SAINT-ETIENNE SCHOOL OF ECONOMICS

POLICY BRIEF

Focus: Environment

How can insurance adapt its social role to take into account climate challenges?

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Summary

First of all, according to La Caisse centrale de Réassurance, the increase in French sinistrality due to climate would be between 27% (CPR 4.5 scenario) and 62% (CPR 8.5 scenario) on average by 2050.(LANGRENEY, LE COZANNET & MERAD, 2023) A lot of other scenarios converge by saying that the climatical changes have deep impact on French insurance especially on sinistrality ratio. Those results lead us to think that a deep structural change due to the climatical situation has to be expected in insurance system in next years.

We choose to focus on one fundamental role of insurance: the social one. Indeed, if we focus on the definition of insurance which lists its main principles, at first sight we cannot notice the social role of the latter. However, according to some reports a concept that is linked to the notion of insurance is the notion of justice. The latter reminds us that insurance has a kind of social responsibility. (MORLAYE 2021, ALBOUY 2015) Regard those texts in addition to some reports from insurers, we choose to admit through our work that insurance has a proved social role. (CNP, 2023)

Keeping in mind the two first points, we wonder how can climatical changes affect the social role of insurance in France. A lot of questions concerning the current management of insurance are raised by the increasing climatological disasters and the resulting uncertainty. The current risk measurement is being overtaken by new environmental challenges. It seems obvious that insurance has to deal with those environmental issues and adapt their current management to avoid a collapse of the insurance system by 2050.

To help you having a deeper understanding of the way the insurance's social role would have to change to face the current climatical situation, we invite you to read this policy brief.

Intro:

Insurance is a mechanism that enables protection against various uncertain future events, such as fire, theft, water damage, illness, etc. Insurance plays a major social role: it guarantees access to essential goods to meet fundamental needs such as housing, mobility, access to healthcare, or protection against natural disasters (CNP, 2023). This model, in France, is based on the principle of risk pooling, meaning that insured individuals pay money to the insurance company to be compensated in case of a claim, i.e., to receive money to deal with this unpredictable event. However, if no claim occurs, then the person is not compensated. Therefore, for the French insurance system not to be in deficit, there must be more premiums collected than claims paid. To achieve this, several parameters must be taken into consideration:

First, not all risks are taken into account by insurance through mutualization. Indeed, for this to happen, the risks must be:

- Homogeneous: it is necessary to group together a large number of similar risks that have equivalent chances of occurring.
- Dispersed: avoid grouping together risks that may occur at the same time and in the same place, otherwise it may not be possible to compensate due to the amount being too high.
- Divided: a single claim must not jeopardize the mutuality.

Second, statistics and probabilities are used to determine the frequency of a claim and its intensity to calculate the average cost of a claim, which allows for an estimate of the amount of the premium to be in balance.

Then, if the risk cannot be mutualized, then there is a division of risks that takes place via:

- Coinsurance: sharing of the same risk between several insurers in proportion.
- Reinsurance: the insurance company will insure itself with another company.

This system could well be jeopardized by climate change, and more specifically, by the increase in natural disasters that could double every 30 years (FRANCE ASSUREURS, 2021). This would have a very significant economic and, above all, social impact, because it is the role of insurance that could be called into question. That is why we will first look at insurance in the face of climate change, and then, in a second step, how to ensure that it can keep its social role, and finally, make a critique of certain measures already in place and our recommendations.

1.Climatical changes and the increasing of risks in French insurance

In this first part, we will focus on the impact of climate change by first reviewing the different forecasts, then showing the cost that this could incur, and finally discussing the risk that certain climate disasters may not be taken into account. It is important to note that the information is based on various forecasts, so the reality may differ.

1.1 The different previsions

It is important to state the different forecasts because, depending on the organization making the forecasts, the assumptions taken may be different and therefore the results as well. However, most of the time, the forecasts made are based on studies conducted by the IPCC and in particular its analysis of the GHG (greenhouse gas) emission trajectory, RCP 8.5,

which models the evolution of temperature if GHG emissions increase at the same rate as currently. This scenario predicts a temperature increase between 1.4°C and 2.6°C in 2050 and between 2.6°C and 4.8°C in 2100 (CCR & MÉTÉO FRANCE, 2018). The climatic consequences are numerous and varied. Furthermore, to have greater precision in the forecasts, the studies carried out are done at the horizon of 2050 to avoid having too long a period which can leave room for greater uncertainty.

1.2 Climatical changes' costs

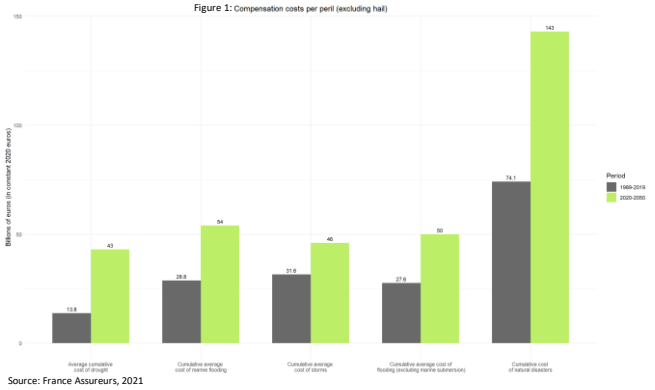
We will focus mainly on the perils that are drought, inland flooding, storms, coastal flooding and hail.

First, we will look at some key figures from the past period to put into perspective the increase in cost due to climate change.

- Between 1989 and 2019, 74.1 billion euros (in constant 2020 euros) of compensation was paid out. (FRANCE ASSUREURS, 2021)
- Between 1990 and 2009, the average compensation per year was 2 billion euros; between 2010 and 2019, the average compensation per year rose to 2.8 billion euros; and between 2016 and 2019, it rose to 3.8 billion. (FRANCE ASSUREURS, 2021)
- The year 1991 was the least affected with 800 million euros, while the year 1999 was the most affected with 13.9 billion euros in constant 2020 euros. (FRANCE ASSUREURS, 2021)

Furthermore, the "Cat Nat" regime, the natural disaster insurance, has been in deficit for more than 5 years, with 2017 being the year with the largest deficit of 439 million euros. The cumulative deficit over the period 2015-2019 reached approximately 1 billion euros. (SENATE, 2023) In addition, insurers have been selling at a loss for 8 years mainly because of climate change. (LANGRENEY, LE COZANNET, MERAD, 2023). While this regime is already under strain, the forecasts made on the potential cost of natural disasters only make things worse.

Figure 1: Compensation costs per peril (excluding hail)



Source: France Assureurs, 2021

The graph 1 shows the potential evolution of the cumulative cost of natural hazards between the period 1989-2019 and the forecast period of 2020-2050. The most important thing to note is that the increase in costs is expected to rise by nearly 93% between the two periods, from €74.1 billion in the period 1989-2019 to €143 billion in the period 2020-2050.

Thus, we can add the risk of an increase in hail, which is addressed in the Covéa study, as it is not considered a natural disaster in the cat nat regime. This study shows that there is a risk of a 40% increase in the frequency of hailstorms, which could lead to a 20% increase in hail-related claims by 2050 (COVEA, 2022). We only mention it now because it is the only study that does so and it provides a probability of risk without a monetary amount, making it difficult to integrate into the graph. However, we thought it was important to mention that the damage to homes, and property such as cars and crops is real and harmful.

Moreover, it is important to take into account that this increase is due to climate change but also to the enrichment of certain areas that are more exposed to certain risks, such as coastal flooding which mainly affects coastal areas. Therefore, the distribution of risks is unevenly distributed across the territory.

1.3 Some risks are not taken into account.

As we have seen in the previous section, certain risks are not covered by the cat nat regime, such as hail for example. In addition, it is important to emphasize that in order for policyholders to be compensated, it is necessary to go through a long process that starts with the filing of a file by a municipality following a natural hazard. This file must then be submitted to the prefect, and then examined by the interministerial commission, which issues or does not issue an interministerial decree recognizing the state of natural disaster. This will allow an expert to assess the damage so that the insured can be compensated. This is a process that can be lengthy and does not guarantee recognition of a natural disaster, as only 50% of municipalities that have applied for recognition of a state of natural disaster for the droughts of 2019 and 2020 have received a positive response (SENATE, 2023).

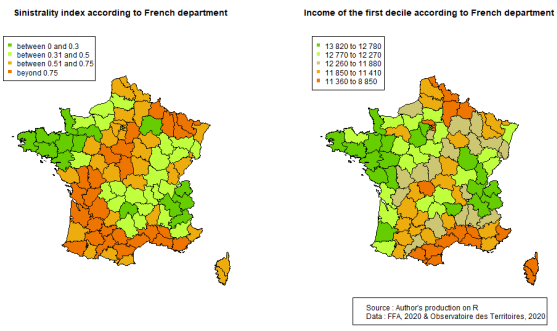
In a context where the costs due to droughts could triple over the period 2020-2050 compared to the period 1989-2019, with a regime already in deficit, it is currently difficult to obtain recognition of this hazard as a natural disaster. This is why it is not excluded to remove this risk from the Cat Nat regime (SENATE, 2023). Thus, it is the mutualization system that is threatened, with social consequences that can be very significant, as we will see in the next section.

2. Maintaining the insurance's social role

So, as it was explained in the first part, climate changes have a significant impact on insurance especially in the way insurances measure the risk. In this part, we will focus on the social impacts of those issues. This section will analyze different insurance data with the aim of identifying some flaws in their system that can be fixed. Actually, the first part will describe the territorial inequalities that emanate from the insurance system. Then, we will analyze the social consequences of the increasing of insurance's additional premiums. Finally, we will point out a kind of lack of consideration of some risks that impact the social role of insurance. Before starting, we remind you that we decided to focus on real data in order to find a hypothesis that can explain some complications in maintaining insurance's social role. We start from the hypothesis that insurance has a social role stated above.

2.1. Territorial inequalities

Figure 2



As we can see in Figure 2, the sinistrality index distribution and one of the incomes seem to be linked. In fact, according to our computation, the is a correlation of -24.94% between the sinistrality index and the last decile income. This number is particularly striking. In fact, if we focus on the correlation between the average income distribution and the sinistrality index, it would be equal to -29.22% and if we look at the correlation between the first decile income and the sinistrality index, it would be equal to -34.80% Thanks to those numbers, we can say that territorial inequalities are accentuated as the decile declines. That literally means that we can find stronger inequalities among the poorest part of the population. If we already find some inequalities due to the distribution of the population linked with their income, we can also find inequalities that can be explained

by the cost of risks. Actually, as we can see in the first map of the second figure, the sinistrality index is different from one French department to another. This uneven distribution leads to strong disparities in the cost of insurance.

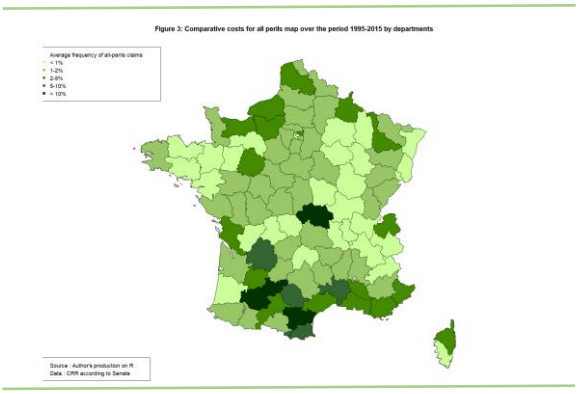


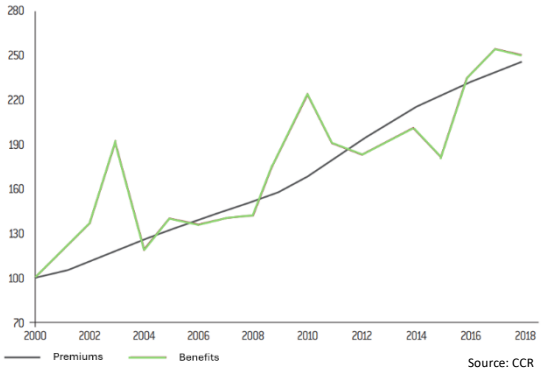
Figure 3 shows us that some French departments are more exposed to climate risks than others and this disparity influences differences in insurer's behaviors according to departments. In fact, in France, 5 departments alone account for two-thirds of the increase in sinistrality (FFA, 2021). We can also underline that some studies underline the link between migratory movement and department's vulnerability to climate risks. (FFA, 2021) In fact, they call this the "migration" factor. The latter explains the relocation to certain households in departments less exposed to risks. Those migrations added to the constant increase in climate risks in some departments led insurers to rethink their strategies. In fact, some of them are considering a geographic reallocation of their portfolio or even refuse to insure areas most exposed to climate change (ACPR, 2021). Those behaviors are usually synonymous with "insurance deserts". The latter can be defined as a situation in which no insurer accepts to insure a geographical area because of the number of claims that occur there. Actually, this phenomenon can lead to strong social and economic inequalities that the government tries to avoid. Considering those ideas and the beginning of this part we could say that climate challenges lead to territorial inequalities in the insurance sector.

By the way, we can expect an emphasis on those territorial inequalities because of the increase in climate disasters. If we link this result with our problem, we can now say that insurance should adapt its system in order to take more into consideration those territorial inequalities and avoid "insurance deserts".

2.2. The social consequences of the increasing of insurance's prices

The law of the 13th of July 1982 that has made up for the lack of coverage for natural hazards, which had previously been poorly insured, led to the creation of the "CATNAT" additional premium. The latter stands for "Catastrophes Naturelles" which means that this additional premium is designed to cover individuals against climatic risks. After this clarification, we might mention a strong increase in the number of claims handled in the residential French market of 5.9% between 2021 and 2022. This data represents almost 3.8 million of new claims during 2022 (FFA, 2022). To answer this growing demand, insurers decide to find funds by increasing the households' contributions. In fact, according to Franck Le Vallois the CO of France Assureurs, housing surcharges will increase significantly by January 1st, 2025. They would expect an increase in housing additional premium of 16 euros per year and per household. Furthermore, insurers think about increasing additional premiums each year to face up to climate challenges. (vie-publique.fr)

Figure 4: Multi-risk home insurance premiums and benefits
On a base of 100 for the year 2000



If we focus on figure number 4, we can see that premiums significantly increased through the years. In addition, the benefits seem to be difficult to anticipate. In addition, to face the increasing climate change-related risks insurers sometimes increase insurance prices in a dissuasive manner in order to encourage households to move or not take out insurance in these areas (vie-publique.fr).

The increase in additional premiums leads to several social consequences. As we show in the previous part, we can observe an uneven geographical distribution of climate risks. Actually, between the French administrative region where the average home insurance cost is lowest, and the region where it is the highest we can note a difference of 60€.(DURRAFOURD, 2023) Considering those territorial inequalities and because of the increasing of additional premium prices, some households would either pay more or won't be able to obtain a wide enough range of insurers while others would know smaller insurance prices increasing with better insurance protection. This enhances the strong socio-economic inequalities linked to the current insurance system. We can also imagine thanks to part one that the increase in insurance prices will lead some households to consider relocating to departments less exposed to risk. Besides, we can notice other social consequences due to the increasing of climate disasters. We can think about the physiological and psychological impact on households that have had to cope with an upsurge in climatic hazards in recent years. The latter can be emphasized by the uncertainty but also through direct exposure to these climatic catastrophes (FUJIKI, 2017). It is also extremely important to underline the impact on households' living conditions after a natural disaster. If we quote FUJIKI (2017), " Households are still affected in their way of life, not only by the drop in income, but also by the possible destruction of their home, by the temporary or definitive relocation to another neighborhood, or even another region, and by a return to the area, which often takes place under difficult conditions.", we can see that climate challenges are synonymous with changes in the economic dynamics and living conditions of certain households.

Even though increasing insurance premiums can be considered as a means to recover from their deficit, we need to take into account the resulting increase in social inequalities. We can conclude this part by mentioning the impact of insurance's prices increasing on purchasing power of French people. Indeed, except for the accentuating territorial inequalities and the other consequences mentioned upper, we can imagine that an increase in prices will lead to a reduced purchasing power of French households considering that insurance is mandatory in France.

2.3. The lack of consideration of some climatical disasters' cost

In this part, we decided to illustrate our point with the example of farmers. For the purposes of this section, we will consider farmers as households and not as companies. Being the first sector affected by climate change, agriculture represents one of the least well-insured sectors of the population. (CAISSE DES DÉPÔTS, 2023) Farmers production (in this case which is consider as a main proportion of their income) directly depends on the weather and especially climate risks. Hence, the increase in hail and drought events directly impact them.

Figure 5: Recognition rate of municipal requests by year and by hazard* since 2012

	Drought			Flooding**			Ground Movements		
	Requests	Recognized	Recognition Rate	Requests	Recognized	Recognition Rate	Requests	Recognized	Recognition Rate
2012	3 155	2 227	70,6 %	4 698	3 914	83,3%	245	166	67,8%
2013	2 419	954	39,4%	676	568	84,0%	92	66	71,7%
2014	1 987	188	9,5%	3 450	2 885	83,6%	169	115	68,0%
2015	1 292	729	56,4%	1 614	1 325	82,1%	61	45	73,8%
2016	516	70	13,6%	2 864	2 332	81,4%	169	135	79,9%
2017	1 534	718	46,8%	2 103	1 538	73,1%	222	193	86,9%
2018	2 583	2 199	85,1%	1 043	830	79,6%	53	41	77,4%
Total	**13486**	**7085**	**52,5 %**	**16448**	**13392**	**81,4 %**	**1011**	**761**	**75,3%**

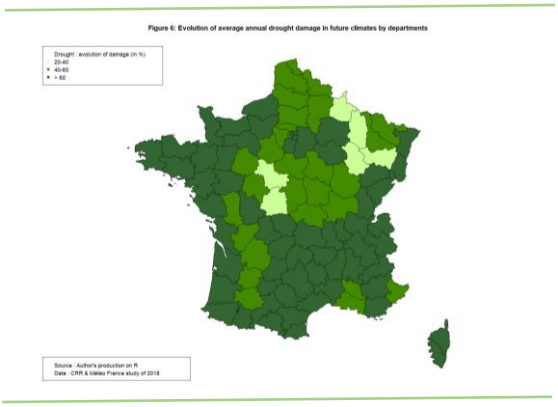
*Only for drought, flooding, and ground movements hazards, that account for 98% of recognition requests

** Floods and mudslides, rising water tables and marine submersions

Source: Senate, mission of information, 2019

Thanks to figure 5, we can say that between the period 2012-2018, only 52,5% of requests due to drought was recognized. This number enhances an issue in the consideration of some risks. We can also find those kinds of lack of consideration concerning hail events. Indeed, after the crop insurance reform of 2023, French government decided to classify climate changes related risks into three categories. The first one, what is called the “common" hazards are borne by farmers. The second one can be insured by insurer on condition that they take out crop insurance which represents additional costs (Agriculture.gouv.fr, 2023). Even if his second category mention insured farmers, it is not the case for all natural hazards. In fact, hail is not among the list of natural disasters covered by insurance (FRANCE ASSUREURS, 2023). It is possible for framers to be covered against hail however, it implies to subscribe another insurance contract which once again represents additional costs for farmers. Considering those costs, we need to emphasize the plight of farm households in the face of poverty. Actually, 16.2% of farm households are below the French poverty line (INSEE & SSP, 2024). Knowing this, we can imagine that a lot of farm households struggle to subscribe additional insurance contracts because of the cost. However, the increasing of natural disasters and the uncertainty lead more and more farm households to subscribe additional insurance contracts. Thus, premiums for specific hail contracts will rise sharply in 2022, by +26.3% (FRANCE ASSUREURS, 2023). We can by the way perceive once again strong inequalities in farm households risk insurance due to the current insurance system. In addition to those inequalities, future projections suggest that farmers will suffer more from unfavorable weather conditions.

As we can see on figure 6, for most of France's departments we would expect an increase of more than 60% in drought damage for next years. This map highlights the plight of the evolution of drought damage. If we link it with figure number 5, we can also expect a real issue for farm households that already have difficulties in obtaining recognition for drought damage.



We can conclude this part by saying that there is a real issue in the consideration of some disasters. Households, especially in our case farm households will face more and more natural hazards because of climate changes. To fulfill its social role, insurance companies should take these informations into account in order to reduce at most the current social inequalities mentioned upper.

3.Our Recommendations

3.1. Cat-Nat premiums aren’t sufficient

In France, the compulsory inclusion of natural disaster insurance (commonly referred to as Cat-Nat) within all damage insurance contracts is mandated by the Code des Assurances, the insurances law.

Our previous analyses have revealed a persistent deficit in this policy over the preceding years, indicating a notable misalignment between the premiums collected and the corresponding risks covered.

To rectify this imbalance, it has been proposed to augment the premiums to better reflect the increasing frequency of natural disasters anticipated in the coming years. A measured approach, as suggested by Langreney, Cozannet, and Merad in their 2023 report, advocates for a gradual incremental rise of 1% annually, complemented by periodic reassessments at five-year intervals.

According to the authors, this is a solution to Cat-Nat's deficit. But we underscored in our previous analysis that there is an important disparity between territories, and the riskiest ones are mainly also the poorest. Increasing the price of Cat-Nat premiums would then be a financial burden for those who already are vulnerable, we can easily imagine scenarios in which some households couldn't insure their belongings because of the cost, even if they live in a risky area.

This scenario is not acceptable. We thus suggest, in addition to the increase of the price, a fairer repartition of Cat-Nat premiums. One of the ways to achieve this could be to equally share the premiums of natural disaster insurance among the policyholders. Going event further, we could imagine a system in which the Cat-Nat premium of a policyholder is directly linked to their financial resources, thus lifting off the weight of Cat-Nat from the poorest households' shoulders, and allowing a real social role of insurance, by a repartition mechanism.

3.2. Index Insurance

Index insurance, or index-based insurance, differs from traditional insurance methods. It is about protecting policyholders against broad risks such as weather hazards, instead of insuring against specific losses that need to be quantified when they occur.

Index insurance doesn't consider how much damage the policyholder has suffered but monitor certain measurable factors that are related to the insured risk. For instance, if crops are insured against drought, the index might be the amount of rainfall in your area over a certain period of time. When a determined threshold is reached, which indicates an anormal condition, the policyholder gets compensated, whether he suffered losses or not, no question asked.

This can be really helpful for farmers since they can benefit from financial aid in a short lapse of time, without having to wait for assessments by experts or paperwork filling to officially notice their losses.

In France, there as been a lot of investments in agriculture, and noticeably irrigation, which helps the country to be better prepared to face risks like drought than those of the South. But even with these investments, France's agriculture still gets affected almost every year by severe ones. That is not to enumerate hazards like hail or freezing that the country faces on a regular basis.

Even if France isn't facing the most severe hazards, the country could still benefit from this type of insurance policies and is well fitted for its high added-value agricultural model. Indeed, the premium's cost can be relatively easily covered by this type of farmer than family subsistence farmers of the South (LAGANDRÉ & CHETAILLE, 2010).

3.3. Paris agreement

Even though the solutions we've seen so far would allow the insurance industry to adapt to climate change and its consequences, this only concerns this industry, and not the impact on the people. The system wouldn't even need to adapt itself if the worldwide policymakers had taken action in order to tackle the human impact on its environment.

In 2015, 55 countries leaders which accounted for at least 55% of the global greenhouse gases emissions gathered together in Paris, coming to an agreement to pursue efforts to limit global temperature rises to 1.5°C, and to keep them well below 2.0°C above those recorded in pre-industrial times.

The global rise of temperatures isn't the only factor influencing the rise in occurrence of climate disasters, but still accounts for a large share of them (ZHU & FAN, 2021). By taking actions to honor this agreement, policymakers would take a step forward in making Earth a better and less risky place to live, and thus limit the pressure put on the insurance industry.

Conclusion:

In France, by 2050, reports project important increases in sinistrality due to factors related to climate change, necessitating an adaptation of insurance models. Our analysis reveals the complex implications of climate change on insurance's social role. Territorial inequalities, underscored by disparities in sinistrality indices across different income strata and geographic regions, highlight the disproportionate burden borne by vulnerable populations. Moreover, the difficulty in addressing certain climatic disasters, notably the inadequate coverage of hail events and the bureaucratic procedures, make challenging the access to compensation for drought-related losses.

Overall, dealing with the connection between climate change and insurance means we need to work together to make insurance stronger, fairer, and able to remain persistent over time. This can be achieved by taking action early to adapt and using new ideas. This way, insurance can keep doing its important job of protecting people's lives and making communities stronger in the face of bigger climate challenges.

References

- ACPR, « Une première évaluation des risques financiers dus au changement climatique Les principaux résultats de l'exercice pilote climatique 2020 », n°122-2021 Analyses et Synthèses, 2021
- Agriculture.gouv.fr, Remongin X., « La réforme de l'assurance récolte » (21st February, 2023), Available on: https://agriculture.gouv.fr/la-reforme-de-lassurance-recolte
- Albouy François-Xavier, « Réinventer le rôle de l'assurance : combattre la pauvreté et la vulnérabilité des citoyens », *Revue d'Economie Financière*, p.185-196, 2015/2 (n°118), 2015
- Caisse des Depots, Lepoivre B., « Assurance : alerte rouge sur l'agriculture », Available on: https://www.caissedesdepots.fr/blog/article/assurance-alerte-rouge-sur-lagriculture, January 3rd, 2023
- CCR & Meteo France, Moncoulon D., Desarthe J., Hajji C., Naulin J.-P., Onfroy T., Tinard P., Wang Z.-X., Veysseire M., Deque M., & Regimbeau F., « Conséquence du changement climatique sur le coût des catastrophes naturelles en France à l'horizon 2050 », September 2018
- CNP, Olympio A., « Le rôle social de l'assurance d'ici à 2040 – Tous assurables ? Réinventer l'assurance dans un monde en rupture », Synthesis, *Cahier de la prospective N°3*, June 2023
- COVEA, Andre G. & Marteau R., « Changement climatique & Assurance : Quelles conséquences sur la sinistralité à horizon 2050 ? », January 2022
- Durrafourd Stéphanie, « Etude : les tarifs d'assurance habitation augmentent de +5% », available on Assurland.com, 5th July 2023
- Economie.gouv.fr, *« Comprendre le mécanisme de l'assurance*. » (s. d.), Available on: https://www.economie.gouv.fr/facileco/comprendre-assurance-risques
- Economie.gouv.fr, « Pourquoi a-t-on besoin d'une assurance ? » (s. d.), Available on: https://www.economie.gouv.fr/facileco/assurance-besoin-types-dommages-personnes
- Economie.gouv.fr, *« Un rapport pour mieux assurer les Français face au changement climatique »*. (2024, 3th April), Available on: https://www.economie.gouv.fr/actualites/rapport-mieux-assurer-francais-changement-climatique#
- FFA (Fédération Française de l'Assurance), « Impact du changement climatique sur l'assurance à l'horizon 2050 », October 2021
- France Assureurs, Lustman F., « Impact du changement climatique sur l'assurance à l'horizon 2050 », October 2021
- France Assureurs, Vansteelandt V., « Comment fonctionne mon assurance ? : 15 questions clés », January 2022
- France Assureurs, « L'assurance multirisque climatique sur les récoltes », 20th June 2023
- France Assureurs, « L'assurance agricole en 2022 », 31st July 2023
- Fujiki K., « Etude prospective des impacts sociaux d'une inondation majeure en région Ile-de-France. Disparités socio-spatiales dans la prise en charge des populations franciliennes en situation de crise et post-crise : une analyse cartographiée et quantifiée des besoins des ménages, de l'évacuation à la reconstruction. », Doctoral Thesis, Chapter 4, p.314-316, Available on: https://www.ccr.fr/documents/35794/35836/Th%C3%A8se+Kenji+Fujiki.pdf/e40a8663-33db-4712-a10a-795f599cfb1f?t=1528455806000, December 7th, 2017
- INSEE & SSP, « Transformations de l'agriculture et des consommations alimentaires », available on: https://www.insee.fr/fr/statistiques/7728903,27th February 2024
- Langreney T., Le Cozannet G. & Merad M., « Adapter le système assurantiel français face à l'évolution des risques climatiques », December 2023
- Lagandre D. & Chetaille A., « L'assurance indicielle, une réponse face aux risques climatiques ? », Grain de sel, p.20-21, 2010
- Morlaye Frédéric, *L'Assurance Demain*, Chap.8 « Quel rôle social pour l'assurance ? Net zéro, ou plus ? », p.95-100, 2021
- Senate, Lavarde C., « La sécheresse ébranle les fondations du régime CatNat », 15th February 2023
- Senate, Leroy J.-C., « Conséquences des épisodes de grêle pour les agriculteurs du Pas-de-Calais », August 31st, 2017
- Senate, Bonnefoy N. & Vaspart M., « Catastrophes climatiques : mieux prévenir, mieux reconstruire », Rapport d'information n° 628 (2018-2019), submitted on July 3rd, 2019
- Vie-publique.fr, « Risques climatiques : quelles propositions pour maintenir l'assurabilité des territoires ? » (2024, 5th April), Available on: https://www.vie-publique.fr/en-bref/293617-risques-climatiques-comment-maintenir-lassurabilite-des-territoires#:~:text=Les%20rapporteurs%20recommandent%2C%20en%20outre,des%20effets%20du%20changement%20climatique.
- Zhu M, Fan B. Exploring the Relationship between Rising Temperatures and the Number of Climate-Related Natural Disasters in China. Int J Environ Res Public Health. 2021 Jan 16;18(2):745. doi: 10.3390/ijerph18020745