15. IMPACTS ON THE INSURANCE SECTOR

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ABSTRACT

The annual global claims rate of the Spanish non-life insurance market from 1967 to 1981 presents an average of 57%, which rose to an average of 71% for the following decades, up to the present, which is accounted for by the low number of companies operating in the sector compiting aggressively, reducing rates in a context of similar loss level set mainly by the motor and multi-risk branches. Initially, these data provide no obvious evidence of climate change among the determinant factors of this evolution or of their degree of influence therein.

Detecting the effects of climate change on Spain's insurance sector involves the study of the loss rate of key covers, such as floods, storms, frost, hail and drought. In other branches, like health, personal accidents or transport, current figures are not sufficiently clear.

The *Consorcio de Compensación de Seguros* (insurance compensation consortium) is a state Body whose objective is to indemnify damages caused by extraordinary events, including nature-related ones and among these, climatic risks. In the 1971-2002 series, compensation for flooding shows an upward trend, with peaks which involve more significant events every so many years. This evolution is attributed to the higher penetration rate of insurance, to an increase in the exposures insured and to the higher volume of capital insured, which is a clear reflection of the socio-economic development of each moment, but we cannot rule out a certain influence of the effects of climate change, although these are difficult to determine.

The international reinsurance sector highlights the fact that in a possible scenario of increased losses caused by climate change the insurance branches most affected would be property related (residential, industry, engineering and fire), which represent their increased value in areas highly exposed to climatic impact, while health, life and liability could be affected, although initially, to a lesser degree. With regard to distribution according to the type of event, Spain follows the international tendency – storms and floods are the most numerous and costly events.

The agricultural insurance system in Spain, through *Agroseguro*) system has undergone continuous transformation processes to compensate results and to insure the highest number of crops possible through a wide range of cover modalities. For this reason, statistics do not allow the loss rate to be analysed in a homogeneous manner. The geographic distribution of these, however, is the reference of the areas that in the event of a significant deviation from climate parameters, would undergo a modification in agricultural production, and adaptation of farming techniques will therefore continue to be imposed. The East of the Peninsula, due to the high hazard of climate and weather phenomena, and to the concentration of crops sensitive to these variables, has been confirmed as the area most exposed to climate change.

The main research needs of the insurance sector focus upon finding the combination of the hazard, vulnerability and economic value exposed or not, together with insurance modalities, in order to recreate specific historic and probabilistic scenarios for the insurance sector (catastrophe models).

Although no clear evidence of the effects of climate change has been detected in the insurance sector, the variety of possible future scenarios calls for surveillance and for the constant adaptation of the methods and techniques for insurance management of risks related to global warming. The capacity for adaptation and the experience of the CCS (insurance compensation consortium) and of *Agroseguro* constitute a guarantee for the requirements with regard to variations in loss rates. But it will be the manifestation of these variations in practice that will

determine the evolution of these systems in the long term, with regard to the search for appropriate, accessible and socially viable insurance solutions, which also include international reinsurance that is attentive to the requirements of each moment, and to State participation that is sensitive to the pertinent backing required.

15.1. INTRODUCTION

15.1.1. Main parameters

15.1.1.1. Worldwide outlook

In the year 2002 the worldwide volume of premium reached 2,504 billion (USA) EUR, which represents 8.1 % of world GDP (Swiss Re 2003). This amount is broken down into Life Insurance 1,464 billion (USA) EUR and Non-life Insurance: 1,040 billion (USA) EUR.

15.1.1.2. Spanish outlook

In 2002 the *volume of premium* reached 48,972 million EUR in gross earned premium which represents 7% of the GDP (DGSFP – *Dirección General de Seguros y Fondos de Pensiones;* Directorate General of Insurance and Pension Funds – 2003). In Great Britain this percentage is 15%; in Switzerland 13%; in South Korea 12%, and in Japan 11%, (Swiss Re 2003). The 2002 volume of premium is broken down into Life Insurance 26,810 million EUR and Non-life Insurance 22,162 million EUR.

Table 15.1 compares the evolution of the main parameters of the sector from 2000-2002.

Table 15.1. *Main Parameters of the Insurance Sector in Spain (2000 – 2002). Source: DGSFP (2003)*

Million EUR	2000	2001	2002
Life and Non-life Gross Earned Premium	41,858	42,763	48,972
Gross Premium / GDP at market prices (%)[1]	6.8	6.5	7.0
Gross Premium / Inhabitant	1,033	1,040	1,170
Non-Life Gross Premium	17,421	19,319	22,044
Loss experience (losses/premium) Gross (%)	75.7	73.9	69.8

The Spanish share *of the world market* is 1.7 %, whereas that of the USA is 38%; for Japan it is 17%; for Great Britain 9%; and for Germany 5%. With regard to expenditure per capita in Spain, this reaches 1,170 EUR; in Switzerland, 4,693 EUR; in Great Britain 3,698 EUR; In Japan 3,335 EUR; and in USA 3,300 EUR (Swiss Re 2003).

In order to give an idea of the *importance of each line of business* in the Spanish non-life insurance market, it is now included according to them and comparison is made between 2001-2002 (table 15.2).

[1] **GDP at m.p.=** GDP at market prices.

Table 15.1.2. *Volume of premium per line of business. Non-life Business. Source: DGSFP (2003)*

LINES OF BUSINESS/PREMIUM (Million EUR)	2001 Premium	2002 Premium	2002 Distribution (%)
Motor	8.840	9.870	44.7
Multirisk	2.771	3.339	15.1
Health Care and Sickness	2.994	3.269	14.8
GTPL	842	1.107	5.0
Burial Insurance	996	1.069	4.8
Other Damage	570	841	3.8
Accidents	691	730	3.3
Credit Insurance and Bonds	459	512	2.3
Transport	395	497	2.2
Assistance	428	378	1.7
Fire	152	224	1.0
Legal Defence	123	126	0.5
Business Interruption	58	82	0.3
TOTAL	19.319	22.044	100

As can be seen in table 15.3, from 1970 to 2002 the *number of insurance companies* has dropped sharply, and if this decrease is already significant in the case of Limited Companies, it is more so if we talk of the Mutuals or the reinsurance companies, although these latter ones were already very few.

To the number of companies inscribed on the Register of the DGSFP on December 31st 2002, that is to say, a total of 399 (compared to 684 in 1970), we must add 351 European companies authorised to operate in Spain through the Freedom to Provide Services System.

Table 15.3. *Private insurance companies classified according to their legal status. Source: DGSFP (2003)*

Direct Insurance Companies	1970	1980	1990	2000	2001	2002
Corporations	479	494	391	259	251	247
Mutuals	139	136	75	52	51	47
Branches of Foreign Companies	55	39	31	39	37	37
Social Benefit Mutuals	--	--	--	69	70	65
Total Direct Insurance Companies	**673**	**669**	**497**	**419**	**490**	**396**
Specialised Reinsurance Companies	11	13	8	4	3	3
Total Insurance Companies	**684**	**682**	**505**	**423**	**412**	**399**

The *number of insurance brokers* (individuals and companies) authorised in Spain at the end of the year 2002 was 4,820. Of these 1,576 are authorised by the Regional Autonomies and the rest, 3,244, by the DGSFP.

15.2. SENSITIVITY TO THE PRESENT CLIMATE

15.2.1. Milestones in the history of the Spanish Insurance business

1412.- Chapters of the Tortosa Court. First document defining and regulating insurance (slaves runaway).

1428.- First specific insurance protocol (Bartolomé Massous, Barcelona notary).

1428.- The oldest known Marine contract signed in Spain.

1435.- The Barcelona City Council creates the first fixed premium insurance institution (marine: cargo and hull).

1537.- The Burgos Traders' University creates the first standard model of an insurance policy (marine activity).

1539.- Rules by the Seville Consulate.

1553.- Rules by the Burgos Consulate.

1737.- Rules from Bilbao. Trade regulations applied in Spain until the Trade Law was approved.

1785.- The first Spanish company working in the fire line of business is created, which is also the first company with shareholders and the first one in Spain to cover risks different from the marine ones: Real Compañía de Seguros Terrestres y Marítimos de Madrid (Madrid Royal Marine and Terrestrial Insurance Company) .

1822.- The first mutual residential fire insurance company is set up in Madrid.

1829.- The first Commercial Code is approved, regulating marine and terrestrial transport.

1842.- The first Fixed Premium Insurance Company is set up covering hail: "El Iris".

1846.- The mutual insurance company of crop and livestock is set up, loans for cereals and capital startup.

1859.- The "Protección Agrícola" (Agricultural Protection) for the crop insurance is set up.

1885.- New Commercial Code, regulating fire, life and terrestrial transport insurance.

1897.- "La Unión Agrícola y Pecuaria" (Agricultural and Livestock Farming Union), is set up in Madrid insuring fire, life, crops and livestock.

1900.- Law covering labour Accidents (work accident insurance).

1902.- First Bill for Agricultural Insurance.

1908.- Instituto Nacional de Previsión (National Benefits Institute).

1908.- First law regulating the private insurance activity in Spain. The regulations governing it date from 1912. Both provisions stipulate the creation of supervising and control organisms (Comisaría General de Seguros, Inspección de Seguros, -General Commission for Insurance, Insurance Inspection -etc).

1910.- Popular Insurance Mutual (Health).

1915.- First Association of Insurance Brokers (Barcelona).

1919.- Compulsory Workers' Retirement Insurance.

1919.- The National Mutual of Agricultural and Livestock Farming Insurance (Mutualidad Nacional de Seguros Agropecuarios) is set up, and serves as a base for the Agricultural Insurance System (Sistema de Seguros Agrarios) under the auspices of the State.

1928.- The Compulsory Travellers Insurance is created.

1928.- Creation of the Export Credit Insurance.

1928-1929.- The Compañía Española de Seguros de Crédito y Caución, S.A. (Spanish Credit Insurance and Bonds Insurance Company) is set up.

1931.- Maternity Insurance.

1940.- The National Rural Insurance Service (Servicio Nacional de Seguros del Campo) is set up.

1940.- Arbitration Court for Insurance.

1941.- Law on Social Benefit Mutuals (Mutualidades de Previsión Social).

1941.- The Riot Risks Compensation Consortium (Consorcio de Compensación de Riesgos de Motín) is set up.

1941.- The collective insurance policy is signed (between the Telefónica and the "Sudamérica").

1942.- The Compulsory Heath Insurance is instituted.

1944.- The Riot Risks Compensation Consortium becomes the Risks on Property Compensation Consortium (Consorcio de Compensación de Riesgos sobre las cosas).

1954.- Law regulating Private Insurance in place of the one from 1908.

1954.- To replace the Compensation Consortia in force at the time, an only Insurance Compensation Consoritum (Consorcio de Compensación de Seguros) is set up.

1962-1965.- Compulsory Motor Insurance is instituted.

1963.- The Social Security System was created.

1964-1967.- Nuclear risk insurance was regulated.

1970.- The Compañía Española de Seguros de Crédito a la Exportación, S.A. (Spanish Export Credit Insurance Company) was set up.

1978.- The Multiperil Crop Insurance Law was approved.

1980.- Agroseguro (agricultural insurance pool) was set up.

1986.- New Regulation on Extraordinary Risks. The surcharges are applied on the insured capital instead of being a percentage of the original premium.

1991.- Legal statute of the Consortium. Public Business Institution. End of the monopoly on the extraordinary risks coverage.

2004.- New regulations on Extraordinary Risks. The business interruption is included in the extraordinary risks coverage.

(Del Caño 1983; Maestro 2000; y Burgaz y Pérez-Morales 1996)

15.2.2. Natural hazards insurance in Spain related to climate change

The specific insurance covers are detailed for *rain, floods, wind* and *temperature variations*, as well as some of their manifestations (i.e. hail, tornadoes), as these are the natural phenomena most likely to vary in behaviour (intensity and/or frequency) due to climate change.

With regard to types of risks, the generic one of property is here considered, the specific *agricultural* risks, due to their sensitivity to the climate and the risks involved in engineering.

Likewise, a section is dedicated to the *Consorcio de Compensación de Seguros (CCS),* due to the important role it plays in the extraordinary risks coverage in Spain[2]. The CCS is a Public Business Institution, with its own legal personality and the full capacity to operate, holding its own assets, different from the State, and subjected in its activities to laws ruling private companies. The aim of the CCS is to compensate for the losses caused by extraordinary events, including natural disasters and among these, climate risks. Its activity has a subsidiary nature, as it will only indemnify when the private insurance company does not cover the extraordinary risk or, covering this, it is insolvent.

15.2.2.1. Property Risks

Precipitations: The private insurance market covers material damage caused by the precipitations (rain, hail or snow) which can either be considered as “atypical and extraordinary” or whose intensity is greater than one single value for the whole Iberian Peninsula.

Claims must be backed with a certificate from the Instituto Nacional de Meteorología (INM) – Met Office – with data from the closest observatory (or observatories) to the loss location.
Private insurance covers losses caused by water leaking through roofs, balconies or windows, as a consequence of filtration in roofs or the overflowing of gutters and hanging drainpipes. Losses caused by hail and snowing of any intensity (including weight of the snow) are also covered. Losses are excluded in case of leakage on ground floors, underground or sewage, or if they are the consequence of poor building maintenance.

[2] According to the regulations on the Extraordinary Risks Insurance approved by Royal Decree 300/2004 dated February 24th.

Floods: The private insurance market does not cover the damage caused by floods. See section 15.2.2.4 on the Consorcio de Compensación de Seguros (CCS).

Wind: The private insurance market usually defines its liabilities regarding losses due to wind when this surpasses one single speed value (km/hour) for the whole country. An INM certificate must support claims with data from the closest observatory (or observatories) to the loss location. For damage caused by strong winds (3 seconds gusts over 135 km/h) and tornadoes, CCS will be liable.

15.2.2.2. Agricultural Risks

Precipitations: Voluntary hail, torrential rains and/or continuous rain insurance for farmers with different rates according to zones and crops. It is developed in the context of the Spanish System of Multiperil Crop Insurance, with private participation through insurance companies integrated into a pool managed by Agroseguro and state participation through the CCS.

Floods: Voluntary floods insurance for farmers with different rates according to zones and crops.

Wind: Voluntary insurance covering wind and/or Sirocco for the farmer with different rates according to zones and crops.

Variations in Temperature and Humidity: Insurance of Frost, Drought and Heat-waves (Scorching) voluntarily by the farmer with different rates according to zones and crops.

15.2.2.3. Engineering Risks

Precipitations and Wind: There is a widely used clause on the market, which indicates that the insurance company will cover the losses caused by “climate phenomena” the magnitude of which surpasses that corresponding to a 10 years return period. The compensation is conditioned to the design and execution of the property insured being subject to the regulations in force and to the required safety measures.

Floods: The private market covers floods through a clause similar to the ones on “Climate Phenomena”, which indemnify losses resulting from a precipitation value equal to or higher than that corresponding to a return period (10 20 years).

15.2.2.4. Consorcio de Compensación de Seguros (CCS)

The indemnities of the CCS are conditioned by the existence of an insurance policy in force in certain lines of business, in which the private market does not assume the losses derived from certain extraordinary risks.

Precipitations: The CCS will not be responsible for damage caused by the direct rain, if this is the only agent of the loss. Please consult definition of Atypical Cyclonic Storm (Tempestad Ciclónica Atípica).

Floods: Covers “extraordinary floods”, which is defined as the “floods of the terrain caused by the direct action of the rainwater, from the thaw or from lakes with a natural exit, from the rivers or tributaries of the natural courses of surface water, when these overflow from their natural courses, as well as sea damage. This will not be seen as such if caused by water from dams, sewers, drains and other subterranean courses, built by man, on bursting, breakage or breakdown due to facts that do not correspond to risks of an extraordinary nature covered by

the CCS, or by rain that has fallen directly onto the insured risk, or that collected by its roof or terrace roof, its drainage network or its patios".

Wind: The CCS covers the losses caused by winds defined as an Atypical Cyclonic Storm, among which are included "Extraordinary Winds" and "Tornadoes".

The data on the atmospheric and seismic phenomena, volcanic eruptions and fallen heavenly bodies were obtained through certified reports issued by the INM, the Instituto Geográfico Nacional (IGN - National Geographical Institute) and other expert public agencies.

Business interruption: With regard to the cover of extraordinary risks by the CCS, it is considered that a business interruption takes place when, as a consequence of certain extraordinary events included in the cover, there is an alteration of the normal results of the economic activity of the insured subject, deriving from the paralysis, suspension or reduction of the production processes or business of the aforementioned activity.

Exclusions by the CCS in relation to Extraordinary Risks

In respect of the *direct cause* of the loss, the CCS will not be responsible for damages derived from:

- Direct rainfall on the insured risk or that collected by its roof or terraced roof, its drainage network or its patios.
- Hail, weight of the snow and non-extraordinary winds (gusts of three seconds below 135 km/h).
- Leaks, filtration or dampness.
- Breakage of dams, sewers or artificial canals (unless the breakage was caused by an extraordinary event).
- Elevation of the phreatic level, movement of slopes, landslides or settling of land, rockfalls or similar phenomena, unless these were caused by rainfall which in turn had caused extraordinary floods in the area and that they happened simultaneously to the aforementioned flood.
- Swell or ordinary flows when they affect properties, which are totally or partially permanently submerged.
- Events, which due to their magnitude or seriousness are classified by the Spanish government as a "national catastrophe or calamity" (this classification has never been applied in the history of the CCS, in spite of the big losses caused by certain catastrophic events).

15.2.3. Statistics 1967-2002 from the (DGSFP) – (Directorate General of Insurance and Pension Funds). Written premium and loss rate of non-life lines of business, direct insurance

The evolution of the Spanish non-life insurance market, with regard to premium and losses, has been gradually approaching the parameters of foreseeable behaviour in a developed country within the environment of the European Union. It began with a very low level, which in 1967 in acquired premium represented 161 million EUR, which was multiplied by 10 in 1979, and by 100 in 1995. Here it can be seen that the percentages of the loss rate/premium relationship gradually increased. Thus, from 1967 to 1981 this relationship stayed at between 50 and 60 per 100, with an average of 57%, whereas from 1982 to 2002 the average was at 71%, with a minimum of 63% in 1982, and a maximum of 78% in 1991 (figure 15.1).

The reasons for this evolution lay, from a general point of view, in the greater control and regulation of the market with regard to reorganisation, which led to a significant reduction in the number of companies in a context of increased competition in the sector, due to the improvement of management and marketing policies. But above all, one must take into account the behaviour of certain lines of business, the weight of which was reflected in the whole Non-Life area, as is the case of Motor (MTPL) and other covers) the loss rate of which in 1989 represented 58 % of total Non-Life claims, its premium totalling, in the same year, 47% of the global amount of premium in this market. The same can be applied to the Multirisk line of business.

In Motor, it must be pointed out firstly that the Spanish car pool underwent a steep increase following the seventies, which, in the absence of prevention measures and with a deficient roads network, led to an increase in claims. And secondly, the rise in the compensation limits in order to respect the minimums imposed by community regulations for the obligatory insurance was to be clearly felt in the payment of claims.

With regard to Multirisk, the marketing of these insurances half way through the seventies not only meant the binding together of the old burglary and fire insurance, among others, in one policy, but also the extension of covers, in parallel with a better knowledge of the insured parties about their compensation rights. The result was to be a turn also in claims, fundamentally in residential insurance and SME's.

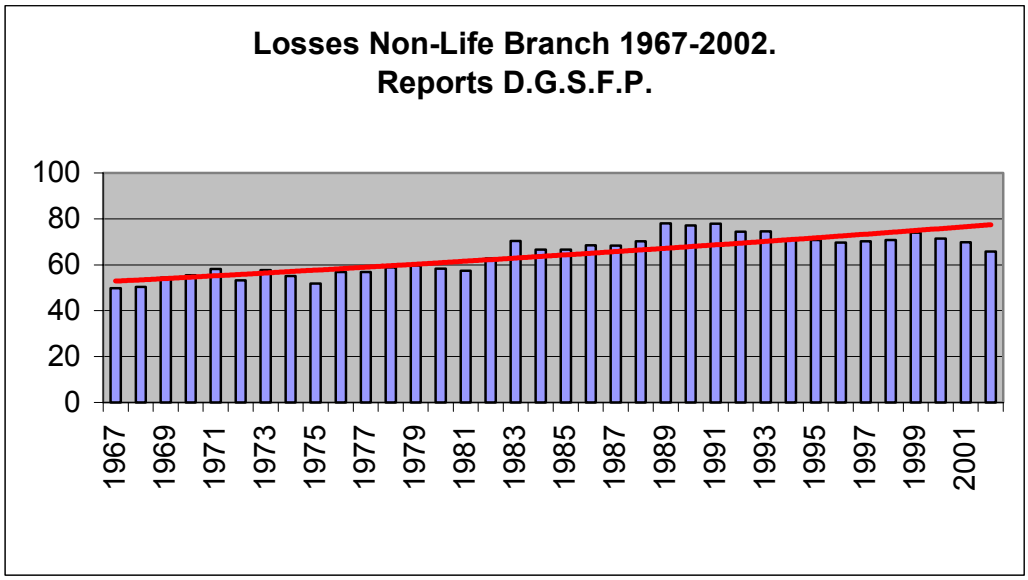

Fig. 15.1. *Statistics Losses 1967-2002 Non-Life Sector in Spain. Source: DGSFP Reports*

15.3. FORESEEABLE IMPACTS OF CLIMATE CHANGE

15.3.1. Extraordinary Risks Coverage

Data from the main reinsurance companies and other worldwide insurance institutions indicate that in recent times, the worldwide loss rate related to climate events (including extreme events) has increased in frequency and intensity.

Along the same lines, the Third Report on Climate Change (2001), using data from the sector, assumes and incorporates this evidence on the increase in claims, and predicts that it is in the field of insurance where the effects will be most felt. It is a question of finding out if this panorama will be reflected in Spain and whether it is possible (and to what degree) to attribute this increase in claims, if it were to be proven, to the phenomenon of climate change.

When reviewing the behaviour of claims related to natural catastrophes in Spain, we must make an important exception: that the statistical data available on losses compensated by the CCS cover at most the last 30 years, so that, dealing with this type of loss rate, the series is excessively short with regard to establishing serious conclusions.

15.3.1.1. Large events

In the nomenclature of the CCS, the “extreme events” are called "large events", and are considered to be so if they have led to payments of over 12,000,000 EUR, since 1992 (CCS 2003).

In the series from 1977 to 2002, 32 large events were accounted (table 15.4.) All of these, except the one that occurred in April 1982 (ETA terrorist attack against the Telefónica building, Ríos Rosas street in Madrid), are natural events. And of these 31 remaining events 29 correspond to phenomena related to floods and 2 events to floods and atypical cyclonic storms together (in Extremadura in November 1997 and in the Balearic Islands in November 2001).

In table 15.4, 7 out of the 10 losses of highest compensation paid by the CCS correspond to the 80’s decade including the 4 most costly losses. The 3 left happened during the 1990-2002 period.

15.3.1.2. Large flood events

In order to obtain the most homogenous data possible, we only took the large flood events (table 15.5). It must also be taken into account that in the CCS statistics for years previous to 1987, the “large events” related to floods include losses caused by rain, wind and snow. Since then, they have been specifically considered under the epigraph “atypical cyclonic storm”.

As it is not possible in the large events previous to 1987 to establish the losses due to rain and those resulting from floods, and in order to be able to compare them with those that, after this time, correspond exclusively to floods, we calculated the percentage that in the general losses of each year previous to 1987 corresponds to rain, wind and snow (atypical cyclonic storm), deducing this percentage, according to each year, from the different large floods events. Logically, on doing this operation, some of the events have been excluded from the table as they did not reach a sufficiently high figure to be considered as “large events”.

It can be seen that some of the previously indicated characteristics of the 10 most important events continue to exist with regard to indemnities paid by the CCS, 6 are maintained in the decade of the 80’s, including the 4 highest losses, and the other 4 in the 90’s. The amount of the indemnities paid by the CCS from 1980 to 1990, for 11 large floods events reached a figure of 1,109,551,537 EUR, whereas the payments for the period 1990-2000, for 13 large events, reached 500,479,267 EUR, half the amount of the previous decade.

Table 15.4. *Large events. Property damages. Extraordynary Risks (EUROS)*

	MONTH AND YEAR OF OCCURRENCE		LOSS LOCATION	CLAIMS	COMPENSATION AMOUNTS (nominal)	COMPENSATION AMOUNTS (updated)
1º	JUNE	1977	Basque Country	3.889	7.842.757	49.822.373
2º	JANUARY	1980	C. of Valencia	390	7.436.635	30.835.697
3º	APRIL	1982	C. of Madrid	46	14.975.833	45.639.676
4º	OCTOBER	1982	C. of Valencia	9.136	60.217.813	171.879.513
5º	NOVEMBER	1982	Catalonia	1.587	15.899.787	44.889.872
6º	AUGUST	1983	Basque Country	24.802	248.266.592	642.103.010
			Cantabria	761	2.192.059	5.669.420
			Navarre	101	254.985	659.479
			TOTAL:	*25.664*	*250.713.636*	*648.431.909*
7º	NOVEMBER	1983	Catalonia	3.899	8.221.845	20.661.293
			C. of Valencia	2.947	8.086.492	20.321.154
			TOTAL:	*6.846*	*16.308.337*	*40.982.447*
8º	OCTOBER	1984	Galicia	4.207	14.424.110	33.413.534
9º	JULY	1986	C. of Valencia	4.327	10.817.899	21.792.716
10º	OCTOBER	1987	Catalonia	3.243	13.214.694	24.803.938
11º	NOVEMBER	1987	C. of Valencia	17.277	115.147.717	215.323.391
			R. of Murcia	1.523	3.064.633	5.730.788
			TOTAL:	*18.800*	*118.212.350*	*221.054.179*
12º	JULY	1988	Basque Country	2.322	22.741.620	40.996.457
13º	SEPTEMBER	1989	C. of Valencia	4.163	18.144.555	30.390.344
			R. of Murcia	984	4.633.371	7.760.440
			Balearic Islands	421	3.714.327	6.221.132
			East Andalucia	431	3.458.602	5.792.818
			TOTAL:	*5.999*	*29.950.855*	*50.164.734*
14º	NOVEMBER	1989	East Andalucia	7.266	70.219.964	116.310.862
			West Andalucia	170	3.254.895	5.391.339
			C. of Valencia	112	1.342.661	2.223.955
			TOTAL:	*7.548*	*74.817.521*	*123.926.159*
15º	DECEMBER	1989	C. of Madrid	97	15.721.178	25.895.837
16º	OCTOBER	1991	C. of Valencia	5.116	16.099.522	23.813.936
17º	JUNE	1992	Basque Country	3.103	20.882.292	29.833.676
18º	OCTOBER	1994	Catalonia	4.631	46.830.863	59.902.115
19º	SEPTEMBER	1995	Catalonia	3.664	20.203.720	24.909.943
20º	SEPTEMBER	1996	C. of Valencia	3.114	12.642.405	15.063.998
			Catalonia	1.594	5.673.158	6.759.825
			Balearic Islands	313	1.320.540	1.573.483
			TOTAL:	*5.021*	*19.636.103*	*23.397.306*
21º	DECEMBER	1996	West Andalucia	1.154	22.867.597	27.034.053
22º	JUNE	1997	Basque Country	5.701	72.555.488	84.929.938
23º	SEPTEMBER	1997	C. of Valencia	7.494	38.202.020	44.496.599
24º	NOVEMBER	1997	Extremadura	3.006	18.951.322	22.001.214
25º	FEBRUARY	1998	East Andalucia	985	23.591.151	27.279.302
26º	SEPTEMBER	1999	Catalonia	6.539	34.515.763	38.615.214
27º	JUNE	2000	Catalonia	2.952	27.510.603	29.965.433
28º	OCTOBER	2000	C. of Valencia	6.914	65.763.977	70.701.844
			R. of Murcia	2.042	8.344.700	8.971.259
			TOTAL:	*8.956*	*74.108.677*	*79.673.103*
29º	SEPTEMBER	2001	C. of Valencia	3.430	30.047.419	31.458.146
30º	NOVEMBER	2001	Balearic Islands	6.901	24.607.222	25.648.391
31º	MARCH	2002	Canaries	1.920	34.694.884	35.730.611
32º	AUGUST	2002	Basque Country	4.609	20.204.327	20.470.204
TOTAL				**169.283**	**1.218.803.997**	**2.203.688.226**

Data at September 30th 2003; Updated at 31st December 2002. Source: CCS, 2003.

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Table 15.5. *Large flooding events*

Month and year of occurrence	Loss location	*EUROS* Compensation Amounts (nominal)	*EUROS* Compensation Amounts at 31-12-2001
June 1977	Basque Country	5.568.357	34.443.899
January 1980	C. of Valencia	1.323.721	5.344.454
October 1982	C. of Valencia	34.805.896	86.734.526
November 1982	Catalonia	9.190.077	25.264.213
August 1983	Basque Country, Cantabria, Navarre	189.790.222	477.958.086
November 1983	Catalonia, C. of Valencia	12.345.411	30.208.094
October 1987	Catalonia	13.214.694	24.151.838
November 1987	C. of Valencia, R. of Murcia	118.212.350	215.242.628
July 1988	Basque Country	22.741.620	39.918.654
September 1989	C. of Valencia, R. of Murcia, Balearic Islands and East Andalucia	29.950.855	48.845.895
November 1989	East and West Andalucia, C. of Valencia	74.817.521	120.668.119
December 1989	C. of Madrid	15.721.178	25.215.031
		522.113.545	**1.109.551.537**
SUBTOTAL	Basque Country (August-83) and C. of Valencia (November-87) excluded	**214.110.973**	**416.350.824**
October 1991	C. of Valencia	16.099.522	23.187.864
June 1992	Basque Country	20.882.292	29.049.344
October 1994	Catalonia	46.830.863	58.433.746
September 1995	Catalonia	20.203.720	24.255.057
September 1996	C. of Valencia, Catalonia, Balearic Islands	19.638.386	22.784.835
December 1996	West Andalucia	22.870.109	26.326.214
June 1997	Basque Country	72.624.932	82.776.266
September 1997	C. of Valencia	38.237.438	43.366.946
November 1997	Extremadura	16.869.297	19.069.253
February 1998	East Andalucia	23.487.433	26.445.345
September 1999	Catalonia	34.731.364	37.834.880
June 2000	Catalonia	27.751.601	29.433.239
October 2000	C. of Valencia, R. of Murcia	74.049.252	77.516.277
		434.276.209	**500.479.267**
September 2001	C. of Valencia	29.554.450	29.751.954
TOTAL		**991.512.561**	**1.674.226.657**
Based on data from CCS			

If we exclude from table 15.5 the 2 losses with the greatest return period (marked with an asterisk), and which in this series could be considered “atypical”, such as the floods in the Basque Country in 1983 and those in Valencia in 1987, the result is a more equal distribution of the 10 most costly losses in this series: 5 in each decade, although the two most important ones are still in the 80’s. Furthermore, it can be seen that the amounts totalling the two decades invert, as was to be expected, their tendency. Thus, from 1980 to 1990 there are payments for 416,350,824 EUR (corresponding to 9 events), whereas from 1990 to 2000 indemnities reach 500,479,267 EUR (corresponding to 1,313 events). It must be kept in mind that we are dealing with updated amounts.

15.3.1.3. All the events due to floods

If we exclude from the valuation of the losses due to floods the two big (“atypical”) losses mentioned for 1983 and 1987 the potential line of tendency is presented in figure 15.2. Thus, we

obtain an ascending trajectory of the line, punctuated every few years by significantly larger events, in periods that are distributed in quite a homogenous manner.

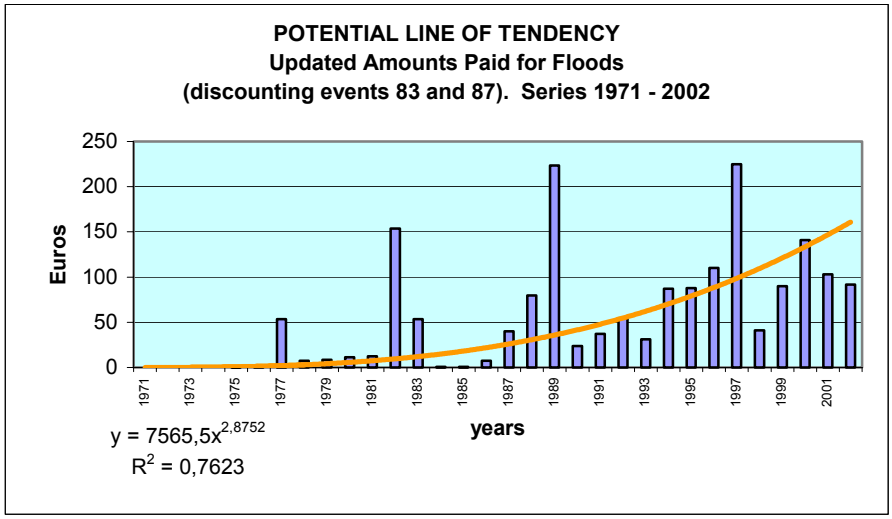


Fig. 15.2. *Based on data from the CCS*

15.3.1.4. Conclusion

To blame climate change for this loss cost evolution obtained through different ways is not sufficiently founded. It is difficult, without any other evidence, to attribute this evolution to factors different to the insurance penetration, the increase of exposed insured properties and the greater volume of insured capital.

From a worldwide perspective, it will also be complicated to calculate in real terms the incidence of climate change in the rise of the loss rate. In a recent Munich Re publication an expert author asked the question: "why floods are becoming more frequent and more costly?", and he asked in the following manner: "The increase in flood losses in recent years and decades is primarily attributable to the booming development of areas near rivers and lakes", along with "carelessness, ignorance, and profit-seeking" (Kron 2003). Then, it seems that climate change is not among the most determinant factors in the increase of these losses.

With regard to these considerations, Pamela Heck, a climatologist from the **Swiss Re** Department of Catastrophic Hazards, stated the following in an interview: "Insured losses increased exponentially during the past 30 years. This increase is mainly due to economic, demographic and geographical factors, such as the rapid increase in property values, their concentration in highly exposed areas and the high vulnerability of modern technology. The actual impact due to climate change is, however, difficult to quantify". This climate expert subsequently insists that the future impact of climatic change and of extreme climatic events in the tendency towards losses is difficult to quantify, however, "certain measures will have a direct impact on loss reduction", referring to the prevention and mitigation of risks (Swiss Re 2004a).

15.3.2. International Reinsurance

A suitable valuation of insured losses resulting from natural elements takes into consideration all the circumstances, that is to say, the increase in the concentration of people and economic

properties, increased vulnerability, the new technologies and, most important, greater insurance penetration in the Spanish market. This series of reasons may make one think that the increase in losses is not exclusively due to climate change, and one must keep in mind that all the already mentioned factors will continue to play their role, and their effects will certainly augment. From this point of view and thinking of the insurance sector, "what is being discussed is not the scale of the actual weather event, but the financial consequences of the claims made upon the insurance industry" (Sammonds 2002).

As a clear example of this concern, we highlight the comments made by the Reinsurance Association of America, which pointed out that 50% of the total insured losses throughout the world over the last 40 years resulting from natural events, including those of geologic origin, have occurred since 1990. If this rhythm continues, the intervention of the governments in the different countries may become necessary to deal with such losses.

In the possible scenario of increased losses, the insurance lines of business that will be most affected must be indicated. The first of these is the one known as "property", which includes property, industry, engineering and fire, and is representative of the increase in the value of the properties in areas highly exposed to climate impact. Other lines of business such as health care, life and GTPL, may be affected, although initially, to a lesser degree.

Fig. 15.3 shows a result very similar to that obtained by the CCS for a comparable period of time. In spite of the fact that the number of claims is low, the accumulation of these over the last decade is significant (1994 – 2003) as is the increase in the economic cost of the losses generated, due to the fact that the figures have been indexed.

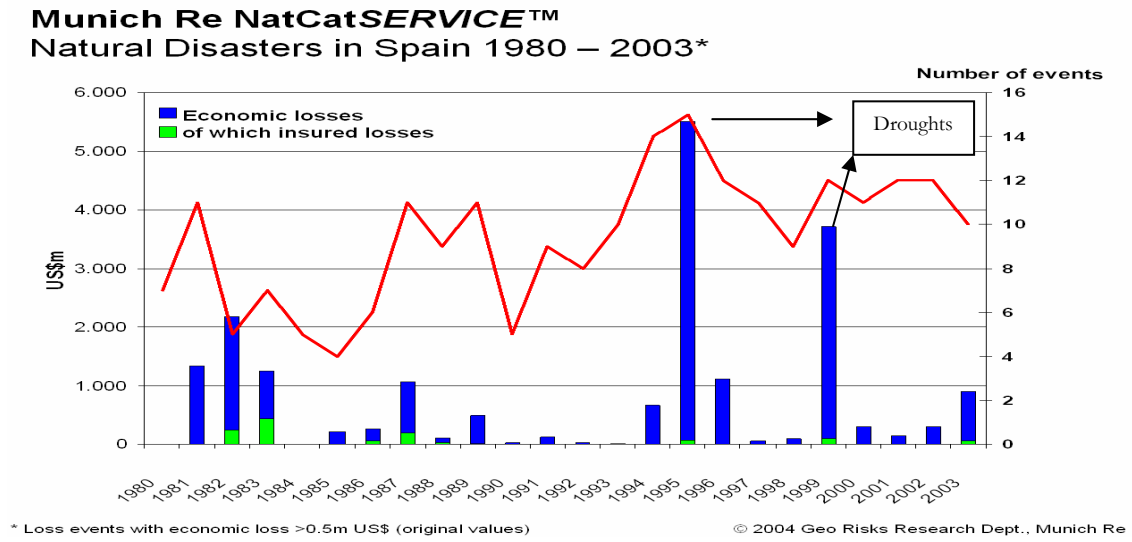


Fig. 15.3. *Natural Disasters in Spain (1980 – 2003)*

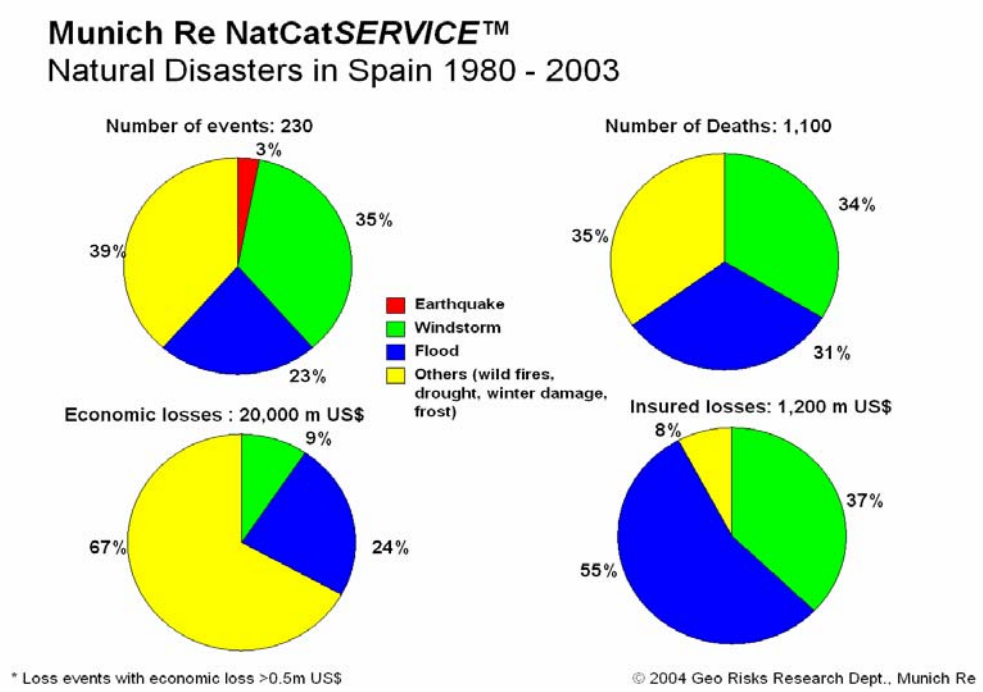


Fig. 15.4. *Distribution of natural disasters in Spain 2 (1980 – 2003). Source: Geo Risks Research Department, Munich Re*

It is also important to identify the zones in which these losses have occurred, as the density of the insurance and the economic value of the property is not the same in urban and rural zones. For example, the hailstorm of August 2003 in parts of Southern Aragón; should this event had happened in urban areas such as Madrid or Barcelona, it would have meant much higher losses.
In reference to the distribution per type of event, Spain follows the international tendency, as storms and floods predominate (fig. 15.4). Munich Re confirms this fact in their 2003 catastrophes study (Munich Re 2003), which indicates that 76 % of insured losses are due to storms and 8 % to floods. In Spain, and with regard to insured losses, floods are more frequent than storms. Due to the fact that Munich Re's procedures for the evaluation of insured and economic losses are not the same as those of the CCS, the data are not comparable.

15.3.3. Agricultural sector

Within the insurance sector, agricultural insurance, for obvious reasons, is the most sensitive to climatology and meteorology. Furthermore, in Spain there has been a long tradition related to the search for optimum formulae for insuring crops against climate hazards, until the current one in force was established, which is an exemplary model of agricultural policy from the insurance sector.

Although the history of agricultural insurance in Spain can be documented since 1902, (Burgaz and Pérez-Morales 1996) with statistical backup, it is not until the year 1940, after the Spanish Civil War, that the State implemented the "System of Agricultural Insurance". Since that year and up to 1980, statistics are available for losses of crops due to hail, but there are no reliable data for floods, droughts, storms, frost or other hazards. There is, however, information on State Aid for Calamities (Ayudas del Estado a las Calamidades), which can be identified with events different from hail, but which is not specified. Since 1980, and introduced by Multiperil Crop Insurance Law 87/1978, cover of frost, wind, rain, floods, etc., has gradually and selectively been added.

Fig. 15.5 shows the loss rate for the 1967-2002 period (the period observed equalling the one in table 2.1) of the total agricultural insurance, where a turn can be observed (350%) in the year 1972, when a crisis occurred in the insurance system due to the high loss rate, which led to the drafting of new technical regulations (rate for hail 1973). Other years with significant losses are 1983 (209%), with floods in the Basque Country; 1986 (242%) with spring frosts and 1992 (265%) with a severe drought. The tendency drops gently for the period studied, showing the compensatory effect of the adjusted rates per crop and zone in the Spanish agricultural insurance system.

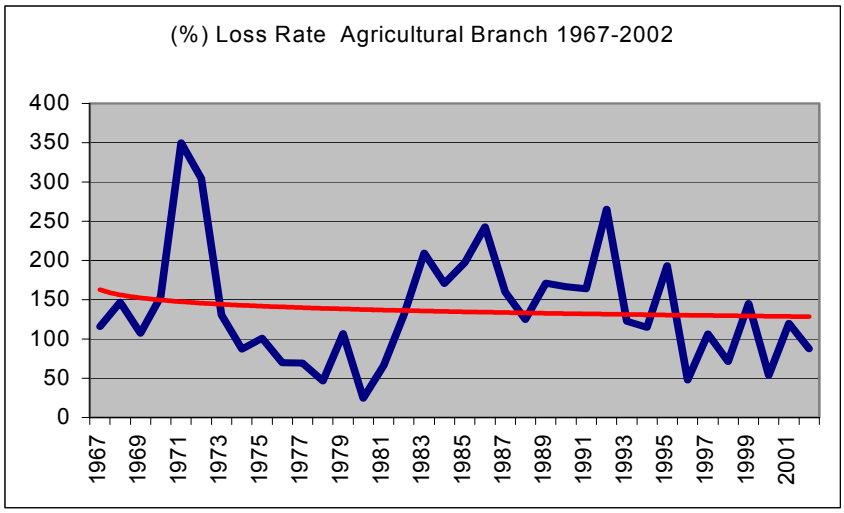


Fig. 15.5. *Source: Based on data from Burgaz and Pérez-Morales 1996, and information from Agroseguro (2003). Loss rate in blue; logarithmic tendency line in red.*

Fig. 15.6 enables us to differentiate between the percentage distribution of the number of claims in agricultural insurance to Agroseguro, due to certain causes. The 5 most significant categories have been selected (for this reason none of the columns reach 100%, although annual data are considered that contemplate 80% or more of the claims), leaving fire, several types of wind and sickness out of the graph due to their lower level of incidence. Noteworthy in the first place is the number of claims following to hail, as this cover involves 50% of the agricultural insurance premium for the series 1987-2002.1987-2002.

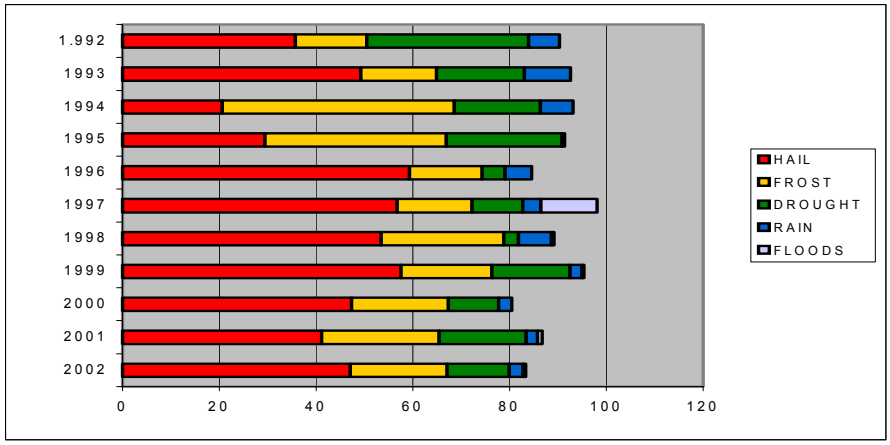


Fig 15.6. *Percentage distribution of the number of losses in agricultural insurance (Agroseguro) 1992-2002. Source: Based on data from Agroseguro (2003)*

The downward trend in the number of claims since 2000 is explained together with fig. 15.7, where there is a decrease in the number of policies since the same year, as owners grouped their own crops and farms under one single policy, albeit this should not be interpreted as a decrease in the volume of insured business.

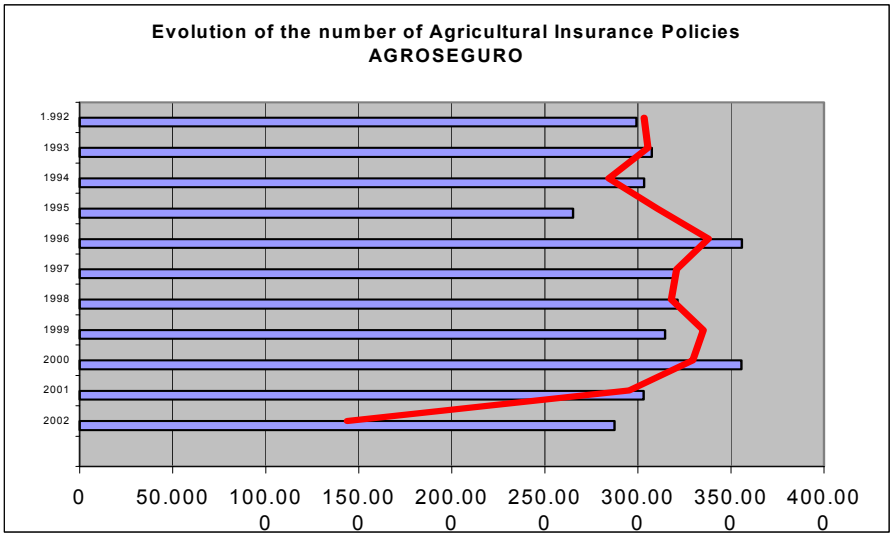


Fig. 15.7. *Source: Based on data from Agroseguro (2003)*

Observing Fig. 15.8, no tendency is identified in the loss experience for hail or frost, causes which were analysed because they were the most representative with regard to volume of premium (53% and 31% in agricultural insurance 2002, respectively), which allows their development to be framed within a scenario of climate change. Rather, the approximation of the loss ratios to 100% in the last few years, from higher values can be interpreted as a response of the adaptation of the insurance system to the needs of the agricultural sector.

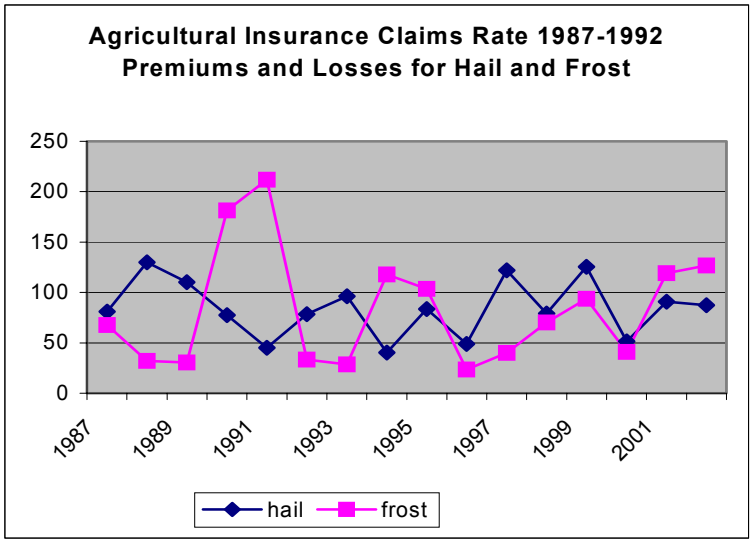


Fig. 15.8. *Source: Based on data provided by Agroseguro (2003).*

15.4. MOST VULNERABLE AREAS

15.4.1. Extraordinary Risks. Indemnities for climate events

The figures shown on the map in figure 4.2 represent the indemnities (updated amounts) paid by the CCS for damage to property by climate events (series 1971-2003), which consist of floods, atypical cyclonic storm, damage by the sea and also, from 1971 to 1986, rain, hail and wind. 80% of these indemnities correspond to floods. It ought to be pointed out that 40% of the indemnities for climate risk considered in the series are jointly concentrated in Valencia and Vizcaya, in almost equal parts.

15.4.2. Main climate and meteorological events in Spain (1980 – 2003, Munich Re)

Table 15.6 now provides details of the main climate and meteorological events on Spanish territory, contained in the Munich Re database since 1980. The amount insured does not appear in all cases, due to a lack of official statistics, and Munich Re therefore bases its calculations on the press and official data and estimates depending on the penetration of the insurance in the affected zone.

15.4.3. Agroseguro maps of climate risk in agricultural insurance

Fig. 15.10 presents the risk map of frost, floods, hail, drought and wind for crops, where the analysis of probability of occurrence (hazard) by the INM is incorporated, along with the loss experience of the agricultural sector according to agricultural regions (for certain hazards, according to municipalities and other subdivisions). Therefore, the distribution of the crops and their sensitivity to these meteorological or climate hazards enables us to differentiate risk areas. In broad terms, the higher risk zones, according to the different phenomena, are:

- frost: interior of the two Northern thirds of the peninsula
- floods: provinces of the Mediterranean coast and specific points on the Northern coast
- hail: North-eastern quadrant
- drought: Southern half and Ebro Valley
- wind: provinces on the Atlantic and Cantabrian coasts, Pyrenees, Southern Mediterranean coast, Zamora, Salamanca and Valladolid.

Fig. 15.11 shows the graph of percentage distribution of communicated individual losses 2000-2003 for agricultural insurance and the main causes – hail and frost, in the provinces with the highest volumes. For hail, Valencia, Lleida, Zaragoza and Castellón, provide the largest level of claims, totalling between 40 and 70% of annual statistics. For frost, the losses are more dispersed throughout the 9 provinces studied, constituting among them all 50 and 65% of annual statistics. For any scenario of climate change with modification in the tendencies of hail and frost, these provinces, particularly Valencia, are the ones whose loss pattern will be most affected, in some cases positively and in others, negatively.

Fig. 15.9. *Indemnities by the CCS. Climatic risks. Damage to property. 1971-2003. Updated figures, in millions of Euros. Based on data from the CCS*

15.5. MAIN ADAPTATION OPTIONS

15.5.1. Involvement

Adaptation to the loss scenario and risk management in a possible climate change, depends on the scope and capacity to react of the insurance institution and of the main actors: the insured party, the insurance market and the state, as well as the degree of involvement of each one of these. This involvement (fig. 15.12) has a double implication: a quantitative one, which refers to the financial capacity and another qualitative one, related to the different ways in which each of these actors can become involved, above all with regard to insurance solutions and alternatives.

The quantitative aspect of the question:

- accessible insurance price for the insured party
- capacity of the insurance and reinsurance market
- capacity of the capital market (alternative transfer of risks)
- capacity of the State (last resort)

The qualitative aspect of the question, that is, the different alternatives for risk finance depending on the involvement of the actors:

- Insured parties: perception of the risk, purchase of cover, preventive measures, participation in the risk (deductibles).
- Insurance market: development of new models of risk management and of new insurance techniques and formulae.
- Capital market: development of finance engineering for the alternative transfer of risks.
- State: adaptation of its participation to the new circumstances, making insurance cover feasible.

Table 15.6. *Insured economic losses in Spain (1980 – 2003) Source: Geo Risks Research Department: Munich Reinsurance Company 2003. Amounts in original value, not updated.*

Year	Event	Zone	Economic losses (mill. USD)	Economic losses (mill. USD)
1981	Wind / frost	Guadalquivir Valley	300	Unknown
1981	Drought	Centre and South	1035	Unknown
1982	Heat wave	Barcelona	4	Unknown
1982	Drought	Centre and South	1500	Unknown
1982	Winter storm	Catalonia	350	224
1982	Winter storm	Catalonia	300	224
1982	Floods	Levante	375	Unknown
1983	Floods	Basque Country, Burgos	1250	430
1985	Frost	Spain	350	200
1985	Cold spell	Costa Brava, Valencia	11	Unknown
1985	Drought	South-east	200	Unknown
1986	Winter storm	Spain	100	48
1987	Floods	Valencia, Murcia	1000	185
1987	Storm	Tenerife	32	Unknown
1989	Floods	Málaga	375	Unknown
1989	Storm	Costa Blanca, Ibiza	65	16
1991	Drought	North	1	Unknown
1995	Drought	Andalucía	4500	Unknown
1995	Cold spell	La Rioja	825	65
1995	Storm	Spain	8	Unknown
1996	Floods	Biescas	20	Unknown
1999	Winter storm	Canary Islands	415	Unknown
1999	Winter storm	Bilbao, Asturias (Martin)	100	24
1999	Drought	Extremadura, Castilla la Mancha	3200	
2001	Hail	Valencia	50	Unknown
2001	Storm	Catalonia, Baleares	6	Unknown
2002	Floods	South	100	Unknown
2003	Storm	San Sebastián, Costa Dorada	1	Unknown
2003	Storm	Aragón, Catalonia	10	Unknown

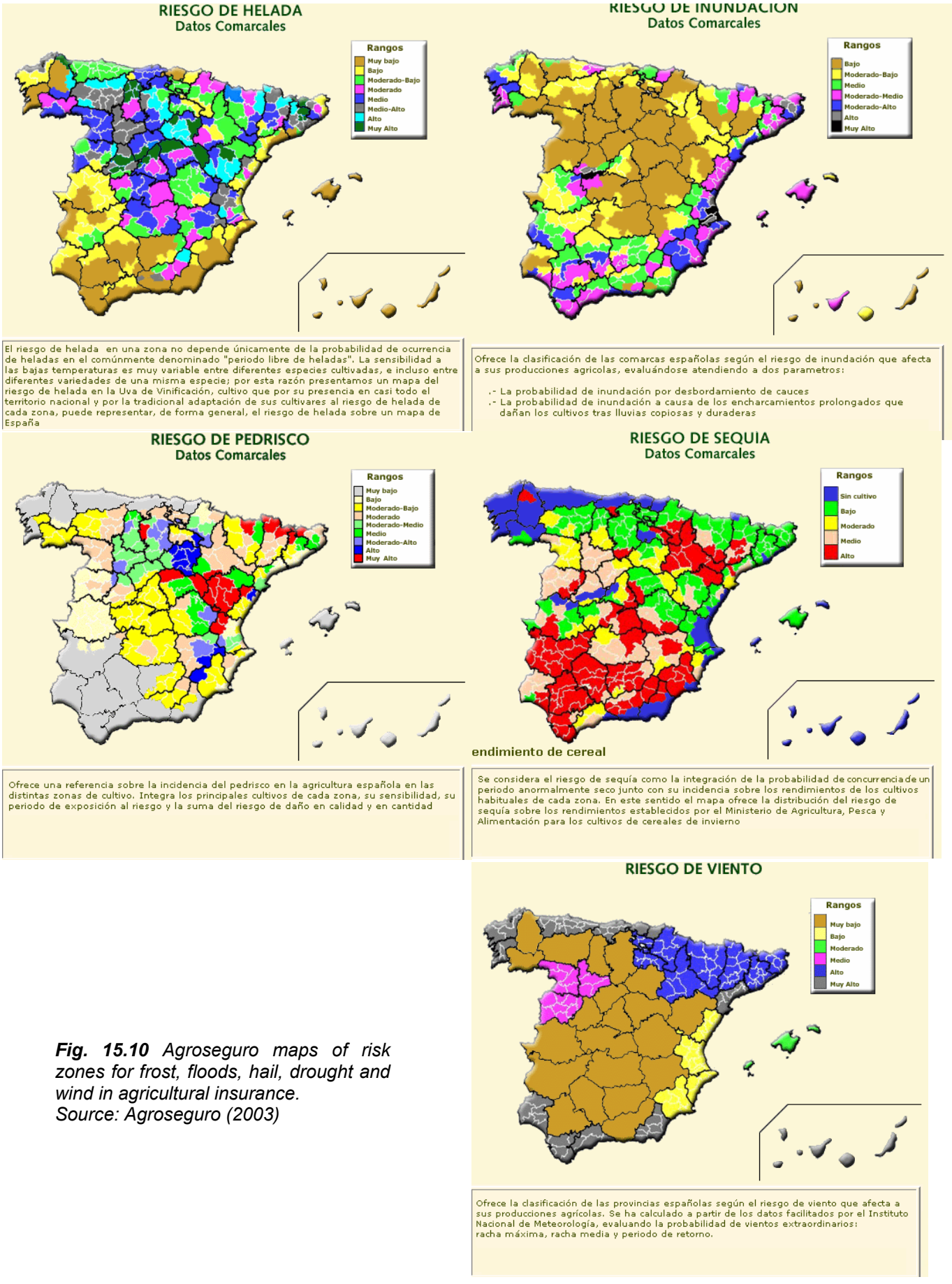


Fig. 15.10 *Agroseguro maps of risk zones for frost, floods, hail, drought and wind in agricultural insurance. Source: Agroseguro (2003)*

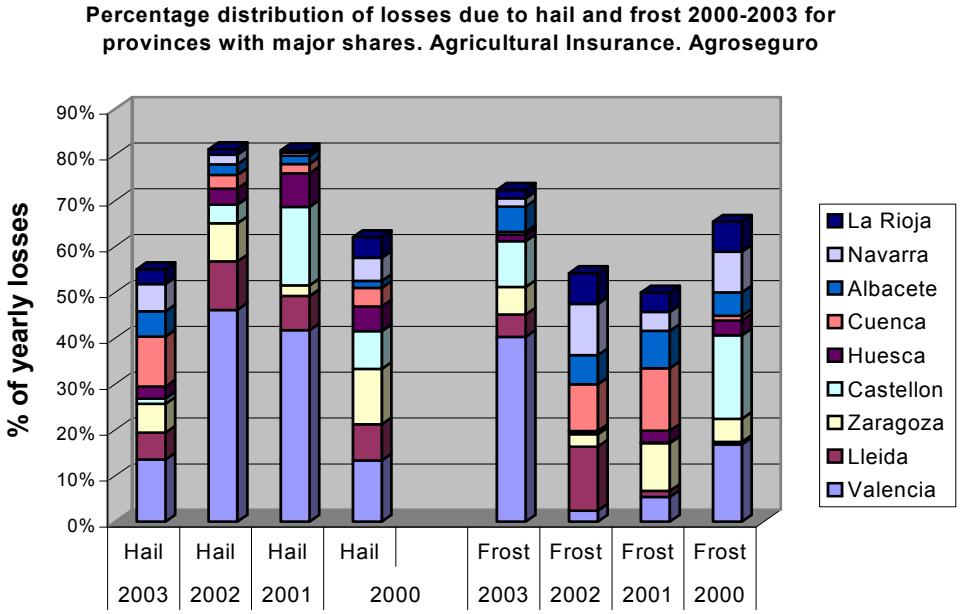


Fig. 15.11. *Source: Based on data from 2003. Agroseguro Report (2003)*

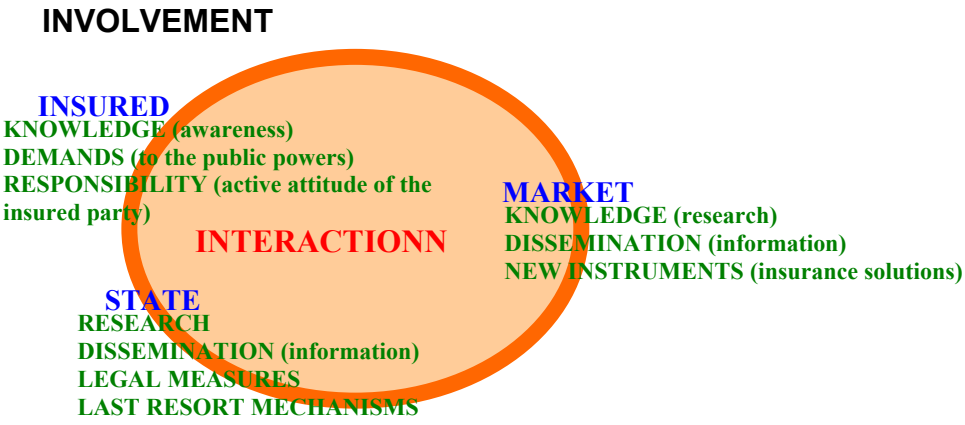


Fig. 15.12. *Interactions among actors involved in insurance solutions and alternatives*

15.5.2. Promotion and information on the insurance

A severe claims scenario resulting from climate change will force a profound change with regard to how the insurance institution will be perceived from the point of view of the different actors (insured party, market, State). A new insurance culture will probably take over, in accordance with the new loss situation, in which some of the fundaments of insurance and other aspects that will be seen to be crucial will be clearly put in practice in relation to the feasibility of insurance solutions; these will require promotion and information actions in order to gain social awareness. In this sense, certain fundamental points must be underlined:

- Insurance as a responsible attitude of the potential affected parties (active participation), involvement in the protection of their lives and property.
- Insurance as an instrument of transfer of risks (possibility of recovery/financing of the loss suffered).
- Insurance as a channel of solidarity among potentially affected parties (mututalisation and distribution of the risk in order to make the cover viable).
- Insurance as a preventive mechanism) application of deductibles, reductions in premium, etc., in order to promote the mitigation of risks).

15.5.3. Dissemination of the prevention culture

Prevention must be a fundamental element in any integral strategy for dealing with risks of a climate nature. There is a need to create a new awareness, a new way of considering and dealing with a problem and, in short, a new prevention culture, due to its implications from different perspectives:

- Prevention as a social value (stability and cohesion factor)
- Prevention as a political imperative (as an objective of general interest)
- Prevention as economic profitability (investment in the future)
- Prevention as a stimulus for research (in knowledge, mitigation, treatment)
- Prevention as a pillar of management of climate risks

Within the specific technical insurance tools, we will now value the possibilities existing in order for the sector to bear a high volume of risks, that is to say, what methods of risk transfer can be considered in order to attempt to reduce the impact of climate change in the insurance sector?.

15.5.4. Actuarial methods

These are the classical methods, typical of the actuarial sciences applied by the insurance companies in order to mitigate and correct the impact of a heavy loss, among which we can highlight:

- Increased rates
- Cancellation of policies (improvement of the portfolio mix)
- Indemnity Limits
- Increased deductibles / franchises
- Improvements in the technical underwriting
- Enhanced loss adjustment

History has shown that, following a serious event the insurance companies tend to raise their premium drastically, as happened after hurricane Andrew in 1992 in the state of Florida (USA). Following a quiet spell, new insufficient rates are set in relation to the assumed risk, whose theoretical level of probability does not vary, in principle (Matthews *et al*. 1999).

15.5.5. Reinsurance

The basic objective of the transfer of risk to reinsurance is to reduce the liability of the direct insurer, in an attempt to avoid future unknown deviations that can become severely aggravated in the case of natural events. The reinsurer reduces the potential losses of the insured on taking on part of the risk, although the former seeks a balance in his portfolio by means of the geographical dispersion of the business assumed (different insurance companies in different

countries) and, particularly, with regard to situations of high losses which are difficult to control, like losses with large return periods.

It must be pointed out that beyond the mere transfer of risk, reinsurance, due to its vast experience in dealing with the hazards of nature, has traditionally offered support to the sector on making numerous profound analyses of markets and large losses, apart from providing consultation in relation to the diverse options for adaptation to the new risks. Table 15.7 shows the rapid positive evolution (2000-2002) of the relevance of reinsurance as a support to direct insurance.

Table 15.7. *Worldwide Direct Insurance and Reinsurance Premiums. Source: Partner Re 2004*

(in Millions of Euros)	**Direct**	**Reinsurance**	**% Cession**
North America	479.300	54.371	11
Europe	289.420	40.987	14
Japan	48.516	1.673	3
Asia	76.119	9.201	12
Rest of the World	19.239	8.365	43
Total 2002	912.594	117.107	13
Total 2000	761.192	86.157	11
% Inc Cession 00-02	20%	34%	2

Reinsurance is not the only way to adapt to climate change, but is rather the traditional option, and it was in the 90's, when what is known as ART (Alternative Risk transfer) was established, coming from the purely financial sector..

15.5.6. ART (Alternative Risk Transfer)

The ART solutions could be considered to be finance products aimed at solving problems related to the transfer of specific risks, more than the use of these as a product of standard reference. These solutions act as a complement to the traditional reinsurance methods in order to optimise the retention of the risk, to reduce the volatility of the revenue throughout time and to obtain new sources of financing capable of assuming business.

Through the different forms of risk transfer presented, the insurance sector shows its capacity to adapt to catastrophic events. The problem is knowing if it is fast enough, and more so, the degree of acceptation of these alternative methods within such a traditional sector.

In short, the ART products were designed to limit the risk in any sector of losses of a potentially unforeseeable amount and erratic recurrence, with the possibility of a scenario of climate change. This transfer of risks can be made by insurance companies, reinsurance companies or by the insured himself, who can go to the finance market and acquire a cat bond, as already happens in some companies of the energy sector.

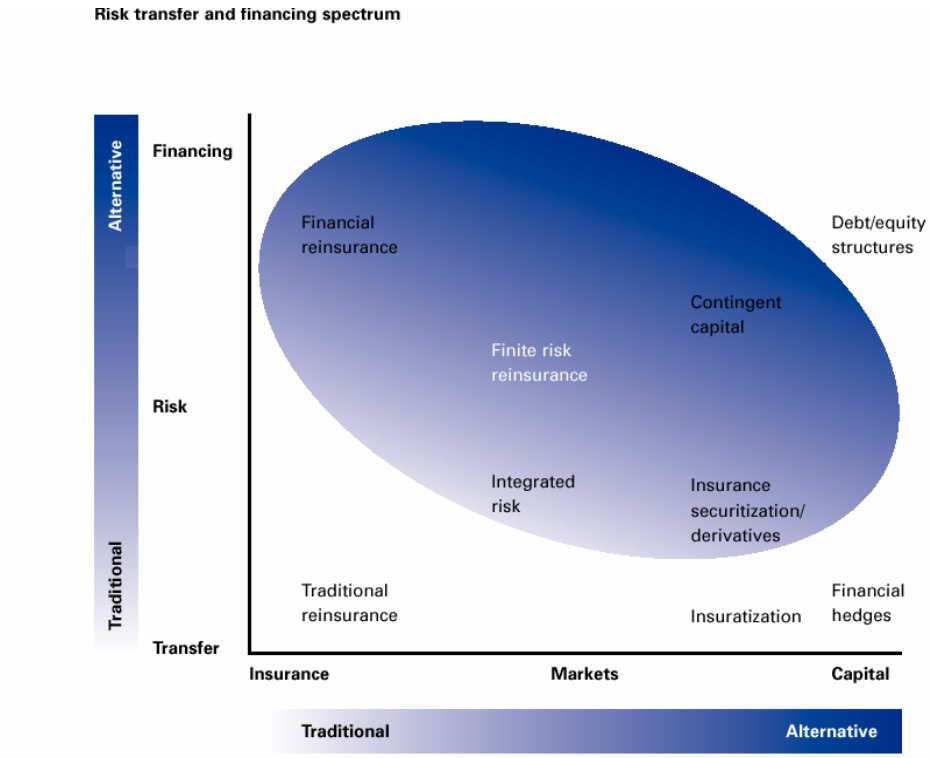


***Fig. 15.13**. Risk Transfer and Financial Spectrum. Source: Munich Reinsurance Company 2000*

We will now give a brief description of the different alternative solutions that can help the insurance sector to adapt to the consequences of possible climate change (table 5.3):

- Methods of risk finance (Financial Reinsurance)
- Capital markets
  - Climate derivatives (Options / Swaps): they function in a very similar way to their homonyms in the capital sector, although in this case they provide protection (hedge) against climate variations (temperature, rains, droughts,...)
  - Bonds (Cat Bonds): they function in a similar way to the more common bonds, but the payment of interest and of the nominal are linked to a meteorological index.

Recently, more alternative methods for the transfer of risks have appeared, as can be seen in figure 15.13, although the ones already described can be considered as the most commonly used ones. In spite of all, and as we are told by the GAO (United States General Accounting Office) and the Swiss Reinsurance Company, the number of Catastrophe Bonds is only between 2.5 and 3 % of worldwide catastrophe cover.

15.6. REPERCUSSIONS IN OTHER SECTORS OR AREAS

15.6.1. Insurance and Reinsurance

The direct effect that a climate change with an increase in losses offers to the sector is obviously a negative one. The technical calculation of the premium that an insurance company has to charge in order to face possible losses is based on past results and claims. If the climate change leads to results of different frequency and/or intensity which are unexpected or

unknown, many insurance companies may find themselves in a situation of insolvency. In the case of Spain and for the private insurance market, the existence of CCS and Agroseguro, constitutes a good backup, although this does not exempt any of the aforementioned “pools” from considering the scenarios of climate change.

With regard to reinsurance, due to its backup role in the sector, it will be directly involved, with greater or lesser losses, in the effects of any possible climate change. And more so if we take into account that it can suffer the impact of the accumulation of losses from different insurance companies in the same affected zone. The incorrect and/or incomplete management of the location of the risks making up a portfolio, whether from the point of view of the insurer or of the reinsurer, could be disastrous in the event of catastrophic losses, on being unaware of their extent and total amount.

15.6.2. Society in general

Although the implications of the possible effects of climate change on the insurance sector in society are not so evident, it is possible to study what has happened in parts of the world with a higher incidence of climate events. As indicated by Swiss Re in a study in the year 2000 (Beder 2001) around 650 United States insurance companies claimed bankruptcy from 1969 to 1998 as a result of natural disasters.

The situation of bankruptcy in an insurance market not only causes a decrease in competition in the sector, a rise in insurance prices, distrust by the insured parties and a direct effect on the Consumer Price Index of these countries, but can also lead to a situation in which insurance cover cannot be purchased. This is what happens in certain zones highly exposed to natural hazards in the USA, where the population has serious problems to find insurance for their properties.

15.6.3. State

As a last resort, the State will be responsible for controlling the insurance offer for these covers, or who will end up providing this protection. In Spain, this is mostly solved due to the existence of the CCS, although they are not responsible for all the possible loss events. There is always room for joint solutions with public insurance complemented by the participation of the private sector and the State. It must also be taken into account that many of the infrastructures belonging to governments have, in many cases, a “self-insurance” system, and in this case, they will be equally affected. In the case of a natural disaster, we must not only consider the direct loss, but also the costs of the reconstruction-recovery.

15.6.4. Bank

At present, finance companies and especially banks are starting to consider the potential of climate change when evaluating the profitability of investments or developing new products (World Bank 1999), which can be considered a new niche in the market and also a new form of competition. What is clear is that in recent years the banking world has been capable of adapting to new and more complicated situations, creating new products and services. A new series of products has already been created, from investment funds based on environmental parameters to sophisticated derivatives designed to correct deviations in relation to meteorological risks.

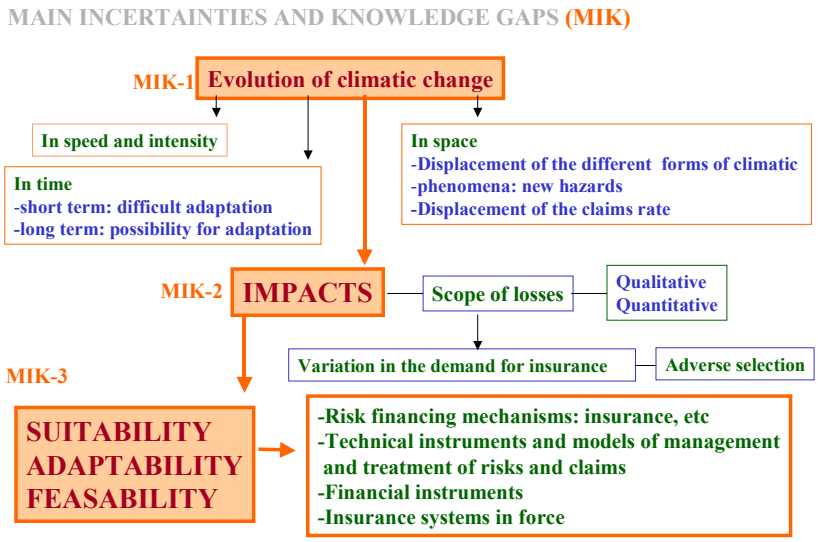
15.7. MAIN UNCERTAINTIES AND KNOWLEDGE GAPS

The main uncertainties and fundamental questions related to the effects of climate change in the insurance sector affect three different levels (table 15.8):

15.7.1. Evolution of climate change

Of all the situations that could be considered possible, it is not certain which one will materialise, what degree of climate variation it will have and how fast it will arrive; this depends on the region, area and zone that is considered. There will logically be more time to react if the period in which the change occurs is longer, and the variation is smaller. The geographic displacement of the different forms of climate phenomena and, therefore, the displacement of losses, is another uncertainty to be considered.

Table 15.8. *Main uncertainties and knowledge gaps*



15.7.2. Impacts and effects that can be expected

The impact, the extent of the damage and the intensity of the losses will depend on the behaviour of the possible climate change and on the vulnerability of the areas affected (exposure to risk, population and values exposed, concentration...). Qualitative, intangible losses, such as those that can affect the social structure, the political system and the culture of a population, are not contexts in which insurance has an important role to play. A quantitatively very high loss may mean, as a consequence, losses in the sense indicated, but it may also mean a qualitative alteration in the way the insurance is conceived and in its modalities and applications.

It can be predicted that the variation in the extent and intensity of the losses (uncertainty) will, directly affect the variation in the demand for insurance. The problem with adverse selection (that only those with the highest levels of risk can obtain insurance) will continue to be latent in the cover of disasters, and nature and scope of the cover system adopted will depend to a great extent, on the way this is dealt with.

15.7.3. Suitability, adaptability, and feasibility of the insurance institution

On the first point (15.7.1), depends the resolution of the suitability, adaptability, and feasibility of the instruments and systems of cover with regard to the scenarios in which they occur, which leads to the question of what margin there will be to manoeuvre, as well as the capacity to respond of the organisations, companies, institutions and organisms that participate or may participate in insurance solutions in relation to these scenarios.

15.8. DETECTION OF THE CHANGE

This is a question of identifying proxys that can be used to indicate a possible climate change in a specific manner in the insurance sector:

15.8.1. Variation in claims

- In key lines of business:
  - **Storms**: The aforementioned increase in losses due to storms in the insurance sector both in Spanish direct insurance and in the CCS statistics, can be related to the increase in exposures and insurance penetration. However, it is a factor to be taken into consideration.
  - **Floods**: The same as for storms.
  - **Frost, drought, hail**: these are lines of business which are traditionally related to agricultural risks. Due to the prolonged statistics on hail cover for this type of risks (1940-2003), it may be possible to identify a pattern of incidence of extreme temperatures in summer with hailstorms.

- Other lines of business: The current figures are not clear enough in sectors like health care, personal accidents or transport, which means to say that there is no clear correlation between these lines of business and the evolution of the present climate.

15.8.2. Insufficiency of prices

The calculation of the insurance price is based on past experience. Recently, prices charged for cover of natural disasters or natural events have clearly been insufficient to deal with the large losses, which could not be recovered in the predicted amount of years, before another great event took place, of similar or higher amounts.

This happens because it is very difficult to consider the potential losses of an extreme event, especially when its return period can vary, like, for instance, a possible climate change. Thus, for a heat wave like the one that occurred in summer 2003 in Europe, a return period of 450 years (Munich Re 2004) was considered. In the following decades, perhaps we will see if this parameter has been reduced with regard to the danger of high temperatures due to a shorter return period.

15.8.3. Reaction of the finance sectors towards profitable sectors

The reaction of the finance institutions may involve the search and continuous creation and growth of adapted finance products, mainly financial derivatives and formulae for the mitigation or adaptation of any industry in this sense. They also adapt existing products, such as mortgages, in order to deal with the risks caused by climate in this new scenario.

15.9. IMPLICATIONS FOR POLICIES

From the insurance sector point of view, we will now enumerate the actions considered to be necessary and positive, along with the organisms that should promote them, in order for the insurance activity to be developed in Spain in an environment more adapted to the foreseeable consequences of climate change:

- Review of the Basic Regulations of Building and Design in order to adapt all types of old and new structures to more extreme and/or more frequent manifestations of climate hazards. Civil Works Office.
- Land Planning and Uses in accordance with the danger level established in each area for climate phenomena. Environment Office, Housing Office.
- Promotion of education in prevention from primary school. Education Office.
- Promotion of prevention. Civil Defence. Home Office
- Financing of research aimed at all areas affected by the climate. Science and Technology Ministry. Health Office.
- Adaptation of insurance cover and International Accounting Regulations (IAR) Ministry of Treasury.
- Feasibility analysis of agricultural policy. Agriculture Office.

For the better development of these measures, once they have been analysed and implemented on a national level, a follow-up must be made in the regional context.

15.10. MAIN RESEARCH NEEDS

Research needs will be distinguished when these are related to the hazard of natural phenomena, the vulnerability and economic value of the insurable properties.

15.10.1. Hazard

This refers to improved knowledge of the phenomena, so that signs of climate change can be detected.

- Adaptation of formats (for instance, new technologies) and deadlines of the data deliverance on meteorological phenomena for the needs of the insurance sector.
- Explanation of the scenarios handled by the IPCC, which are specific to Spain, for their suitable use in all fields of study.
- Standardisation meteorological and climate variables measurements, as well as of procedures with European countries.

15.10.2. Vulnerability

- Experimental studies of crops and structures vulnerability in the different geographical areas to the main meteorological and climate phenomena in their most extreme manifestations.
- Statistics that are detailed and prolonged over time related to data on claims for the Spanish insurance market, both per areas and per catastrophic events, to help to detect climate change.

15.10.3. Economic value

- Updated statistics on the insurance penetration in Spain according to types of risk, specified in insured values.
- Updated statistics on the real estate pool (census), as a potential insurance market.

The combination of hazard, vulnerability and economic values exposed or not, together with the insurance types, in order to recreate historic scenarios and specific probabilistics for the insurance sector, has led to *catastrophe models (cat models)***,** very widespread throughout markets outside Spain. In some cases, the influence of medium and long-term climate change is included in order to generate databases of stochastic events. Cat Models are not used within the Spanish insurance market, meaning that the insurance companies will not comply with the standards of the Rating Agencies to get a sound qualification. This is very important for shareholders, stock markets and international competition.

15.10.4. Monitoring

This analysis of insurance market evolution during last decades, trying to identify past effects and guess future reactions to climate change, should not finish here. The creation of a Monitoring Observatory of the insurance sector behaviour is proposed in a foundational framework, including entities such as CCS and Agroseguro, as well as insurance and reinsurance market participants, both national and international.

15.10.5. Conclusions

15.10.5.1. Statistical data

Having analysed the available statistics, we can reach conclusions in relation to each data set:

Loss experience in the DGSFP non-life lines of business (1967-2002)

The global loss experience from 1967 to 1981 presents an average of 57%, whereas from 1982 to 2002 this was 71% (table 2.1). It has been argued that this increase in the average by over 10 points between the two periods is due to the reduction in the number of companies operating in the sector, which began to compete fiercely, reducing rates while maintaining a similar loss rate. Although we cannot fully rule out their influence, these data do not allow us to consider climate change in a clear and obvious way among the determinant factors of this evolution, and less so, to distinguish their degree of participation therein.

CCS floods compensation (1971-2002)

The ascending tendency in the series for the period analysed (table 3.4) has been attributed to the increase in the insurance penetration into a society with more insurance culture and to the increase in both exposures and insured values. Without totally ruling out its influence, no clearly identifiable signs have been detected to indicate that climate change has left its mark –or to what degree- in the tendency presented for this period. The Mediterranean coast (mainly Valencia) and the Basque Country (Vizcaya) concentrate a high percentage of claims due to climate risks and could be considered as zones that are sensitive to the consequences of climate warming in the future.

Munich Re data base of climate and meteorological events (1980-2003)

The economic costs of the events registered by Munich Re for just over two decades rise in the second half of the period. Therefore, the tendency, described in the previous two points, towards an increase in events and losses is yet again sustained. The coastal provinces of the Mediterranean form part of several loss scenarios, and they are then profiled as a more susceptible zone with regard to a change in climate and meteorological parameters.

Loss experience in Agricultural Insurance (Agroseguro 1967-2002)

The agricultural insurance scheme has undergone continuous transformations in an attempt to compensate for results and to cover the highest number possible of crops by means of a varied range of covers. Thus, statistics do not allow us to analyse the loss rate in a homogenous way. However, the geographical distribution of the loss experience is the reference of the zones that, if a significant deviation were to occur in the climate parameters, would present a modification in agricultural production, in a positive sense in some cases (lower number of frost events, which are also less intense), or negative in others (increase in the number of storms accompanied by hail). An adaptation of farming techniques will continue to be imposed. In general terms, it can be said that the Eastern half of the peninsula, due to the high hazard level of climate and meteorological phenomena, and to the concentration of crops sensitive to these variables, has been confirmed as the most delicate zone, with particular incidence in the province of Valencia.

To summarise, no clear signs have been detected of the effects of climate change in the insurance sector in Spain, the trajectory of which is described by the permanent evolution of the market in search of better formulae, incorporating the influence of the socioeconomic development characteristics of each era. It is therefore impossible to compare the annual or multi-annual statistics homogenously. However, the tendency observed in other markets towards an increase in the number of catastrophic events, the intensity of these and their economic and insured cost, is also occurring in Spain.

> "The development of insured losses since 1970 reveals a clear trend towards higher losses. This rise can, for the most part, be explained by economic, demographic and geographical factors. Specifically in industrialised countries, there was a demonstrable and rapid rise during this period in insured values (…). Greater vulnerability to losses is to be expected against the backdrop of a potential shift in climate zones caused by climate change".

Swiss Re (2004b)

15.10.5.2. The present and future of Spanish insurance market

In Spain, the insurance of phenomena derived from a possible climate change is consolidated through the CCS (accidents and property) and Agroseguro (crops and livestock).

The CCS, which has accumulated much experience since it was set up (1954), has handled so far a loss rate within a context of moderate natural hazard level with regard to the covered phenomena. Its excellent management in synch with the private insurance market, and backup by the State as last resort, means that they constitute an exemplary system worldwide, based on solidarity and the mutualisation of risks.

With regard to Agroseguro, set up in 1980 and based on a series of enriching antecedents since the beginning of the century, both positive and negative, which have served to design an optimum and dynamic system in accordance with a sustainable and modern agricultural policy, also faces the difficult challenge every year, together with the private insurance market, of

adapting actuarial techniques to an activity which is in a clear process of technological development.

The permanence and vast experience of the CCS and Agroseguro systems would seem to indicate that the insurance sector in Spain is prepared to absorb variations in losses derived from short and medium-term climate change. Thinking of the long-term, and depending on the scenario of climate change that may occur, the suitable combination of certain insurance techniques and agile financial tools with an international reinsurance system that is heedful of the requirements of every moment, and with state participation sensitive to any needs for backup, may lead to solid and imaginative insurance solutions at accessible prices for society.

Fig. 15.14 relates in a qualitative (A) way the sensitivity of the insurance lines of business that could be affected by climate change, with each meteorological hazard (wind, precipitations and temperature), the occurrence patterns of which might vary. For these same lines of business, graph B shows, also qualitatively, the insured interests that are most involved in each one of these.

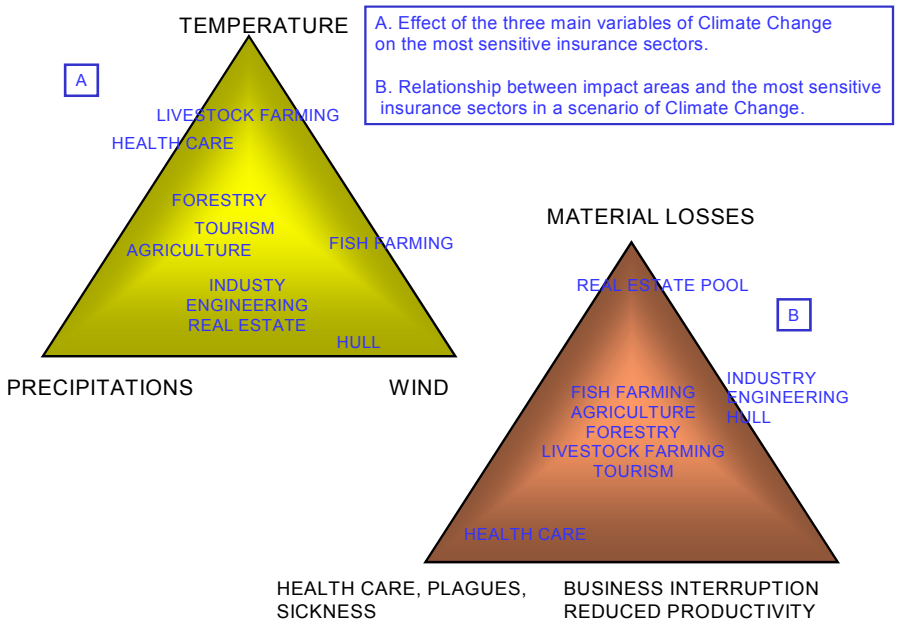


Fig. 15.14. *A) Effect of main variables in the insurance sector; B) Relationship between sensitive insurance sectors*

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