

Climate adaptation in manufacturing firms: lessons from Surat

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Introduction

- Climate change can induce various risks for firms and on its supply chains (Linnenluecke, et al. 2012)
- Predominant focus of adaptation has been governments and communities and not firms
- World Economic Forum (2015) listed the failure of adaptation measures by businesses as number five among global risks with highest impact

Introduction (contd.)

- Adaptation in the context of industries has been examined in Chapter 11: Industry, Energy, Transportation and Adaptation of the IPCC's Second Assessment Report which notes that certain components of industry, energy and the transport sectors display a greater degree of sensitivity to climate change.
- Gap in literature on climate proofing of industrial networks
- Focus on climate risks faced by industrial firms
- Role of adaptation measures of firms in case of slow versus sudden onset climate events

Overview of presentation

- Introduction
- Literature
- Surat's climate profile
- Surat's industrial profile
- Slow onset versus sudden onset adaptation in Surat
- Key messages
- Policy implications

Climate change adaptation and firms

- The effect of climate change varies across business structures so adaptation can take many forms.
- Adaptation is complex and a firm's response will be determined by whether the impact, is in the short or long term.
- Many firms may not classify their actions as adaptation and use risk management to describe some measures of adaptation (Averchenkova, et al. 2015).

Adaptation by firms

- What is required for climate change adaptation by firms:
- First, understanding the nature of the climate risk;
- Second, assessing the vulnerability that the firm faces with respect to the risk,
- Third, understanding the nature of the regulatory barriers that may arise in overcoming the vulnerability.

Adaptation 1

- “Development is the best form of adaptation”
- IPCC (2012) Special Report on *Managing the Risks of extreme Events and Disasters to Advance Climate Change Adaptation* – role of development policy in addressing climate change has been recognized in the literature, the same cannot be said about its underlying causes
- Stern (2006) *Stern Review* – “Adaptation is the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect”

Adaptation 2

- IPCC has defined adaptation as “any adjustment in natural or human systems in response to actual or expected stimuli or their effects..”
- The IPCC’s Fifth Assessment Report, AR5 (2014) underlines the fact that the adaptation literature ascribes different meanings to the terms opportunities, constraints and limits and this increases the ambiguities related to understanding the issue or addressing it
- It also points out that in moving from the general definition, it is important to understand who is adapting, to what are they adapting, and what is the process of adapting (Smit et al. 1999)?

Adaptation 3

- Developing countries are the most vulnerable to climate change, as noted by the UNFCCC (2007). The UNFCCC's Adaptation Private Sector Initiative is designed to assist developing countries' in their adaptation efforts.
- Based on the findings of the Fourth Assessment Report (AR4), and drawing largely from Chapter 17, Assessment of Adaptive Practices, Options, Constraints and Capacity (Adger et al. 2007), it can be concluded that there are substantial limits and barriers to adaptation, particularly in developing countries. For such countries, adaptation constraints are related to their governance structures, quality of national institutions and on-going development challenges
- Adger et al. (2005) evaluation of adaptation is complicated by how adaptation will work under changing conditions including short and long term impact of adaptation action

Literature 1

- Activities sensitive to climate change include transportation, construction, offshore oil and gas production, manufacturing dependent on water, tourism, and industry located in coastal regions or permafrost regions: the effect of climate change on these industries and the transportation sector will vary according to the risk they face.
- Surveys of the research on these issues have suggested that only a small percentage of firms conduct strategic adaptation (defined as anticipatory and target-oriented action to increase resilience to climate change (Meinel and Schule, 2018)).
- Based on a search of the Scopus database, Tan et al. (2017) conclude that only two papers have addressed this issue since 2005. Both papers were on energy production.

Literature 2

- Linnenluecke, et al. (2012) offers a framework for organizational adaptation and resilience to extreme weather events for firms. It states that while firms have organizational capabilities for addressing challenges arising out of competitive conditions, they are largely not equipped to handle situations arising out of extreme weather events.
- Agrawala et al. (2011) classifies adaptation responses into three categories: no adaptation, 'soft' or no regret, and 'hard' or implementation of adaptation measures.
- CDP data reveals that most of MNCs are 'cautious' or with little or no climate measure in place

Effect of climate on industry 1

- The sectors in agro industries that depend on products such as grain, sugar and rubber are vulnerable to changes in precipitation patterns and intensity of extreme weather events.
- Sea level rise would affect the cost of protecting transport infrastructure and industries located in coastal regions.
- The literature examining the effect of heat has been mainly in the context of residential consumers – more research is needed to examine this effect in the case of firms (Auffhammer and Mansur, 2014).
- Higher temperatures would reduce the need for heating, and increase that for air conditioning.

Effect of climate on industry 2

- GIZ (2013) has presented two cases of adaptation by micro, small and medium enterprises (MSMEs) in the textiles and the metal working industries in India.
- It makes a distinction between the impact of climate change on the location and buildings, operating processes, logistics and stocks, and observes that while the buildings or the logistics and stocks were not particularly affected by climate change (especially in the metal working industry), the operating processes did show decreased productivity in summer months in both industries.
- Majority of small and medium firms do not have the capacity and resources to predict the impact of climate changes on their operations and hence quickly make the adjustments necessary to overcome these challenges.

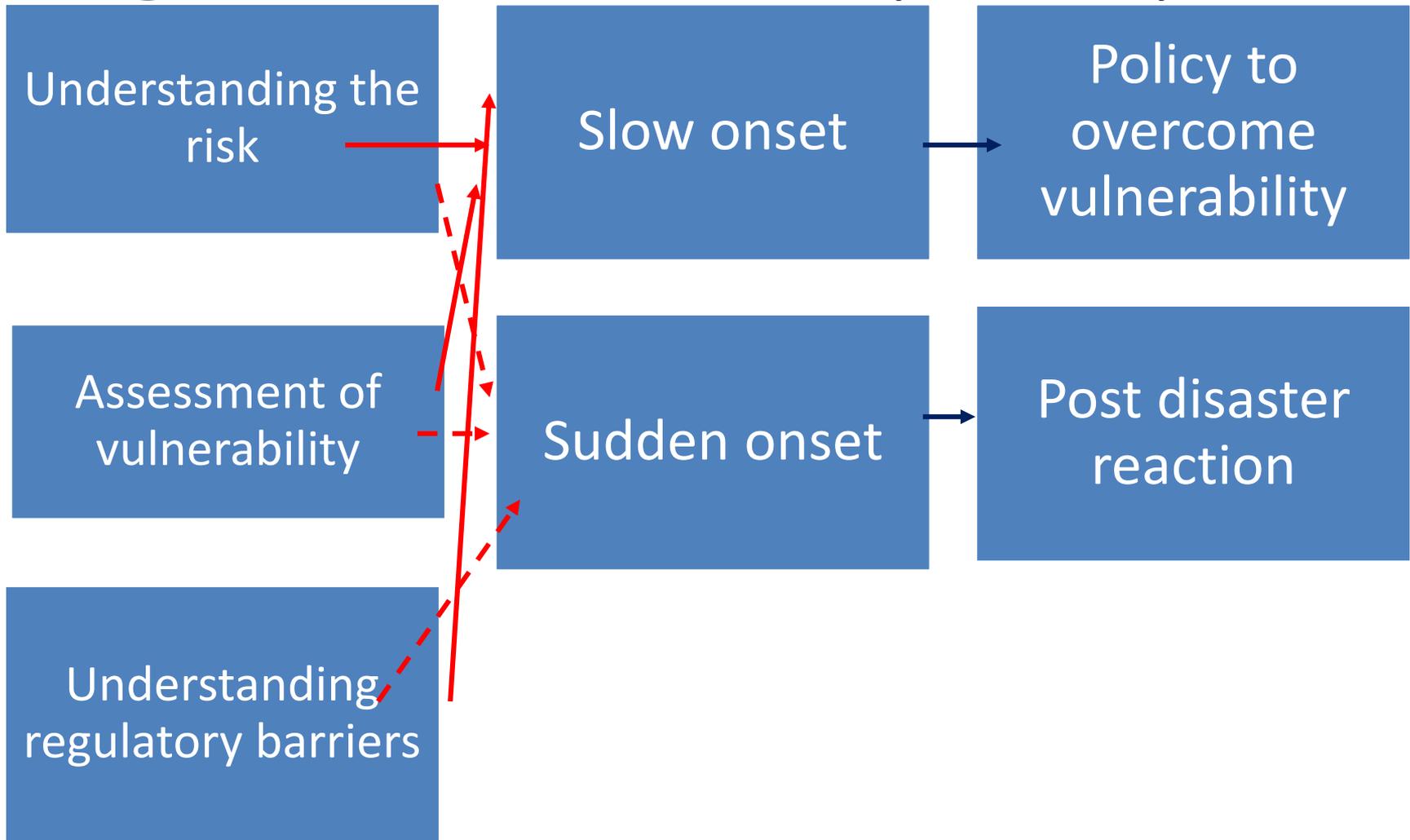
Effect of climate on industry 3

- Three components that play a critical role in dealing with climate change adaptation:
 - First, understanding the nature of the climate risk;
 - Second, assessing the vulnerability that the firm faces with respect to the risk,
 - Third, understanding the nature of the regulatory barriers that may arise in overcoming the vulnerability.
- Once a firm has an understanding of all these aspects, it can, in the case of a gradual onset climate risk, devise a policy to overcome the vulnerability.
- The overall picture is more complicated, since there are interdependencies between these components.
- While numerous studies have looked at the issue of risk (Bierbaum et al. 2013), the second and third parts have not received that much attention. More importantly, the recognition that climate change affects various aspects of a firm's decision making process including its sourcing of raw materials, its inward and outward bound supply chain, as well as the choice of its location, is only beginning to be understood.

Framework for climate change adaptation by firms in slow and sudden onset events

- However, above framework will not hold in the case of a sudden onset climate risk: depending on the losses that the firm faces in one instance, it may take adaptive measures to combat the risk in future.
- Alternatively, policy measures by firms needs to take account those to overcome vulnerability (in case of slow onset) or post disaster reaction (in case of sudden onset)

Figure 1– framework for adaptation by firms



Surat's climate profile

- **Temperature:** Regional climate models (CSAG 2010) show that monthly average maximum temperatures are likely to increase by 0.5° C per decade and between 2070-2100 the maximum temperature may increase by around 4°.
- **Precipitation:** Currently Surat receives annual rainfall ranging from 950-1200mm. Models show that under different scenarios this could increase by 200mm to 450mm. Additionally Surat, due to its physiographic setting, is at risk from extreme point rainfall events (EPRE).
- **Sea Level Rise:** Since Surat is a coastal city, there have been repeated cases of tidal inundation into slums located along the creeks.
- **River Flow:** Surat lies near the estuary of Tapi river and the creeks run across the city. The threat of higher glacial runoff and melting translates into higher risks of increasing water yields of the Tapi (around 22-29% increase for 2070-2100). This exacerbates the risks of river bank flooding.

Surat's industrial profile

- Surat is the India's tenth and Gujarat's second most populous city and the textile hub of the country.
- Today, apart from the traditional industries of textile manufacturing, trade, diamond cutting and polishing industries, intricate Zari works, the base has expanded to chemical industries and the gas based industries at Hazira (near Surat) established by leading industry houses such as ONGC, Reliance, ESSAR, and Shell.
- Much of the industrial development is located within the limits of Surat city. In fact Surat is truly an industrial city with over 50% of workforce engaged in manufacturing activity (GSIDS, 2016).
- Surat is a dominant player in the textile sector. Surat is one of the largest centers in the world for production of synthetic fabrics, mainly nylon and polyester.
- Gujarat accounts for almost 80 percent of the diamonds processed in India. Of this, 90 percent are processed by the units located in and around Surat alone. Out of every 10 diamonds made in the world, eight are made in India, of which seven are cut and polished in Surat.

Slow versus sudden onset in Surat

- How did the different industries adapt to temperature rise (slow onset) versus flooding (sudden onset) in the case of Surat?
- Sudarshan and Tewari (2014) document the responses of the weaving and diamond industry changes in temperature. In the case of the diamond industry and the weaving, the response to the change in temperature was to install more air conditioning. In the case of the weaving industry, more frequent breaks were allowed.
- In the case of the flooding, the diamond industry moved their inputs (raw diamonds) to safer locations. This was not possible in the case of the weaving industry and much of the inputs and newly made output or grey cloth was damaged due to the flooding.
- Due to the nature of the events, in the sudden onset case, there was little time to react (6 hours) while this was not the case in the case of the temperature rise. Hence in case of sudden onset, the adaptation takes the form of post disaster reaction, while in the case of gradual or slow onset; it is possible of design policy to overcome the vulnerability.
- However, even in sudden onset disasters, policies could be designed, if the event were to occur again. Since floods have occurred in Surat many times, lessons have been learnt from previous instances of flooding. One innovative example was the use of the flyovers to park cars with finished goods of the weaving industry in the 2013 flood. In fact, compared to the 2006 floods, the losses for the city from the 2013 floods were insignificant.
- Many other measures were instituted. The first is the installation of the Early Warning System in case of the chance of flooding of the Ukai reservoir. One of the commonest signs around Surat is the markings on the pillars to indicate the level of the water of the 2006 floods. (societal actions)

Evidence of adaption in Surat

Industry	Slow onset	Sudden onset
Weaving	Air conditioning and more frequent breaks for rise in temperature Source: Sudarshan and Tewari (2014)	Use of flyovers to park cars with finished goods in 2013 floods Source: our survey
Diamond	Air conditioning for rise in temperature Sudarshan and Tewari (2014)	Raw diamonds moved to safer location for flooding Source: our survey

Key messages

- Adaptation responses can be categorized in various ways (Burton, 2009; Smit et al. 2009)
- Adaptive capacity has been defined by IPCC as “the potential or capability of a system to adapt to (to alter to better suit)” depends on the changes in processes, practices, or structures that may be needed to combat effects of climate change in the case of manufacturing firms

Policy implications

- Policy responses of firms have to be viewed in the context of slow onset versus sudden onset events
- Policy responses can be designed in case of slow onset events to overcome vulnerability
- In case of sudden onset events, post disaster responses can be designed such that if the event were to occur again, the responses could be faster or better
- Challenges of differences between private and societal effects with private actions leading to maladaptation in some instances – for governments

THANK YOU