INSURERS INVOLVEMENT IN THE CONSEQUENCES OF GLOBAL WARMING

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Abstract

Global warming is a fact, even though many governments are in denial. Mankind is killing its planet home, originally out of genuine ignorance, but now out of fear of economic consequences. Meanwhile, the consequences of pollution from unsustainable economic growth are increasingly evident, in extreme weather, regional changes in weather, melting ice caps, and rising seas.

The failure of climate summits in Copenhagen (2009), Mexico (2010), and Durban (2011) reveals the stranglehold of the world's dominant economic system. While the talking continues, we are past the tipping point: we should now be in crisis management mode. Food and water supplies are already threatened. There will be mass migrations. Some low-lying cities and nations will be submerged. Agricultural land will be inundated. Property damage will be enormous. Economies will collapse.

Adversity is the core concern of professionals in the field of risk management and insurance, having dealt with enormous numbers of catastrophe claims. International reinsurers are continuously expanding their research into global warming. The big insurers and reinsurers are going centre stage, demonstrating their vital role in the management of climate risk, and collaborating with governments and communities.

บทคัดย่อ

สภาวะโลกร้อนที่เป็นจริงขณะนี้ยังไม่ได้รับการสนใจจากหลายรัฐบาลว่ามนุษยชาติกำลังทำลายที่อยู่อาศัยของตนเอง รวมถึงผลที่ตามมาของระบบเศรษฐกิจที่ไม่ยั่งยืนที่ปล่อยมลภาวะมาทำลายสภาพอากาศ ซึ่งมีผลกระทบต่อการละลายของน้ำแข็งและระดับน้ำทะเลที่สูงขึ้น

ผลจากสภาพอากาศที่เสียในประเทศโคเปนเฮเกน ปีพ.ศ. 2552 และประเทศแม็กซิโก ปี พ.ศ. 2553 รวมถึงเมืองเดอร์บาลประเทศแอฟริกาใต้ ปี พ.ศ. 2554 ทำให้เห็นว่ามีผลกระทบอย่างมากต่อระบบเศรษฐกิจทั่วโลก รวมทั้งจำนวนอาหารและน้ำซึ่งมีผลต่อเนื่องทำให้จำนวนผู้อพยพเพิ่มขึ้น ดังนั้น ทุกคนควรหันมาร่วมมือกันจัดการกับปัญหานี้ นอกจากนั้นบางเมืองที่อยู่ในพื้นที่ต่ำก็กำลังจะจมอยู่ใต้น้ำ พื้นที่ส่วนเกษตรกรรมก็เจอกับปัญหาน้ำท่วม ทำให้ทรัพย์สินและเศรษฐกิจสียหายมหาศาล

ความทุกข์ร้อนนี้มีผลให้บุคคลที่อยู่ในวงการการจัดการความเสี่ยงและประกันภัยต้องเจอกับสภาพการเรียกร้องค่าสินไหมจากภัยธรรมชาติจำนวนมากมาย ดังนั้นผู้รับประกันภัยต่อทั่วโลกจึงให้ความสนใจเกี่ยวกับวิจัยสภาวะโลกร้อน และบริษัทประกันภัยและรับประกันภัยต่อใหญ่ ๆ มีบทบาทอย่างมากในการร่วมมือกับภาครัฐบาลและสังคมในการจัดการกับปัญหานี้

วิจัยนี้กล่าวถึงถึงผลกระทบของสภาพอากาศที่เปลี่ยนไป และการวางแผนหนทางการแก้ไขของบริษัทประกันภัย รวมถึงรายงานที่เกี่ยวข้องโดยบริษัทประกันภัย รัฐบาล และองค์กรอื่น ๆ

Introduction

The background to global warming and its consequences for climate change is described, and the types of action needed to make it a managed change. This is followed by an examination of the field of risk management (which includes insurance) and how this is desperately needed. Examples are given of the need and benefits, and of the limitations. All this is the prelude for discussing the insertion of risk management into the managed climate change arena.

Our planet Earth is 5 billion years old. Primitive life forms began 3.5 billion years ago. Humans have been on Earth for only 0.004% of the 5 billion years (Richardson, 2009). In 1996 we were warned that "discontinuities, irregularities, and volatilities seem to be proliferating ... and even the planet Earth seems to be under attack" (Bernstein, 1996:329). In the first decade of this 21st century, there have been exceptional meteorological events, including the strongest hurricanes ever recorded, with tropical cyclones even appearing in Europe (Swiss Re, 2006; Munich Re, 2006). 98% of scientists agree that the climate is warming because of human activity (Colwell, 2011). Global temperature and sea-levels are rising. One study found that increased melting of glaciers and snow in the Himalayas and Tibet threatens the food availability for millions in Asia (Insurance Journal, 11 June 2011). Our future climate and its effects are already determined. We must reduce harmful emissions, and radically adapt to the inevitable changes.

Lovelock, an atmospheric chemist, was the first scientist to warn us, in a 1969 scientific meeting in Princeton, followed by a book in 1972. His hypothesis, initially bitterly criticised by scientists, is that the Earth (Gaia) is a living organism, a complex interactive self-regulating system consisting of physical, chemical, biological and human components, with an extraordinary and unstable atmosphere of gases greatly influencing, and influenced by, life on Earth. Gaia, he warned, is under threat because of human population increase, degradation of land, depletion of resources, pollution, climate change, abuse of technology and destruction of biodiversity (Lovelock, 2007). He asked why we deny this peril.

Rees (2003), an eminent British scientist, published 'Our Final Century', warning that the odds are no better than 50/50 that our present civilization will survive until the end of the

present 21st century. Wright (2005) reported the USA Pentagon prediction that within a generation there would be worldwide famine, anarchy and warfare, should climate change fulfill the more severe projections. Many scientists and politicians see global warming as the most serious threat human society has ever faced, which will destroy water and food supplies across the world, triggering giant migrations and worldwide conflicts (McCarthy, 2009).

Climate change is compounded by exponential population growth. The global population in 1925 was 2 billion (Wright, 2005). By 2010 it was 6.8 billion. It is estimated to rise to 9 billion by 2040: an increase of 1 million every four days (US Bureau of Statistics). By mid-2009 the world's hungry had risen to one billion (United Nations Food Agency, 19 June 2009). Some countries are already experiencing water and food shortages, with worsening prospects.

Our greed and fecundity are more than our Earth can sustain. 'One day, perhaps, we will learn to control our appetites and duplication rates' (Weisman, 2007, p267). The crucial question, today, is 'whether we humans can make it through what many scientists call earth's latest great extinction' (Weisman, 2007, p269). What is needed is a switch from short-term to long-term thinking, from recklessness and excess to moderation' (Wright, 2005, p125).

The United Nations International Panel on Climate Change (IPCC) predicted in 2001 a temperature rise between 1.4 to 5.8 degrees Centigrade. Six degrees does not seem much. For periods, and in one place, it is not, But collectively, for the world, it is immense. 18,000 years ago, most of Britain was under an ice sheet one mile thick. The global temperature was only 6 degrees less than now (Lynas, 2007). Between 1550 and 1850 British winters were so severe it was called 'the little ice age'. The river Thames froze: the ice on it was so thick that winter fairs were held, for thousands of people, with fires on the ice to roast oxen. The cause? The average temperature had dropped by only half a degree.

A joint chairman of IPCC said twelve years ago that we had already tipped over the edge of preventive action, and that we should now be in crisis management mode (Houghton, 2004). Laszlo (2006) predicted that 2012 would be the tipping point year, because of population pressure; poverty; social and economic conflict; warfare; shortages of water, food and energy; worsening pollution; and nuclear disasters; all compounding with the consequences of climate change. Laszlo said we could change all this if we moved quickly to a sustainable world (but little has really changed since he first published his book in 2005).

A Lloyds of London (2006) report has a wealth of information about scientific findings: CO2 levels are at their highest for 650,000 years; the 1990s was the warmest decade for a thousand years; severe hurricane activity for at least the next 20 years based on natural cycles alone; and the need for reassessment if the West Antarctic ice sheet collapses.

Global warming has been described as the world's greatest challenge (Dow and Downing, 2011). Yet many organizations and nations are in denial. Almost all governments base their legitimacy, democratic or not, on their economic success and increasing GNP. Consequently, taking action which will harm their economies and expectations of greater prosperity, is prov-

ing to be beyond their ability. The climate problem is a complex mixture of science, economics, politics, nationalism, sociology, and psychology.

The United Nations Copenhagen Climate Summit in 2009, and Mexico in 2010, and Durban in 2011, failed to reach significant binding agreement to cut CO2 emissions. The real reason is not ignorance, but because most governments dare not risk the damage to their economies if they took the urgent necessary action. There would be consequent social unrest and worse. Capitalism and communism are both materialist Utopias offering rival versions of an earthly paradise (Wright, 2005). Once, paradise might have been possible; now it is unsustainably impossible. Yet each country still strives for greater economic growth, as a matter of national pride and political success, often with the thinnest cloak of 'sustainability'. Nixon (2011) exposes the world leaders who still call for continued economic growth of global free trade on a vast scale, yet we are the world's most destructive creatures and destroy the planet's resources at a rapidly growing rate that is unsustainable. The old campaigner, Lovelock, 2007, p8), says it is much too late for sustainable development; what we need is a sustainable retreat. The success rate of thee international climate conferences is disturbingly low: the world is a selfish place (Bangkok Post, Editorial, 19 November 2011, p8).

Climate change is converging with other huge hazards, population growth, water availability, adequacy of food supplies, the industrialisation of China, India, Brazil, Russia and many other countries with the resultant growth of middle class consumers. Friedman (2005) deals with this convergence. Some countries have a land-grab strategy to secure future food and water. China, Korea, Japan, Malaysia, Saudi Arabia, Bahrain, Jordan, Kuwait, Qatar, United Emirates, and Egypt, have acquired huge tracts of land in Madagascar, Sudan, Pakistan, Laos, Burma, Cambodia, Indonesia Philippines, Ukraine, Uganda and Brazil (Roberts, 2009, p12).

Some Present Effects of Climate Change

As an international statesman said of climate change, seven years ago (Patten, 2005 p295), 'The threat is real and immediate', and evidence grows each year. He cited the example of the flood barrier in the river Thames, erected at enormous expense in 1980 to protect London from excessive tidal surges. It used to be activated once or twice a year, but the average in 2005 was four times a year, predicted to increase to thirty time a year in 2030, and will then fail altogether, flooding parts of London with six feet of water. Parts of Bangkok are below sea-level. New York is considering expensive floating barriers which would protect only part of the city.

There is a league table of cities threatened by rising seas. First to go is Venice, followed by a cluster comprising Los Angeles, Amsterdam, Hamburg, St. Petersburg, San Francisco, and Lower Manhattan. The next cluster includes South London, Shanghai, Edinburgh, and New Orleans. The final cluster, if sea levels rise above eight meters includes all New York, all London, and Taipei (IPCC, NASA, New Scientist.com, accessed October 2011). Some other obvious cities seem to have been missed from this list.

Small low-lying island States, e.g. Maldives, are now affected, and will disappear under the sea. In 1989 a conference of 14 small States in the Caribbean, South Pacific, Indian Ocean, and Mediterranean, made a Declaration, holding the industrialised nations responsible for taking action. Most of these States have a national action plan but lack the resources to be really effective (Alleyne, 2007).

A record heatwave in Russia in 2010, with the hottest day for 130 years, set fire to grain fields, causing the government to stop grain exports. Egypt, a big importer, had to find other sources at greater prices; China increased its imports from Canada. Due to the dry weather, rice harvests plunged in Vietnam and Philippines (Fraser and Rimas, 2010). This sudden shortage of basic food reveals the vulnerability of the world's food supply in the face of climate change and population growth.

The same applies to water. Escalating population, farming, and industrial growth have already caused tensions between neighboring countries. There are more than 250 internationally shared rivers covering nearly half the total land mass. A UN estimate is that by 2025 one third of the global population will live in countries affected by water shortages, which already affect 450 million people in 29 countries (Vidal, 2010).

Bangladesh is low-lying and has regular severe floods. It is also the world's most densely populated country. Evacuation of 20 million people seems to be the only solution, and the government Finance Minister has said that Europe and USA must open their doors to these climate refugees (Grant, Randerson and Vidal, 2009). The United Nations estimates that there could be 200 million climate refugees by 2050, and the chairman of the Intergovernmental Panel on Climate Change (IPCC) said the Bangladesh Minister's plea must be taken seriously.

Risk Management and Insurance

There is urgent need for planned activity, to exert some control over the risks involved, thereby softening the severity of the social and economic consequences of climate change. Insurers' long experience of risk management and disaster management, empowers them to be a significant force in managing some of these consequences.

The quantification of risk can be expressed as:

$$Risk = probable\ frequency\ of\ occurrence\ \mathbf{X}\ probable\ severity\ of\ occurrence$$

Risk Management is a disciplined approach for managing risk systematically. It has three main parts: identification, evaluation/prioritization, and control. The aim is to produce a list of evaluated priorities and then the action to take in controlling the frequency and severity of these priorities (Dickson, 1991). Controlling includes: avoidance (stop a process); reduction pre-incident (by improving a process), reduction post-incident (e.g. provision of rescue, food, water, doctors, crisis management); and transfer or retention (transfer includes transferring the financial part of the risk to an insurer or government; retention means bearing the risk without

transfer). The following model captures the essentials.

Risk management

INDENTIFY	**EVALUATE**	**CONTROL**
risks	a list of risks	the priority risks
(make a list)	(prioritise)	(avoid, reduce, transfer/retain)
various	various	[AVOID: stop a process]
techniques	techniques	[REDUCE pre-loss probability]
		REDUCE post-loss: crisis management]
		[TRANSFER to: insurer/government.]

(**Source:** author)

Many qualitative and quantitative techniques help to measure the frequency and severity of risks. Some are statistically complex. They all inevitably have a margin of error, great or small, because of uncertainty of the future, how things might change for better or worse (Kunreuther, 2002).

Climate Risk Management uses the above three steps for climate-sensitive decision-making. It promotes sustainable development. It involves strategies aimed at maximizing positive and minimising negative outcomes, e.g. in agriculture, food security, water resources, and health. It covers a broad range of action: early response systems, strategic diversification, dynamic resource allocation rules, financial instruments, and capacity building (Lawrence, 2010).

Insurers and Climate Change

Lloyds of London (2006) the prestigious 200 year old international insurance centre, issued a strong warning that insurers must face up to the increasing threat of climate change, or risk extinction. Climate change presents an unavoidable and rapidly growing risk to insurers, with many challenges: because risks and perils are changing; weather disaster records are being broken; and various significant stakeholders (e.g. regulators, investors, rating agencies) are scrutinizing the capacity of insurers to manage the risk exposure. Insurers will experience more record insurance losses, rating downgrades, reductions in cover, price shocks and reduced capacity. Many insurers have already responded to climate change, through new products and services, including hurricane loss prevention methods, green products which reward mitigation efforts, involvement in carbon offset projects, and strategic investment portfolios in firms which promote sustainability (Greig, Le Serve and O'Sullivan, 2007).

Lloyds of London, issued a scathing call-to-arms report in 2006. It acknowledged the increasing scientific evidence of climate change and its impact on insurance and that change would be faster than previously thought, complained that there was little evidence of change in insurers' response, and that urgent active management of climate change was imperative, indeed long overdue, beginning with insurance research. It acknowledged catastrophe modeling by insurers, after Hurricane Katrina, but said it should have been done before the event. Insurers would now have to predict ahead, not merely base decisions on historical data. Pric-

ing and capital allocation models must be regularly updated, not just in extremis, to reflect the latest scientific evidence. Insurers must plan for a higher frequency of extreme events, over longer storm seasons and a wider geographical area (Lloyds of London, 2006).

The Lloyds report continued with more prescriptions for the insurance industry. As exposures and losses increase, insurers will need to 'regularly review conditions of coverage against risk appetite' (p5) and do more to educate the public about changing exposures. The report encourages insurers to use their vast financial assets to use their influence as investors in companies to influence the green behaviour of boards of directors.

The Lloyds report stresses its faith in an insurance market 'left to free market forces' (p5) as long as it is allowed to price risk adequately, but this view could change if this freedom is removed or the pace of climate change increases: Insurers would then have to consider the long-term insurability of weather risks. The report favours a meaningful partnership between insurers and governments and business, and this should address the problems of increasing concentrations of population and economic wealth in high risk areas.

The conclusions of the Lloyds report are demanding. It is time for insurers to take a more leading role; they cannot treat climate change as peripheral but treat it as normal business. Climate change must inform underwriting strategy in pricing and policy wording, and must guide business strategy. Insurers must be central to a new impetus to engage with meaningful tangible partnerships to mitigate risk, and must seize the opportunity to make a difference to the future of society (Lloyds, of London, 2006).

The prevalence of catastrophes around the world has made insurers and governments consider the risk management of catastrophes, how they can be lessened in frequency and severity (Eilers and Lawrence, 2010). Reinsurers have warned that rising temperatures will make floods and hurricanes become more common across the world (Kron, 2006. Insurance is about risk. As people who understand and manage risk, insurers are well placed to lead the way in analysing and reducing the risk of climate change (Diugolecki, 2009). The insurance industry accounts for more than 7% of global GDP, and its core competency is the assessment and absorption of risk (Liedtke et al., 2009). Therefore it has the potential to make a decisive contribution to managing the risk of climate change.

The Geneva Association, the respected scholarly insurance think-tank, published a background paper in 2009 on engaging the global insurance industry in applying risk management expertise to climate change (Liedtke et al, 2009). Its major theme is insurers' role in mitigating climate change. It discussed how to obtain insurers 'involvement in a low-carbon and climate-resilient economy', and gave some specific examples. The role could include conducting and sharing risk research; developing new insurance products; and promoting loss prevention. Insurers want to help counter climate risks through active co-operation in implementing sustainable building codes, and will work closely with policy-makers to communicate to customers the climate risk levels and strategies of mitigation and adaptation. Insurers often 'pool' risks with other insurers and reinsurers to provide greater financial capacity, and would do so

for climate change risks but expect policy-makers to produce robust data and make it freely available to allow risk assessment. To fully engage the insurance industry, there must be a conducive political, legislative, and regulatory framework, an efficient international plan to reduce emissions, and robust national plans for adaptation.

Insurers have their own internal problems connected with climate change, especially in estimating the probabilities, of frequency and severity. Insurance premiums are based on statistical analyses of probability; too little premium means an annual insurer's loss, which cannot be sustained for long. Traditional methods of calculating risk exposure may significantly underestimate systemic risk, which is a major problem with climate change, and is formidable in its potential awfulness. As climate change is global it involves the interdependency of seemingly totally separate risks. Statistically, the problem is known as *leptokurtic distribution*, or the fat-tail effect (Kousky and Cooke, 2009).

Catastrophe modeling studies the ways in which extreme events compound damages, beyond those expected from a normal distribution. 'Climate change creates new risks, alters the risks we already face, and also, importantly, impacts the interdependencies between these risks' (Kousky and Cooke, 2009, p2). They point out that if small errors are made in calculating insurance reserves, risks can be seriously underestimated. Extreme events compound damage and thus create fat tails, as does damage from many extreme events. The remedy is to study micro-correlations between variables, correlations so small as to be ignored or undetected, but potentially devastating in their consequence, threatening an insurer's solvency.

An example of linkages is that in an El Nino year, precipitation is likely to be more extreme in California, leading to mudslides and floods; nutrient-poor water is likely to cause fish declines in Peru; and drier conditions are more likely in Australia, increasing the risk of bush-fires. A rise in sea levels could also potentially introduce micro-correlations across damages in geographically diverse areas. Tail dependence occurs when bad outcomes occur together, yet this receives little attention from climate scholars. An example is a connection between computer networks and highly infectious tropical diseases (which are predicted to spread due to climate change). One likelihood is that a pandemic will not only create sickness and death but also mass quarantines. Those quarantined at home will increase the use of telecommuting, putting pressure on networks and leading to failures and other vulnerabilities.

If insurers cannot or do not accurately estimate the increased expected losses, they may stop insuring some risks. However, if insurers are able take account of these dependencies, the greater identified risk means that their premiums would have to increase. The price may be more than customers are willing to pay. This then raises the issue of government involvement.

In a 2009 report by the professional Chartered Insurance Institute in Britain, there are concerns about correct pricing of risk by insurers, with a recommendation that they should add an extra climate change premium of 2-4% for flood cover. Furthermore they should add another 30% for storm and 50% for flood for the 'super catastrophe factor' (Diugolecki, 2009). Faced with increasing frequency and severity of risks, and newer emerging risks, insurers can

find themselves up against their natural limits, beyond their capacity and ability. One limit is an insurer's solvency margin, a specific excess of assets over liabilities. Another is the uninsurability of some risks. A third is the insurer's skills to handle complex probability statistics for uncertain risks (Kitseree and Lawrence, 2006). Some solutions are better risk management systems, insurance pools and alternative risk transfers, and government involvement.

Can insurers cope with climate change catastrophe claims? There were 1,300 victims of Hurricane Katrina in Louisana USA in 2005, and 1.75 million property and business interruption claims, which when added to three other hurricanes nearby in the same year, produced a total of 3.3 million claims in one year (Newall, 2006). That is a severe test of insurers' ability to handle such claims quickly, professionally and compassionately. The future will be more testing (Lawrence, 2010).

The Involvement of Governments and Insurers in Various Countries

Because of the exposure to immense loss, weather risks usually have to be managed and financed by governments as well as insurers. They both now have substantial experience of a variety of catastrophes. Government and insurer practice has wide variations, within regions and within countries. In Europe, there is no consensus, but fifty national variations, with diverse solutions on a national or even local basis. The provision of catastrophe insurance is mostly by insurers and reinsurers, based on technical factors. Government risk management has a wider definition, e.g. building codes, zoning, fire protection, research (Eilers and Lawrence, 2010.

French law defines the 'effects of natural disasters' as 'non-insurable direct material damage' whose main cause is the abnormal intensity of a natural agent, which the usual preventive measures could not have hindered. This means that storm and snow are insurable, but the two main natural disasters in France, flooding and clay volume change (which can cause building subsidence) are non-insurable. Therefore a natural disaster insurance system was created in France in 1982, in which all insured houses, buildings and cars are covered against natural disasters, the premium being included in those insurances and not being dependent on actual risk exposure. Some insurers consider that this French system does not allow insurers to do their job of assessing risk and pricing it appropriately, and deters them from building up a data bank and risk models. The government provides an unlimited guarantee to this system, to one reinsurer, Caisse Centrale de Reassurance, which thus guarantees the system's solvency (Grislain-Letremy and Villeneuve, 2010).

China Re has called for urgent action in China, to set up a catastrophe insurance system comprising public and private partnerships as well as disaster insurance schemes. Current recovery efforts are funded largely by central and local governments, which will be inadequate in the future. Some small scale insurance schemes exist in the countryside in 17 provinces, but none in cities and towns. China Re considers that disaster insurance funds could be subsidised by government. Commercial disaster insurance should also be promoted as there is currently low awareness of the risks and insurance. (Asia Insurance Review, Vol..II, Issue 82, 26 April 2011).

In Britain there have been serious floods since 2000, mainly affecting private dwellings, producing insurance claims but also needing government assistance. For over twenty years many local planning authorities have allowed houses to be built on river flood plains. A consequence of the severe floods is that many insurers then refused flood cover in some areas. However, in 2010, some mortgage lenders announced that they would no longer insist on flood cover as a condition for lending money. Thus do local governments and national Banks act irresponsibly, in the interests of seeking more customers, ratepayers or mortgage-interest payers (Kitseree and Lawrence, 2006).

5,000,000 British properties (17% of the total) are at risk of flooding. The UK government-funded report in 2012 on climate change risk assessment identifies flooding as the biggest climate risk for Britain, costing billions annually if adaptations are not made.(Ramsbottom et al. 2012) The UK government will publish a national adaptation plan in 2013. The government persuaded insurers to continue flood cover, even in areas which suffered major floods. The agreement expires in 2013, and insurers want to see significant government investment in flood prevention and management before a continuation agreement can be signed. Some in the insurance community are pessimistic about continued flood cover in some areas, because it is an obvious case of adverse selection and because reinsurers would not want to support such disregard of basic insurance financing (Gloyn, 2011).

The Korea Insurance Development Institute has said that natural disaster products must be introduced. The cost of local damage from natural disasters soared to an annual average of US$1.53 billion in the last decade compared with US$36.2 billion in the 1970s. The cover available has few buyers, and even the government funded wind and flood insurance only covers 2-3% of homes. The Institute says that it will cooperate with the Korea Meteorological Administration to create a variety of weather indices as the base for insurance policies, and will also review the availability of weather derivatives and catastrophe bonds for local insurers (Asia Insurance Review, Vol. II, Issue 65, March 2011).

Australia seems plagued by a succession of catastrophic floods. A novel suggestion by the Local Government Association of Queensland says it would be more cost-effective for big insurers to help pay to 'flood proof' the state's towns, e.g. with levees. The insurers respond that they will not tolerate this passing of responsibility for flood mitigation costs as it is the sole responsibility of governments, who could prevent floods through decision-making and appropriate land-use planning (Asia Insurance Review, Vol III, Issue 47, 7 Mar. 2012). IAG of Australia had previously called on the government to address its inadequate level of investment in natural disaster mitigation infrastructure, and to impose tougher and more transparent zoning decisions for disaster-prone areas. IAG's modeling predicts a 15% increase in the most destructive cyclones (Asia Insurance Review, Vol.II, Issue 242, 6 Dec. 2011.

CGU Insurance of Australia, which is automatically covering flood cover, is increasing its household premiums by an average of 20% in 2012, the largest increases falling on those areas most at risk. The increase is because of the greater frequency and severity of natural catastrophes, not just flood. QBE and Allianz are taking similar action (Asia Insurance Review, Vol.3,

Issue 29. 10 Feb. 2012). As insurers are now compelled to include flood cover, the Australian Institute of Actuaries had called on the government to subsidise premiums. A national insurance pool was considered to be inappropriate and have unintended consequences. Australia is at great risk from global warming as over 80% of its population live within 50 km of the coast. In Thailand, catastrophic flooding in late 2011 caused 1,000 plants in seven industrial estates to cease production. The domestic airport in north Bangkok was flooded. 1.3 million households were affected, as well as 557,000 SMEs. According to Standard & Poor's Rating Services, the gross insurance loss could be US$16-18 billion, higher than previously estimated. This could mean downratings for some small regional reinsurers and local insurers, and the need for more capital (Standard & Poor's, 2012). (More details about Thailand are in another article in this journal: Channak, 2012).

Swiss Re, the world's second largest reinsurer, warned emerging markets that with their rapidly increasing wealth they should address their poor disaster prevention and management, and their underdeveloped insurance markets. Globally, insurance coverage for disasters is low. In a new Swiss Re report, the low taker-up of earthquake insurance is attributed to the relative low frequency of earthquakes, and complicated pricing structures. This leads to post-disaster financing, largely through governments, i.e. the taxpayers. The report also stresses the need for stringent building codes. Swiss Re also say that secondary agents, like tsunamis are frequently underestimated in earthquake models (Asia Insurance Review, Vol. III, Issue 13, 19 January 2012).

At the 2nd Asian Climate Change Summit in January 2012, insurers were urged to work together and with governments to mitigate risks. This is especially important because of the interconnectedness of risk due to supply chains which have become more widespread and sophisticated. Insurers should lend governments their expertise in risk management, incentivize loss reduction, develop new insurance products, and raise awareness of the impact of climate change among their stakeholders (Asia Insurance Review, Vol.III, Issue 21, 31 Jan.2012)...

Thus, insurer and governments share catastrophe risk management, but there is no international consensus on the division of responsibilities. Yet, the threat of global warning "is the most imposing scientific and technical challenge that humanity has ever faced", according to the U.K. Environment Minister (uk.yahoo.news.com 13 October 2006).

The Vital Importance of Reinsurers

Without reinsurers there could be only small capacity insurers and markets, with large risks being uninsurable. Reinsurers not only act a reserve fund for direct insurers thus increasing their financial capacity, but they also have a detailed overview of the mix of risks, their tendencies, and uncertainties. Their professional statisticians, actuaries, and researchers, produce data unmatched by insurers. They are the brains of the industry. They have shown their commitment to engaging with climate change, in many ways.

The role of reinsurance in regional catastrophic risks is substantial, promoting country risk

management, risk modeling and disaster risk financing (Eilers and Lawrence, 2010). A major reinsurance broker has examined how reinsurers and insurers should respond to the increasing catastrophe risk. Its report cites the vulnerability of many Asian economies to this risk, with an urgent need for action. International reinsurers and insurers have the expertise and capacity to underwrite this risk, and development Banks are keen to promote pre-event risk financing schemes to reduce dependency on post-loss funding. National insurance pooling schemes should be considered, to make this insurance effective and affordable, to build up a national catastrophe fund, and to reduce the financial consequences of disasters (Christian, 2010).

The same international reinsurance broker explained the finer points of modeling catastrophe risk (Aon Benfield, 2010). Catastrophe risk is a significant financial hazard for insurers. It adds a long-tail effect to the enterprise risk profile and drives the volatility of a company's earnings and capital. It therefore needs prudent management, yet the data, tools and personnel used in the measurement, monitoring and management of this risk are far from perfect. What is essential but tricky is a delicate balance of science and art, of hard facts and human judgment.

This broker also has a multi-disciplinary team of seismologists, meteorologists, hydrologists, geologists, structural and civil engineers, mathematicians, actuaries, and software experts. The team provides a service to insurers for forecasting the impact of catastrophe risk. Another service for clients is 'Impact on Demand', an innovative and versatile platform which enables clients to visualize and quantify their exposure to catastrophe risk, to perform sophisticated and detailed analysis to enable insightful decisions. This service can include individual risk-mapping, underwriting analysis, risk driver analysis, claims planning and preparedness, post-catastrophe analysis, and identification of exposure accumulations (Aon Benfield, 2010).

Disasters are rigourously analysed by Munich Re.. Reinsurers, generally, are refining their risk assessment models for catastrophes, especially windstorms and hurricanes, climatic cycles, and global warming (Swiss Re, 2006). Indonesia has had a special catastrophe reinsurer since 2004, PT Assuransi Maipark Indonesia, a joint undertaking by all licensed insurers and reinsurers. It sets pricing levels, and has a statistical data base for earthquake and other catastrophe risks (Jacinto, 2006). In 2011 the World Bank urged Indonesia to introduce an integrated disaster prevention system and disaster insurance for the country.

Japan's constant vulnerability to catastrophes was brutally confirmed in the March 2011 tsunami, with its awful consequences for coastal towns and which caused a nuclear meltdown. Insured losses amounted to US$33.2 billion (16% of the total economic loss). Japanese general insurers recovered two-thirds of their loss from reinsurers. Insurers had set up an annual catastrophe fund in 2005, statistically calculated, and checked for accuracy by the Financial Services Authority. (Kawachimaru, 2006). The 2011 catastrophe in Japan, and in Thailand, dreadful though they indeed are, can be catalysts for plans to mitigate and manage the coming greater climate change disasters (Lawrence, 2010).

Conclusion

The insurance community is positioning itself at centre stage, in its proclamations and actions concerning the consequences of global warming. Much more, by lots of other 'Earth stakeholders', is needed. Many people and governments seem to be in a state of denial about the increasing climate change catastrophes, even though, by now, we should be in crisis management mode (Hamilton, 2010). Many of the scientific reports on mitigation action emphasise 'collaborative capacity building' as extremely important, taking a 'multi-sector' approach, instead of the usual top-down approach by experts or governments (e.g. Alleyne, 2007).

Governments may be waiting to be pushed by their citizens rather than take the necessary harsh and unpopular measures, such as not building in low-lying areas and preparing for the abandonment of such sites already-built, abandoning any thought of coastal or riverside protection, rationing food and water, and forming riot-control and looting-control squads, and worse (McGuire, 2002). Unimpeachable sources were used by Dyer (2010) for his apocalyptic predicted consequences of climate change: collapse of the European Union, civil war in China, nuclear war between Pakistan and India (and more).

The dire warnings aims at shocking us out of our denial of 'an inconvenient truth' (Gore, 2006). However, reading the long catalogue of awful climate predictions, can make us agree with the English poet Shelley, who wrote:

> *Cease - drain not to its dregs the urn of bitter prophecy.*

Regrettably, there is much more. In 2011 The Asian Development Bank warned that millions of Asians will flee their homes to safer havens within and across borders, as weather patterns become more extreme. Failure to make preparations **now** for vast movements of people could lead to humanitarian crises in the coming decades. Asia and the Pacific are vulnerable because of their high exposure to environmental risks and high population density, and could experience population displacement on an unprecedented scale. The climate migration issue will grow in magnitude and take different forms, and needs national governments and the global community to urgently address this (Abbugao, 2011).

A recent update of their 2001 forecast by the OECD warns that carbon emissions are likely to rise by 70% by 2050, locking-in more disruptive change, and the world's temperature will be 3-to-6 degrees C higher than in pre-industrial times, compared with the UN target of 2 degrees (OECD, 2012). The report also predicts that the potential cost of inaction could be as high as 14% of average world consumption. The OECD, formed in 1961, with 30 countries, includes in its new report, not only OECD countries but also the rising nations of Brazil, China, India, Indonesia, Russia, and South Africa. These rapidly growing economies are increasingly polluters on a level with the largest of the OECD countries, and the emissions from Brazil, China, India and Russia will grow by 46% to 2030, surpassing those of the 30 OECD countries combined. However, this OECD report has a positive strategy and action plan involving cooperation by all the stakeholders, and the economic cost would only be 0.2 percentage

points in annual economic growth.

Nixon (2012), who is scathing about our worsening plight, is also positive about our ability to master global warming. His call-to-arms, to encourage a paradigm shift, is based on his belief that breakdowns can create breakthrough opportunities, as quantum leaps are often initiated by small steps by millions of people. In addition to providing many statistics, he is inspiringly hopeful, providing a multitude of things which people can do themselves and to influence governments: he has produced a survival handbook.

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