

Climate Change, Insurance, and Households: A Literature Review

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Summary

This literature review was conducted as part of the research project Försäkringsbranschen och klimatförändringen: kort- och långsiktiga konsekvenser av bostadsägares riskuppfattningar, betalningsförmåga och riskbeteende för försäkringsbranschen (The insurance industry and climate change: Short- and long-term consequences of household owners' understandings of risk, ability to pay, and risk behaviour), funded by the Länsförsäkringar Research Foundation.

The costs of weather-related natural disasters have been rising, and one effect of this is a shrinking gap between insurance premiums and losses. At the same time, increasing responsibility has been placed on individual homeowners in terms of maintaining and adapting their homes to a changing climate. However, not everyone has the financial resources or knowhow to take this responsibility. In addition to examining how homeowners perceive their role and ability to adapt their homes to a changing climate, it is important to study the conditions under which homeowners do or do not adapt their homes. The aim of this literature review was therefore to identify previous research, primarily in the fields of insurance and climate change, households, insurance and climate change, and climate change through the lenses of gender, class, and ethnicity and their intersection.

The review is based on material from several searches of the research literature about insurance and climate change published in academic journals since 2004. The searches combined open searches of full-text databases with specific searches of a number of leading journals. Various search terms and combinations of search terms were used, including insurance, climate change, households, gender, and intersectionality. Due to this complex search process, it is impossible to define how many articles were found, because the number depends on the combination of search terms used (many thousands in some cases and only a handful in others, including overlaps).

The general field of insurance-related studies of climate change is fairly large, but as soon as "household(s)", "gender", or, most of all, "intersectionality" is included in the search, the number of identified publications decreases considerably. The identified articles were then categorized according to the three areas of investigation: climate change from the insurance industry perspective, climate change and insurance from the household perspective, and climate change through the lenses of gender, class, and ethnicity and their intersection. These themes have been described and analysed, resulting in the following conclusions:

- Research into climate change, insurance, and households concentrates on vulnerable countries in different continents and, in particular, on household owners in high-risk areas. The corollary is that there are fewer studies of less vulnerable countries, including the Nordic countries, and of low-risk areas.

- Some studies discuss responsibility for the effects of climate change, but consensus is lacking regarding what party should or could take this responsibility. Of particular interest is the power balance between the insurance industry and government.
- One stream of research treats how the insurance industry is affected by climate change, and another how homeowners respond to this change. Accordingly, there is a lack of bridging between disciplines and research fields that can enhance knowledge of the consequences and opportunities for the insurance industry. There is also a need for transdisciplinary research in order to understand the relationship between climate change, insurance, and household owner willingness to pay for insurance and to prepare for future risks.
- Most of the studies are quantitative and based on surveys, meaning that there is a lack of qualitative research that can foster a deeper understanding of how individuals perceive the risks of climate change and how they are acting in order to protect themselves from them. There is also a lack of studies of households and citizens in climate change and climate risk research; such research is important because the household perspective can offer a bottom-up perspective on aspects of climate change.
- Last, very few studies in each field we reviewed draw on an intersectional perspective. Some articles treat various power structures, especially gender, but as isolated categories and seldom in relation to feminist or gender theories.

Further research is primarily needed in terms of:

- transdisciplinary research to understand the relationship between climate change, insurance, and household owner willingness to pay for insurance and to prepare for future risks;
- studies fostering a deeper understanding of how individuals perceive the risks of climate change and how they are acting in order to protect themselves from these risks in relation to supporting and obstructing structures;
- more complex analyses of the underlying structural factors shaping how households relate to climate-related risks and insurance;
- studies of current low-risk areas, because climate change entails different challenges for insurance companies, households, and societies depending on the location; and
- studies of households and the insurance industry, rather than of individuals and governmental policy, as a way to offer a bottom-up contextualized perspective on the insurance aspects of climate change.

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1. Introduction

1.1 Background

This literature review was conducted as part of the research project *Försäkringsbranschen och klimatförändringen: kort- och långsiktiga konsekvenser av bostadsägares riskuppfattningar, betalningsförmåga och riskbeteende för försäkringsbranschen* (The insurance industry and climate change: Short- and long-term consequences of household owners' understandings of risk, ability to pay, and risk behaviour).

First, it must be established that modern capitalist societies cannot function without insurance, whether privately or state provided. This is because insurance enables individual risk-taking and provides a financial safety net in the face of uncertainty (Krieger and Demeritt, 2015, p. 2). Whether insurance is privately or state provided, governments have been keen to regulate the activity (Larsson and Wallerstedt, 2015). Partly as a result of this foundational role of insurance for capitalist societies and their governments, scholars are increasingly interested in the role insurance does and can play in steering modern societies, particularly through providing financial incentives and compensation.

Insurance plays a key role in this project, both in terms of how people view insurance in general and in relation to climate change in particular, and in terms of how to steer, or manage, social and economic behaviour in the face of climate change. More precisely, the project investigates how the insurance industry and insurance companies may respond to climate change, and to household preparedness, understanding, ability, and willingness to pay (WTP) regarding climate-related risks, as well as how this relates to aspects of gender, class, and ethnicity from an intersectional perspective. The overall aim of this review is to identify previous research in this field, particularly as related to three particular areas: 1) insurance and climate change; 2) households, insurance, and climate change; and 3) climate change through the lenses of gender, class, and ethnicity and their intersection.

In adapting to climate change, homeowners bear considerable responsibility, especially in new construction and the upkeep of existing houses (Anttonen et al., 2003). People seem increasingly willing to pay for safety, but to what extent and for exactly what is unclear. Moreover, only a small percentage of people in a country such as Sweden have the financial means to distribute all their private risks related to housing through the capital markets. In a society where responsibility for personal security is increasingly individualized, it is also important to highlight these issues from the perspective of insurance coverage on equal terms. The literature review concentrates on how households,¹ and above all household owners,

¹ "Household" can be defined in various ways and the term, as used in this research area, could be said to be quite inclusive. For example, "household" is used as a synonym for a group of residents (Apine, 2011; Kellens et al., 2011; Kreibich, 2011; Poussin et al., 2015) or citizens (Scannell and Gifford, 2013) in very general terms without treating the term in a theoretical or analytical way.

make sense of climate risks and insurance in relation to their own homes; it does not investigate the development of insurance companies over time or the development of the insurance and reinsurance industries.

When examining how households make sense of climate-related risks to their own homes, it is important to take into consideration structures that not only affect risk perceptions and risk behaviours but also shape people's everyday lives at a general level. Insurance viewed through the lens of intersectionality or from the standpoint of feminism is an almost completely unexplored area. However, intersectional analysis (cf. Cole, 2009) makes it possible to highlight the interconnectedness of such structures and how they affect homeowners' understanding of risk (cf. Olofsson et al., 2014).

Below we briefly introduce the area of insurance companies in relation to climate change. After that we describe how the literature searches were performed. Section 3 presents a review of literature on insurance, households, and climate change in four subsections, and section 4 concludes the paper.

1.2 The insurance industry in times of climate change

Higher average temperatures and more extreme weather as a consequence of climate change have led to human suffering and increased costs for both public and private actors as well as for the affected individuals. For example, increasing river flows during winter months can lead to landslides, erosion, and mudslides. Existing houses are built to cope with the climate of the past but are often poorly equipped for changing conditions. It is also unclear to what extent we should take account of future climate change impacts when new housing is built. Swedish studies of views of responsibility find that many individuals believe that energy companies, not households, are responsible for ensuring the security of the electricity supply. Accordingly, many households do not make the preparations that, according to the authorities, are required to safeguard the security of electricity supply. After the storm "Per" in 2007, it turned out that many families had not been prepared beforehand and that the experience of the storm did not contribute to increased preparedness (Guldåker, 2009; Statens energimyndighet, 2007).

Climate change entails addressing uncertainty, risk, and long time horizons – exactly what are at the core of the insurance industry. Unsurprisingly, the insurance industry has for a number

The term "household" is also commonly used in studies of "local people" (Manandhar et al., 2015; Sada et al., 2014) as a way to refer to a certain part of a larger population. Farming households in Africa or Southeast Asia largely dominate this literature (Ashraf and Routray, 2013; Below et al., 2012; Benhin, 2008; Bewket, 2012; Hailelassie et al., 2011; Perez et al., 2015; Sada et al., 2014; Wood et al., 2014). As noted by Wood et al. (2014), a long history of focusing on the household level has provided important local-level insights for climate adaptation strategies in the agricultural sector. In other words, the quite extensive focus on farming households in research into households and climate change seems to be the result of an underlying research interest in the agricultural sector, rather than in the household perspective per se or its adaptation to climate change. We have adapted to this rather broad understanding of the term and used it accordingly.

of years recognized the need to analyse the consequences of climate change in terms of both increased claims costs and the ability to continue to provide good insurance coverage for everyone (Tucker, 2005). Some argue that the insurance industry is the sector that will be hit the hardest by the consequences of climate change. Accordingly, the insurance industry often argues that others, such as household owners and/or governments, should bear the costs of risk mitigation measures (Herweijer et al., 2009). It seems reasonable to believe that the insurance industry will use its power to influence other industries affected by climate change, such as the forest industry.

According to Krieger and Demeritt (2015), it is possible to distinguish between “optimists” and “pessimists” regarding the possibility of using insurance as a means of risk governance. Basically, the optimists believe that insurance companies are key actors in risk assessment and management. Webster and Clarke (2015) argue that the insurance industry could reclaim all increased claims due to climate change by increasing the insurance premiums on, for example, energy producers, in a kind of insurance-led levy that acknowledges both present carbon emissions and the industry’s carbon inheritance. Similarly, Porrini and Schwarze (2014) argue that governments could benefit significantly from using an insurance instrument capable not only of covering damage but also of providing an incentive for risk-reduction behaviours (cf. Botzen and van den Bergh, 2008; Keskitalo et al., 2014).

Another example of an optimistic approach is described in *Climate Change and Insurance* by Carroll et al. (2012). This book takes the insurance industry’s perspective on climate change (Trexler, 2013) and argues that the evolution of climate change from emerging to accepted risk may follow the same path as other formerly emerging risks, such as asbestos, tobacco, and hazardous waste, including the potential for significant liabilities. Hence, Carroll et al. (2012) see the risks of climate change to the insurance industry in terms of liability, but not the risks to society if climate change is to be dealt with by the insurance industry. However, the impact of climate change on the profitability of the commercial insurance sector is unlikely to be severe, as insurance companies are capable of shifting changed risks to the policyholders, provided that they are properly and promptly informed of the consequences of climate change (Tol, 1998). It is also argued that climate change could bring new business opportunities for insurance companies (Botzen et al., 2010), for example, by prompting the development of insurance products and/or terms and conditions that incentivize risk reduction (Herweijer et al., 2009).

The pessimists doubt insurance as a way of governing climate change and question the emergence of neoliberal forms of governance and insurance (O’Malley, 2004), often using Ulrich Beck’s dystopic vision of the risk society as a point of departure. In such a view, insurance has played out its traditional role because risks are so great that insurance is no longer viable. Krieger and Demeritt (2015) represent this more pessimistic stance in their study of flood insurance in the UK and Germany. Although they do not rule out the positive

potential of insurance in risk governance, they question how to overcome the political and social barriers to pricing risks adequately and the negative interactions between financial support and risk reduction. These difficulties are rooted in insurance companies and in the embeddedness of insurance markets in various social, institutional, and political contexts that influence, and even determine, how insurance is incorporated into risk governance.

Irrespective of whether one wants to adopt an optimistic or pessimistic approach, it is widely recognized that the costs of weather-related natural disasters have been rising (Mills, 2005). The impacts include an elevated need for assistance from outside affected areas and a shrinking gap between insurance premiums and losses. The impacts of climate change have accelerated several forms of unrelated adverse structural change already underway in the insurance industry. These manifest themselves as a rise in competition among insurance companies, consolidation due to the reduced viability of small firms, increased risk exposure by way of globalization, and a growing proportion of competing self-insurance and alternative risk transfer mechanisms. However, climate change does not just represent a challenge to the insurance industry in the face of increasing risks; as mentioned, new business opportunities might emerge and the industry could foster the transition towards climate-resilient societies. To mitigate the financial consequences for households once flood damage occurs, insurance contracts could potentially be used to stimulate precautionary behaviour by providing premium reductions for households that had implemented appropriate measures (Aerts and Botzen, 2011; Botzen et al., 2009). However, Bubeck et al. (2013) demonstrate empirically that insurance companies do not normally use premium reductions to stimulate precautionary household behaviour.

Taking these various approaches into account, it could be claimed that the future role of insurance in helping society cope with climate change is uncertain (see also Mills, 2005). Insurance companies may rise to the occasion and become more proactive in terms of improving the science and crafting responses. Or they might retreat from oncoming risks, thereby shifting a greater burden to governments and individuals. Accordingly, when emphasizing the short- and long-term consequences for household owners, it is uncertain how these policyholders will react both to climate change and to the actions undertaken by insurance companies. Botzen et al. (2009) and Kunreuther (2015) emphasize the role insurance can play in mitigating damage by providing incentives to policyholders to undertake damage-reduction measures, and their findings indicate that household owners are willing to invest in mitigation in exchange for reduced insurance premiums.

2. Method and literature searches

To describe the state of the art in research into insurance and climate change, relevant research published over the last approximately ten years was identified and analysed. In other words, this is a desk-top study based on previous research. Several literature searches were conducted to capture the insurance perspective on climate change, the household perspective on climate change and insurance, and social science perspectives on households and climate change in a broader sense. The literature searches have thus been both narrow and wide in scope in order to say something about themes and gaps in the research field.

The literature searches combined open searches of full-text databases, for example, Business Source Premier, with specific searches of a number of leading journals: *Environment and Behaviour*, *Global Environmental Change*, *International Journal of Environmental Studies*, *International Journal of Climate Change Strategies and Management*, *Journal of Risk and Insurance*, and *The Geneva Papers on Risk and Insurance – Issues and Practice*. To cover the research field of risk, searches concentrated on the following journals: *Journal of Risk Research*, *Health, Risk & Society*, *Risk Analysis*, *International Journal of Disaster Risk Reduction*, and *Journal of Risk and Uncertainty*. It must be noted that the searches were inclusive, so the literature review, to some extent, includes material from reports, dissertations, and articles not included in the journal and database searches.

To capture literature relevant to the research project, various search terms and combinations of search terms were used covering the areas of insurance, climate change, households, gender, and intersectionality.² The terms were searched for in abstracts published after 2004. To gain an overview of the kinds of climate risks these articles were treating, separate searches were conducted using the terms “flood”, “storm”, and “landslide”. These are, admittedly, only a few of today’s climate risks, but they are vital for the present research project. The searches found that most studies have examined flooding, while storms and landslides have not been studied to the same degree, at least not including the household perspective.

In the Appendix, Tables A and B cite examples of searches to illustrate how many search hits were found using the different search strategies, for both the general search and the specific searches of particular journals. For example, the combination of “climate change”, “insurance”, and “household” in the specific search identified only eight articles, i.e., Bubeck et al. (2013), Highfield et al. (2013), Hochrainer et al. (2010), Nance (2015), Perez et al. (2015), Thieken et al. (2006), Trærup (2012), and Ullah et al. (2015).

²All these search terms have been used in one way or another: Insurance*, Climate* Change*, Climate* Risk, Environmental Risk, Natural Hazard, Natural Disaster, Flood, Storm, Landslide, Drought, Flood, Storm, Landslide, Erosion, Household, Family, Parenthood, Homeowner*, Residential property owner*, Private property, Life insurance, Flood Insurance, Household Insurance, Willingness-to-pay, WTP, Cost-benefit analysis, Risk, Preparedness, Resilience, Adaptation, Perception, Management, Responsibility, Intersectional*, Gender, Socioeconomic, Race, Ethnicity.

The many articles found through the open searches indicate that the field of insurance studies of climate change is not insignificant; for example, 5985 articles were identified in just one search combining multiple search terms (see Table B in the Appendix). However, including a household perspective reduced the number of articles to 480, and adding other perspectives, i.e., gender, ethnicity, and social class, identified only a handful of publications (i.e., eight). When gender or intersectional approaches were included, the lack of relevant articles addressing both insurance and climate change was obvious, one and no article, respectively, being identified.

The identified articles were read and categorized according to the three themes addressed in the review: 1) insurance and climate change; 2) households, insurance, and climate change, and 3) climate change through the lenses of gender, class, and ethnicity and their intersection. Each subcategory was then further categorized according to the content/focus of the research (see section 3). The various categories and themes were then analysed, using a simple kind of content analysis; thereafter, conclusions were formulated (see section 4).

3. Review of the literature on climate change, insurance, and households

3.1 Brief overview of the field

In this section we present the general findings from the literature review, starting with an overview of social science research into climate change more generally. Most of these more general studies examine climate change or climate risks, either by considering several types of climate risks (Ho et al., 2008; King et al., 2014) or by considering public perceptions of, and attitudes towards, climate change in general, without focusing on any specific climate risk (Gifford and Comeau, 2011; Scannell and Gifford, 2013). In this literature, we find studies that explore local knowledge of climate change by illustrating how such knowledge is embedded in peoples' everyday practices and livelihoods (Nyantakyi-Frimpong and Bezner-Kerr, 2015; Sada et al., 2014). Some studies look more specifically at how climate change affects households' (or more precisely smallholder farmers') access to livelihood capital, such as land, livestock, water, and food production capacity (Haileslassie et al., 2011; Molua, 2015). Among the articles treating a specific climate risk, flooding is the dominant topic (e.g., Ajibade et al., 2013; Bubeck et al., 2012; Harries, 2008; Harvatt et al., 2011; Siebeneck and Cova, 2012), while only a few articles examine other climate-related risks, such as storms and cyclones (Hossain, 2015; Joerin et al., 2012; Mahmud and Prowse, 2012; Yi et al., 2015), landslides (Apine, 2011), or drought (Bewket, 2012; Sarker et al., 2013). Last, most identified articles treating flood risk perceptions are explorative and do not apply a theoretical analysis (Kellens et al., 2013).

Most studies examine geographic regions identified as particularly vulnerable to climate change and climate risks such as flooding or drought. Hence, much of this research is conducted in Southeast Asia (e.g., Brouwer et al., 2007; Coulthard, 2008; Sarker et al., 2013; Udmale et al., 2015) and Africa (e.g., Below et al., 2012; Bewket, 2012; Sugden et al., 2014), but also in a European context (e.g., Baiocchi et al., 2015; Harvatt et al., 2011; Perez et al., 2015). Research into households and climate change in Europe is also almost exclusively concerned with flooding, flood-prone areas, and flood-prone households (e.g., Poussin et al., 2015; Terpstra and Lindell, 2012). Many of these studies are quantitative, based on surveys, and concerned with the correlation between public flood risk perceptions and mitigating activities (Bubeck et al., 2013; Kellens et al., 2011; Kreibich, 2011). Studies conducted in African communities or treating African households and climate change almost exclusively concentrate on increasing temperatures and droughts (Bewket, 2012; Yila and Resurreccion, 2014). This research often includes African farming communities and smallholder farmers, studying their perceptions of, and adaptation to, increasing temperature (Below et al., 2012; Benhin, 2008; Nyantakyi-Frimpong and Bezner-Kerr, 2015). The studies of households and climate change in a Southeast Asian context are somewhat more diverse in scope; however, like the studies conducted in an African context, they tend to concentrate on smallholder

farmers and their adaptation to climate change (Haileslassie et al., 2011; Sarker et al., 2013; Wood et al., 2014). While most of these studies are concerned with households in rural areas, some include more urban areas of Southeast Asia, for example, studying the influence of corruption in cyclone preparedness on household climate adaptation in Bangladesh (Mahmud and Prowse, 2012).

The following presentation addresses the three main objectives of the review, namely, to identify research into: 1) insurance and climate change; 2) households, insurance, and climate change; and 3) climate change through the lenses of gender, class, and ethnicity and their intersection. The first and second research areas turned out to be more or less unrelated. Research in the first field explores how the insurance industry is affected by climate change and by industry responses, past and future, to these changes more generally, which is seldom related to how households or homeowners respond to these changes. In contrast, research into how people and/or households think about and respond to climate change and climate risks regarding their own homes rarely considers questions of who has or should have the responsibility to secure their homes against climate risks, and to what degree it is possible to rely on insurance. The last area aims concerns the extent to which intersectional perspectives and feminist knowledge are included in the analysis of climate change.

Subsection 3.2 addresses the research field of insurance and climate change from the insurance industry perspective, focusing on the following themes: 3.2.1 – the insurance industry in light of climate change, 3.2.2 – threats and opportunities, and 3.2.3 – political pressure on the insurance industry and the industry's adaptation to such pressure. The subsection ends with a concluding summary (3.2.3). Subsection 3.3 considers households, insurance, and climate change, doing so in terms of 3.3.1 – risk perceptions, experience, and insurance and 3.3.2 – WTP for proactive protection against climate change effects and for insurance, and ends with a summarizing discussion (3.3.3). Finally, subsection 3.4 presents research into climate change through the lenses of gender, class, and ethnicity and their intersection. Part 3.4.1 treats gender as a causal explanation of climate change attitudes and behaviour, while part 3.4.2 considers feminist and intersectional approaches; this subsection also ends with a concluding summary (3.4.3).

3.2 The insurance industry and climate change

This subsection presents studies of insurance industry perspectives. The first part deals with more common issues related to adaptation to climate change. The second part deals with threats and, in particular, climate change-related opportunities for insurance companies. The third part treats political issues and the fourth part is a concluding summary.

3.2.1 The insurance industry in light of climate change

Insurance is part of a broader patchwork of public and private strategies for spreading risks across time, large geographical areas, and diverse social and commercial communities (Mills, 2005). Private insurance, the market-based strategy, is an alternative to depending on the state to manage risk. Indeed, private insurance has become a central institution of governance beyond the state, a key institution for aspects of governance such as risk management, security provision, and population management. Experts have outlined a history of increasing differentiation and risk segmentation of consumers in various insurance markets, as insurance companies have increasingly sought to create target markets for “preferred” and “super-preferred” risks or otherwise to protect themselves from the increasing calibration of risk. Segmentation is simultaneously a process both of marketing and of risk assessment or underwriting, because preferred risks are doubly desirable as the insurance clients are seen to be both affluent consumers, on one hand, and less risky in terms of claims, on the other. However, insurance companies also protect themselves by pooling substandard risks, as those insured in the resulting pool, having little market choice, are compelled to purchase insurance under the most substandard arrangements.

The insurance industry has traditionally based its view of risk on historical records of hazard occurrences (Herweijer et al., 2009). However, insurance companies’ increased exposure to weather risks indicates the importance of implementing strategies to reduce their vulnerability. This could involve traditional measures, such as limiting risks, raising premiums, transferring damage, or damage control. The first two measures may be undesirable, because they limit insurance availability and merely shift the risk to households, businesses, and/or the public sector. One could argue that insurance companies also have a societal responsibility not only to reduce their own risk but also to serve their clients and help them protect themselves against the unbearable financial consequences of major climate risks. Other strategies that reduce risk and are also beneficial for policyholders, in that they limit climate change losses and do not impair insurance availability, involve the promotion of emission reduction and adaptation measures in cooperation with public agencies.

In addition, insurance companies should have incentives to influence policyholder behaviour so as to limit the effects of climate change (Thieken et al., 2006). Insurance companies could stimulate the undertaking of cost-effective risk-reducing adaptation measures at the policyholder level. The most significant near-term threat to the industry’s property and casualty businesses stems from the potential for the characteristics of the insured weather hazards to differ from those of the past as a result of climate change. If this statistical non-stationarity in hazard cannot be adequately anticipated by an insurer through its underwriting practices (in particular, the pricing and diversification of risks across a portfolio) and in its risk capital reserves, then it could undermine the financial stability of the organization.

It should be noted that the body of literature related to catastrophe insurance, crop insurance in particular, is vast and rapidly growing (e.g., Botzen and van den Bergh, 2008, 2012b; Brouwer and Schaafsma, 2013; Browne and Hoyt, 2000; Hazell, 1992; Kleindorfer and Kunreuther, 1999; Kunreuther, 2006; Vandever, 2001).

3.2.2 Threats and opportunities

Managing risks posed by climate change requires urgent action both to mitigate atmospheric greenhouse gas levels through reducing global emissions and to adapt to climate changes at a local level to minimize risks and maximize potential opportunities. According to Herweijer et al. (2009), the insurance industry has an important role to play in both these responses. Adaptation, or the lack thereof, is particularly critical to the insurance industry as it directly affects the very core of the property and casualty businesses, shaping the risk landscape insured and the concept of “insurability” itself.

The risk of natural disasters, occurring because of climate change, is likely to increase the demand not only for natural disaster insurance but also for re-insurance. Baumer and Bajraktarevic (2012: 39) argue that the re-insurance industry “has moved to new catastrophe modelling systems, developed new insurance products, flaunted ‘green’ initiatives and created new defences against climate-related claims in order to analyse and more effectively assess the probability of risks and integrate problem solving mechanisms systems”. Botzen and van den Bergh (2012b) highlight the new opportunities for the insurance market that have arisen because of climate change. Consequently, knowledge of individual risk beliefs and of behavioural responses to changing risks is relevant to insurance companies, as it allows them to estimate the demand for new insurance products (Botzen and van den Bergh, 2012a).

Herweijer et al. (2009) suggest that insurance companies should promote risk awareness and risk-reducing behaviour through risk-based pricing. In fact, a number of insurance companies in the United States are offering premium discounts for homeowners who participate in Business and Home Safety programmes. In principle, risk-based pricing is the practice of charging individual insurance policyholders premiums that directly reflect the risk of losses to which they are exposed, that is, the technical risk price. In practice, premiums are based on a number of internal operational considerations (e.g., desire of insurance companies to make a profit) and external factors (e.g., competition among companies and regulation), so differences in premiums between policyholders may not be directly related to the risks covered. However, risk-based pricing in the property and casualty market has the additional benefit of incentivizing businesses and household owners to limit or reduce the risks to which they are exposed in order to take advantage of lower premiums, as is observed in markets for other insurance products, such as automobile coverage.

Other methods of achieving mitigating risk have significant immediate and long-term benefits. For example, simple experiments with a catastrophe model can illustrate the loss reduction

benefits of various adaptation measures; for example, adapting for flooding by elevating a property or changing its characteristics (e.g., cladding and shutters) to improve flood resilience or resistance. A study performed by Lloyd's of London (2008) emphasized that adaptation to rising sea levels could reduce average annual storm surge losses for individual properties in high-risk coastal communities in the 2030s to below present-day levels. A case study of a property on the tropical Atlantic coastline found that, in the absence of adaptation, sea level rise alone would increase 1 in 200-year losses by 20 per cent by the 2030s; in contrast, a simple adaptation measure, such as building a home on an elevated platform (0.5–1.5 m high), reduced losses to 10–80 per cent below their present-day level (Lloyd's of London, 2008).

While risk mitigation measures can clearly reduce losses significantly, barriers to their realization include the magnitude of costs, who pays these costs, and who reaps the benefits. If adaptation measures are more expensive than the losses they are designed to prevent, they are unlikely to appear cost-effective. While insurance companies are primarily concerned with insured losses, cost-benefit calculations need to be rigorous and take into account uninsured losses (including those, such as social disruption, that cannot be directly measured in financial terms) and appropriate timescales (Mills, 2009). In other words, there may be circumstances in which it makes financial sense for insurance companies to offer incentives, in addition to lower premiums, to encourage policyholders to invest in risk mitigation measures (Botzen et al., 2010; Herweijer et al., 2009; Mills, 2005, 2009). However, the cost of offering such incentives to significant numbers of policyholders will need to be considered alongside the likely benefits in terms of reduced losses within a portfolio. Some insurance companies do offer lower premiums, sometimes indirectly via discount and credit schemes, to policyholders who invest in risk mitigation measures.

The tension between opportunities and threats can be illustrated in the following way: On one hand, Kunreuther (2015) claims that insurance premiums based on risk send signals to residents and businesses as to the hazards they face and enable insurance companies to lower premiums for properties where steps have been taken to reduce risk. On the other hand, Lamond et al. (2009) argue that insurance can induce moral hazard in those who are able to prevent flood damage, if insurance removes the incentive to undertake mitigation measures. This view is supported by Lo (2013a) and Zahran et al. (2009). This reasoning can be exemplified by the German insurance system, in which the premiums are risk-based and therefore very expensive in high-risk areas, where insurance companies often decline to offer or renew insurance contracts (Bubeck et al., 2013; Thieken et al., 2006). This trend towards risk-averse policies in some insurance companies has to some extent appeared in the United Kingdom as well (Lamond et al., 2009). This is why some previous studies (e.g., Kreibich, 2011) found that insurance coverage among households in high-risk and unprotected areas can decrease after extreme flooding.

3.2.3 Political pressure on the insurance industry and adaptation to such pressure

An increase in the magnitude or frequency of weather hazards with future climate change could lead to an increase in the risk of correlated losses from, for example, coastal or inland flooding. Such increases in expected losses due to climate change would have profound consequences for the future affordability and availability of coverage. Herweijer et al. (2009) report that recent evidence from the United States suggests that such major changes in policies offered by private insurance companies to cover household owners' properties, particularly if introduced relatively rapidly, could induce negative public and political reactions. Insurance companies may find that other parts of their businesses can be affected by public and political dissatisfaction. In Florida, for example, regulators have attempted to prevent private insurance companies from withdrawing coverage for wind damage by making licenses to write automobile policies contingent on maintaining adequate provision of household owners' property insurance. This suggests that the insurance industry is likely to face increased regulatory scrutiny and action if it does not respond appropriately to the threat of rising uninsurability.

North American studies addressing insurance concentrate on floodplains, providing spatial delineation guides for local planning and development decisions (Highfield et al., 2013) and local government mitigation activities (Zahran et al., 2009). American flood insurance reforms have had an impact on vulnerable communities and regional property markets (Nance, 2015), while household insurance purchases correspond to flood mitigation activities by local governments (Zahran et al., 2009). Most of these studies have investigated the effect of the US government's National Flood Insurance Program (Kunreuther, 2015; Landry and Jahan-Parvar, 2011; McKenzie and Levendis, 2010; Petrolia et al., 2013; Pompe and Rinehart, 2008; Young, 2008; Zahran et al., 2009). According to Pompe and Rinehart (2008) and Young (2008), the Program has resulted in a significant cost to US taxpayers. Some authors argue that the Program primarily shelters lending institutions rather than flood victims (e.g., Young, 2008). Pompe and Rinehart (2008) argue that government involvement in property insurance for coastal property owners in the USA has encouraged building in high-risk areas while keeping insurance premiums too low to cover property losses, shifting the cost of insuring high-risk properties to taxpayers. Kunreuther (2015) argues that insurance companies and insurance regulators in the USA have limited experience of catastrophes caused by climate change. This is why both parties tend to engage in short-term intuitive thinking, instead of long-term deliberative thinking, when making insurance-related decisions, such as insurance for low-probability and high-consequence events.

Adaptation and risk mitigation can have significant benefits in terms of helping existing private insurance markets to continue to function. In the developed world, the impetus and funding for adaptation will come primarily from national and local governments. With such a clear stake, the private insurance industry has an opportunity not only to contribute to the

formulation of public policy on adaptation, but also to directly influence adaptation through its business practices. Both can be achieved through a combination of strategies. Such strategies not only incentivize and enable adaptation as an opportunity, but are themselves a necessity for ensuring the sustainability of weather-related insurance. However, the insurance industry often argues that others, such as homeowners and/or governments, should bear the costs of risk mitigation measures. The willingness or capacity of insurance companies and governments to pay for risk mitigation measures depends on who accrues benefits from these measures and over what period.

3.2.4 Concluding summary

It is widely recognized that the costs of weather-related natural disasters have been rising (Mills, 2005), and that this will affect insurance companies. It is further argued that the whole insurance industry may be hit very hard by the consequences of climate change, and that the industry has recognized the need to analyse the consequences of climate change in terms of increased claims costs and the ability to continue to provide good insurance coverage for everyone (Tucker, 2005).

One way the insurance industry could react would be to argue that others, that is, governments, household owners, and others, should bear the costs of risk mitigation measures (Herweijer et al., 2009; Thieken et al., 2006), using its power to influence or force governments, household owners, and other industries (e.g., the forest industry) affected by climate change to take responsibility for proactive actions. Although mitigating climate change risk can significantly reduce losses, the basic question is who should bear the cost of mitigation measures. An argument supporting such a view is that modern societies cannot function without insurance, because insurance enables individual risk-taking and provides a financial safety net for those who suffer property damage, whether or not it originates from climate change (Krieger and Demeritt, 2015).

Another way the insurance industry could react would be to recognize that the risk of climate change-related natural disasters is likely to increase the demand for natural disaster insurance. Bearing this in mind, insurance companies could develop new insurance products while promoting risk awareness and risk-reducing behaviour through risk-based pricing (Botzen and van den Bergh, 2012a; Herweijer et al., 2009). Botzen and van den Bergh (2012b), in particular, emphasize the new opportunities for the insurance industry that have arisen because of climate change. Accordingly, knowledge of individual risk beliefs and behavioural responses to changing risks are relevant to insurance companies, as it allows them to estimate the demand for new insurance products and risk-based pricing.

According to Herweijer et al. (2009), the insurance industry can have an important role to play in both scenarios presented above. Adaptation, or the lack thereof, is critical to the insurance industry as it directly affects the very core of its future business. Given this, it is noteworthy

that Kunreuther (2015) argues that insurance companies in the USA have limited experience of catastrophes caused by climate change, and that they consequently tend to engage in short-term intuitive thinking instead of long-term deliberative thinking when making insurance-related decisions concerning low- and high- probability events.

In the European context, studies of climate change and the insurance industry have predominately been conducted in Germany, the Netherlands, and the United Kingdom. Most of these climate risk studies have concentrated on high-risk areas and been oriented towards flooding and flood insurance (e.g., Botzen et al., 2009; Bubeck et al., 2013; Lamond et al., 2009). Similarly, North American insurance studies have focused mostly on floodplains and local government mitigation activities (Highfield et al., 2013; Zahran et al., 2009). At the same time, studies of low-risk areas are apparently lacking.

3.3. Households, insurance, and climate change

The importance of household and citizen perspectives on climate change has been emphasized by several researchers (e.g., Brouwer et al., 2007; Bubeck et al., 2012; Bukvic et al., 2015; Coulthard, 2008; Harvatt et al., 2011; Scannell and Gifford, 2013; Udmale et al., 2015), who emphasize the need for more research into households and citizens in the field of climate change and climate risks. Here, the household perspective is described as a way to offer a bottom-up perspective on aspects of climate change (Bukvic et al., 2015), by focusing on how citizens understand and manage climate risks rather than on geopolitics or policy implications. As noted by Coulthard (2008), households and communities are the key local-level actors when it comes to actually implementing adaptation to climate change. Hence, to mitigate the negative effects of climate change, citizens' attitudes and behaviours must be better understood (Scannell and Gifford, 2013).

Previous research into households, insurance, and climate change from the household or homeowner perspective indicates the importance of a context-specific understanding of the impact of climate change and a need to move beyond generalized assumptions regarding the nature and utility of adaptive capacity in facilitating adaptation (Elrick-Barr et al., 2014). Farming and/or resource-poor households around the world are common study populations in this respect (e.g., Brouwer et al., 2014), including in research into crop insurance in Australia (Khuu and Juerg Weber, 2013) and into resilience to floods, heavy rains, pest and diseases, and droughts in Asian and African countries (Hochrainer et al., 2010; Perez et al., 2015; Trærup, 2012; Ullah et al., 2015). In the following subsections, we present studies of householder risk perceptions in a broad sense and, after that, of householder WTP for climate change mitigation in one way or another. Included in householder WTP is protection against various effects of climate change, the role of insurance policies in taking mitigation action, and intention to pay for insurance coverage. Section 3.3 ends with a concluding summary.

3.3.1 Risk perceptions, experience, and insurance

Studies in a European context have been conducted mostly in Germany (e.g., Bubeck et al., 2013; Thielen et al., 2006), the Netherlands (e.g., Botzen et al., 2009; Botzen and van den Bergh, 2012a, 2012b), and the United Kingdom (e.g., Lamond et al., 2009) and concentrate on flooding, flood insurance, and household behaviour regarding flood mitigation. The results of these studies are presented in the following. Botzen and van den Bergh (2012a) demonstrate that individuals tend to correctly estimate their flood risk exposure relative to other risks, but underestimate their risk exposure in general. At the same time, risk awareness, risk perceptions, and geographical characteristics are important determinants of the decision to undertake mitigation (Botzen et al., 2009). Bubeck et al. (2013) demonstrate that the German respondents' estimates of the effectiveness of flood insurance in coping with potential flood damage and their ability to obtain insurance policies play a large role in the decision to purchase flood insurance. Furthermore, success in obtaining insurance may lead to complacency among residents, who see no advantage in pursuing other, more costly, damage mitigation actions (Lamond et al., 2009).

In a literature review, Bubeck et al. (2012) argue that factors such as coping appraisal are related to mitigation behaviour, while risk perception as a means to explain and promote private flood mitigation behaviour is not supported on either theoretical or empirical grounds. In another study of people's experiences, Bubeck et al. (2013) found that flood experience had a negative influence and living in an area protected by technical flood defences had a positive influence on the purchase of flood insurance. Only a handful of the insured households stated that they were encouraged by their insurance companies to implement mitigation measures, received information on how to flood-proof their houses, or were offered reduced premiums as a reward for undertaking such actions. To overcome this problem, Thielen et al. (2006) suggest that flood hazards and mitigation strategies should be better communicated to both household owners and insurance companies.

However, a number of studies have found a relationship between risk perception/behaviour and insurance coverage. Results from the Philippines indicate that perceived susceptibility to coastal hazards is affected more by households' spatial location and resource dependency than by socioeconomic conditions (Combest-Friedman et al., 2012). However, important differences exist based on the type of hazard and the nature of the risk being measured. Resource dependency variables are more significant in determining the perceived risk of coastal erosion and sea level rise than is experience of flood events. Spatial location is the most significant factor determining households' perceived risk to their household assets, but not perceived risk to their livelihoods. However, a study from the USA, which considered physical vulnerability to climate change in terms of water shortage, found that vulnerability is not a significant determinant of risk perception (Saleh Safi et al., 2012). General beliefs such as political orientations and climate change-specific beliefs such as believing in the anthropogenic causes

of climate change and connecting locally observed impacts to climate change are the most prominent determinants of risk perception (cf. Semenza et al., 2008).

In a US-based survey study, Petrolia et al. (2013) investigated revealed behaviour under environmental risk, finding that risk aversion was positively and significantly correlated with the decision to purchase a flood insurance policy, as were perceived expectations of hurricane damage, eligibility for disaster assistance, and insurance company credibility. Another US study (Basolo et al., 2009) investigated households' perceived preparedness for earthquakes and hurricanes. The results indicate a positive relationship between high confidence in local government management of disaster and exposure to more sources of information on preparedness, respectively, and higher perceived preparedness. The study also highlights a lack of preparedness for post-disaster conditions among households. Similarly, a Taiwanese study (Hung, 2009) finds that demand for insurance increases with previous disaster experience, such as flood experience, proximity to a river, and perceived risk. Results from Australia indicate that the likelihood of having flood insurance coverage was associated with perceived social norms, but not perceived flood risk – that is, social norms play a mediating role between insuring decision and risk perception (Lo, 2013b). This implies that adaptive behaviour is not necessarily a function of risk perception, but an outcome of its impacts on how individuals situate themselves in their social circles or in society.

Households in general tend to have a low level of preparedness to protect themselves against damage caused by various weather events. Even those who live in areas at risk of exposure to various natural disasters seldom act to minimize the risk of damage to people or property (Siegrist and Gutscher, 2008). Many are also sceptical as to whether or not certain weather events, such as flooding, are related to climate change. A previous study found that both people who have and people who have not experienced floods are sceptical about whether climate change is causing or worsening flooding (Whitmarsh, 2008). In addition, it seems as though people's actions to prevent damage are limited if they continue to believe that individual actions have little meaning if the state does not also act (Niemeyer et al., 2005). Other studies emphasize the importance of emotions to take mitigation action (Harries, 2008; Sundblad et al., 2007).

3.3.2 Willingness to pay

Increased attention is being paid to the role insurance can play in mitigating damage by incentivizing policyholders to undertake damage-reducing measures. A few studies of households and insurance issues, mainly from the Netherlands and Germany (Botzen, 2013), find among other things that promoting flood risk-reduction activities through flood insurance, building codes, and other flood-proofing measures may be an effective means of limiting residual flood risk (Kreibich et al., 2005; Thielen et al., 2006). The willingness of household owners in the Netherlands to undertake measures to mitigate flood damage in

exchange for benefits on hypothetical flood insurance policies indicates that many household owners are willing to make investments in mitigation (Botzen et al., 2009). Survey results also indicate that household owners have a fairly accurate understanding of the impact of climate change and other environmental risk factors, and that most have made the most obvious risk mitigation investments (Schulte and Miller, 2010). Further mitigation efforts primarily relate to the value household owners place on amenities associated with their houses and to their perceptions of the impact of mitigation efforts undertaken on neighbouring lands (Schulte and Miller, 2010). In the same vein, it is argued that homeowners might be reluctant to invest significant sums in reinforcing their roofs to withstand wind damage if the financial benefits are only realized over an extended period of lower premium payments, particularly if the returns are not guaranteed for the long term (Herweijer et al., 2009).

Botzen and van den Bergh (2009) studied the role of insurance in reducing uncertainty associated with climate change losses for individuals, concentrating on the value individuals place on reducing increased flood risks by means of insurance coverage. They used rank-dependent utility and prospect theories, and the risk premiums were estimated under three climate change scenarios for the Netherlands. Even when they used different theories, the estimated risk premiums for the three climate scenarios indicate that the WTP³ increases more than does the expected value of the insurance when the probability of flooding rises. According to prospect theory estimates, risk premiums should increase by 40–60% in the low-climate-change scenario and by 70–100% in the high-climate-change scenario relative to current levels.

An Australian study demonstrated that households' WTP for climate change mitigation was significantly influenced by their beliefs regarding future temperature rise (Akter and Bennett, 2011). Another study elicited individual risk beliefs and the demand for low-probability, high-impact flood insurance using the contingent valuation survey method (Botzen and van den Bergh, 2012a). It found that the WTP of individuals who demand flood insurance is on average considerably higher than the expected value of the flood risk faced. Botzen and van den Bergh's (2012a) findings indicate that perceptions of flood risk are an important determinant of WTP, while objective risks derived from geographical characteristics influence the WTP to a lesser extent (cf. Brouwer and Schaafsma, 2013).

Studies also find that communication is an important variable when it comes to WTP and climate insurance. Communication of baseline probabilities and changes in flood probabilities using risk ladders facilitates the comprehension of risk by policyholders, and has a pronounced effect on the WTP (Botzen and van den Bergh, 2012a). Botzen et al. (2013) further

³ Worth noting is that different theories are used in WTP studies related to climate change. For example, Hung (2009) used fuzzy set theory in studying household attitudes towards buying flood insurance under preference uncertainty, while Botzen and van den Bergh (2012a) and Petrolia et al. (2013) used prospect theory. Moreover, Bubeck et al. (2013) and Glenk and Fischer (2010) used protection motivation theory and/or coping appraisal theory.

illustrate how communication interacts with individual flood hazard frames, finding that particular communication frames considerably increase WTP. Moreover, the communication of risks, such as changes in flood probabilities (Botzen and van den Bergh, 2012a), and insurance policy conditions can increase household WTP for insurance (Botzen et al., 2013). WTP for flood insurance is also related to social influence. For example, uninsured households would be more interested in insurance if they expected positive responses from their neighbours (Lo, 2013a). Homeowners' precautionary behaviour is positively influenced by neighbours and friends who have implemented flood mitigation measures (Bubeck et al., 2013).

Underlying WTP are the socioeconomic conditions and the household context. Head et al. (2011) suggest that capacities to deal with risk and uncertainty vary with a range of social and local factors, tending to coalesce into patterns of vulnerability and resilience that offer strong predictors of which households are most likely to be sustainable in the longer term. A study from the Caribbean examined differences in household vulnerability as the combined result of socioeconomic inequalities in entitlements and exposure to natural hazards, demonstrating that lower-income groups suffering longer from exposure and with more damaging effects, as well as households in lower-income areas, take more measures to prevent flooding than do higher-income households (Linnekamp et al., 2011). Researchers also increasingly tend to emphasize the abilities (e.g., adaptation, coping strategies, and resilience) of these vulnerable groups (see, e.g., Bewket, 2012; Yila and Resurreccion, 2014). Studying residential property selling prices, that is, consumer WTP for a property before and after flooding due to a hurricane, McKenzie and Levendis (2010) found that a property's geographical elevation is positively related to its selling price.

In developing countries, the less affluent might be unable to afford insurance, so Brouwer et al. (2014) investigated the willingness and ability to pay of Vietnamese households, mostly farming households, for micro insurance to reduce socioeconomic vulnerability and increase the coping capacity of residents living in various flood-prone coastal zones (cf. Baumer and Bajraktarevic, 2012). Wang et al. (2012) investigated people's risk awareness, insurance acceptance, opinions on governmental disaster management measures, and WTP for home insurance against disasters in China. The respondents were asked about the most frequent disasters in their localities, such as floods, landslides, mudflows, rainstorms, sandstorms, earthquakes, typhoons, storm surges, hailstorms, forest wildfires, structural fires, snowstorms, freezing rain, and droughts. The findings indicate that respondents had correct perceptions of the risk of natural disasters in their area. However, respondents from regions with a greater risk of various natural disasters tended to expect the government to undertake to cover losses and considered insurance less important. The latter finding can to some extent be related to Botzen and van den Bergh's (2012a) results, which indicate that public compensation for flood damage lowers the demand for private insurance.

Not considering insurance explicitly but individual behaviour more generally, Jones and Clark (2014) tested two models, one that correlates respondents' perceived costs and benefits with the public acceptability of two policy options, and another that investigates the impacts on perceived social costs and benefits of the policy options. Their findings indicate that the perceived social costs and benefits of proposed policy options influence the level of public acceptability of these policies. Furthermore, specific social capital parameters (i.e., social trust, institutional trust, social networks, and social reciprocity) influence the perceived policy costs and benefits and significantly affect the level of public acceptability of the proposed policy option.

3.3.3 Concluding summary

The importance of context-specific understanding of the impact of climate change is emphasized by Elrick-Barr et al. (2014). Climate change may, for example, result in rising sea levels and more powerful storms, seriously threatening countries such as the Netherlands (where one-quarter of the land is below sea level). According to the government of the Netherlands, the infrastructure and people must be protected from potential disasters caused by climate change. This means that new efforts must be made to improve safety, and to that end the Netherlands has invested EUR 75 billion to protect itself against possible flooding in the future.

Unsurprisingly, studies conducted in the Netherlands have a particular focus on how to mitigate flood damage. Schulte and Miller (2010) found that household owners have a fairly accurate understanding of the impact of climate change and other environmental risk factors, and that most of them have made the most obvious risk mitigation investments. However, further mitigation effort relates to the value household owners place on amenities associated with their houses, and household owners might be reluctant to make risk mitigation investments if the financial benefits are perceived as insignificant (Botzen et al., 2009; Herweijer et al., 2009; Schulte and Miller, 2010). Moreover, Bubeck et al. (2013) found that very few insured households perceived being encouraged by their insurance companies to implement mitigation measures. Studies of flood mitigation behaviour among households along the river Rhine (Bubeck et al., 2012, 2013) emphasize the need to provide practical information to households to encourage them to implement mitigation behaviour. For example, policies to stimulate proactive behaviour should emphasize that flood mitigation measures at the household level can effectively prevent or reduce flood damage, so practical advice should be provided on how to deploy such measures.

Another example of the relationships between governmental activities related to climate change and research interest is found in the USA, where several researchers have examined the US government's National Flood Insurance Program, which has resulted in significant costs to US taxpayers (Pompe and Rinehart, 2008; Young, 2008). Also in this case, household

insurance purchases have been found to correspond to flood mitigation activities (Zahran et al., 2009).

The literature review also reveals that whether or not individuals act to prevent themselves from various risks related to climate change depends on their perceived responsibility to prevent these risks. Many insured households believe that the opportunities for meaningful individual action are limited, considering themselves part of a citizens' collective (Bickerstaff et al., 2008). In the same vein, Guldåker (2009) reports that many Swedish families were unprepared for the storm "Per" in 2007 and that the experience of the storm did not contribute to increased preparedness for future events. The general view was that the electricity supplier was, and should be, responsible for energy loss mitigation.

Focusing on household WTP for insurance related to the impact of climate change, several studies (Botzen and van den Bergh, 2012a; Brouwer and Schaafsma, 2013; Hung, 2009) demonstrate that perceptions of flood risk are an important determinant of individual WTP. The same pattern regarding the association between beliefs about future temperature rise and WTP is found in an Australian study (Akter and Bennett, 2011). Moreover, factors such as housing conditions, and disposable income influence WTP (Hung, 2009; Lo, 2013a). In addition, Botzen et al. (2013) illustrate how risk communication interacts with individual frames of reference, and that such communication can increase household WTP for insurance.

3.4 Climate change through the lenses of gender, class, and ethnicity and their intersection

Research into climate change and insurance does not pay much attention to gender, class, and ethnicity, at least not other than as control variables in quantitative analyses. In this last section, we therefore present research into these issues more broadly.

3.4.1 Gender as a causal explanation of climate change attitudes and behaviour

In our literature search, we found numerous articles that treat aspects of gender, class, and/or ethnicity in relation to climate change. The absolute majority of these articles is concerned with gender aspects in relation to climate change, for example, explaining differences in risk perceptions as an outcome of gender (Gifford and Comeau, 2011; Ho et al., 2008; Kellens et al., 2011; McCright and Dunlap, 2011, 2013; Scannell and Gifford, 2013) or focusing on various gender-related vulnerabilities with regard to climate risks and climate change (Ajibade et al., 2013; Perez et al., 2015; Sugden et al., 2014; Yila and Resurreccion, 2014). According to several studies in journals concerning climate change, gender is a good predictor of victims' attitudes towards natural disasters. Women tend to be more concerned about the risks of natural disasters than are men (Ho et al., 2008) and to display more climate change engagement (Scannell and Gifford, 2013). Many studies also highlight gender differences in vulnerability; for example, women in the South will be affected more by climate change than will men in

those countries (Ajibade et al., 2013; Perez et al., 2015; Yila and Resurreccion, 2014). Several of these studies emphasize how vulnerability is not to be understood as expressing gender differences but rather as expressing structural, social, and economic conditions related to gender that interact and thus determine household and individual vulnerabilities to climate risks and climate change and the ability to address these (Perez et al., 2015; Sugden et al., 2014; Yila and Resurreccion, 2014). Some feminist researchers question the discourse of women as especially vulnerable and virtuous, and argue that generalizations about women's vulnerability and virtue can lead to an increase in women's responsibility without corresponding rewards (Arora-Jonsson, 2011). Some studies also imply that women, compared with men, display a higher degree of both engagement and competence in adapting to climate change (Gifford and Comeau, 2011; Scannell and Gifford, 2013; Terpstra and Lindell, 2012).

In some quantitative studies (Ahsan and Warner, 2014; Hailelassie et al., 2011; Kreibich, 2011), socioeconomic background is considered a variable in explaining various aspects of households and climate change. For example, in searching for variables that can explain households' precautionary measures towards climate change, Kreibich (2011) concludes that socioeconomic factors such as residential building ownership and household size are the most significant explanatory factors. In another study of household risk perceptions and responses to climate change, Jewitt and Baker (2011) illustrate how both perceptions and responses vary greatly with socioeconomic status, age, gender, and the spatial or temporal distance of the risk. The authors cite the example of poorer groups' prioritizing of household-level risks to health and food security, while global environmental risks were mentioned by only the wealthiest respondents.

Even though these articles are all concerned with how gender, class, and/or ethnicity together "create stratified patterns of vulnerability with regard to climate change" (Sugden et al., 2014: 258), few make use of findings and theory from gender research, and none of them applies an explicitly intersectional approach. The empirical analyses of climate change applying ecofeminism or feminist political ecology are primarily related to gender mainstreaming (Alston, 2014), vulnerability (Arora-Jonsson, 2011), adaptation (Carr and Thompson, 2014; Sultana, 2014), and environmental justice (Cutter, 1995; Di Chiro, 2008). The analyses are, for example, framed in terms of women's human rights within climate policy allowing a more systematic understanding of gendered distributive effects (Bendlin, 2014). Gender mainstreaming refers to the process of incorporating a gender perspective into any action, policy, or legislation in order to ensure that the concerns of all are addressed and that gender inequalities are not perpetuated through institutional means (Alston, 2014). However, the implementation of gender mainstreaming across the globe has not necessarily resulted in advances for women, as it is usually accompanied by a rollback of women-focused policies and programmes.

Many of the articles (e.g., Gifford and Comeau, 2011; Ho et al., 2008; Kellens et al., 2011; Scannell and Gifford, 2013; Sutton and Tobin, 2011; Tranter and Booth, 2015) on the gender aspects of climate change are quantitative and treat gender as just one variable among others, instead of contextualizing gender aspects in social and economic structures in order to analyse and problematize the ever-recurring correlation between climate change and gender differences or gender-related vulnerabilities. However, there are examples of such contextualizing studies as well. For example, in a study (Sugden et al., 2014) of stratified social formation in the Eastern Gangetic Plains of Nepal and India, policies and other initiatives to address climate change are criticized for not being effective unless they address the deeper structural intersections between class, caste, and gender. Although the authors emphasize gendered vulnerability (Sugden et al., 2014), they also acknowledge that it is gender together with class and caste that create stratified patterns of vulnerability to climate change.

3.4.2 Feminist and intersectional approaches

An increasing number of scientists claim that it is not enough to conduct descriptive studies to meet the challenges presented by climate change. Instead, research needs to analyse the underlying structural causes of differences in vulnerability and in access to resources (Arora-Jonsson, 2011; Sugden et al., 2014). In the literature review we found several articles (e.g., Below et al., 2012; Baiocchi et al., 2015; Perez et al., 2015) concerned with how gender and class/socioeconomic background intersect to create patterns of vulnerability, for example, by illustrating how women in low-income neighbourhoods recorded higher impacts and slower recovery than did other social categories of women and men during urban flooding in Lagos, Nigeria (Sugden et al., 2014). Brouwer et al. (2007), in their study of socioeconomic vulnerability and adaptation to climate change and flooding in Bangladesh, conclude that households with lower income and less access to productive natural assets are exposed to higher risk of flooding. A similar conclusion was reached by Hossain (2015) in a study of human vulnerability to cyclones and storm surges in coastal Bangladesh, where socioeconomic and physical factors of human vulnerability play a significant role in determining the level of household vulnerability to disasters induced by cyclones and storm surges. A few of these articles also consider aspects of culture, caste, or ethnicity (Ajibade et al., 2013; Sugden et al., 2014).

Insights from climate adaptation research and feminist theory indicate that, without addressing practices that perpetuate social biases and discriminatory attitudes and structures, gender inequalities and associated gendered vulnerabilities and adaptive capacities are unlikely to change (Terry, 2009). Tschakert and Machado (2012) argue that this requires a shift in perception from needs to rights. This research has developed perspectives of gender and inequality in particular that are only loosely connected to power and to more critical perspectives found in ecofeminism and gender studies more broadly. The fairly large field of studies of vulnerability to environmental changes and crises displays a similar tendency, that

is, to consider structures of power, such as gender, but not to apply theoretical or analytical tools from feminist or gender studies. It is often argued that presenting women as passive victims of climate changes and hazards risks wrongly diagnosing the causes of vulnerability. Instead, a sound analysis requires that one go beyond merely describing how men and women are affected differently, to analyse the underlying structural causes of vulnerability that mediate access to resources (Arora-Jonsson, 2011). Furthermore, such research attempts to bridge the knowledge gap between local experienced-based and expert-based knowledge by presenting micro-level evidence regarding the gendered impact of increasing water stress and regarding innovative gendered local adaptive strategies (Reed et al., 2014; Singh and Singh, 2015).

Some articles are comparative and thus treat several geographical regions (Arora-Jonsson, 2011; Perez et al., 2015; Wood et al., 2014). By comparing discourses on women, gender, and climate change in Sweden and India, Arora-Jonsson (2011) makes an analytical point by highlighting how the debates are structured differently in the North and the South and how these debates, by focusing on women's vulnerability or virtue, deflect attention from inequalities in decision-making. Other than that, we found no studies of households and climate change in a Nordic context in our search of the selected journals.

Applied to climate change, studies applying a gender perspective demonstrate that, without addressing practices that perpetuate social biases and discriminatory attitudes and structures, gender inequalities and associated gendered vulnerabilities and adaptive capacities are unlikely to change (Terry, 2009). Intersectional analyses not only illustrate the consequences of the constitution of power through, for example, the unequal distribution of resources among the "so-called" vulnerable when confronting environmental challenges, but can also expose positions of privilege often ignored or taken for granted (Gaard, 2015). In addition, such analyses can expose how these power structures and positions are challenged and renegotiated in the realities of, for example, a changing climate (Kaijser and Kronsell, 2014).

3.4.3 Concluding summary

The review demonstrated that gender as well as variables that can be considered to measure social class, such as income and education, are often included in quantitative analyses of perceptions, behaviour, experiences, WTP, etc., related to climate change (Kellens et al., 2013). There are clear indications that women tend to be more concerned than are men, who are relatively more sceptical of climate change in general, and that both income and education also have important impacts on peoples' perceptions and opportunities to act in the face of a changed climate (Whitmarsh, 2011). There is a tendency to relate issues of gender, class, and ethnicity to vulnerability (Ajibade et al., 2013), even though some argue that we must shift the focus from needs to rights (Tschakert and Machado, 2012). Although the importance of gender and other structures of inequality is well documented, few studies contextualize these results

in terms of social, political, and economic power and even fewer use ecofeminist and intersectional research to uncover underlying layers of inequality in terms of both privilege and vulnerability (Kaijser and Kronsell, 2014).

4. Conclusions

The aim of this review was to identify previous research, particularly in the areas of 1) insurance and climate change; 2) households, insurance, and climate change; and 3) climate change through the lenses of gender, class, and ethnicity and their intersection. In this concluding section, we summarize the themes and gaps that we identified when analysing the identified research.

Estimates of the amounts of research in the main field of this survey and its various subfields are mixed. On one hand, the body of literature related to catastrophe insurance is arguably vast and rapidly growing (e.g., Botzen and van den Bergh, 2008, 2012a, 2012b; Brouwer and Schaafsma, 2013) and a great many researchers are following governmental activities in response to ongoing climate change (Browne et al., 2015). According to this view, there are also a number of studies of household WTP and of policyholder views of insurance. On the other hand, researchers claim that more studies are still needed. Bubeck et al. (2013) argue that few studies have addressed precautionary behaviour, in particular, how individuals respond to flood-coping appraisal, and Browne et al. (2015) argue that there is a lack of studies of risk perception regarding natural hazards. Basolo et al. (2009) claim that the impact of information exposure on actual preparedness seems to be limited, and Browne et al. (2015) ask for insurance decisions unconnected to governmental activities such as the US government's National Flood Insurance Program. Moreover, research into policyholders' view of insurance (including WTP) through the lens of intersectionality, that is, gender, class, and ethnicity, is relatively rare. Judging by the few relevant papers found, intersectionality seems to be an issue reduced to opportunities to take out private health insurance. Altogether this indicates that research into insurance and climate change has a lot to learn from environmental studies in other fields of research, such as ecofeminism, environmental sociology, and risk perception studies.

In short, our main conclusions regarding themes and gaps are as follows:

- Research into climate change, insurance, and households concentrates on vulnerable countries in different continents and, in particular, on household owners in high-risk areas. The corollary is that there are fewer studies of less vulnerable countries, including the Nordic countries, and of low-risk areas.
- Some studies discuss responsibility for the effects of climate change, but consensus is lacking regarding what party should or could take this responsibility. Of particular interest is the power balance between the insurance industry and government.
- One stream of research treats how the insurance industry is affected by climate change, and another how homeowners are responding to this change. Accordingly, there is a lack of bridging between disciplines and research fields that could enhance our knowledge of the consequences and opportunities for the insurance industry.

There is also a need for transdisciplinary research in order to understand the relationship between climate change, insurance, and household owner willingness to pay for insurance and to prepare for future risks.

- Most of the studies are quantitative and based on surveys, meaning that there is a lack of qualitative research that can foster a deeper understanding of how individuals perceive the risks of climate change and how they act in order to protect themselves from them. There is also a lack of studies of households and citizens in the research field of climate change and climate risk; such research is important because the household perspective can offer a bottom-up perspective on aspects of climate change.
- Last, very few studies in each field we reviewed draw on an intersectional perspective. Some articles treat various power structures, especially gender, but as isolated categories and seldom in relation to feminist or gender theories.

In particular, two types of studies can be motivated by our conclusions: 1) studies of insurance company adaptations to increased climate risk, including strategies to respond to threats and seize opportunities; and 2) studies of household adaptations to increasing climate risk, studies that take demographic variables into account. Related to our conclusions, we also suggest more complex analyses of the underlying structural factors explaining how households relate to climate-related risks and to insurance. One example of the complex impact of climate change on gender relations was cited by Sugden et al. (2014) when studying how climatic and political economic pressures can be understood as external drivers that, in combination with local-level social structures and processes (e.g., class relations and migration patterns), create new patterns of vulnerability. It is vital to find a way to understand and approach the multiple, intersecting axes of identity that shape how impacts will be distributed and experienced (Osborne, 2015). Finally, as mentioned at the beginning of this literature review, environmental studies have made important conceptual and empirical contributions, such as ecofeminism, and problematized the human-nature divide in relation to structures of power (Gaard, 2015). Unfortunately, these developments are still missing in the research fields explored here.

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Appendix: Number of articles found using each search strategy

Table A. Journal search: Used search terms and numbers of hits

Journal (2005–2015)	Household + preparedness/ perception/management	Household + climate change	Household + climate change + insurance
<i>Journal of Risk Research</i>	12	1	0
<i>Health, Risk & Society</i>	2	1	0
<i>Risk Analysis</i>	18	10	2
<i>International Journal of Disaster Risk Reduction</i>	24	25	2
<i>Journal of Risk and Uncertainty</i>	4	0	0
<i>Environment and Behavior</i>	11	3	0
<i>Global Environmental Change</i>	29	59	3
<i>International Journal of Environmental Studies</i>	4	4	0
<i>International Journal of Climate Change Strategies and Management</i>	12	20	1
Number of hits	116	123	8

Table B. Business Source Premier search: Search term categories, used search terms, and numbers of hits

Search term categories	Search terms	Number of hits
Homeowner	Homeowner* OR Household* OR Residential property owner*	17,315
Insurance	Insurance	14,982
- Homeowner insurance	- OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance	220
Climate change	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought	9406
Climate change and insurance	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought AND Insurance OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance	5985
Willingness to pay	Willingness-to-pay OR WTP OR Cost-benefit analysis	3157
Climate change, insurance, and homeowners	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought AND Insurance OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance AND Homeowner* OR Household* OR Residential property owner*	480
Climate change, insurance, homeowners, and gender	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought AND Insurance OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance AND Homeowner* OR Household* OR Residential property owner* AND Race or ethnicity or class or sexuality or gender or women or female or male	8
Climate change, insurance, homeowners, and gender	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought AND Insurance OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance AND Homeowner* OR Household* OR Residential property owner* AND Gender	1
Climate change, insurance, homeowners, and intersectionality	Climat* Change* OR Climat* Risk OR Environmental Risk OR Natural Hazard OR Natural Disaster OR Flood OR Storm OR Landslide OR Drought AND Insurance OR Homeowner* Insurance OR Private property insurance Non-life insurance OR Flood Insurance OR Household Insurance AND Homeowner* OR Household* OR Residential property owner* AND Intersectionality	0

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