefit from warmer temperatures such as grapevines, legumes and carrots and in the UK the increasing temperatures give scope to grow crops not traditionally grown. Conversely, other crops experience detrimental effects including salads and wheat which are more sensitive to increased temperatures. Some soft fruit requires a frost (vernalisation) for budding, and so the outlook for blackcurrants and similar fruit in Kent is poor.

The unusually high temperatures which were experienced in July 2006 in the UK demonstrate this point. It was reported that "the food supply chain is increasingly worried by the damage to crops from the ongoing high temperatures"[8].

Further effects of temperature changes include the length of growing seasons and change in geographical locations where crops are grown. For example, southern UK is becoming an ideal location for crops which are more usually grown in Europe such as grapes and soft fruits. In North America, there is likely to be a significant shift northwards in location where many crops are grown. In tropical countries, some crops are near their temperature tolerance threshold, and will fail.

In Arctic regions, the shorter winters are leading to softer ground conditions, with serious implications for logging operations, and knock-on costs for the paper and pulp industries.

Warmer temperatures are impacting upon the transportation and storage of perishable crop types. Greater use of refrigeration will be increasingly required, adding to growing costs for producers.

Warmer temperatures will likewise have significant impacts upon livestock and dairy farming. Livestock farming is dependent upon arable crops for animal feed so the changes already outlined in this chapter will consequently impact upon livestock farmers. For example, the longer growing seasons for forage crops allow greater availability, along with the potential of new forage crops. However, one concern is that the quality of forage may be affected by the changing climatic conditions.

The occurrence of heat stress in animals is likely to increase with the warmer temperatures. Effective procedures and redesign of animal housing will have to be adopted to overcome this, particularly with those who use intensive housing for animals. The fertility of animals is also reduced by higher temperatures.

Higher temperatures will create ideal pre-conditions for arson, as well as giving rise to more severe incidences of wildfire from natural and accidental causes[9].

BOX 1
increased disease challenges

Climatic changes will bring about new disease challenges. Some pests and diseases will increase in response to the altered climate as well as new types emerging. On the other hand, some types of pests and disease may decrease or cease to exist in certain areas. As with the geographical shift in cropping patterns discussed earlier, there will be a shift in location of where certain pests and diseases are found.

The timings when pests or diseases may occur will also be altered as a result of climate change. For example, aphids which are the most significant pests in relation to crops in the UK are starting to hatch earlier in the year. This will result in a greater extent of crop damage due to crops being in a more fragile condition when they are less mature.

In terms of meeting these new challenges a number of options can be considered. Risk assessment and forecasting are two key ways in which action can be taken to adapt to the new challenges that are presented. Rothamsted Research is a useful source for this. One example is in respect of Light Leaf Spot disease, a serious disease of oil seed rape. Rothamsted have designed models to assist in forecasting the occurrence of this disease for farmers based on weather and crop factors providing both a preliminary forecast in September and then final forecast the following Spring .

The usage of fungicides and pesticides may be a further strategy. However, the environmental effects of these chemicals will have to be assessed as well as the potential for pesticide resistance which may occur as a result of increased use.

Animal health is also at risk with climate change. For example West Nile Virus and Blue Tongue Virus have both recently appeared in north Europe, and will become more common in warmer weather due to favourable conditions for the midges which carry them. The obvious risk is slaughter, or costly vaccination, but Swiss Re calculate that the risk of interrupted sales of healthy, but quarantined, animals is about 70 times that of forced culling.

7 Financial Risks of Climate Change, June 2005 – Summary Report, Association of British Insurers

8 "Summer Deluge could end in Autumn Drought" V Elliott, The Times, 29/07/06

9 Climate Change and Insurance: An Agenda for Action in the United States, Allianz and WWF, 2006

Changing rainfall

Increased precipitation in winter months will potentially lead to water logging and flooding problems. This may lead to damaged crops and increased need for crop drying and effective drainage systems to reduce these effects.

Summer months are likely to bring lower rainfall causing droughts and water shortages. This is likely to cause a reduced quality of crops and reduce crop yields. There will be an increased demand for irrigation during these times leading to water conservation issues. At the same time, there is also a trend to more intense summer rainfall; when it rains it will come in torrents. This will be difficult to manage, with flash-flooding and runoff problems.

These changes may lead to changes in location of where crops are grown both in the UK and globally.

Landowner and tenant liability for damage and accidents due to runoff and pollution is likely to increase[10].

Rising sea levels

Sea Levels are expected to rise globally by 10-50cm by the 2050's[11]. The UK is currently sinking in some areas most notably the south and east which may increase the impact of rising sea levels. Rising sea levels result in coastal erosion and coastal flooding therefore impacting most on agricultural activities carried out on low lying areas. In the UK, approximately 57% of grade 1 agricultural land is below the 5 metre contour. Areas such as the Lincolnshire coast, Thames estuary, The Fens and Somerset are extremely vulnerable to flooding. The problems are obvious in many developing countries which are dependent on low-lying deltas, e.g. Bangladesh.

Weather extremes

A further effect of climate change is that the number of extreme weather events is likely to increase. These events include extremely strong winds, droughts, torrential rain, hailstorms and heat waves. These are difficult to plan for and can lead to catastrophic results such as the loss of entire crops, which will significantly impact upon activities such as agriculture and forestry.

13.4 Contribution of farming and forestry on climate change

Contribution to greenhouse gases

It is important not to forget the actual contributions that agriculture and forestry themselves make to climate change. Agriculture and forestry are the second largest source of greenhouse gases in the UK generating 7% of the UK's emissions[12]. These greenhouse gases include carbon dioxide but more notably methane and nitrous oxide. Farming activities contribute only 1% of UK's carbon dioxide emissions but 66% of nitrous oxide emissions and 46% of the country's methane emissions. These latter two gases, however, are actually more damaging to the atmosphere[13].

As mentioned, the contribution that UK agriculture makes to carbon dioxide levels is relatively small. This is made through burning fuel in farm machinery, consumption of electricity, decomposition of organic matter, changes in land use and through respiration of living organisms. The transportation of produce is an indirect way in which agriculture contributes to greenhouse gas emissions. The sector also contributes significantly to methane levels, mostly through direct and indirect emissions from livestock, and nitrous oxide, which originates from animal wastes, fertilisers and, to a lesser extent, from natural processes in the soil.

At a global level, the situation is different, however. Through clearance of natural forests, and methane from rice-fields, agriculture generates over 20% of manmade GHG emissions[14]. This is clearly a major concern.

13.5 Use of farming and forestry to combat climate change

Agriculture and forestry can also be used as a means to combat climate change

Whilst we have seen that agriculture and forestry make significant contributions to greenhouse gases in the atmosphere, it should also be noted that soil and vegetation absorb approximately 40% of carbon dioxide emissions on a global scale[15]. In particular, woodland stores or sequesters substantial amounts of carbon dioxide.

[10] Agriculture & Climate Change NFU, 2005

[11] Climate Change & Agriculture in the United Kingdom, DEFRA

[12] "Carbon's coming "Farmers Weekly, 26th October 2006

[13] "Carbon's coming "Farmers Weekly, 26th October 2006

[14] IPCC Working Group II, Fourth Assessment Report

[15] "Carbon's coming "Farmers Weekly, 26th October 2006 – statistics noted as being from recent NFU report.

A second significant way that agriculture and forestry are being used to combat climate change is through the growth of energy crops. These energy crops are used to produce biofuels and biomass and are set to play an increasingly larger role in the future of agriculture. The subject of energy crops will be discussed in greater detail later in this chapter.

Forestry and woodland

The global area of forest in 2005 was estimated at just under 4 billion hectares which represents 30% of the total land area and 0.61 hectare for each member of the global population.

The global forest has been steadily declining as a result of deforestation of approximately 13 million hectares per annum. This is partially offset by an increasing area of new forest, predominantly as a result of afforestation programmes in Europe and China. This reduced the net loss of forest to 7.3 million hectares per annum for the period 2000-2005. Since trees store carbon above and below ground, removing them is a major source of greenhouse gases.

The importance of forest and woodland as a carbon sink cannot be underestimated. It is estimated that there are 638 gigatonnes of carbon in the forest ecosystem which is greater than the total quantity of carbon in the atmosphere[16]. Maintaining the global forest should therefore be a key component of any action plan against climate change, as noted by the Stern Review. This will involve action to minimise deforestation particularly in areas of virgin forest (South America and South East Asia), afforestation schemes bringing land into forest[17], and efficient reforestation schemes following cropping or natural disasters.

Traditionally forestry insurance has been a specialist area providing cover for larger managed forests and plantations. Forests will become increasingly vulnerable to the natural hazards of fire, storm and flood as a result of climate change. It will be important, however, that funding is available following loss or damage for reforestation to minimise further impact. The role of insurance combined with risk management measures, particularly for smaller forests and plantations (which can be significant in aggregate) will be crucial.

Food miles

The concept of 'Food Miles' is becoming an increasingly important measure in helping to reduce greenhouse gas emissions. Reducing the number of food miles is a further way in which agriculture can contribute to combating climate change. Food miles are a measure of how far food travels from the farmer who has produced it to the end consumer. Over the last 30 years the distance travelled by food produce has increased significantly. "Since 1978 the amount of food moved about within the UK by HGV has increased by 23% and the average distance for each trip has jumped by 50%"[18].

DEFRA commissioned a report by AEA Technology into food miles as an indicator which was published in 2005[19]. This report, whilst confirming that food transport has a significant and growing impact, concluded that a single indicator based on total food kilometres was an inadequate indicator of sustainability. It identified a total impact cost (not just climate change) to the UK for food transport of £9billion per annum. The largest single item was the use of the private car for food shopping, although collectively HGV and air freight costs made up the majority.

The report also concluded that whilst transport costs should be reduced where possible this was only one factor in food production. The energy used in crop production also had to be considered and potential reductions there could outweigh the transport impact. So, for instance the energy used in growing salad crops under glass in the UK could exceed the energy used in transporting those crops from a country where they are grown under natural conditions outdoors, or by using waste heat and carbon dioxide.

13.6 Changing cropping patterns

As mentioned earlier in the chapter, climate change is having an impact on cropping patterns. There are a number of aspects to this which need to be highlighted:

a. The geographic shift of where crops are grown as a result of climate change.
b. Changes to growing seasons and crop quality and their impact upon farm management systems.
c. Scientific development of new strains of crop and animal.
d. The emergence of certain crops being grown to produce renewable energy.

[16] Global Forest Resource Assessment 2005, Food and Agriculture Organisation of the UN, Rome 2006

[17] However, in their early years, afforestation schemes are net creators of carbon dioxide, due to soil disturbance, and planting operations, so they are not a quick fix.

[18] www.fwi.co.uk/gr/foodmiles/facts.html

[19] The Validity of Food Miles as an Indicator of Sustainable Development: Final Report for DEFRA June 2005

Geographical shift

The changing climatic conditions have led to a geographical shift in where certain crops are grown and this is likely to be seen to a greater degree in the future.

In the UK, crops grown in the southern regions will gradually shift northwards, as a result of higher temperatures. This will enable them to be grown at their optimum temperatures. Similarly, many crops across North America will shift northwards to be able to benefit the more favourable growing conditions. This is especially for crops which are temperature sensitive.

Following on from the geographical shift, crops will appear in areas which were previously unsuitable due to the cooler climate. For example, southern regions in the UK are increasingly being used for growing crops more usually found to be grown in Europe. These crops include maize, sunflowers, soft fruits and grape vines. In June 2005, the BBC reported "Walnuts, usually a continental crop, are being grown in Kent and farmers say the move is because of climate change"[20].

Growing seasons and crop quality

Climate change is having an impact upon the length of growing seasons. In the UK, there has been an increase in the length of growing season, for many crops as a result of increased temperatures. This should result in greater availability of produce grown in the UK throughout the year.

A further effect of the warmer temperatures is that many crops mature at a quicker rate. During the unusually high temperatures of July 2006 it was reported in respect of salad crops that "Produce that normally takes 60 to 80 days to grow is now ready for picking within 40 days. The production for baby leaves is down from 28 days to 12 to 14 days"[21].

However, a drawback of the earlier maturity of crops is that it may impact upon quality of the produce.

Effective management systems will be required to deal with these factors. It is likely that there will be increased pressure to produce and use new crop varieties which are suited to these conditions.

The wine industry is a useful example to demonstrate a number of the issues discussed here.

BOX 2
The wine industry and climate change

The following extract clearly demonstrates the effects of climate change in the high quality wine production industry.

"While the observed warming of the last 50 years appears to have mostly benefited the quality of wine grown worldwide, the average predicted regional warming of 2 degrees Celsius in the next 50 years (2000-2049) has numerous potential impacts:

- changes in grapevine phenological timing, i.e. stages of plant development
- disruption of balanced composition in grapes and wine (heat means less acid, stronger wines)
- alterations in regional wine styles
- spatial changes in viable grape growing seasons

It is estimated that the premium wine production area in the United States may reduce by up to 81% by the late 21st century. This will mainly be attributed to the increased number of extremely hot days." *

In Europe, similar changes will occur, with vineyards moving north as temperatures rise in traditional growing areas. Already, the permissible region for growing champagne has been redefined. In the southern hemisphere, Chile, Argentina and New Zealand should cope well with climate change and have plenty of room to move south to cooler wine regions if the temperature rises too far. Australia and South Africa, the other two big Southern Hemisphere producers will not fare so well, due to temperature and lack of water. Already Australian vineries are recycling water for internal and external production uses.

* Source "Extreme heat reduces and shifts United States premium wine production in the 21st century". Proceedings of the National Academy of Sciences, 103(30): 11217–11222. White, M.A., Diffenbaugh, N.S., Jones, G.V., Pal, J.S., and F. Giorgi (2006).

Scientific development of new strains of crop and animal

Climate change will add urgency to the search for new breeds and strains of crops and animals that can tolerate more extreme conditions, or higher levels of pollutant such as salt. Although this will help to adapt to climate change, it will mean that historical experience with traditional varieties and breeds is no longer so useful. In some cases it could give rise to potentially new sources of liability, eg from the escape of GMO varieties into organically farmed land.

[20] BBC News Website

[21] "Summer Deluge could end in Autumn Drought" V Elliott, The Times, 29/07/06

Energy crops

As already highlighted the production and use of energy crops are one way of mitigating the effects of climate change. This is having an impact upon cropping patterns. Crops such as oilseed rape, sugar beet, wheat and wood are all examples of UK crops that can be used in the production of biofuel and biomass[22]. It is likely that this will have a substantial influence on the type of crops grown as the demand for these crops rises. The most rapidly developing area is in the production of biofuels.

There are a number of different biofuels in production or development including bio-ethanol, bio-diesel and bio-butanol. 101 Ethanol plants were in production for the 2006 US harvest with a capacity of 4.8bn gallons. 32 further plants are in development which will add a further 2bn gallons production. It is estimated that 20% of the US corn crop is now used for biofuels yet that accounts for just 3% of fuel use[23].

The move to biofuels in the UK is driven by the Renewable Transport Fuel Obligation (RTFO) as part of a European initiative. This will require 5% of fuel by volume in the UK to be derived from renewable fuels by 2010[24]. European ministers have agreed to commit to an extension to 10% renewable fuels by 2020[25].

The UK consumed 40.8m tonnes of fuel for road transport in 2004[26]. The 10% target for biofuels therefore represents a 4.8m tonne equivalent. The quantity of biofuel produced per hectare depends on the crop utilised and the fuel produced, but by way of example, oilseed rape can produce approximately 1.5t of biodiesel per hectare. On this basis over 3m hectares of agricultural grade land will be required to meet the 10% target. This represents over 50% of the total arable acreage in the UK of 5.136m hectares in 2005[27].

Whilst this is an oversimplified calculation it makes the point that meeting the 5% and 10% RFTO targets will not only potentially impact on UK food production, but will require both the development of more efficiently produced second generation biofuels and importing biofuel from outside the UK. This pattern will be replicated in other countries as they each set statutory targets for biofuels (eg 20% of US corn provides 3% of its fuel, see above). This creation of a market provides opportunities for developing countries but also represents a threat to local cropping patterns, bio-diversity and virgin forest and grassland. Large areas are already being converted to palm oil, soya and sugar cane plantations in South America and South East Asia for the production of biofuels.

Some agencies are already expressing concern that a balanced approach is essential if the targets are to be met in a sustainable way. By way of example, the European Environment Bureau together with two other NGO's appended the following notes to their press release of 7 March 2007.

"Biofuels are often referred to as 'carbon neutral'. They are not. In reality, they release greenhouse gases throughout their production cycle. Indeed, the emissions savings on offer are highly variable and can be very small, or even negative, depending how they are grown and processed. The GHG savings from biofuels risk being lost if their production causes the loss of high carbon-absorbing land-uses. Between 10 and 30% of global GHG emissions are already due to land-use change. This is principally as a result of tropical deforestation, but grasslands also represent an important 'carbon sink'."

In April 2008, the World Bank carried out a study[28] that concluded that biofuels had been a substantial contributory factor in the rise in world food prices, with consequent harmful effects in poor countries. Since then the enthusiasm for "first generation" biofuels has diminished, but research continues into bioenergy crops which can grow on marginal land.

Chapter 12 "The Energy Sector" examines the insurance implications under the heading of renewables.

13.7 Climate change and the market potential for farming insurance

Definition of agricultural insurance

The generally accepted definition of agricultural insurance is for only crop, livestock and forestry insurance (narrow definition); if one includes property, machinery, liability and other non-life classes of insurance for agricultural producers (broad definition) the premiums are much greater.

The current position

The size of the market is difficult to establish. Overall, agricultural insurance is underdeveloped worldwide. In 2001, total agricultural premiums (narrow definition) amounted to US$6.5 billion while the estimated total value of agricultural

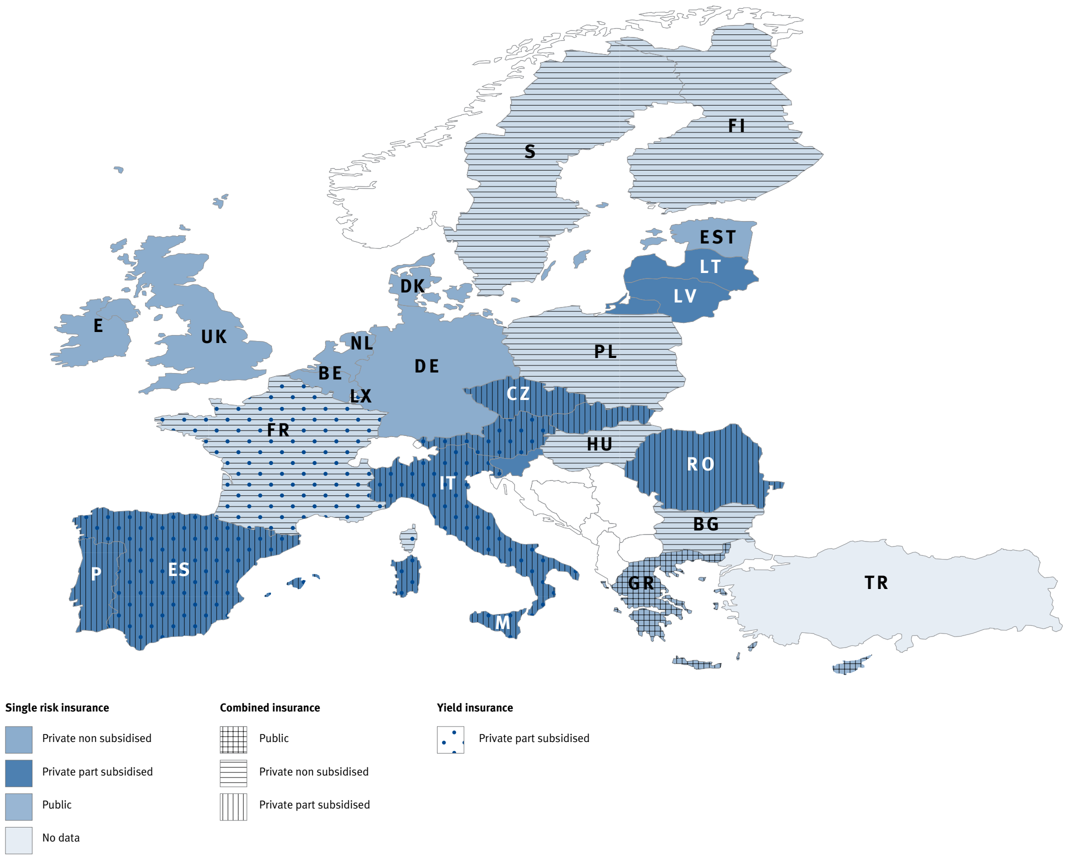
22 Biofuel is the equivalent of oil-based fuel, but made from processing plants; biomass is solid fuel, like wood and plant residues from processing food crops
23 Business News feature Daily Telegraph June 15 2006
24 Department for Transport website
25 BBC News 15 February 2007
26 DTI Regional and Local Road Transport Consumption Statistics, DTI Website
27 DEFRA Website Table 3.2 UK Crop Areas and Livestock Numbers
28 A Note on Rising Food Prices, D. Mitchell, April 8 2008. Unpublished, for World Bank
29 Agricultural Insurance Revisited: New Developments and Perspectives in Latin America and the Caribbean M Wenner, 2005
30 "Insurance in Emerging Markets", Sigma 2007/1 Swiss Re

production worldwide was US$1.4 trillion. Thus, agricultural premiums as a share of output were a miniscule 0.4%[29]. Globally, Swiss Re reckon the market in all emerging countries together was about half that, at $1billion in 2005, but with a potential size of $10 billion if penetration reached western levels.[30] Figures for the broadly defined sector are not generally compiled. In UK, it is around £1 billion premium income, since one of the major insurers in that field had a turnover of £900 million in non-life insurance in 2006[31]. (Much of that was non-agricultural, but against that other insurers hold a large part of the broadly-defined agricultural insurance market.)

Generally cover for growing crops is limited in the private market, due to the potential for catastrophic losses, and the problems of adverse selection and moral hazard. Full multi-peril crop insurance is only available with government backing, and only in a few countries, and generally runs at a large loss for the risk-bearer. As an alternative, governments and other agencies often provide disaster aid to poor farmers, removing some of the need to have insurance, though relief aid has many drawbacks itself. Another difficulty is that the smaller the farmer, the higher the cost of distribution. An interesting point is that in systems where the government bears the risk, often private insurers play an important part in administration, through issuing policies, keeping records, and handling claims.

Private market cover for crops is thus limited to specific perils like hail, and fire and wind-storm for forests. Practice varies widely even within the EU[32] (see Figure 3). Plant and machinery cover is widely available. Liability cover is available, but the sector is generally seen as a high risk one.

Figure 3: Main agricultural insurance systems in EU (narrow definition)



One review notes 'Even in very well developed systems such as the USA and Spain, participation rates, 20% and 31%, respectively, are still relatively low indicating that effective agricultural risk management must be seen as an "integrated layer system" that includes on-farm, individual risk reducing and coping activities and strategies; informal group based or mutual insurance schemes, formal private market insurance programs, and government sponsored and financed catastrophic disaster relief programs. Insurance by itself is no substitute for good production practices, careful attention to crop mixes, financial savings, and price hedging. Insurance must be seen as a mechanism for removing residual risk that cannot be covered by on-farm or household actions.'[33]

31 NFM Annual Report and Accounts for 2006

32 Agricultural Insurance Schemes: Summary report, November 2006 European Commission Joint Research Centre (JRC), Ispra, Italy

33 "Agricultural Insurance Revisited: New Developments and Perspectives in Latin America and the Caribbean" M Wenner

The influence of climate change

Climate change is going to add uncertainty to the agriculture and forestry sector, because the future climate will be different. Climate change may also create opportunities for more exotic crops, and diversification into leisure activities. The measures taken to adapt to the new climate , such as new cropping patterns, mean that there may be little experience to rate risks. Apart from the direct effect of the weather on crops and animals, climate change will likely increase sociological risks like arson and pollution by exacerbating the underlying conditions. A particular issue in the UK is the amount of low lying land which is generally used for agricultural purposes. The rising sea levels may make this land unviable. In other countries saline intrusion into ground water could become a serious difficulty.

All of this means that climate change will strengthen the need for insurance. If left to conventional practices this might be unsatisfied, but as we shall see new techniques could overcome the barriers.

The influence of climate change regulations

Now that it is accepted that climate change is real, governments are developing measures to reduce it (mitigation) and to cope with it with the unavoidable impacts (adaptation). Both approaches could increase the use of agricultural insurance.

The need to store carbon could lead to a higher value being placed on bio-assets, like managed and natural forests, with a consequent requirement to protect that value. Similarly, the growing use of bio-renewables could lead to a wider range of potentially insurable crops, if the usual barriers to crop insurance can be overcome.

More insidiously, government policies aimed at reducing emissions will inevitably mean that the price of energy and other critical inputs for agriculture, such as fertiliser, will rise sharply. For small farmers in developing countries this is a major risk, even if not normally insurable. The context of global demand and supply, and related increasing cost of production driven by energy prices, is expected to become a major issue in future, and will strengthen the pressure for OECD nations to provide financial support at least in a transitional phase until alternative forms of energy become less expensive and widely available.

In that context, agricultural insurance could play a large role for deploying finance from OECD countries to developing countries as part of the adaptation component of fresh international agreements to tackle climate change. The worst effects of climate changes will be felt in developing countries, which are often subject to weather extremes, and are more dependent on agricultural sector, which is obviously weather-dependent. Part of a negotiated deal to succeed the Kyoto Protocol will have to be funding to assist those countries. OECD nations are reluctant to simply provide ever-escalating disaster aid, and indeed developing countries do not want to depend upon post-event "charity", conditional upon the economic situation, and the general level of requests for funds. This is creating an opportunity for insurance-type instruments, which provide more certainty, and can be linked to risk management[34].

Reaching small farmers is normally a high priority with politicians. Figure 4 shows the type of risk transfer products which might be required.

[34] "Climate Change and Insurance: Disaster Risk Financing in Developing Countries". Gurenko, 2006

Figure 4: Emergency insurance schemes for agriculture in developing countries

	Crisis Safety Net	Cargo Net	Productive Safety Net
Purchased By	Government, relief agency, NGO or other institution with society-wide responsibilities	Farmer, farmers' association, credit institution, NGO or development organisation	Farmer, farmers' association, NGO, government, development organisation
Impact of Insurance Scheme in Bad Year **(when a climate shock occurs)**	Payout available when climate shock occurs, allowing rapid response, minimising long-term effects	Payout enables creditors to be paid back. Householders are protected from the direct impacts and retain more of their assets	Payout allows for a quick recovery from shock. Productive assets are not compromised, protecting insured from backward slide into poverty
Impact of Insurance Scheme in Good Year **(when no climate shock occurs)**	Safety net diminishes uncertainty and enables better decisions by all groups	Risk distribution allows access to credit and improved livelihood strategies – allowing escape from the poverty trap imposed by climate	Greater confidence and certainty enable greater investment and economic growth

Source: Index Insurance for Climate Risk Management & Poverty Reduction, IRI, 2008

There are already some projects in this area, financed by development banks and similar organisations[35], not generally related to climate change adaptation specifically. What is needed is a dramatic scaling-up. While climate change is increasing the risks for the agricultural sector, it also holds the possibility of a quantum leap in financial assistance for developing countries, as part of the cost to OECD countries of managing climate change. This could include a rapid expansion of agricultural insurance. As will be seen, there could be a substantial role for the private sector in such schemes, and also there is a growing interest in developing ART solutions within the private market anyway, which taps new sources of capital among non-shareholder investors, and within the communities at risk.

New tools

Fortunately, several technical advances mean that agricultural insurance may now be more feasible than previously, even for poor communities.

- Remote sensing technology, e.g. satellites, automatic weather stations, global positioning systems (GPS), and the transmission of captured data to databases.
- Computer processing power. For example, insurance companies now often use geographic information systems (GIS) as a tool to conduct pricing. Partner Re, which has one of the largest agricultural portfolios, has been using GIS since 1997 to model natural hazard risk.
- Communication technology – the internet, broadband connections, wireless networks – means that information can beshared widely, quickly, and remotely.
- More sophisticated meteorological, probabilistic risk, and bio-system models.
- ART products have been developed for clients ranging from sovereign states to individuals, covering a variety of risks (see below for weather derivatives, and Chapter 6 for capital market products).

Weather index insurance

Weather index insurance is insurance that is linked to a weather index such as rainfall, rather than an actual loss from weather, such as crop failure. This resolves a number of fundamental problems that make traditional insurance unworkable in rural parts of developing countries.

Firstly, the transaction costs are low so it is cheap. There is no need for field inspections during the underwriting or claims processes. Secondly, claims are paid fast, so avoiding distress sales of assets or ruinous loans. Also, moral hazard is reduced; the farmer has the incentive to make the best decisions for crop survival, since claims do not depend on a loss.

[35] World Bank, Managing Agricultural Production Risk: Innovations in Developing Countries, CRMG, 2005

There are over 30 good examples of crop and animal index insurance. One of the best index insurance projects started in India in 2003. Index insurance was sold to 1500 smallholder farmers in Andhra Pradesh and Uttar Pradesh along with other micro-finance products thanks to World Bank Group Technical Assistance. It was rapidly copied by other insurers, and In 2008 in Rajasthan alone 675,000 policies were sold to farmers. Swiss Re reinsures part of the portfolio to the tune of US$50million per year. The scale-up is continuing with growing momentum; a wide range of crops is covered with increasingly sophisticated indices, with financial partners offering related products[36].

With the dramatic growth, issues such as the availability and cost of weather data, subsidised premiums, regulation of agents, and consumer education are important. The most important concern is basis risk ; since the payout is not linked to a loss, but to a defined weather condition, it is possible for farmers to suffer a loss but receive a payout, if the loss is due to an undefined cause, or the weather station does not record very local conditions.

Figure 5: Minimal data needs for design of weather based Indices

• Thirty years or more of weather data (precipitation, temperature, relative humidity, wind, barometic pressure)	• Little potential for measurement tampering
• Limited missing values and out of range values	• Actual crop yield data at district level and preferably at the farm level
• Data and recording procedure intergrity	• Agronomic crop yield models
• Consistency of observation techniques: manual v automatic	• Metadata (Notations as to when and how changes were made in instruments, location and reporting methods)
• Limited changes in instrumentation/orientation/ configuration	• Availability of nearby weather stations for a "buddy check"

Source: Partner Re, 2004

Developing successful products requires good data (see Figure 5), skilled experts in a range of sciences, and good two-way communication with farmers. For a more detailed assessment of index insurance see World Bank, Managing Agricultural Production Risk: Innovations in Developing Countries, CRMG, 2005.

13.8 Recommendations

Insurers and intermediaries

- Ensure an up-to-date knowledge among staff of climate change and its implications for the agriculture sector, and government and EU policy relating to weather risk there.
- Support research in this area.
- Review standard covers for agricultural clients in view of the rising risk profile of, e.g. fire and flood due to changing climatic conditions. Important aspects to be considered by insurers and possible actions to be taken include:
  - Terms and conditions
  - Acceptance criteria of risks for these perils
  - Building standards
  - Flood management policies
  - Risk assessment tools
  - Additional capital requirements
  - Alternative risk transfer mechanisms
- Investigate the huge possibilities of new agricultural markets and new products, e.g. crops for energy, carbon storage in forests, microinsurance, weather derivatives and other ART, in developed and developing countries.
- Work with global initiatives, associations, research institutes and with international development organisations to define public-private sector partnerships.

[36] IRI, 2008

[37] Wenner , 2005

Investors

- Review the prospects and potential for investment new assets such as growing carbon storage.

CII

- Ensure that educational and library material is up-to-date concerning agricultural; insurance and climate change.

ABI

- Ensure that risk management and insurance are considered when important new strategies concerning climate change are being developed in the agriculture and forestry sector.

Government

Support the use of private market insurance resources to manage the risks and opportunities of climate change in agriculture and forestry. In particular, provide good quality climate and crop data, encourage risk management, and avoid subsidies and disaster relief if possible, because those undermine a self-reliant rural economy[37].

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Biography

Joanna Bean BA (Hons), ACII

NFU Mutual Underwiter

Joanna Bean graduated from Lancaster University in 2001 with a degree in Management and Organisation Studies. Since 2001 she has worked as an underwiter for NFU Mutual. Her current role is within the Head Office Underwriting department specialising in both farming and commercial insurance. Her interests include environmental issues particularly that of climate change.

Dr Andrew Dlugolecki

Andrew spent his salaried career with General Accident (now part of Aviva Group), starting in 1973 as a statistical analyst. Early projects included the effect of weather on motor and property claims. There followed a variety of interesting jobs at senior level, including managing the UK branches, and then emerging countries. A merger in 2000 led to a change in corporate direction, and departure for him.

When scientists started to investigate the economic implications of climate change in 1988, they asked various industry associations to identify experts to work with them. The British Insurance Association nominated Andrew, and he continued this "sideline" even as he worked in other areas, and then as a second career after he left Aviva.

Andrew's work on climate change covers three major aspects. Firstly, advice to politicians: he has been the chief author on insurance and financial services in major studies of climate change commissioned by the UK government, the EU, and of course the Intergovernmental Panel on Climate Change.

Secondly, in education, he has chaired three major studies of climate change by the UK Chartered Insurance Institute (1994, 2001 and 2009). He prepared and mentored modules of an e-learning training package on climate change and finance for financial institution executives, under the auspices of UNEP Finance Initiative (UNEPFI). He often gives talks and writes articles.

Thirdly, he continues to be active with business clients. He has been an advisor to the Carbon Disclosure Project and the UNEP Finance Initiative since 2000.

Andrew's qualifications include degrees in pure and applied mathematics, and a doctorate in applied economics. Among his affiliations he is a Fellow of Chartered Insurance Institute, and a visiting Fellow at Norwich University's Climate Research Unit. When IPCC received the Nobel Peace Prize in 2007, Andrew was one of those cited who had "contributed substantially" to their work.

Biography

David Martin

David initially trained at Agricultural College and worked in farming before commencing his career in Loss Adjusting in 1976. He worked for Ellis and Buckle and post merger Cunningham Lindsey for almost 30 years. This was initially as a general adjuster and manager before concentrating on complex and major loss. He was part of their Specialist Adjusting Unit and during that time led the initial response to two of the largest claims resulting from the first IRA terrorist bomb in the City. In 2005 he became a founding partner and director of Adjusting Solutions a niche London Market Adjuster.

David specialises in Product Liability claims especially (but not exclusively) in agriculture, horticulture and the food industry. He also has expertise in financial loss, particularly Business Interruption and Professional Indemnity claims. His experience extends to a detailed understanding of risk managed programmes and the requirements of the corporate market. It also includes the railway industry as David managed the claims programme for railway infrastructure for a number of years.

David has given evidence at trial on behalf of Insurers in both Civil and Criminal litigation.

David has written articles and given training tutorials in agricultural, horticultural and glasshouse claims as well as business interruption and product liability claims. His interest in climate change stems from his farming background and a concern that the potential issues for liability insurance were not being addressed.

David is a Chartered Loss Adjuster and Chartered Insurance Practitioner. He is also a FUEDI European Loss Adjusting Expert and Fellow of the International Federation of Adjusting Associations. He is a Past President of the Insurance Institute of Luton and St Albans, a former examiner in Consequential Loss and Agriculture for the CILA and currently is a panel member for their Accreditation to Chartered Status.