



Global climate change and planet protection: Multinational adaptation

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Abstract

Adapting to climate change requires all hands to be on deck by many actors in the society. Of recent, major research focus has been on governments, communities and the third sector as key actors in the adaptation process. The objective of this research is to assess the extent global climate change has relationship with planet protection in a multinational adaptation using a family of approaches collectively described as empirical statistical downscaling as a methodology. Yet, there is a growing emphasis internationally on understanding the role of, and the need to engage businesses in adaptation looking at their potentials to finance projects, as well as develop and deploy technologies and innovative solutions, and enhance the scale, and cost-effectiveness of certain adaptation criterion. In several occasions, many multinational corporations (MNCs) are purportedly beginning to take steps to adapt their operations to climate change. Some stated reasons for their engagement which include minimising potential impacts on their supply chains, improving resource efficiency, enhancing the production and use of sustainable raw materials, and supporting customers', suppliers' and communities' efforts to adapt to climate change. In conclusion, there is a paucity of work analysing adaptation actions by MNCs, their motivations and contribution to broader adaptation and climate resilient development efforts, as well as possible instances of maladaptation. We apply a three-tier framework on drivers, responses and outcomes to examine the state of knowledge according to recent literature on private sector and MNC adaptation to climate change. The research recommends building adaptive capacity of the MNCs, its supply chain and of the community where it operates; to transferring as well as adopting technologies and acting on opportunities related to adaptation.

Keywords: Global warming, Climate Change, Planet, Adaptation, MNC

Introduction

Climate is constantly changing, and the signals indicating that changes are occurring can be evaluated over a range of temporal and spatial scales. Climate can be viewed as an integration of complex weather conditions averaged over a significant area of the Earth (typically on the order of 100 km² or more), expressed in terms of both the mean of weather represented by properties such as temperature, radiation, atmospheric pressure, wind, humidity, rainfall and cloudiness (among others) and the distribution, or range of variation, of these properties, usually calculated over a period of 30 years. As the frequency and magnitude of seemingly unremarkable events, such as rainstorms, change, the mean and distribution that characterize a particular climate will start to change. Thus the factors influencing climate, as defined here, range from events occurring over periods measured in hours on up through global processes taking centuries.

Today, it is widely agreed by the scientific community that climate change is already a reality. The rate and duration of warming observed during the twentieth century are unprecedented in the past thousand years.

Increases in maximum temperatures, numbers of hot days, and the heat index have been observed over nearly all lands during the second half of the twentieth century. Collective evidence suggests that the observed warming over the past fifty years can be mostly attributed to human activities.

Global warming involves a temperature change on planet Earth. The temperature is climbing gradually so that the average person does not feel it. However, there are indirect lines of evidence that the average person can see and feel. Increasing unusual weather patterns reported by the news media nearly every day indicate climate change. More floods in parts of the world and more intense droughts in others indicate climate change. Fires raging in some areas and unusual snowfalls in others indicate climate change. A season of intense tornados and more intense hurricanes indicates more energy in the atmosphere and that is climate change. As the Earth's global temperature increases, rates of evaporation also increase placing more water in the atmosphere. More evaporation dries out the land, soils, forests and takes more water from the ocean. All are signs of a changing climate. A warming Earth is climate change and it is affecting everyday life throughout the globe. Thus 'global warming' is used to refer to Earth's gradually increasing temperature.

Planet protection is a practice and guiding principle of protecting the solar system bodies from contaminations by earth life, and protecting the earth from possible life forms that may be returned from other solar system bodies. When the planet gets warmer, more extreme weather, disappearing Arctic ice cap, and receding glaciers throughout most of the world have consequences, such as drowned coastal areas, decline of the polar bears and other Arctic animals, and disappearing, glacier-fed, fresh water supplies for over a billion people. The current rate of sea level rise is 3.2 mm per year, which a cause for concern in low-lying or hurricane-prone coastal areas like Bangladesh, or certain disappearing Pacific islands, or the U.S, Gulf Coast.

Climate change is expected to lead to major impacts on human and natural systems and increase risks for individuals, businesses, infrastructure, assets and economies (IPCC, 2014a). No single intervention will deliver adaptation to climate change, as efforts cutting across various sectors and timescales will be required. Adding to this complexity is the uncertainty and long-term timescales of climate change impacts, which go beyond normal investment decision cycles in the private sector and policy planning cycles of governments (McKenzie Hedger *et al.*, 2008) ^[14]. The magnitude of the climate challenge has led to a growing recognition at international and national levels of the need to engage multinationals (Biesbroek *et al.*, 2010) ^[5].

Yet, the role and impact of multinationals in delivering adaptation and, more generally, climate- resilient development, is poorly understood-perhaps with the exception of certain sectors, such as insurance, tourism, energy and utilities or the food and beverage sector, that have been more visible in terms of their response to climate risks. There is also very little assessment of how private sector action can potentially increase risks and lead to maladaptation, i.e. actions that lead to inadvertent increases in vulnerability to climate change impacts (Barnett and O'Neill, 2010) ^[2].

Private corporations differ in size, and in the location and economic sector they operate in. Some are single businesses operating locally while others, known as Multinational Corporations (MNCs) have a parent company that controls assets and equity capital of subsidiaries, associate enterprises

or branches operating across various countries (United Nations Conference on Trade and Development (UNCTAD), 2014).

An important pre-requisite for MNC and private sector adaptation is a capacity to adapt. Adaptive capacity influences the extent a business is aware of its vulnerability, and can evaluate, make decisions about and implement adaptation measures, whether in anticipation or in response to climate change impacts (Berkhout *et al.*, 2004) ^[3]. In this context, building adaptive capacity is important and involves creating the information and conditions (regulatory, institutional, and managerial) that are needed before adaptation actions can be undertaken. Not all corporations have adequate capacity to deliver adaptation to climate change for their operations or the communities in which they operate. This is why under the Climate Investment Fund over USD29 million has been set aside to "contribute to the financing of innovative programs and projects that engage the private sector in activities associated with reducing countries' exposure to climate risk and uncertainty" (Climate Investment Funds (CIF), 2014).

Climate change is as to block pathways out of poverty in developing countries mostly Africa. Any increase in disasters whether large or small will threaten development gains and hinder implementation of Sustainability Development Goals (International Consortium for Agricultural Systems Application, 2016). In the decades to come, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to the existing hazards (International Consortium for Agricultural Systems Application, 2006) because there is no best solution to climate change, so, it provides new incentives for the need to plan ahead and to anticipate extreme events and trends. With the context of extreme weather events mostly flooding, management strategies must meet the present needs while providing a path of adjustment for the future.

Statement of the Problem

Nigeria, and other parts of the world are exposed to climate change-induced dangers of desertification, erosion, flooding, frequent and intense drought, storms, heat waves, rising sea levels, ocean acidification, shift in wind pattern, health effect, severe hurricane, hotter temperature, as greenhouse concentration rise, so does global source temperature, and other ecological problems. Climate change and protecting the planet are global problems that need a global solution, and are one of the most serious issues on the global political agenda with series of efforts to find solutions through Multinationals approach, international collaborations, and negotiations which informed the research.

By the state of relationship between climate change and planet protection, Nigeria and indeed, the world are highly at risk in the area food and nutrition, poverty and hunger. Nigeria efforts and multinational enterprise actions must be informed by these realities as it affects different sectors of the economy in Nigeria like Aviation, oil industry, Agriculture, Water resources, energy, health, mining, manufacturing, engineering and construction, service industries, transportation and quaternary sectors.

Objective of the Study

1. To assess the extent global climate change has relationship with planet protection in a multinational adaptation

Defining MNCs adaptation to climate change (conceptual review)

Adaptation to climate change is defined in the 5th Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) as “the process of adjustment to actual or expected climate and its effects” (IPCC, 2014b). A key challenge for any study on adaptation and businesses is terminology: companies use a wide range of terms when describing their responses to climate risks: resilience, business continuity, enterprise risk management, or flood risk management, to name a few. Looking for ‘adaptation’ may not necessarily reveal any of those actions. As mentioned by Agrawala *et al* (2011) ^[1] many actions undertaken by businesses to improve their resilience or manage environmental or climate risks may be part of their standard risk management processes and will not be explicitly labelled as adaptation.

The need for clarity on the definition of adaptation for MNCs is important as there is confusion amongst businesses of its meaning. In particular, the synergies and distinctions between adaptation and mitigation are far from clear in a corporate context (United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). For example, a 2009 survey by Natural Resources Canada found that of the 40% of businesses claiming to be taking adaptation measures 73% of them were in fact describing mitigation actions and only 18% described adaptation actions, while the synergies between both sets of actions were largely overlooked (National Round Table on the Environment and the Economy (NRTEE), 2012) ^[17].

In addition, it is important to consider whether and in what way adaptation to climate change means anything new or different for businesses. Anticipating and responding to risks is considered business-as-usual for many companies, alongside their efforts to respond to other external changes and stressors, such as industry structures and institutional conditions, suggesting that corporate adaptation is part of corporate risk management.

Weinhofer and Busch (2013) ^[24] see adaptation as involving the generic risk management stages of identifying, assessing and responding to the risks. In fact, many companies appear to incorporate climate change risks into existing risk management or business continuity plans and processes. A 2012 CDP study of the UK FTSE 100 companies found that only 10% of companies surveyed have a specific climate change risk management process, whereas 88% have integrated risk management into their multi-disciplinary company-wide risk management processes (Carbon

Disclosure Project (CDP), 2012b). This trend does not appear to be UK specific as Crawford and Seidel’s study of the S&P Global 100 companies found that a majority of companies reported including changes in extreme weather risks due to climate change into existing business continuity plans and processes (Crawford and Seidel, 2013) ^[6].

Yet, adaptation to climate change may represent an additional challenge for business beyond adapting to economic, policy or legislative changes, as it involves adapting to complex, non-linear and potentially irreversible environmental changes with uncertain impacts (Linnenluecke and Griffiths, 2010). Climate change can also be seen as a ‘risk multiplier’ and businesses have yet to understand its full meaning and impact on all aspects of their business and in particular their supply chains (Gledhill *et al.*, 2013). Through the application of a three-tier framework on drivers, responses and outcomes the following section investigates the state of knowledge according to recent literature on private sector and MNC adaptation to climate change. A family of approaches collectively described as empirical statistical downscaling is used as a methodology.

An analytical framework for taking stock of the state of knowledge

A tripartite division is proposed based on a distinction between drivers of MNC adaptation, responses by MNCs and outcomes of MNC actions (see Figure 1). This is a simple framework, which can be applied at company level (MNC), for a certain sector or to geographical boundaries such as a country, region or city. At a given point in time an MNC may experience multiple drivers and these may vary not only by industry but also by the country where it is domiciled or where it operates. Similarly, a company may pursue multiple responses with various outcomes. The result is a dynamic setting characterised by continuous feedback loops that both shape and are shaped by MNC adaptation actions.

The analytical framework proposed is useful for three main reasons. First, it allows for the collation of a very diverse set of studies according to consistent categories to enable us to summarise the state of knowledge. As each dimension is understood and clarified it becomes useful for the relevant actors in each domain, in particular for policymakers who are interested in promoting MNC-led adaptation while ensuring that it adds to broader societal adaptation. Second, the approach enables identification of questions that remain unanswered and to outline a way forward to address the main gaps. Third, it is a tool to help deal with the considerable diversity of MNCs across sectors and jurisdictions.

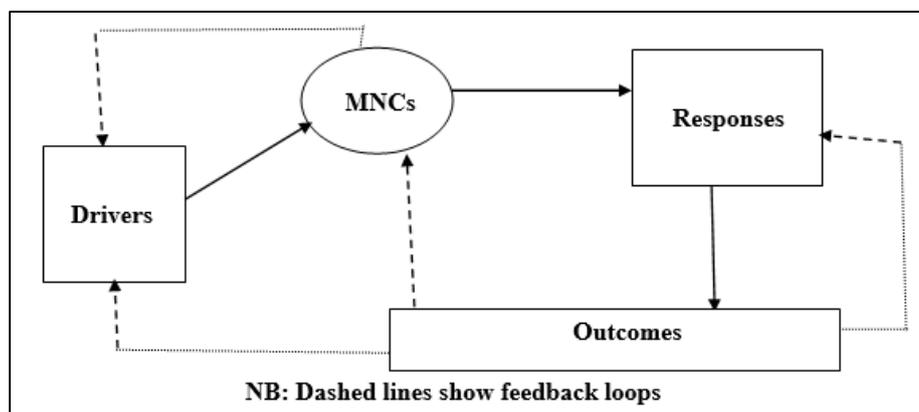


Fig 1: Analytical framework for understanding MNC

Some relevant points concerning the application of our analytical framework to the literature need to be stated. First, evaluating MNC climate change adaptation actions is complicated by several factors. Example, as highlighted above, organisations not classify their actions as adaptation per se, and may use other terms, such as resilience or risk management. In light of this, lack of conceptual clarity we have opted to be inclusive in reviewing a broad array of papers with a different understanding of adaptation. Our approach responds to the cross-disciplinary treatment required to understand actions by MNCs in response to climate change and its impacts.

A second related point is the use of the term 'private sector' which is often applied interchangeably and unevenly across academic and policy literature often with little clarification whether referring to MNCs or other types of corporations. Our review suggests large companies have received more attention than small and medium sized businesses but findings are far from representative of the population of MNCs that in 2009 amounted to 82,000, with approximately 810,000 foreign affiliates worldwide (United Nations Conference on Trade and Development (UNCTAD), 2009). Our review of MNC adaptation to climate change was based on two main sources: (i) relevant peer-reviewed academic papers through searches in Web of Science and Google Scholar; and (ii) relevant grey literature, as this literature reflects some of the latest thinking in the field (Wilby and Vaughan, 2011).

MNC adaptation and the investor carbon disclosure project

Given a paucity of systematic data as input to our analytical framework we undertook a quantitative review of responses to the Investor CDP survey by a subset of companies in the 2012 Global FT 500 list who voluntarily answered the questionnaires at two points in time: 2009 and 2010. Our final sample consisted of a total of 386 corporations. Our examination did not review open-ended questions.

We found the source an imperfect input for our three-part framework; not unexpected, since CDP investor's questionnaires were not designed with adaptation analysis in mind. Only in 2009 did it include a limited number of adaptation question. At a more basic level it remains unclear to what extent responses conflate adaptation with risk management, resilience, etc. Limited instrument validity and reliability suggest adaptation research reliant on CDP data to be at best exploratory. In-depth interviews can help to validate conclusions (see for example Agrawala *et al* (2011))^[1].

The growing role of MNCs for overall adaptive capacity raises the desirability of a data collection effort specifically designed to monitor private sector adaptation. This would go beyond UNFCCC's Adaptation Private Sector Initiative (PSI) designed to assist developing countries to improve their understanding of climate change impacts and their vulnerability, and respond accordingly.

Drivers of multinational corporation adaptation to climate Change

Understanding what might drive and motivate the private sector and in particular MNCs to adapt to climate change is critical as it can enable policy makers to provide and support favourable conditions for corporate adaptation and can provide entry points for non-profit organisations, international organisations and governments to engage with businesses on

climate change adaptation. Our review of the literature finds that private sector adaptation action appears to be motivated by a range of drivers external and internal to a business. These drivers are discussed below, although we recognise that this internal/external division is slightly artificial, as the internal capabilities and processes of businesses are influenced by markets and shaped by and fitted to their external social and institutional environment (Berkhout, 2012)^[3].

Internal Drivers

Internal factors and capabilities within a company can influence its decision to adapt to climate change (Berkhout, 2012; Galbreath, 2011^[3, 10]). Companies will seek to reduce costs, minimise disruption to their production and services, increase their profitability and improve their ability to do business, which can all be motivating factors for adaptation action. In addition, key decision makers such as executives, managers and change agents at lower levels of a company can play a key role in influencing a company's pro-environmental behaviour. Based on findings from the Caring for Climate survey UN Global Compact *et al* (2011) highlight the need for internal champions to identify and communicate climate risks and opportunities and support adaptation decision-making. They state that foreign ownership, firm size, export orientation, financial performance all correlate with environmental performance and are likely organisational predictors of corporate engagement on climate change. Although they focus on mitigation aspects, these factors may be an important factor in a company's actions on adaptation to climate change.

External Drivers

Many businesses are already experiencing direct and indirect climatic impacts and anticipate that these will increase in the future (Agrawala *et al.*, 2011; Galbreath, 2011^[1, 10]). These climatic impacts have been identified as one of the key drivers for private sector adaptation to climate change, as businesses start to internalise and consider these risks in their investment decisions.

Agrawala *et al* (2011)^[1] found that although private sector awareness of climate risks was increasing, only a minority of businesses who responded to the survey had conducted risk assessments and fewer still had evaluated adaptation options, which suggests that awareness of climate risks alone will not be sufficient to drive large-scale adaptation action in the private sector. Regulatory and legal drivers also play a critical role in stimulating private sector engagement by encouraging or requiring adaptation action by businesses.

In addition, financial disclosure rules can require companies to disclose the physical risks from climate change when these risks impact a company's financial situation. Such disclosure rules or guidelines are in place for companies listed on exchanges in the US, Australia, Denmark, South Africa, Sweden and the UK (Crawford and Seidel, 2013)^[6]. Governments also have a key role to play in encouraging MNC adaptation by providing credible, readily accessible scientific information, models and tools, co-financing research and development of new products and services, and forming public-private partnerships (Agrawala *et al.*, 2011; Crawford and Seidel, 2013^[1, 6]; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). For example, the Spanish government is supporting the development of new technologies to improve water resource management through CETAqua, a public-

private partnership between the government, a university and the water company Agbar (United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). Reputational, corporate citizenship and stakeholder/investor pressures represent additional stimuli for private sector adaptation, as they may enhance the rationale to act.

The Global Framework for Climate Risk Disclosure released in 2006 is a guidance from institutional investors to companies reporting on climate change and calls for them to report on the material and physical impacts that climate change may have on their business and operations as well as on the actions they can take to adapt to these impacts and the costs of such actions (Crawford and Seidel, 2013) ^[6]. However, some authors suggest that reputational drivers and corporate citizenship are unlikely to drive strategic adaptation and may instead only result in superficial and cosmetic changes (Agrawala *et al.*, 2011 ^[1]);

Market drivers also play a role, as companies seek to respond to changing demand, develop new products and services, access new markets and seize new business opportunities from climate change (Agrawala *et al.*, 2011 ^[1]; Carbon Disclosure Project (CDP), 2012a.

As stated by the managing director of the Carbon Disclosure Project: "Adaptation is not only a story of risk management, but also of opportunity. Companies that act today may gain competitive advantage tomorrow. Adaptation, in short, is good business" (Carbon Disclosure Project (CDP), 2014). Several sectors have recognised that adaptation represents new business opportunities, including the agricultural, consulting, water and insurance sectors.

Multinational corporation adaptation responses

Categorising adaptation responses

There are thus various ways in which MNC adaptation responses can be categorised. A common distinction is between anticipatory/proactive and reactive adaptation (Smit *et al.*, 2009). Reactive adaptations are implemented in response to a climate hazard or extreme event such as flooding that necessitates an urgent response. Proactive adaptation is becoming increasingly urgent for business to reduce or avoid adverse climate impacts and to seize beneficial opportunities (Munasinghe and Swart, 2005) ^[16]. There are some examples of pioneering proactive MNC responses such as IBM's development of a software system to collect and analyse weather, rainfall and water-level data to support local government and emergency decision making on flood threats and evacuation plans (Forstater *et al.*, 2009). However, proactive business stances have been hampered by perceived uncertainty about the magnitude and timing of impacts, as well as a lack of policy and regulatory incentives. Reactive approaches continue to dominate and be perceived by corporations as sufficient (Kolk and Pinkse, 2005). This standpoint is often based on the view that existing management structures are adequate to manage climate related risks or that handling slow onset climate changes is simply an extension of well-established incremental adjustments to other changes or risks (National Round Table on the Environment and the Economy (NRTEE), 2012) ^[17].

Adaptation processes can be divided further into three broad categories: no adaptation actions, no regret or 'soft' adaptation measures or thirdly, the implementation of 'hard' adaptation measures (Agrawala *et al.*, 2011) ^[1]. In other words, MNC adaptation responses can be understood as

ranging from indifferent or 'wait and see' to active. Some companies are yet to take any adaptation measures. This 'no adaptation' response can be attributed to multiple factors, which are often company specific. No regret/soft adaptation activities characteristically address current climate variability concerns and are co-beneficial to existing operations, while also supporting resilience to climate variability and risks. In some cases, they are likely to have been undertaken irrespective of predicted climate change impacts. Such measures usually entail adapting existing procedures and operations to be more flexible or resilient to climate change. Examples include early warning systems, insurance schemes and 'green infrastructure' such as restoration of wetlands.

Responses level of MNCs engagement and risk faced

Drawing on CDP data, several authors (Crawford and Seidel, 2013) ^[6] have developed detailed analyses of how MNCs are addressing climate change risks. Based on their investigation of CDP data from 136 Global S&P 500 companies Kolk and Pinkse (2005) propose a useful typology (ranging from 'cautious planner' to 'explorer' corporations) for categorising MNCs according to their emergent climate change response strategy. They found that the majority (67%) of corporations fall in the narrow range of 'cautious' (little to no specific climate measures in place) to 'emergent' planners (early stages of considering a more comprehensive and concrete climate strategy). Only 5% of corporations were classified under their definitive cluster: 'horizontal explorers' (exploring and entering new markets and opportunities, sometimes through partnerships). Our review of the literature broadly affirms this trend with the most common MNC adaptation responses falling under cautious or emergent planner categories, often with a strong internal focus.

Some climate risks are internal, some emerge across supply chains and others relate to external risks such as shareholder expectations and regulatory markets (National Round Table on the Environment and the Economy (NRTEE), 2012) ^[17]. Given their diversity, MNCs experience different combinations of these risks, which in turn result in either internal or external responses, or both. Commonly reported methods used by MNCs to manage physical climate change risks include using conventional business continuity or emergency preparedness plans, conducting a specific environmental vulnerability assessment, investing in upgraded equipment or infrastructure, transferring risk through insurance policies, and using climate change specific research or forecasting models to supplement conventional risk management activities (Crawford and Seidel, 2013; Gasbarro, 2013) ^[6].

Multiple additional categories of private sector response to climate change can be identified in the literature: risk management strategies, climate change sensitivity analyses, changes in operational practices; activities in political arenas; changes in corporate governance; public awareness campaigns, capacity building, entering new product markets/diversification; working with existing suppliers to ensure minimisation of climate impacts, geographical diversification and relocation, inter-firm co-operation; changes in operational practices; research collaborations and initiating partnerships or collaborations for supporting adaptation (Agrawala *et al.*, 2011 ^[1]; Crawford and Seidel, 2013; Galbreath, 2011) ^[6, 10]

As a specific adaptation response in the consumer products sector India Unilever transformed laundry detergent to need less rinsing with a consequent predicted annual saving of 14

billion litres of water in the region and, for the water sector, Siemens is working on technology to reduce the cost and energy intensity of sea to drinking water conversion (Forstater *et al.*, 2009). Often, these specific adaptation measures are undertaken as collaborative ventures between business and public or third sector actors. Some MNCs in the insurance industry have explored the issue of climate change by collaborating with scientists, publicly engaging in policy debates, and also assessing the climate impacts on and opportunities for their own products (Mills, 2009) ^[15]. They do this on their own or through sectoral initiatives, such as Climate Wise and UNEPFI's Insurance Working Group, as well as industry organisations such as the Chartered Insurance Institute, the Geneva Association and national trade bodies. Surminski (2010) provides an illustration of how some insurers are engaged in risk reduction activities in the context of climate adaptation. The initiatives include raising awareness of disaster risks, promoting action by government, developing new modelling and risk assessment capabilities and supporting action by individuals through incentives, information, financial support and terms and conditions for policies.

Other MNCs such as SABMiller and Nestle have adopted a strong partnership ethos to support improved resource management decisions and facilitate local knowledge sharing in the communities in which they operate (Wales, 2014). Public-private collaboration on resilience building and adapting to climate change are often most effective when linked objectives exist within a sector but opportunities to scale-up such co-operative arrangements have been inadequately

Outcomes of multinational corporation adaptation

Evaluation of adaptation to climate change by private sector in general and by MNCs specifically has not received much attention in business and management academic literature (Goodall, 2008; Patenaude, 2011) ^[12]. One of the challenges for the evaluation of outcomes by MNCs is the lack of incentives for companies to share the information about their climate risk exposure and actions to address it, since it can be sensitive for their competitiveness (Agrawala *et al.*, 2011) ^[1]. While there are a range of case studies and illustrative examples, no comprehensive measure exists to calculate the impact of adaptation activities. Measuring and tracking climate resilience is inherently difficult, not just in the context of the private sector (Surminski, 2013; Wilby and Vaughan, 2011). Furthermore, the interplay of different actions and the difficulty in defining baseline conditions without the interventions make attribution of impact to a particular adaptation response a challenging task. For example, reduced damages from flooding could be due to changes in planning control or construction of new flood defences or an artefact of natural variability in the flood regime (Wilby and Vaughan, 2011).

Reflections on the current understanding of multinational corporations and climate adaptation

The analytical framework presented in this paper has allowed us to consider MNC adaptation along three dimensions: what triggers and stimulates adaptation action ('drivers'), what type of action is taken ('response'), and what are the implications of these actions ('outcome'). There are three-tiered framework to include additional components and feedback loops that characterise MNC climate change adaptation and emphasises the broader societal context that

has a constraining or facilitative effect on such adaptations. Feedback loops in particular deserve attention as additional entry points to advance MNC and overall societal adaptation.

The Knowledge gap and Fault-Finding Thoughts

MNCs are still predominantly at early stages in adaptation responses, often making slight adjustments to existing practices without full consideration of climate change risks. As such multinationals have to date tended to respond to climate adaptation concerns through several key overarching strategies: redesigning or developing new practices and products within their own operations to improve resilience to climate impacts; by building a resilient workforce and redesigning or developing new products and services that assist vulnerable countries and communities to adapt to climate and other risks; through initiating partnerships with governments, communities and other actors to develop resilience-building policies and practices, stopping service for product provision, or ignoring climate change.

A further major gap is the lack of critical assessment of the risk of maladaptation by MNCs. Considering the growing demand for private sector engagement in adaptation, particularly within developing countries (Biagini and Miller, 2013; Pauw and Pegels, 2013) ^[4, 19], it is critical to understand if and how actions by MNCs can benefit or hinder societal adaptation, growth and development efforts, particularly in developing countries. This is a critical policy question to enable governments to amplify synergies between MNC-led and government-led adaptation efforts in the countries where MNCs operate and to minimize potential adverse impacts. In addition, another area that merits further analysis is the extent to which various forms of partnerships on adaptation between MNCs, governments, NGOs and academia influence the capacity to adapt and implementation of adaptation action both for the MNCs and the communities.

Finally, MNCs adaptation remains a nascent area of investigation and would greatly benefit from further interdisciplinary research and integration of the lessons learnt. For example, applying insights from risk management and organisational change literature to climate change-related stimuli, as well as building upon the more extensive literature on CSR would help generate relevant knowledge on MNC adaptation.

Conclusion and Recommendation

Growing interest among policy makers to 'engage with the private sector' and MNCs in particular has brought the expectation that MNCs will play a key role in driving adaptation. The very extensive and diverse body of work reviewed here notwithstanding, additional research is still required to understand more fully the relative importance of different drivers of MNC adaptation, the extent that adaptation responses embody climate change risk substantially, and the impacts or outcomes of adaptation measures for societal and organisational resilience. Key limitations are in part due to lack of conceptual clarity about adaptation and of benchmark objectives and evaluative criteria. Our review summarises insight from the recent literature into how researchers and adaptation experts have approached MNC adaptation, as well as how companies themselves have presented their activities. However, we notice that while providing useful pointers, this often does not provide the answers to key questions that decision makers' may have.

Based on our analysis, we suggest moreover that such guidance would benefit from a comprehensive evaluation of outcomes of adaptation responses by MNCs to a set of objectives, from reducing vulnerability of the MNCs itself, of its supply chain and of the community where it operates; building adaptive capacity of the MNCs, its supply chain and of the community where it operates; to transferring as well as adopting technologies and acting on opportunities related to adaptation. An adaptation-focused systematic data collection effort to monitor MNCs and more broadly private sector adaptation could support such efforts. Determining synergies with national adaptation policies and an appropriate mix of public policy and market responses requires better understanding of internal and external drivers and responses of corporate adaptation as well as their outcomes.

In other words, what is needed is better clarity on the broader context and a consideration of 'what we need to know about MNC adaptation and why'. Determination of 'what do we need to know about MNC adaptation and why?' clearly depends on the state of current knowledge relative to the problems that need addressing: for a business it may be a question of better understanding the actions by competitors or assessing climate resilience of suppliers. For governments, the focus may be on how much action can be expected privately, what policies are required to support and/or incentivise adaptation action, or how to avoid maladaptation. The articulation of an appropriate mix of public policy and market responses depends on a better understanding of the current level of corporate adaptation.

References

1. Agrawala S, Carraro M, Kingsmill N, Lanzi E, Mullan M, Prudent-Richard G. Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks. OECD Environment Working Papers No.39. OECD Publishing, 2011, 56.
2. Barnett J, O'Neill S. Maladaptation. *Global Environmental Change*. 2010; 20:211-213.
3. Berkhout F. Adaptation to climate change by organizations. *Wiley Interdisciplinary Reviews: Climate Change*. 2012; 3:91-106.
4. Biagini B, Miller A. Engaging the private sector in adaptation to climate change in developing countries: importance, status and challenges. *Climate and Development*. 2013; 5:242-252.
5. Biesbroek GR, Swart RJ, Carter TR, Cowan C, Henrichs T, Mela H, Morecroft MD, *et al.* Europe adapts to climate change: Comparing National Adaptation Strategies. *Global Environmental Change*. 2010; 20:440-450.
6. Crawford M, Seidel S. Weathering the storm: building business resilience to climate change. Centre for Climate and Energy Solutions, 2013, 112.
7. Carbon Disclosure Project (CDP), Climate change resilience in Europe. A snapshot of the private sector. Report prepared by Acclimatise, 2014.
8. Climate Investment Funds (CIF), Access to competitive funding (2nd round) - For innovative programs and projects that engage the private sector in PPCR, 2014.
9. Forsyth T. Panacea or paradox? Cross-sector partnerships, climate change, and development. *Wiley Interdisciplinary Reviews: Climate Change*. 2010; 1:683-696.
10. Galbreath J. To What Extent is Business Responding to Climate Change? Evidence from a Global Wine Producer. *Journal of Business Ethics*. 2011; 104:421-432.
11. Gasbarro F. Corporate responses to climate change: from a mitigation to an adaptation perspective. PhD Thesis. Scuola Superiore Sant'Anna, 2013, 147.
12. Goodall AH. Why Have the Leading Journals in Management (and Other Social Sciences) Failed to Respond to Climate Change? *Journal of Management Inquiry*. 2008; 17:408-420.
13. Kolk A, Pinkse J. A perspective on multinational enterprises and climate change: learning from 'an inconvenient truth'? *Journal of International Business Studies*. 2008; 39:1359-1378.
14. McKenzie Hedger M, Mitchell T, Leavy J, Greeley M, Downie A, Horrocks L. Desk review: evaluation of adaptation to climate change from a development perspective. Institute of Development Studies, 2008.
15. Mills E. A global review of insurance industry responses to climate change. *The Geneva Papers*. 2009; 34:323-359.
16. Munasinghe M, Swart R. Primer on climate change and sustainable development: Facts, Policy analysis and applications. Cambridge University Press, Cambridge, 2005.
17. National Round Table on the Environment and the Economy (NRTEE), Facing the Elements: building business resilience in a changing climate. Advisory report. Canada, 2012.
18. Patenaude G. Climate change diffusion: While the world tips, business schools lag. *Global Environmental Change*. 2011; 21:259-271.
19. Pauw P, Pegels A. Private sector engagement in climate change adaptation in least Developed countries: an exploration. *Climate and Development*. 2013; 5:257-267.
20. Pauw WP. Not a panacea: private-sector engagement in adaptation and adaptation finance in developing countries. *Climate Policy*, 2014, 1-21.
21. United Nations Global Compact, United Nations Environment Programme (UNEP), Business and climate change adaptation: toward resilient companies and communities, 2012.
22. United Nations Conference on Trade and Development (UNCTAD), World Investment Report 2009: transnational corporations, agricultural production and development, 2009.
23. Wales A. Making sustainable beer. *Nature Climate Change*. 2014; 4:316-318.
24. Weinhofer G, Busch T. Corporate Strategies for Managing Climate Risks. *Business Strategy and the Environment*. 2013; 22:121-144.