



Facing the Impacts of Climate Change: Indian MSMEs and Adaptation



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Foreword



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CMD, SIDBI

Globally responsiveness towards environment protection measures, including reduction in greenhouse gas emissions, has gained momentum. Expectations from businesses on this front have also grown and they have started realizing the emerging new business opportunities from these measures as also themselves dealing innovatively with environment, climate change and social aspects. Realizing the need to enable the country to minimize environmental risks and to adapt to climate change measures while simultaneously seeking to assure greater sustainability of India's growth trajectory, the government is addressing sustainable economic development in its policy agenda and increasing awareness on responsibilities of businesses. SIDBI's efforts are in consonance with the component of enhanced energy efficiency of the National Action Plan on Climate Change of Government of India, which provides incentives and supports businesses in mitigating the risks of climate change and strengthening resilience to the unavoidable effects of climate change through appropriate adaptation measures. There is a need for banks and financial institutions to align their lending operations in accordance with the Environment and Social Risk Framework, which is a global best practice. This has already been piloted by SIDBI for Indian MSMEs.

As a development bank, SIDBI is empowering the entire value chain in the Indian MSME domain with access to financial and non-financial services. By promoting investment in "green" or energy efficient technologies, it is advancing the responsive climate change agenda. We are happy to see this paper as an outcome of our collaboration with GIZ to foster responsible competitiveness among MSMEs.

This discussion paper aims to bring mitigation and adaptation to climate change to the Indian business mainstream by increasing awareness and encouraging constructive dialogue on business action towards reducing the impacts of climate change on the Indian economy. The discussion paper provides MSMEs the necessary background information on climate change impacts and opportunities as well as showcasing a few illustrative case

studies. It aims to raise awareness on business risks related to climate change and how to manage these risks on firm level.

This discussion paper is hence an important step towards strengthening responsible competitiveness and implementing the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business (NVGs) released in 2011 by the Ministry of Corporate Affairs - specifically the environmental responsibilities stressed in the NVGs. We are confident that MSMEs have the inherent vibrancy and resilience to come up to the expectations of a globalised world. We hope this paper would encourage our MSMEs to adopt energy efficiency and environment friendly measures, so as to improve the climate of the country.



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CMD, SIDBI



Foreword



Manfred Haebig
GIZ Private Sector Development

The world has become increasingly aware of the need to reduce greenhouse gas emissions. Businesses globally have started to take advantage of new business opportunities by dealing innovatively with the challenges related to climate change and changes in the framework conditions introduced as policy responses to them. Dealing innovatively with the direct and indirect impacts of climate change can make businesses “climate proof”, minimizing climate risks, while enabling them to gain competitive edge through innovations. Realising the emerging business opportunities, many businesses in India, including micro, small and medium enterprises, MSMEs have started to introduce mitigation measures, for example to improve energy efficiency. However, the private sector at large has not yet recognized how product, process, business model and organizational innovation may reduce risks arising from climate change impacts or enable businesses to make use of new opportunities. Changing framework conditions resulting from climate change or from political responses represent both an opportunity and a risk for the competitiveness of businesses and therefore must be managed accordingly.

Under the framework of Indo-German bilateral development cooperation the German Federal Ministry of Economic Cooperation and Development (BMZ) through its implementing agencies Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and Kreditanstalt für Wiederaufbau (KfW) jointly with and Small Industries Development Bank of India (SIDBI) are strengthening the role of Indian MSMEs to contribute to climate change mitigation and adaptation. Through various activities, SIDBI has shown to be a leader in promoting investment in green or energy efficient technologies among MSMEs.

We at GIZ are convinced that the private sector is essential in the development of “climate solutions”: Industry is the second-largest consumer of energy, with MSMEs accounting for 80% of industrial enterprises. The private sector, including the MSMEs, can therefore play a significant role in reducing greenhouse gas emissions by applying sustainable, resource and

energy-efficient production processes. At the same time, businesses can become "green innovators".

This Discussion Paper is one of the results of the joint efforts of GIZ and SIDBI to strengthen the growth and responsible competitiveness of MSMEs. With illustrative case studies, this paper aims to increase awareness among Indian businesses on mitigation and adaptation to climate change, encouraging dialogue on business action for implementing the National Action Plan of Climate Change, at the same time managing the risks and exploiting the opportunities of climate change. It is an important contribution to strengthening responsible competitiveness and implementing the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business (NVGs) released in 2011 by the Ministry of Corporate Affairs, specifically the environmental responsibilities stressed in the NVGs.

The Discussion Paper is part of a series, aiming to raise awareness and facilitate exchange and debate among MSMEs, their associations and the wider business community on

- business and innovation opportunities related to climate change
- business risks related to climate change

Businesses can get practical support from an E-Learning Programme on www.climate-expert.in, which provides simple tools helping businesses manage climate change risks and formulate a risk management strategy.

We would like to encourage a discussion on the role Indian businesses play in "Greening" the Indian Economy. We hope this Paper contributes to a constructive debate and discourse!



Manfred Haebig, GIZ Private Sector Development

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Executive Summary

Facing the impacts of climate change is a key challenge of this century – not only for governments, but also for communities and businesses. In India expected impacts are particularly great and will affect the fundamentals of its natural environment, with consequences for society and economy.

Climate change phenomena are usually depicted as environmental effects on a macro-level, e.g., rising temperature or change in rainfall patterns, but thinking about the challenges of climate change impacts should not stop here. In order to prepare India for the challenges of climate change, its impacts need to be taken seriously as social, economic and business issues as well.

It is essential to take stock of existing climate change impacts on societies and economies as well as projected impacts that are likely to happen in the future. This includes assessing potential impacts on different actors, as well as an analysis of their options for addressing these. The business sector and individual businesses are, of course, an integral part of this – and in India MSMEs play a particularly important role. Businesses which prepare for climate change impacts, which can be gradual changes or single extreme weather events, first and foremost need to assure their business continuity – but they can also make use of related business opportunities. Responses can range from selecting single effective adaptation measures to developing a comprehensive adaptation strategy. Potentially, this even involves changes in the medium- and long-term business strategy, including the product portfolio of a company.

The report links macro-level climate change trends with their effects on two severely affected MSME- dominated sectors in India, textiles and metalworking. Enterprises in these sectors experience direct impacts on their buildings, manufacturing processes and infrastructure, e.g., from higher frequency of hot days or heavy rainfall, but also indirect impacts



on their supply chains and markets, including rising energy and raw material prices or change of demand in response to climate change effects. Based on a climate change sensitivity assessment at sector level and two case studies at the company level, the analysis shows that climate change plays a catalytic role speeding up and intensifying already existing challenges for MSMEs in India, including resource strain and infrastructural problems. Furthermore the study provides insights on the social dimension of adaptation and its importance for responsible business practices, thereby sketching out the role of business and in particular MSMEs in adapting the Indian society and economy at large.

Climate change impacts like more frequent and more intense floods are already felt by Indian MSMEs, even if they are often not recognised as such. The reasons why Indian MSMEs are particularly affected by climate change impacts are manifold, and they are closely connected to general challenges of MSMEs like limited financial resources and access to credit. At the same time these general challenges to a large part explain why so far MSMEs primarily “react” to climate change impacts rather than anticipate and plan for these. Indian MSMEs are known for their ability to swiftly react and modify according to changes in prices and market demand – however, given the magnitude of challenges that lie ahead this “reactive” approach to climate change adaptation may be too short-sighted. This is all the more true for those MSMEs operating on low technology levels, as they are more severely affected by climate change than businesses with high-technology facilities, and simultaneously have fewer resources and capacities to face climate change impacts.

While the analyses conducted for this report allow drawing first conclusions on the importance of raising the awareness of Indian MSMEs to adapt to climate change, more empirical research is needed to analyse and quantify the overall outlook of the Indian economy, and in particular MSMEs, towards climate change impacts.



1

Introduction and Objectives



The need to adapt to climate change is now a reality and of particular importance for India. Adaptation means to change the variables of a country – or any system – in a way that minimises the impacts of climate change. India’s need for adaptation is particularly great and urgent – its vulnerability to climate change impacts has been rated as “extreme”.¹ Several reasons can be named for this: India has a geographic disposition to be strongly affected by both gradual changes and extreme weather events like floods and droughts, amplified by its geographic diversity. The large share of the particularly climate-sensitive agricultural sector in the Indian economy further magnifies its vulnerability. Its oftentimes precarious infrastructure is prone to be severely damaged by climate change impacts. But not only geographic and economic, also social issues are of importance: a large share of people living in poverty as is the case in India considerably increases a country’s vulnerability. This is because their inadequate housing situation as well as lack of access to basic services like health care, electricity, water and infrastructure makes them directly susceptible to climate change impacts; furthermore their food supply is often dependent on local agriculture. People living in poverty lack the resources to endure extreme weather events by their own means, and have very limited access to insurance.

India thus urgently needs to identify measures to adapt. One aspect that has been rarely addressed by policy makers and researchers so far is the impact that climate change has and will have on the Indian micro, small and medium enterprises (MSMEs) sector. MSMEs are of great economic importance for India’s economy and the focus of policy makers has been their relevance for growth and job creation. As this study illustrates, climate change poses a threat to the Indian MSMEs sector; many enterprises have already been negatively affected by climate change.



Already existing pressures on resources are catalyzed and magnified by climate change impacts, and its negative effects for the Indian economy and especially for MSMEs need to be taken seriously. Future climate change impacts could have consequences to the point of putting not only enterprises but entire industries out of business. In order to minimise these risks, MSMEs need to be aware of the relevance of climate change for their business and identify ways of how to face the challenges resulting from climate change.

The overall objective of this study is to contribute to the discussion on climate change adaptation: While providing a framework for understanding and assessing climate risks for MSMEs in India is a focus of the study, it additionally provides background information on climate change impacts in India and key adaptation concepts. This is complemented by the presentation of approaches for businesses to determine adequate adaptation measures that address both climate-related risks and opportunities.

The study is directed at policy-makers as well as businesses, especially Indian MSMEs and their associations. It aims to support these in the following ways:

- **Policy-makers:** The study aims to inform policy- and decision-makers on climate change impacts on Indian MSMEs. Entry points for further research and analysis as well as policy development in the field of private sector adaptation measures are presented and practical adaptation approaches for businesses are laid out.
- **Businesses, particularly MSMEs:** The study aims to support businesses, particularly MSMEs, in understanding the relevance of climate change impacts for their businesses. It presents approaches for assessing and managing climate risks and for the identification of adequate adaptation measures. Furthermore it seeks to raise the awareness of businesses on climate change impacts and business opportunities, and hence the need to integrate climate change concerns into the business strategy.

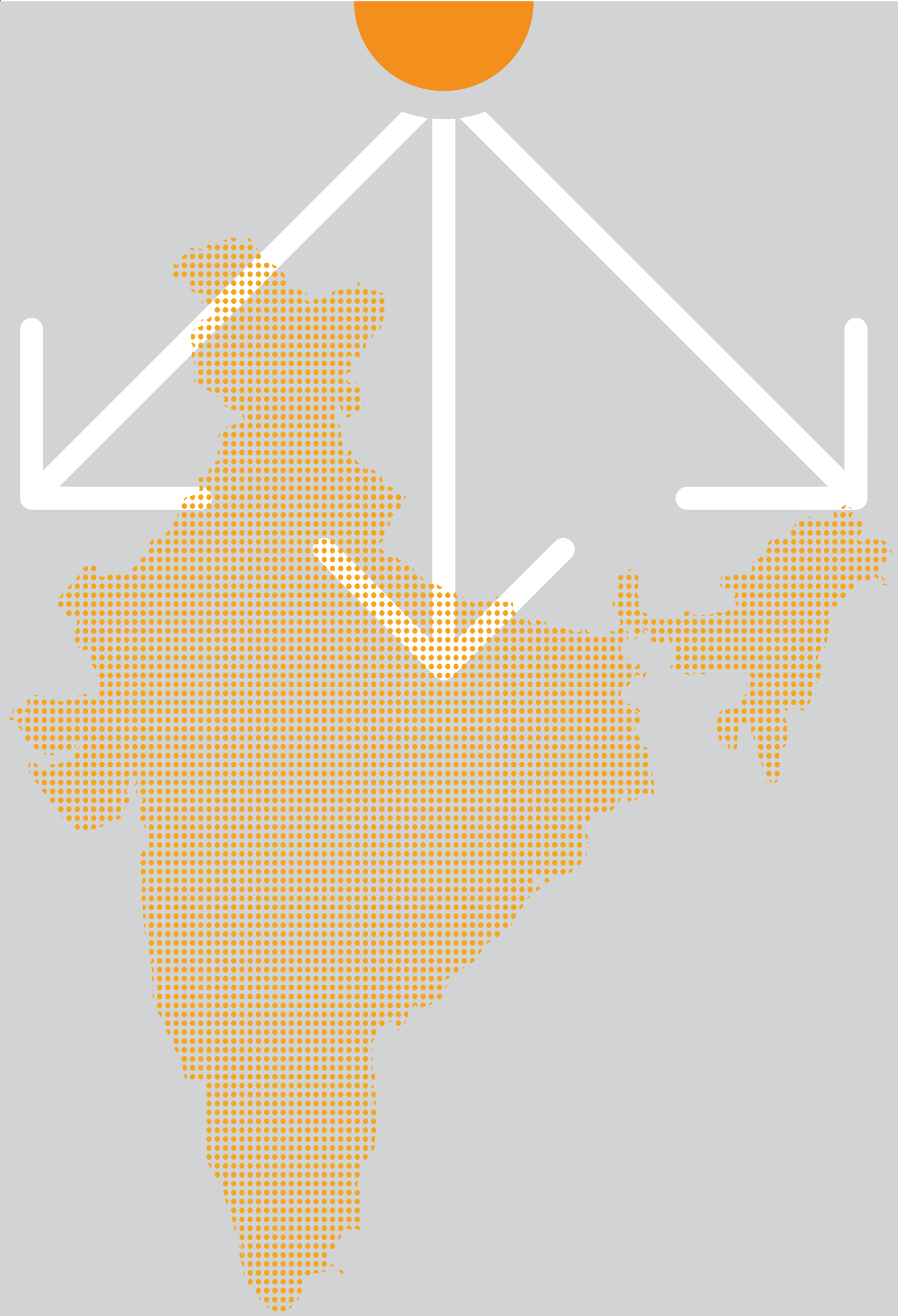
In the first section, the study provides a snapshot of expected and already observable impacts in India, followed by an analysis of their implications for MSMEs. Policy responses in the field of adaptation on the international, national, state and local levels are considered, followed by two perspectives on how to improve the abilities of Indian MSMEs to adapt – first, by strengthening their adaptive capacities and second by positioning adaptation as an integral part of attempts to promote business responsibility.

The first section therefore lays the theoretical foundation for the second part of the study, in which a number of practical approaches are presented, including an example of an assessment framework for business risks resulting from climate change. This assessment is then applied for assessing the sensitivity of two MSME sectors (textiles and metalworking) and for analyzing two case studies on concrete climate-related risks that Indian MSMEs already face.

Discussions around climate change impacts in India so far have been dominated by focusing on impacts on eco-systems. Few efforts have been made to analyze the impacts of climate change on the economy or society. There is a need to systematically analyze the impacts of climate change on different actors in the economy, including the business sector. This study makes a first attempt at filling the knowledge gap by connecting macro-level changes with their repercussions on two severely affected MSME sectors in India. However, more research is necessary in order to inform policy making and provide businesses with empirical evidence on the business case for climate change adaptation.



1 Maplecroft 2011: World's fastest growing populations increasingly vulnerable to the impacts of climate change – 4th global atlas reports, available online at http://maplecroft.com/about/news/ccvi_2012.html.



1

Introduction and Objectives

PART 1: CONTEXT AND POLICY RESPONSES





2 Climate Change Impacts in India

2.1 Country Impacts and Adaptation Pressure

Climate change impacts can already be felt in India, and the risks and opportunities they pose for society and economy are becoming evident: According to India's Meteorological Department, for example, the year 2010 has been the warmest since 1901 with an annual mean temperature increase of almost 1° C. This surpassed the previous five warmest years, which have all occurred since the turn of the century, notably 2002, 2003, 2006, 2007, and 2009.²

India's diversity makes it difficult to assess future climate change impacts and likely challenges for the country as a whole. In fact, India is in surface the seventh-largest country in the world, stretching over four major climatic regions. While potential impacts of climate change thus vary significantly across India, some general trends affect the whole of the country. According to climate projections by the International Panel on Climate Change (IPCC), India will be faced with a diverse bundle of impacts in the coming decades.^{3,4} The major effects are:

- **Rising temperatures:** While most pronounced in the Himalayas, a general warming trend is already observable across India.⁵ Projections come to the conclusion that the annual mean surface temperature will further increase by 1.7°C to 2°C/year until 2030 on average, and temperatures are likely to rise by as much as 3–4 °C towards the end of the 21st century.⁶ Due to geographic and seasonal differences, extremes may be considerably higher.
- **Precipitation changes:** Over the same period, there is a predicted increase in extreme rainfall and rainfall intensity in the Ganga, Krishna, and Godavari river basins.⁷ While rainfall is predicted to increase in quantity in some regions, longer periods of drought are expected in others, leading

to changes in forestry vegetation. Changes are observable already, throughout most of the country: for example, while more rain falls per year on average in Gujarat today compared to 15 years ago, the span of drier monsoon cycles seems to lengthen.⁸ Another highly affected region is the Himalayas, which have the largest concentration of glaciers outside of the polar caps, feeding South Asia's major rivers and ensuring a year-round water supply for millions of people. Over the past 30 years, the majority of glaciers in Bhutan, India, and Nepal have been retreating and thinning with accelerated losses in the last decade.⁹

- **Rising sea levels:** Because of its long coastline, India is also severely affected by rising sea levels; a rise of more than 10 cm has been projected until the mid-century.
- **Increase of extreme weather events:**¹⁰ A greater number of high surges and an increased occurrence of cyclones in the Bay of Bengal are predicted.

The degree of vulnerability of a country or region is not only dependent on climate impacts but also on socio-economic factors. Strengthening India's socio-economic development is at the top of the government's agenda. While the Indian economy witnessed dynamic growth over the past two decades, social problems remain. The Indian government has taken up the course of addressing poverty and aligning growth and social inclusion through promoting its agenda of "inclusive growth". Through several initiatives, the government seeks to create employment, boosting manufacturing as well as innovation in order to promote economic growth which is viable in the long-term and also contributes to poverty reduction.

Climate change impacts, however, are threatening economic and social gains that have already been achieved, while at the same time putting India's long-term growth trajectory at risk. Single extreme weather events can cause the gains of recent years to be wiped out, as demonstrated during the 2010 floods in Northern India and Pakistan when extremely heavy rainfall destroyed large parts of the city of Leh within a few hours, leaving thousands homeless.¹¹ Gradual change like temperature rise may make entire industries uneconomical. In addition, such impacts will affect food security, further worsening the situation of India's poor, who are most affected by changing price levels. Rural areas are particularly vulnerable to the impacts of climate change as they lack resources to adapt and are highly dependent on the local, climate sensitive natural resource base, including water and food.¹²



Given the past and expected impacts of climate change on India described above, Indian society is under pressure to effectively adapt to climate change. Adapting to climate change means to implement measures to “moderate harm or exploit beneficial opportunities” from the consequences of climate change.¹³ Effective adaptation requires the collaboration of different actors, particularly government, civil society and business: Effective adaptation by business is not only an important precondition for India’s sustainable socio-economic growth. Companies can also enhance the adaptive capacity of society at large by providing innovative products and services which help to adapt to climate change. Therefore, Indian business’ awareness of the challenges ahead and its engagement in the development of measures to adapt to the impacts of climate change are crucial for a successful adaptation of the Indian economy and society.

2.2 Impacts, Risk and Opportunities for Indian Businesses

Since the initiation of economic reforms in 1991, India has grown to be a trillion dollar economy with a diverse industrial base and a growing service sector. The most important sectors in terms of their share of GDP are agriculture, textiles manufacturing, steel production, and information technologies.

India’s MSMEs are extremely important both for the economy and society. The MSMEs sector contributes 8% of the country’s GDP¹⁴ and consists of approximately 30 million units, accounting for 45% of manufacturing turnover in terms of value and employing more than 70 million workers.¹⁵ Against this background activities designed to reach India’s climate change goals have to be responsive to the situation of the MSMEs sector. As climate change impacts are locally specific, MSMEs strongly embedded into local contexts are particularly suited to contribute to minimising vulnerabilities and realising potential business opportunities.

2.2.1 Climate Change and Indian Businesses – Impacts and Risks

The potential impacts of climate change on businesses can be classified as either direct or indirect:

- Direct impacts of climate change affect the physical assets of a business, such as buildings, machinery and equipment or other vital infrastructure.

- Indirect impacts of climate change affect business operations through changes in the business environment, such as new regulations and market demand, changes in prices and availability of inputs and financing or effects on stakeholders, for example employees.

Companies that are not prepared to manage the direct and indirect impacts of climate change may face competitive disadvantages, especially if their competitors are better prepared or less affected by climate impacts.

But most Indian companies have not yet begun to understand how climate change will affect them. This is all the more true for India's MSMEs: For most of them it is a higher priority to manage immediate challenges instead of long- or term risks. At the same time, MSMEs are highly vulnerable to climate risks as they often lack the financial resources to endure even a single rupture in supply or demand, caused for instance by an extreme weather event or a new environmental or climate regulation.

While the impacts of climate change on India were presented at a general level in section 2.1, they can be concretised with regard to business. The exact nature of these impacts on a company depends on an individual set of factors, e.g., location and industry sector, but generally impacts of particular relevance to many Indian companies can be identified:

- **Rising temperatures:** Average temperatures as well as temperature extremes have been increasing and are projected to further increase across India. For business, temperature rises are likely to have indirect impacts such as reduced productivity of workers or increased energy use, as more cooling is required in manufacturing processes. Rising temperatures can also negatively affect crop yield and harvests.
- **Precipitation changes:** Higher precipitation in some regions such as Gujarat, and less rainfall in others have indirect impacts on yields, buildings, sewerage and ground water availability.
- **Loss of freshwater:** A report by the Intergovernmental Panel on Climate Change (IPCC) states that "water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change".¹⁶ The industry demand for water in India is estimated to more than triple between 2000 and 2025.¹⁷ Decreasing availability, declining quality and growing demand for water are likely to have serious repercussions for the cost and productivity of companies. Furthermore, water being typically one of the most contentious issues with



local stakeholders, reputational damages especially for highly water-intensive industries are likely.

- **Price hike of energy:** Climate change affects both supply and demand of electricity: while higher temperatures lead to an increased demand for energy, e.g., for air conditioning and cooling, it also affects supply, e.g., by damaging business operations of energy providers. At the same time, energy needs in India are expected to triple between 2006 and 2025.¹⁸ For all these reasons, energy prices are likely to show greater volatility and gradually increase over the next decades.¹⁹
- **Regulatory requirements:** Both the need to reduce greenhouse gas emissions for mitigating climate change and the need to adapt to the impacts of climate change has already triggered policy action, changing the framework conditions for business (for initiatives undertaken in the field of adaptation see section 2.3). More stringent regulation affecting business can be expected in the future, especially in the fields of emission reduction and resource consumption. Besides national and state-level regulation relevant to all Indian businesses, exporting MSMEs need to also anticipate the policies of foreign countries.²⁰

In many of these areas climate change impacts will further propel already existent trends resulting from the Indian economy's rapid growth such as the limited availability and increasing costs of water and energy. But climate change impacts will also result in completely new challenges to businesses that have to be analyzed at a case by case basis.

All of these impacts can be framed as risks to business. Therefore, the best way for business to monitor and effectively address these risks is to integrate climate change impacts into a company's risk management. How exactly this can be done is further elaborated in the second part of this paper.

2.2.2 The Significance of Climate Change Impacts for MSMEs

Within the private sector of India, MSMEs will be at high risk from the impacts of climate change. This is due to a variety of factors which are specific to Indian MSMEs. These can be linked to India's growth spurt which was not always flanked by the necessary infrastructural measures or adjustments to framework conditions. Most notably with regard to climate change, the following factors can be named – but because of India's federal nature, their relative importance varies:²²

- **Insufficient infrastructure:** Most MSME units are characterised by insufficient infrastructure, including road access, energy and water supply, and use of outdated and low-investment technologies and practices. A case in point is the degree to which MSMEs are responsible for environmental stress in India: An estimated 70 percent of the total industrial pollution load is attributed to MSMEs.
- **Limited access to credit for investments and limited capacities to upgrade production facilities:** MSMEs often lack the ability of accessing finance from banks, including new financial products for technology upgrade. Financial institutions are often reluctant to lend to MSMEs because of lacking collateral, small ticket size and therefore high transaction costs for the banks.²³ However, some banks, including SIDBI have started to see the opportunities by offering innovative financial and non-financial services. SIDBI has taken the lead in "greening MSMEs". Still, there is a need to strengthen the capacities of bankers and financial institutions to lend profitably to this segment." Concerning climate change, the situation is intensified by low awareness on the side of MSMEs about resource efficiency, putting them at risk for gradual changes like temperature rises and subsequent price hikes of water and energy.
- **Limited financial resources to buffer disruptions or react to new urgent challenges:** Disruptions in cash flow pose immediate danger to MSMEs because their capacity to deal with business disruptions or other financial losses is low. This is aggravated by the fact that MSMEs often lack the resources to assess, monitor, and adapt to climate change-related risks.
- **Limited capacity and resources to research/develop new products/processes:** Established MSMEs in particular miss out on new product and process opportunities as they usually lack the capacities and resources to invest in research and development.
- **Limited availability of skilled personnel:** The above points are all related to one of the biggest challenges the Indian MSME sector: the scarcity of



skilled staff that would lead the business with a strategy and long-term vision for adapting to climate change.

- **Position of MSMEs at the bottom of global supply chains and pressure from Indian buyers:** Many MSMEs are suppliers to larger companies including multinationals. Often facing high competition, they have limited leverage regarding prices and delivery times of their offer, which leaves little room for developing a long-term business strategy. Big Indian conglomerates and corporations have started to internalise risks related to climate change by furthering their vertical integration, thus proofing their supply chains against climate related external shocks – but potentially endangering the business case of small-scale suppliers.²⁴

However, Indian MSMEs have many times proven that they are able to change if the need arises or a new business opportunity emerges. For example, MSMEs that are suppliers of Indian conglomerates or exporters have to comply with stringent environmental and social standards that are applied across the respective supply chains, for example to meet legal restrictions or as reputation management.²⁵ Oftentimes, the client companies assist their suppliers in adhering to their standards. The ability of MSMEs to respond to their clients' demands proves that change within the sector is possible as long as the business case is clear and financial and technical support are made available.

2.2.3 Opportunities for Business Resulting from Climate Change

Assessing the impacts and resulting risks from climate change is important for businesses to adapt swiftly and effectively to a changing climate. Early and informed action can reduce losses and ensure business continuity. But the impacts of climate change also present new opportunities for business.

A 2007 survey by the World Business Council for Sustainable Development questioned businesses about business opportunities that may arise for them due to climate change. The top answers from those that saw opportunities were that they expected "new products and services" and "new markets"²⁶ to come about. For the manufacturing industry, increasing demand for low-water, energy-efficient and other sustainable products and services were named as potential fields worthy of further exploration, as well as resilient materials, including for buildings and infrastructure.

Furthermore, increased demand for cooling equipment and services in response to an expected rise in temperatures was stated to offer revenues for the supplying businesses, as were refitting equipment components.

Potential opportunities also exist in building the resilience of infrastructure and service sectors, the key ones being healthcare, waste management and sanitation, water management, off-grid energy, micro-insurance and microfinance, and information and communication technology.²⁷ A recent study identifies additional opportunities from climate change in a variety of business activities relevant for many sectors; financing thereof could partly come from government adaptation schemes (see box 1).²⁸

Businesses can best become aware of these opportunities and effectively realize them by incorporating climate change impacts into their medium and long-term business strategy. Hereby, it is highly important for companies to consult with existing and potential new customers and develop demand-oriented new products and services, ensuring that they are adapted to changing needs. Box 1 provides a snapshot of different

Box 1	Business opportunities resulting from climate change
	<ul style="list-style-type: none"> More effective water treatment facilities and a range of other water-related efforts, including recycling and technologies to reduce use.
	<ul style="list-style-type: none"> City and town planning, from revising existing designs to planning wholly new cities.
	<ul style="list-style-type: none"> Various climate-proofing products, such as improved roofing and insulation.
	<ul style="list-style-type: none"> Software applications: Consumer software applications and enterprise software applications on mobile devices concerning climate-related services.
	<ul style="list-style-type: none"> Flood and other disaster-response services, from replacing damaged equipment to clearing up affected areas.
	<ul style="list-style-type: none"> Flood mitigation and relocation, including adapting coastal defences, levees and other infrastructure for sea-level rises.
	<ul style="list-style-type: none"> New construction materials, technologies and processes, as well as new approaches to design and planning.
	<ul style="list-style-type: none"> Climate-related insurance offerings, from building damage to crop losses, and cover for perishable goods.
	<ul style="list-style-type: none"> Other financial products, from simple loans to help others pay for adaptation work, to climate derivatives and investment funds.



- Advisory, legal and consulting services contributing to resilience building.
- Risk management services.
- Weather and other information services.
- Public relations and lobbying: Offering media and public relations management services to deal with the situations presented by changing climate.
- Training and education to increase awareness of climate change and capacity to manage resulting risks and realize opportunities.
- Medicines and healthcare: Change in the demand driven by new geography for diseases that are tropical or sub-tropical, such as dengue in South America.
- Supplying alternative raw materials for those that are at risk from climate change.

business opportunities in general; MSMEs can benefit from these new opportunities by finding their place in the value chain or become “climate innovators” in these fields.

2.3 Adaptation Policies: Creating Business Risks and Opportunities

Climate change has been on the international agenda for nearly two decades now. For many years attention was primarily given to the mitigation of climate change (for a differentiation of mitigation and adaptation see box 2). So far, however, progress in terms of commitments for climate change mitigation has been slow. At the same time, new figures suggest that international efforts for climate change mitigation are not enough to limit global warming: current greenhouse gas levels in the atmosphere are already very close to the levels assumed to result in a 2°C warming since the pre-industrial era until 2020; 2011 has again been among the 15 warmest years ever recorded.²⁹ Altogether, 13 of the 15 warmest years on record have occurred since 1997.

As the impacts of climate change are predicted to further increase in the next decades (see 2.1 and 2.2), policies for adaptation are now moving centre stage on the agenda of governments. This includes the governmental authorities in India, at the national, state and municipal levels.

Climate change impacts directly and indirectly affect societies and economies and thus require action by all actors of society. This calls for joint efforts by the public and the private sector.³⁰ In the emerging policy framework for adaptation it is therefore important that business-related impacts of climate change are adequately addressed and that business is effectively engaged to contribute to tackling the adaptation challenge.

The following sections provide an overview of the emerging policy framework on adaptation as relevant to business, discussing the state of development of adaptation policies at various policy levels, their relevance to business and the degree to which policy makers seek to engage the private sector in policies for adaptation. The section will highlight that emerging policy frameworks related to adaptation impact MSMEs in three distinct ways:

- They pose stricter requirements on business, for instance in the fields of energy efficiency, safety standards and efficient water use.
- They support MSMEs in developing their adaptive capacity and reducing their vulnerability to climate change, e.g., through training programmes on energy efficiency and financial support for adaptation measures.
- They open opportunities for the private sector including MSMEs to contribute to climate change adaptation in India by providing the required products and services, including in the framework of public-private partnerships (PPPs).

Box 2	Responses to climate change	
	Adaptation	Mitigation
	What are the climate's impacts on an organization or nation?	What are the system's impacts on the climate?
<p>Climate change adaptation refers to the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences.</p> <p>Climate mitigation is any activity or intervention to reduce the sources or enhance the sinks of greenhouse gases.</p>		

While the framework at the global level is still very much in its infancy, this section demonstrates that policies within India are already evoking these three types of impacts:



2.3.1 International Level

International efforts to combat climate change have led to a number of international agreements, with the United Framework Convention on Climate Change (UNFCCC) being the most important one. Adaptation has been part of this framework from the outset. The Kyoto Protocol calls on states to implement programmes and support technology development for adaptation. To support developing countries in adapting to climate change, it launched the global Adaptation Fund. Until recently, however, most efforts within the framework of the global climate negotiations have remained focussed on mitigation.

In fact, the international policy framework to support adaptation is still in the midst of development. A major step forward was taken during the 16th Conference of the Parties (COP) to UNFCCC in Cancun in 2010, where the states agreed on a global Adaptation Framework. With the aim of promoting adaptation particularly in developing countries, it lays out basic features of a global work plan on adaptation. A separate body, the Adaptation Committee, has been mandated to provide overall advisory on adaptation to the COP and to promote the implementation of the framework. In addition, the Technology Mechanism was launched to promote the development and dissemination of climate technologies including those supporting adaptation. At COP 17 in Durban states made a next step in institutionalising this framework, defining the set up and roles of the Adaptation Committee. While the role of business was acknowledged during discussions, so far no concrete role or action plan has been carved out by the Committee.

Thus, so far states were not able to use international negotiations as a driver of adaptation across the globe. Because the policy framework is still in the process of development, its effects on the ground will be notable only in the future. As a result of the Durban negotiations, binding commitments in the field of climate change mitigation and adaptation by all governments cannot be expected before 2020. The Government of India has been one of the prime advocates of postponing a global climate agreement with binding commitments for emission reductions. India continues to underline the principle of “common but differentiated responsibilities” which assigns the main responsibility for financing mitigation and adaptation measures across the globe to industrial countries. The industrial development paths of today’s high-income countries, it is argued, have been the major drivers of global warming.

Developing and emerging countries should have the same chances for economic growth and social developments, while the costs of mitigating and adapting to climate change should be primarily carried by developed economies.

This stance has not been held by India alone; rather, it has been jointly represented by the so-called BASIC coalition of Brazil, South Africa, India and China in international climate negotiations for long. However, India's rejection of binding commitments of all states before industrial countries have fully realised their commitments under the Kyoto Protocol could be losing ground in the near future. Calls for quicker progress in international climate negotiations by the developing and least developed countries most vulnerable to climate change impacts are becoming more frequent.³¹ Also, a loosening of positions within the BASIC coalition is becoming probable in the near future. China increasingly recognises the opportunities from climate change in terms of cost savings and opportunities for long term growth.³² It has taken first steps for shifting towards a Green Economy, seeking low-carbon growth opportunities in markets like renewable energy and energy efficiency solutions. In Durban already, China showed more flexibility to take up negotiations on binding commitments for all states³³, and in the end BASIC countries including India joined the Durban compromise: to extend the Kyoto Protocol, but to take up negotiations on an encompassing climate agreement to be concluded by 2015.

2.3.2 National Level

Given both India's vulnerability to the effects of climate change and the increasing climate impacts from the country's accelerated growth, the Indian government has established several national policies addressing climate change mitigation and adaptation. The most prominent effort is the **National Action Plan on Climate Change (NAPCC)** launched in 2008. It outlines the government's overall strategy for confronting the challenges posed by climate change. Within the NAPCC, eight National Missions were formulated for achieving key goals in the context of climate change. They include both mitigation and adaptation efforts and are coordinated by the respective ministries:

- National Solar Mission (M/o New and Renewable Energy)
- National Mission on Enhanced Energy Efficiency (M/o Power)
- National Mission on Sustainable Habitat (M/o Urban Development)
- National Water Mission (M/o Water Resources)
- National Mission for Sustaining the Himalayan Eco System (M/o Science



and Technology)

- National Mission for a Green India (M/o Environment and Forests)
- National Mission for Sustainable Agriculture (M/o Agriculture)
- National Mission on Strategic Knowledge for Climate Change (M/o Science and Technology)

Some of these missions are of particularly high relevance for the business sector as funding and incentive schemes are made available. The most important missions concerning climate change adaptation and businesses are described in more detail in table 1.

So far, the Government of India has predominantly approached the topic of climate change as an environmental and livelihood challenge. Little discussion so far has been on the business risks and business opportunities related to climate change impacts. NAPCC, as the national climate policy more generally, has been strongly driven by the Ministry of Environment and Forests (MoEF). None of the chief responsibilities in implementing the Missions (see list above) has been assigned to the ministries who could play a role in addressing business-related aspects of mitigation and adaptation – the Ministry of Corporate Affairs (MCA), the Ministry of Commerce and Industry (MCI), and the Ministry of Micro, Small and Medium Enterprises (MoMSME). However, implementing the National Missions is a cross-cutting task requiring action by several ministries. In fact, the governance structure of some Missions already mirrors this need for a cross-sectoral approach. For example, the National Solar Mission is steered by an inter-ministerial steering group, chaired by the Minister for New and Renewable Energy and composed of representatives from all relevant ministries and other stakeholders.

By strengthening such mechanisms of cross-sectoral cooperation in its climate policy the Indian government can effectively address business-related impacts of climate change and exploit the potential contributions of the private sector for adaptation.

Considering SIDBI's apex role in promotion, financing and development of the MSME sector, SIDBI can play the role of a change agent to strengthen MSMEs' adaptation capacities. By engaging in various activities aligned to the government's national priorities and offering innovative financial- and non-financial services, SIDBI already is a key actor to promote "Green Growth" and cleaner production of MSMEs.

Table 1

Relevant National Missions for Business

National Mission for Enhanced Energy Efficiency (NMEE)

Although India has been continuously expanding its energy production, it remains a net-importer of fossil fuels.³⁴ As the total demand for electricity in the country continues to rise, a more efficient use of energy resources is required both for economic and ecological reasons. In order to improve energy efficiency and reduce energy use, the Energy Conservation Act was passed in 2001. With the Act, the Bureau of Energy Efficiency (BEE) was established to promote the efficient use of energy and the labelling of energy-intensive products. In the framework of NAPCC the Bureau coordinates the development and implementation of the NMEEE. NMEE contains four major initiatives:³⁵ **1)** establish a market-based trading scheme for energy certificates, **2)** transform existing markets to incentivize energy efficiency, including through labelling and public procurement, **3)** install new financing mechanisms for energy efficient technologies, and **4)** enhance the policy framework for the uptake of energy efficiency measures in the industry. The Perform-Achieve-Trade (PAT) scheme for energy certificates was in fact launched in 2011.

Climate change might influence the availability and costs of energy in multiple ways, be it through natural disasters destroying energy infrastructure or through regulatory initiatives posing higher prices onto "dirty" energy sources. In fact, the Indian government has taken first steps in this direction by introducing the so called clean energy tax on coal in June 2010.³⁶ Therefore, improving energy efficiency is a key component of any business strategy for climate change adaptation. The Mission's market based approach enables the business sector to actively participate and benefit from energy efficiency measures.

National Water Mission

India already is a water-stressed country: while demand for water is growing across all sectors, incidences of droughts, floods and declining groundwater are increasing.³⁷ One sixth of the country's geographical area is drought prone and on an average floods affect around 7.5 million hectares of land area per year.³⁸ With the two main sources of water being rainfall and the snowmelt of glaciers in the Himalayas, access to water is distributed unequally throughout the country, both geographically and in terms of seasonal distribution. The main objective of the National Water Mission is the "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management".³⁹ Five goals have been identified: **1)** development and implementation of a comprehensive water data base assessing the impacts of climate change on water resources, **2)** promotion of citizen and state action for water conservation, augmentation and preservation, **3)** identification and focused attention to particularly vulnerable areas, **4)** increase of water use efficiency by 20%, and **5)** promotion of integrated water resources management in river basins.

The private sector including MSME is an important partner for achieving the Mission's objectives, both because it is a major consumer of water



and because it is an important source of innovation for water efficient processes and technologies. While water scarcity and rising water prices already challenge Indian society and business (see section 2.1), climate change is likely to put additional pressure on water supply. Enhancing water efficiency and sustainably managing water withdrawal therefore are key components of a business adaptation strategy for Indian MSME.

Jawaharlal Nehru National Solar Mission (JNNSM)

India's energy production is highly dependent on fossil fuel combustion: the recent share is about 65 percent of the total energy production, while the total amount of renewable energy sources, including small hydro projects and biomass, is at 11 percent.⁴⁰ The National Solar Mission is led and coordinated by the Ministry of New and Renewable Energy (MNRE). The Mission's core objective is "to establish India as a global leader in solar energy"⁴¹ by creating an enabling policy and regulatory environment for the spread of solar technology at national, regional and local levels. It seeks to generate 20,000 MW of solar power by 2022, including through the extension of grid-connected as well as off-grid solar plants, support to building solar manufacturing capabilities, and the distribution of 20 million solar lighting systems in rural areas.

With its national solar mission, India has launched a massive programme to foster the development of renewable energy utilization. The private sector will play a key role in achieving the Mission's goals, both in the framework of public-private partnership and through independent research and development for solar technologies based on the incentives provided. For MSMEs engaging in solar technology can form part of a business adaptation strategy in two ways: solar technologies contribute to reducing the business' reliance on conventional energy sources and hereby reduce their vulnerability to energy shortages and price hikes; also, MSMEs are particularly apt to manufacturing single parts required in solar technologies, allowing for a future oriented growth path as part of an adaptation strategy.

National Mission on Strategic Knowledge for Climate Change

The National Mission on Strategic Knowledge for Climate Change (NMSKCC) seeks to address a number of gaps in existing research in climate change impacts on India.⁴² While elaborate global climate models exist, knowledge on the potential impacts of climate change on the various regions of the country is still relatively limited and uncertain. The same holds true for knowledge on the potential impacts of different technologies and policy interventions. Also, in India existing knowledge is strongly fragmented across different research institutions and governmental bodies. For addressing these problems, NMSKCC seeks to restructure and enhance systematic climate change research in India including through the formation of knowledge networks among existing institutions, the set-up of new Centres of Excellence for climate related research, and human and institutional capacity building for enhanced modelling of regional climate change impacts and technology choices. Also, it intends to provide targeted support to the seven thematic missions under the NAPCC, e.g.

through impact models of different policy and technology options for climate change mitigation and adaptation.

The Mission will contribute to a better availability of regionalised data on climate impacts and better assessment of technology options for adaptation, key preconditions for MSMEs to proactively and successfully adapt to climate change impacts. Furthermore NMSKCC seeks to directly engage the private sector in research and development activities for mitigation and adaptation technologies through networks and public private partnerships.

National Mission on Sustainable Habitat

Due to the growing population pressure, Indian urban areas already suffer from great stress on infrastructure systems such as for water supply, sewerage and drainage, or waste management. Climate change is likely to exacerbate existing stresses on urban habitats. In this context, the National Mission on Sustainable Habitat seeks to promote the sustainability of habitats through enhanced energy efficiency in buildings, better urban planning, improved management of solid and liquid waste including through enhanced recycling, and the extension of public transport.⁴³ Furthermore it seeks to strengthen the ability of habitats to adapt to climate change by improving the resilience of infrastructure, strengthening disaster management and improving warning systems for extreme weather events.

In the context of the mission MSMEs will be faced with greater requirements, but also greater support for introducing measures to adapt to climate change, including strategies for disaster risk reduction. At the same time, the mission offers great opportunities for MSMEs to enter new business areas of long-term importance to urbanizing India, for instance by enhancing the recyclability of its products or the offering of new products and services contributing to a more sustainable habitat.

Besides the overarching policy framework on climate change, many national Ministries have **sectoral policies, programmes and projects** which address issues of adaptation to climate change, for instance in the field of watershed development in rural areas, infrastructure projects for adapting the capacity of sewerage systems to greater, or initiatives to support the dissemination of energy efficient technologies in MSMEs (see below). Often, these initiatives are not explicitly framed as adaptation initiatives but they de facto contribute to reducing vulnerability to climate change impacts.

Policy initiatives in the fields of **rural development** often relate to climate change adaptation. For instance, in the field of rural development the Indian Watershed Management Programme (IWMP) of the Department



of Land Resources / Ministry of Rural Affairs (MoRA) aims to restore the ecological balance in rural India by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water.⁴⁴ In a similar vein, the National Watershed Development Project for Rainfed Areas run by the Ministry of Agriculture supports rural populations and farmers in coping with irregular rainfall patterns through watershed management, protection of soil erosion and adapted farming methods.⁴⁵ Focusing on the household level, the National Rural Drinking Water Programme of the Ministry of Drinking Water and Sanitation (MoDWS) supports state governments in ensuring sustainable drinking water availability, convenient delivery systems and achieving water security in rural areas.⁴⁶ Besides improving access to and purification of groundwater it seeks to strengthen water conservation and water harvesting. In the field of **urban development** the Urban Water Supply and Sanitation Programme of the Ministry of Urban Development (MoUD) involves infrastructure projects for leakage reduction, water harvesting, water recycling and reuse, as well as for installing disaster proof sewerage systems. For example, the Ministry co-finances the Brihanmumbai Storm Water Disposal System project, a several thousand crore rupees project of the municipality of Mumbai to completely overhaul the water drainage system of the city, enhancing its capability to cope with flooding during heavy rains and storms.⁴⁷ In its infrastructure projects, MoUD seeks strong involvement of the private sector in the framework of public-private partnerships (PPPs).⁴⁸

In the policy area **technology and innovation**, many of the objectives of the National Science and Technology Policy of 2003⁴⁹ directly relate to adaptation issues: ensuring sustainable food, agricultural, nutritional, environmental, water, health and energy security of people, and developing technologies for the effective forecasting, prevention and mitigation of natural disasters. Concrete policy initiatives include the Water Technology Initiative⁵⁰, a research and development programme for holistic solutions to the problem of water contamination and water scarcity at household levels. Wherever feasible, it seeks collaboration with industry and civil society organisations for technology development and demonstration projects.

Other policy initiatives relating to adaptation target Indian businesses more directly. The **national manufacturing policy** set out in the National Manufacturing Plan⁵¹ of 2007 seeks, amongst others, to promote the

“greening” of manufacturing and the promotion of clean technologies. This includes support programmes to Indian MSMEs for adopting more resource efficient technologies, namely the programmes “Energy Efficiency in SMEs”, “Financing Energy Efficiency in MSMEs” and “Promoting Energy Efficiency and Renewable Energy in Selected MSMEs” run by the Bureau of Energy Efficiency.⁵² While resource efficiency is an important pillar of climate change mitigation – particularly so in the case of energy efficient technologies – it also helps companies to adapt to climate change. For instance, more water efficient technologies reduce businesses’ vulnerability to water constraints and rising prices during severe droughts. Also, policy measures for resource efficiency contribute to raising awareness on climate change and environmental degradation among MSMEs, providing a basis for intensifying efforts in adaptation.

The **national disaster management policy**⁵³ issued by the Ministry of Home Affairs in 2009 explicitly takes into consideration the probable effects of climate change in leading to more frequent and intense natural disasters like cyclones, floods and droughts. It envisions an integrated, proactive approach to disaster management, focusing on disaster prevention, mitigation, preparedness as well as disaster response. As announced in the policy, business can expect more stringent regulatory requirements from the policy, particularly in the fields of safety standards and building codes. On the other hand, under the policy business will be supported in adapting to disaster related risks through capacity development and the provision of new risk-insurance schemes. And thirdly, the policy looks to engage the capabilities of the private sector in developing technologies and implementing projects required in disaster prevention, mitigation, preparedness and response through financial support, formalised involvement in policy development and implementation mechanisms, and the development of PPPs.

The government’s policy initiatives in the field of **business responsibility** touch on the issue of business adaptation to climate change as well. The government’s prime initiative, the “National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business”⁵⁴ (NVGs) released by the Ministry of Corporate Affairs in July 2011, highlight the need to integrate sustainability and inclusiveness into the core of businesses. Even though climate change is not explicitly mentioned in the principles, the NVGs offer a framework for businesses to take social and environmental responsibilities seriously and to take action on climate



change. It highlights the role of MSMEs in the Indian economy and, in a specific chapter, outlines a trajectory for MSMEs to adopt and integrate the guidelines into their business. The business case for compliance with the guidelines was strengthened in November 2011 when the Securities and Exchange Board of India (SEBI) announced that listed entities, initially the top 100 companies in terms of market capitalization, are mandated to submit Business Responsibility Reports in line with the nine principles set out in the NVGs as a part of their Annual Reports.

The above mentioned policies and programmes are relevant to business in three distinct ways:

- Several policies and programmes announce or already implement more restrictive rules for business, namely in the areas of water management, resource efficiency, disaster risk management, and building safety. By doing so, the policies encourage business to proactively adapt to climate change impacts, for instance the expected increase in extreme weather events as well as growing constraints and raising costs of energy and water. Therefore, the changing policy frameworks pose new risks to business, but if adequately addressed, they support the long-term sustainability of companies in light of the impacts of climate change.
- Secondly, numerous policies and programmes not only make new demands on adaptation measures by business, but also support companies in implementing the same. This involves on the one hand targeted capacity building for instance in the fields of energy efficiency, safety measures and risk management. On the other hand several initiatives provide financing and insurance schemes to support businesses in reducing their vulnerability to climate change impacts.
- Thirdly, the changing policy environment opens new business opportunities for the private sector including MSMEs. Public expenditure in programmes and projects for improving the climate change resilience of public infrastructure, developing watersheds, enhancing water harvesting, recycling and reuse, and implementing safe and resource efficient technologies are clearly on the rise. As suppliers to and partners in these initiatives, companies can contribute to India's adaptation to climate change, while gaining new opportunities for business growth.

2.3.3 Regional / State Level

At a general level, in the Indian federal system State Governments have two important roles in policy development and implementation: Firstly, they often carry important responsibilities in implementing national

policies. These are often designed to be customised, implemented and monitored on the state level. Secondly, State Governments and their agencies possess considerable competencies in developing and implementing their own policies relevant to adaptation and business, for instance in the provision of land and raw materials, the provision of basic infrastructure, the local tax framework, and the promotion of industrial growth along the lines of their own agendas.

Engaging State Governments in policies for climate change mitigation and adaptation is of great importance in India. Given the great diversity of the country in terms of climatic, geographic, economic and social conditions, responses to climate change must be adapted to regional and local circumstances. In fact, State Governments have key roles in many sectoral policies relating to climate change impacts and adaptation, for instance policies in water management, soil conservation, and disaster management. A comprehensive assessment of these initiatives would exceed the limits of this study. In terms of their relevance to business, however, they present similar potential risks, benefits and opportunities as the national level programmes lined out above.

Overarching policy frameworks on climate change mitigation and adaptation at state level are still under development. MoEF has requested all Indian states to develop state-level action plans on climate change (SAPCC) as strategic guidance for implementing the NAPCC across India. Currently, most state-level governments are still in the early stages of developing and implementing SAPCC. After a repeated postponing of the deadline for submissions, only 14 of the 28 Indian states had submitted SAPCC by July 2011.⁵⁵ Most action plans have been prepared only recently, and many still have a draft status. Therefore, in most cases implementation of the measures envisioned in the SAPCC is yet to be taken on.

The majority of SAPCC which are publically available^{56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66} pay considerable attention to adaptation issues. In particular, issues of water management, drought proofing of agricultural land and disaster management are addressed. It can therefore be expected that state level action on adaptation will speed up considerably in the years ahead.

Many of the envisioned activities are directly relevant to business, be it in terms of business opportunities resulting from public investments in



adaptation measures or in terms of new requirements, e.g., in the field of water management. By closely observing these developments MSMEs will be able to anticipate and effectively address risks and seize opportunities resulting from these developments.

2.3.4 Community Level

Information on local adaptation policies in India is limited and scattered. It is therefore difficult to provide a comprehensive picture of adaptation policies at the community level. Existing evidence, however, suggests that select local governments in particularly vulnerable regions have started to put considerable effort and investments in projects and programmes for climate change adaptation, often supported by international donors.⁶⁷ ⁶⁸ Concrete initiatives implemented in these fields include flood protection, drought management, and disaster management in particularly vulnerable areas, e.g. Gujarat, Tamil Nadu, West Bengal, and Andhra Pradesh.

Several municipal governments have launched major adaptation projects for cities.⁶⁹ A project already being implemented is by the city of Pune in Maharashtra, located at the confluence of three rivers. The city has developed and implemented a comprehensive strategy for reducing the risk of flooding.⁷⁰ The programme activities ranged from capacity building to conducting a hazard and vulnerability assessment, land use planning and environmental protection, constructing new dams, dykes and seawalls, establishing early warning systems, and implementing community education and resilience programmes. The capital city of Maharashtra, the coastal city of Mumbai, is implementing a large-scale programme for completely renewing the city's drainage system, adapting it to higher frequencies and intensities in rainfall and storms (see section 2.3.2). Currently, the state of Maharashtra is planning to develop comprehensive district level action plans for climate change adaptation, including one for Mumbai. These are to be based on the results of a large-scale research project launched in 2010 which assesses the regions' vulnerability to climate change and potential adaptation strategies at district levels.⁷¹

The intensified engagement of local authorities in initiatives for adaptation is not surprising as it is the local level where the impacts of climate change are most immediately felt. In fact, many traditional strategies and technologies for adapting to climate impacts already exist at the local level which have helped communities including local businesses sustain over generations.⁷² However, due to gradual climate change and the

increase of extreme weather events particularly vulnerable communities often lack the necessary infrastructure, resources and knowledge to deal with climate related challenges before risks become actual threats.⁷³

Governmental initiatives for enhancing climate change adaptation at the community level are likely to further increase in the years to come. While initiatives at the community-level in most cases predominantly focus on livelihood-protection, local businesses are engaged as well, for instance in the framework of capacity building workshops on adaptation. Also, these programmes provide opportunities for companies, particularly local MSMEs, to join in on developing solutions to adaptation challenges and partner with governments in project implementation. By staying informed about ongoing or planned policy initiatives for adaptation at the community level, MSMEs can keep track of opportunities for enhancing their own adaptive capacities as well as contribute to enhancing climate resilience of their communities.



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3 Promoting Business Adaptation to Climate Change in India



In India, awareness and skills for effectively adapting to climate change are not strongly developed among businesses, particularly MSMEs. Policy makers and multipliers in the private sector can strengthen business adaptation to climate change in manifold ways. Two particularly promising avenues in the Indian context are lined out below: the strengthening of key capacities required of organisations to adapt to climate change and integration in initiatives that promote business responsibility.

3.1 Strengthening the Adaptive Capacity of Business to Climate Change

If a company's adaptive capacity is fully exploited, it achieves resilience to disruptions from climate change, fosters the ability to reorganise business operations with a minimum loss of function, and enhances the realising of opportunities. The consultancy Alexander Ballard Inc developed a framework of nine complementary capacities which need to improve jointly if effective adaptation is to take place in a systemic way.⁷⁴ These nine categories are briefly described below.

- **Awareness:** The ability to realise what climate change means for the organisation's viability, for the viability of its work, for society and for the planet, now and into the future. This concept includes the realization that climate change is here to stay, i.e. it will affect core business, operations and infrastructure in the long term. Awareness is necessary to limit vulnerabilities in a carbon-constrained future.
- **Agency:** The capacity to spot, prioritise and develop opportunities for

meaningful and timely action in response to information about climate change. Research shows that people resist increasing awareness unless they think they will be able to make a difference. Businesses have far greater opportunities to respond to climate change than individuals so their responsibility and motivation should be greater.

- **Leadership:** The extent to which a formal leadership team can identify a vision in relation to climate change, can engage with support and legitimise its implementation. A top-bottom approach when it comes to changing business operations is needed. Without support from the leaders it is less likely that efforts will spread through the business and beyond.
- **Agents of change:** The capacities to identify, develop, empower and support a group or “ecosystem” of champions at different levels so that they can be effective agents of change. The effectiveness of such agents within a business will depend on the amount of support and resourcing, degree of networking, and level of responsibility given to them by senior managers. Of course it is also important, apart from having passionate individuals in the work force, that all employees realise the importance of the pressing issue that is climate change. Appropriate responses to emerging problems can be found faster through an effective internal communication and training that can, e.g., decrease the vulnerability of a certain technique performed.
- **Working together:** The capacity to involve, respects the needs of, communicate with, learn from, and act in collaborative partnerships with internal and external groups. A good relationship with the surrounding community ensures a win-win situation if, on the one hand, communities and businesses benefit from each other’s adaptation measures, and if, on the other hand, climate change impacts are discussed together to avoid future impacts. Companies constantly interact with a range of actors: stakeholders, associations, government agencies, foundations, economic market forces, colleagues and competitors. These networks make it possible to influence one another. If these interactions can be taken to a macro scale, a system-wide behavior can emerge that ensures the scaling up of efficient systems and knowledge building.⁷⁵
- **Learning:** The extent to which the organisation can learn from experience and use what it learns to improve procedures, strategies and mission. Due to the fact that climate change adaptation has been looked at more closely only recently, there is no state-of-the-art approach to address climate change. It is therefore vital that actions taken are constantly reviewed and assessed according to their progress. Because solutions to climate change impacts are very much business specific, every company has to find its own mechanism to learn for the future.



- **Managing operations:** The embedding of procedures to get to grips with climate change in a systematic way. These develop as the organisation's ambitions and competencies grow. As climate change presents an additional risk factor for many businesses, impacting on the ability to carry out other organisational functions, it is essential that climatic considerations are integrated into existing risk management processes.
- **Programme scope and coherence:** How far projects sit within an overall programme of action that is suited to the scope of what an organisation is trying to achieve and updated in the light of what is learned – where to build on success or to address constraints.
- **Using expertise:** The capacity to recognise, access and deploy the necessary skills, understanding and technical and change expertise to make the biggest difference. In order to facilitate the process of evaluating and assessing technological adaptation options, it is best to rely on an expert familiar with the business operations instead of relying on a specialist consultant. Efficiency and effectiveness save time, money and reduce reliance on external sources. The categories are put forward to guide a (self-) assessment of adaptive capacity and identify the most urgent fields of action. At the heart of these categories is the understanding that organisations are not static but dynamic organisms made up by the behaviour and decisions of many people. As such, these organisations are capable and required to react flexibly to changing circumstances. This is also true for the interaction between the categories, as they are mutually reinforcing – or, on the other hand, an underachieving category can stall the success of others, and overall capacity. Furthermore, adaptive capacity is not a goal that can be reached but needs to be pursued continuously and in light of changing circumstances. How to motivate in particular Indian MSMEs to integrate this continuous work on adaptation into their business practices is explored in the following section.

3.2 Addressing Adaptation as Part of Responsible Business Practices

When thinking about how best to assist MSMEs in adapting to climate change impacts, it is important to keep in mind that adaptation at its core is a social issue. Of course, environmental considerations play an important role concerning, e.g., toxic effluent of a factory caused by an extreme weather event affecting flora and fauna. But the main purpose of adapting in the business sector is to achieve business continuity and realize opportunities in times of a changing climate while minimising business

impacts on communities and society. An additional aim of adaptation is to find common ground and identify win-win situations for companies and the communities in their vicinity. In view of the object of this study, Indian MSMEs, this means that the sustainable development of India will either be propelled by the adaptive capacity of its business sector or be harmed by lack thereof. Thus adaptation is directly connected to responsible business practices and the role that business plays within society. Therefore, integrating the issue of adaptation into policy initiatives relating to business responsibility is an important avenue for Indian policy makers to mainstream adaptation among Indian business.

While in India the National Voluntary Guidelines (see chapter 2.2) are the most relevant document in this regard, the globally most significant guidance on social responsibility is ISO 26000 by the International Standards Organisation. This guidance seeks to assist organizations in contributing to sustainable development, going beyond legal compliance. The proposed approach presents seven core subjects that can be used in drafting and implementing socially responsible practices. By linking the issue of climate change adaptation to the seven core subjects of ISO 26000, the connection between adaptation and social responsibility can be demonstrated.

3.2.1 The Key Issues of ISO 26000 Set Into the Context of Adaptation

- **Organisational governance**

Organisational governance is concerned with accountability, transparency, ethical behaviour, respect for stakeholder interests, and respect for the rule of law. Responsible organisational governance plays an important role for effective adaptation. In particular, keeping in mind the interests of their stakeholders is of prime importance for companies to develop effective adaptation measures: Business continuity is dependent on this and can be further strengthened when building the adaptive capacity not only of the company itself, but also of neighbouring communities, ensuring a “licence to operate” in the area of operations.

- **Human rights**

This subject is concerned with respecting the civil, political, economic, social and cultural rights of people affected by business decisions, for instance the right to clean water. These aspects of responsible business practices can easily be linked with climate change adaptation measures: If there is no or unsuccessful adaptation, in case of extreme weather events, toxic effluents or large fires may threaten surrounding communities.



Climate change will also put severe additional stress on resources, particularly water and the scarcer water resources might be overused by factories. But even adaptation measures which are effective for the company might threaten the rights of surrounding communities, for instance if dams protecting factory building exacerbate the flooding of surrounding villages. On the other hand, effective adaptation measures which involve a dialogue with neighbouring communities can contribute to protecting livelihoods and hereby effectively safeguard human rights.

- **Labour practices**

The core subject of labour practices concerns employment relations, conditions of work and social protection, occupational health and safety, and human development and training in the workplace. No adaptation or mal-adaptation to climate change will further aggravate problems already existing in the Indian MSME sector with regards to labour practices. Especially conditions for health and safety in the workplace may deteriorate: Inadequately insulated building will increase heat stress on employees when temperatures rise, and inadequately fixed equipment might lead to severe accidents in case of more frequent hurricanes or floods. On the other hand, there is a positive correlation between responsibility for decent labour practices and effective adaptation. For instance, if a company decides to build knowledge and capacity of its workers on climate change and adaptation, workers cannot only make use of this knowledge in their workplace, but can transfer it to their community context.

- **The environment**

Part of this subject is the prevention of pollution, sustainable resource use, climate change mitigation and adaptation and protection and restoration of the natural environment. All of these topics are closely related with climate change. The explicit reference to climate change mitigation and adaptation as subcategories of the core subject "environment" demonstrates their importance for businesses and society alike. As pointed out above, sustainable use of water is of high importance in times of changing climate. Also, pollution prevention figures as a key concern of adaptation as well, as polluting substances can create large-scale environmental and health problems when factories are damaged during extreme weather events. Finally, the restoration of the natural environment is in many cases the best way to avoid detrimental long-term impacts of climate change, for instance through the restoration of natural flood areas or the planting of mangrove forests on coastal lines which can prevent soil erosion.

- **Fair operating practices**

Fair operating practices regard issues like anti-corruption policies, responsible political involvement, fair competition, the promotion of responsible business practices in their sphere of influence and the respect for property rights. For instance, if businesses cooperate on adaptation with key buyers and suppliers, be it by sharing knowledge and skills or by jointly developing and implementing projects, companies avoid that business relations are destroyed by the impacts of climate change. Also, the respect of property rights is key for businesses who seek to innovate new technologies and products adapted to climate change challenges; at the same time the issue of property rights might be renegotiated if considering to make available new technologies for adaptation to society at large. Finally, beyond the basic premises of ethical behaviour in relations to political authorities, businesses, including MSME and industry associations, can lobby for the provision of climate-proof infrastructure as well as for rules to govern finite resources like water.

- **Consumer issues**

Consumer issues revolve around the topics of fair marketing, factual and unbiased information and fair contractual practices, protecting consumers' health and safety, sustainable consumption, consumer service, support, and dispute resolution, consumer data protection and privacy, and access to essential services and education and awareness. Consumer issues are connected with adaptation in multiple ways. Companies can promote the development and sale of sustainable products which contribute to mitigating climate change and / or help consumers adapt to its impacts. Through innovative products, companies including MSME can assure that also consumers at the base of the pyramid have access to essential services like room insulation or water provision, reducing their vulnerability to climate change impacts. Furthermore, through transparent, informative marketing of such products and services, companies can contribute to raising awareness and building knowledge among consumers on climate change and potential activities for adaptation.

- **Community involvement and development**

The subject of community involvement and development is particularly important in the context of India, where businesses can and are in fact expected to contribute to inclusive growth in more ways than providing employment. Subcategories of this core subject according to ISO 26000 are education and culture, employment creation and skills development, technology development and access, wealth and income creation, health and social investment. Climate change further aggravates social problems,



as its impacts will most severely affect people living at the base of the pyramid. Furthermore, many problems that businesses face due to climate change also affect the neighbouring communities, such as natural disasters. Thus, businesses, and in particular Indian MSMEs, need to assure that communities' viewpoints are heard and respected. In fact, if MSMEs develop adaptation measures in consultation and collaboration with communities, they can not only ensure their own short-term survival when faced with extreme weather events, but they can build mutually beneficial long-term relations with the communities they operate in.

3.2.2 Adaptation as a Corner Stone of Business Responsibility

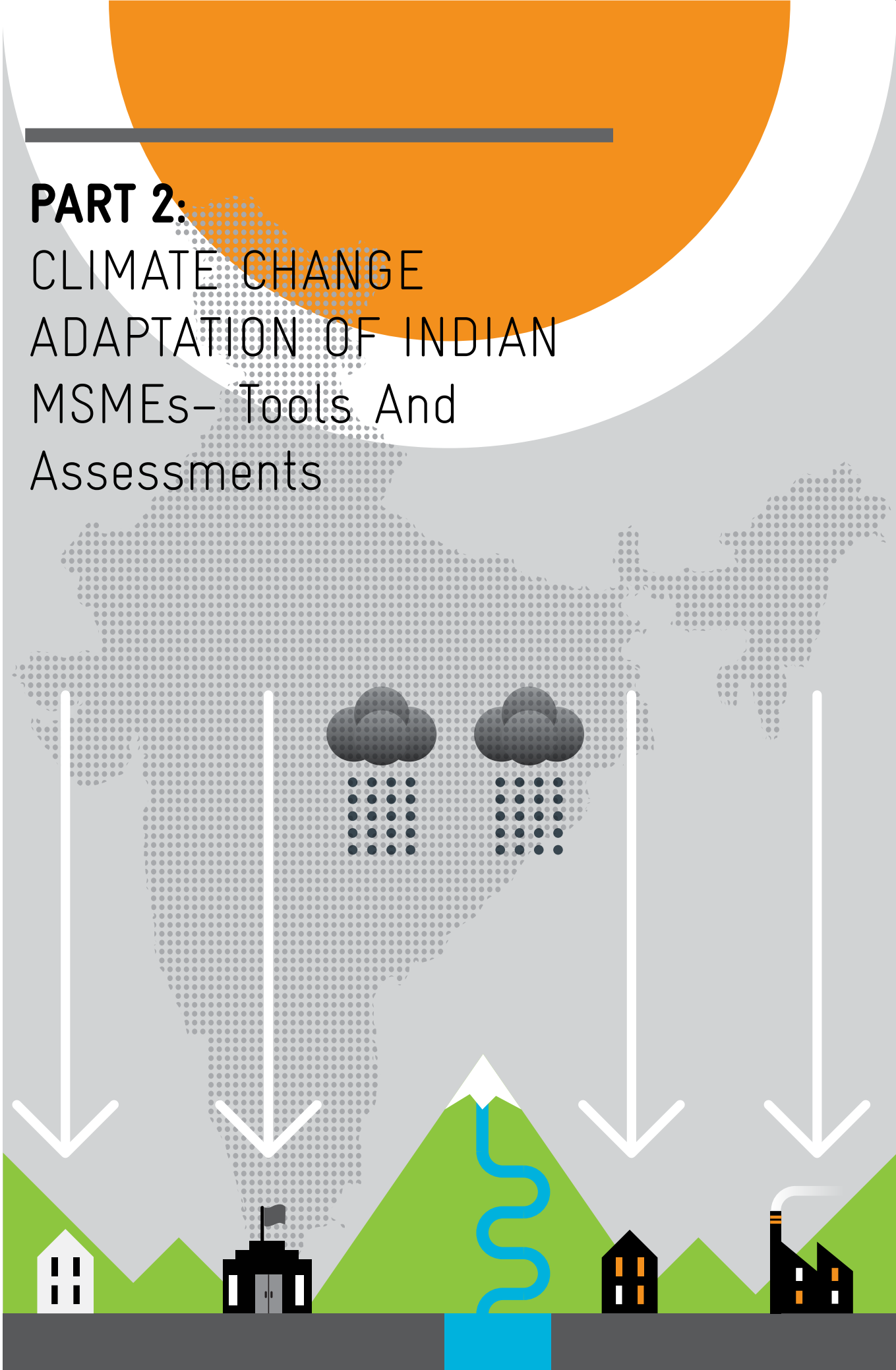
As argued above, adaptation is a key component of responsible business behaviour and as such should be integrated in corporate strategies. If businesses ignore or inadequately respond to adaptation challenges they negatively impact their workforce, the environment, and surrounding communities. Conversely, effective adaptation efforts strengthen business responsibility. Rendering factory buildings more resilient to hazards enhances the health and safety of employees, a key aspect of responsible labour practices. Similarly, collaborating with businesses along the value chain on adaptation is an important element of fair operating practices and amplifies its resilience towards the impacts of climate change. Adaptation measures are also closely connected to environmental responsibility, involving activities like restoring green cover as flooding areas or increasing water efficiency. Finally, by taking into consideration the needs and interests of surrounding communities when planning adaptation measures, businesses demonstrate responsible organisational governance, safeguard human rights and contribute to sustainable community development. In order to reap the benefits of adaptation as a corner stone for business responsibility, companies need to fully exploit their adaptive capacity not just with regards to their own business operations, but also with regard to their environment and stakeholders.



74 Ballard, Alexander, 2008. Adaptive Capacity Benchmarking: A Handbook and Toolkit. Available online at: http://www.alexanderballard.co.uk/dcs/ACB_Handbook_v2003_final_with_logos_rev.pdf.

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PART 2: CLIMATE CHANGE ADAPTATION OF INDIAN MSMEs- Tools And Assessments





4

Assessing Company-Specific Risks and Identifying Adaptation Measures for Businesses

4.1 Adapting to Climate Change – Key Steps and Tools for Businesses

Successful adaptation to climate change impacts by businesses can take various forms, differing in scale and scope. Adaptation measures can entail changes to buildings and machinery, or the development of new products, the overhaul of energy and water intensive processes or be directed at human resource by way of trainings and awareness raising activities. It depends on the individual situation of each business to decide which measures have to be taken at which point in time to adequately respond to the challenges that climate change poses.

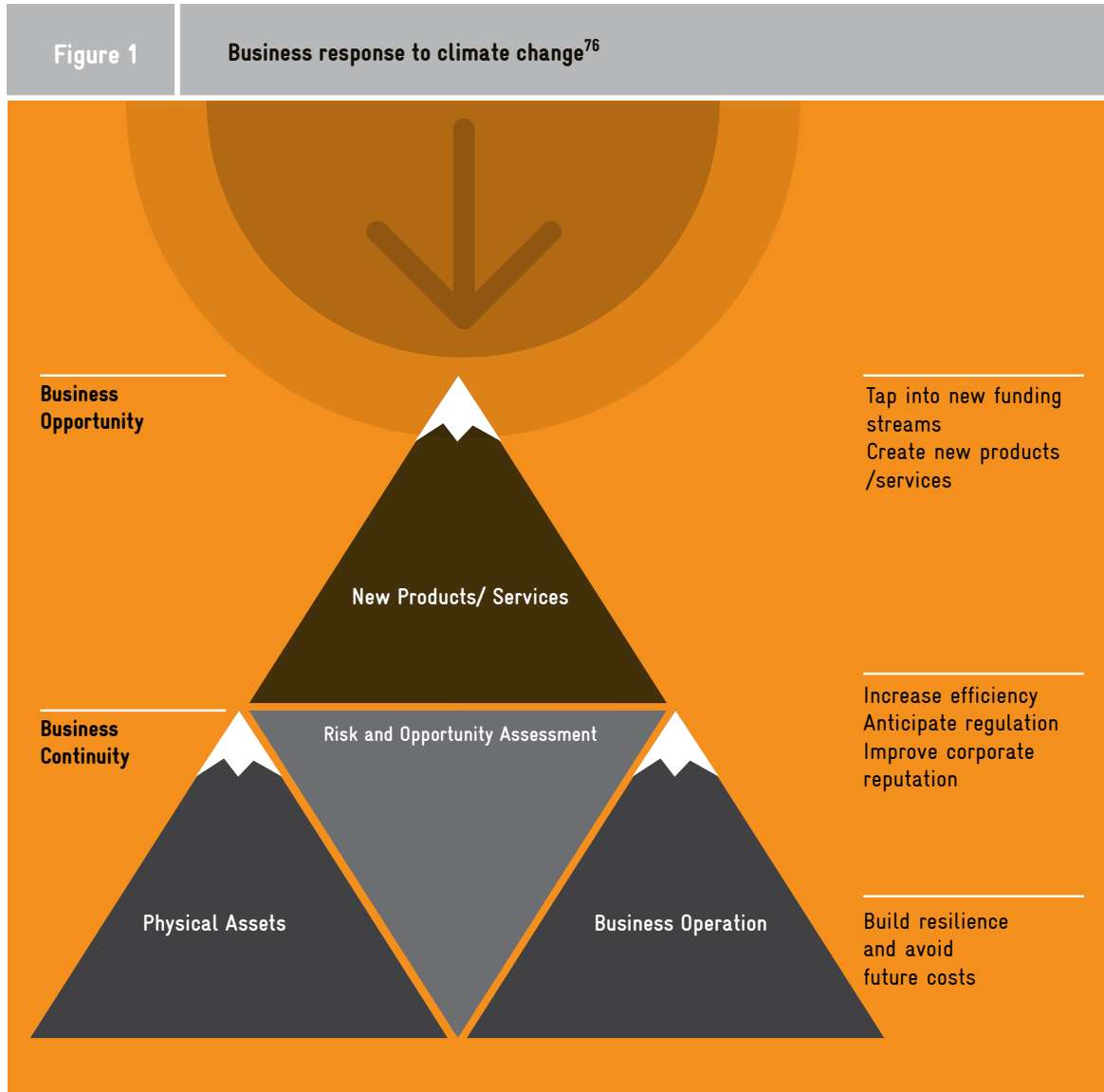
Businesses can respond to direct and indirect impacts by two complementary sets of measures, assuring their business continuity and realising opportunities resulting from climate change (see figure 1):

- 1 Assuring business continuity by building resilience and avoiding future costs**
 - Adjustments of physical assets, including machinery, plants in response to direct impacts, e.g., flooding, general increase of temperature, etc
 - Adjustments to business operations, including value chains, anticipation of climate related regulation, and working with stakeholders on adaptation, thus improving corporate reputation in response to indirect or second-level impacts, e.g., increasing efficiency to respond rising input material prices, adjusting the characteristics of products to reflect consumers' change of preference due to climate change, etc
 - Realising competitive advantage through increased efficiency and risk management

4

2 Realising business opportunity

- Adapting the business case – identification and development of entirely new products and services and tapping into new funding streams, including publicly funded adaptation schemes.



While realising business opportunities resulting from climate change is an important topic— either by the development of new products or services (see section 2.2.3), or by tapping into new funding streams made available by national governments and the international community, this study focuses on the risks companies have to face and how they can assure business continuity. Comprehensive guidance for companies to adapt to climate change impacts is provided by the Climate Expert, an e-learning programme tailored to Indian MSMEs. It assists Indian MSMEs⁷⁷ in identifying and assessing risks as well as opportunities resulting from climate change for their company, and guides them in developing



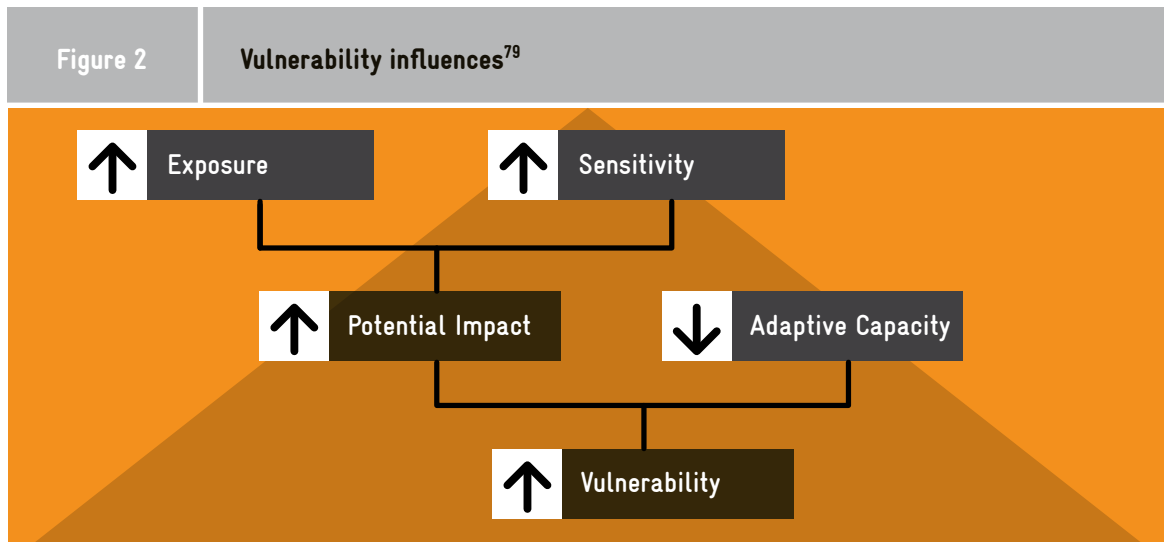
a comprehensive adaptation strategy for their business.

The definitions in box 3, adapted from the Intergovernmental Panel on Climate Change Glossary of Terms⁷⁸, provide information on the various concepts that determine adaptation needs and the capabilities of systems to respond to changes in climate.

Box 3	Key concepts determining adaptation needs and response capabilities
Exposure	Exposure is “the degree of climate stress upon a particular unit analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events.” Exposure contains two main elements: the change in climate itself such as sea level rise, precipitation changes etc., and the exposure felt through climate change, e.g. resource constraints, property damages etc.
Sensitivity	Sensitivity is “the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).” Sensitivity is the biophysical effect of climate change, also potentially influenced by socio-economic changes. Potential Impact refers to “the degree to which a system is sensitive to climate stimuli”, which is synonymously used for risk.
Adaptive capacity	Adaptive capacity is “the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.” It depends on the availability of human, social, physical, natural and financial resources and highly influences the vulnerability of systems to climate change stimuli or impacts. Access to resources depends on external factors such as policies, institutions and power structures.
Vulnerability	Vulnerability, is “the degree to which a system is susceptible to, [and/] or unable to cope with, adverse effects of climate change, including climate variability and extremes. [It] is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.” Vulnerability and sensitivity are proportional – the higher the sensitivity, the higher the vulnerability. In contrast, vulnerability is inversely related to adaptive capacity – the higher the adaptive capacity, the lower the vulnerability.

4

The interrelations among these influences are illustrated in figure 2. As the arrows indicate, vulnerability positively correlates, i.e. jointly grows or decreases, with exposure, sensitivity and resulting potential impact on an organisation. Conversely, vulnerability negatively correlates with adaptive capacity, i.e. an increase in adaptive capacity results in a decrease of vulnerability. This also shows that multiple options exist for reducing an organisation's vulnerability to climate change impacts: reduce an organisation's exposure (e.g., retreat from plant location), reduce its sensitivity (e.g., enhance insulation of buildings) or increase adaptive capacity (e.g., integrate climate change impact in risk management systems). While options for reducing exposure to climate change impacts are few and, as in the case of a transfer of plant locations, usually very costly, most adaptation measures of MSMEs will address sensitivity and adaptive capacity.



4.1.1 Typology and Analysis of Risks Businesses Face

Being aware of and prepared to deal with climate change impacts is crucial for businesses to successfully adapt to climate change. The following typology of risks resulting from direct and indirect climate change impacts that companies have to face due to climate change (box 4) can assist companies to grasp the diversity of issues that they are confronted with.

While indirect impacts should be assessed at the level of the company, the direct impacts are best assessed separately for each production facility, due to the local specificities of direct impacts.

**Direct Impacts**

Physical Assets: Storms and floods may damage buildings, equipment and other physical assets. Therefore, adaptation efforts must take into account the overall physical infrastructure of a business possibly affected by climate change. This includes changing requirements in maintenance and operation.

Indirect Impacts

Resource-use: Access to core inputs, including water and energy, will become increasingly unreliable. The dependency on continuous water and energy supply for production is a main factor of climate risk for business.

Supply chains: The provision of raw materials (or intermediate products) is a crucial part of business operations. Changing temperatures and precipitation patterns may lead to decreased availability and increased price of critical raw materials in the supply chain. Also, an increase in extreme weather events like heavy storms or rainfall may lead to costly disruptions in production and transport due to damage to railroads, ports, bridges, power plants and other infrastructure.

Losses in productivity: The impacts of a changing climate can have immense repercussions on business productivity. For instance, companies may experience increased absenteeism of their workforce, decreased productivity during heat waves, or declining health in the aftermath of large floods.

Market risks: Certain products and services will become less relevant or ineffective. The impacts of climate change may lead to changes in consumer behaviour (for instance, less demand for winter clothing). Also, they might lead to a reduced spending power of consumers due to rising costs for their own adaptation.

Liability risks: The increasing occurrence of extreme weather events may lead to rising insurance costs. Also, in case of foreseeable physical risks from climate change the owner of a business cannot appeal on "an act of nature", resulting in non-liability of the insurer.

Reputational risks: Failing to adapt to climate change impacts incurs reputational risks for companies, for instance when employees incur physical harm from damages of factory buildings during storms or floods. Similarly, companies can experience reputation losses if their own adaptation efforts inadequately take into account their effects on neighbouring communities, e.g., when constructing dams in a way which during heavy rains increase the levels of flooding in surrounding areas.

Regulatory risks: The impacts of climate change can result in regulatory changes like stricter requirements in the fields of energy efficiency or disaster proof building design. If companies fail to comply with these norms, they run risk to be fined or even lose their license to operate.

In order to assess the risks resulting from climate change impacts for a particular business the following information needs to be collected and analysed:

- **Concrete (local/ regional) risks:** What impacts have been experienced in the past and are to be expected in the region and on the premises where the business is located; what are the impacts on its main market regions?⁸¹
- **Likelihood of occurrence:** Which impacts are most likely to occur for the specific sector/business? This also includes the aspect of time – more imminent threats have to be treated with more urgency.
- **Severity of potential damages:** How severe are the potential damages to be expected? Can they lead to insolvency?

The most effective way of analysing risks is by using a structured risk assessment. Based on the assessment, risks can then be prioritized according to a matrix linking likelihood and severity of impacts (see figure 3). While the assessment is concerned with collecting risk, the matrix would reflect the danger posed by each one relative to the others. Of course, the climate risks, such as flooding, can be cross-referenced with the types of risks listed above – for example, assessing severe flooding with supply chain impacts.

4.1.2 Six-Step Approach to Developing an Adaptation Strategy and Supporting Assessment Tools

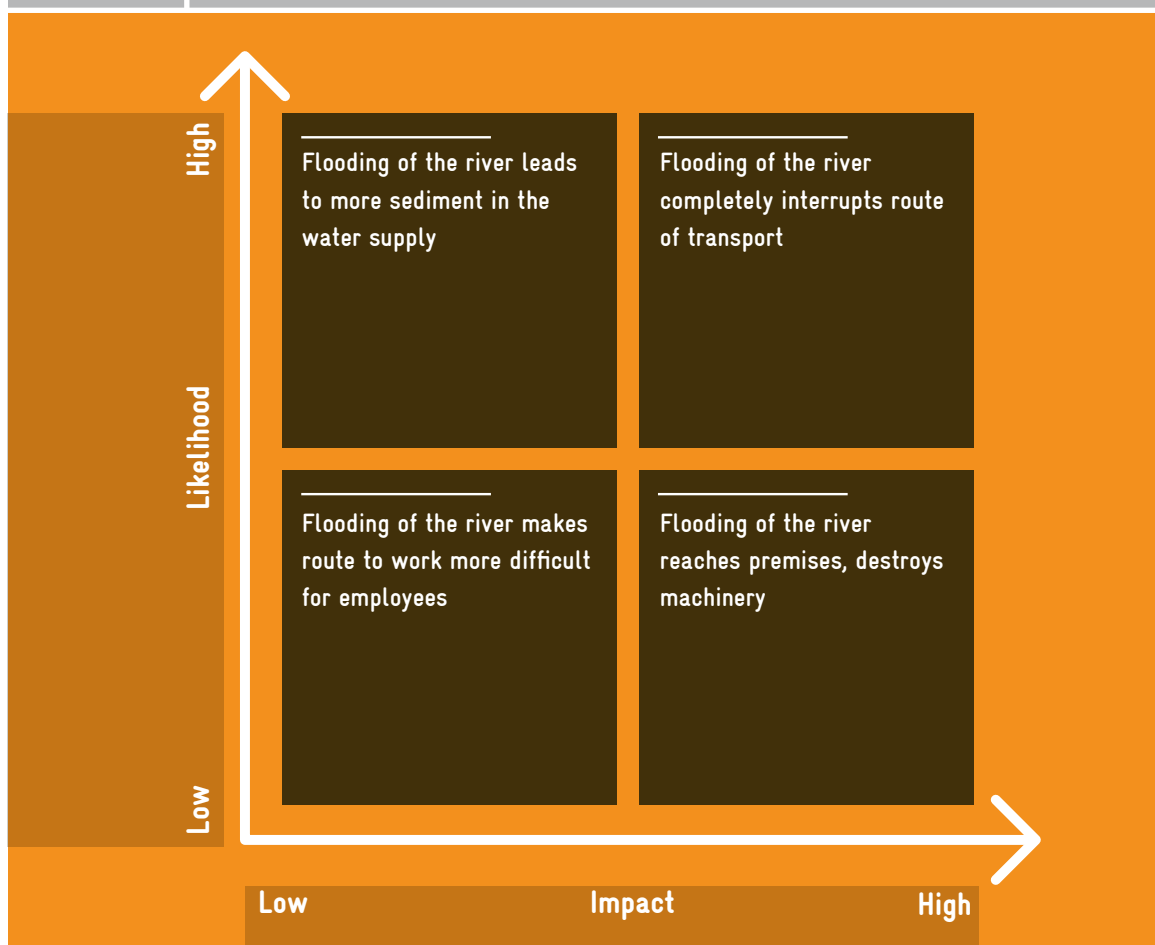
An exemplary approach for identifying and implementing adaptation measures for businesses involves six distinct steps. A crucial prerequisite is the company's knowledge of climate impacts and related risks.

- **Identifying risks** for physical assets and business operations posed by climate change which can threaten business continuity
- **Analysis and evaluation of risks and sensitivities**, selection of the most relevant
- **Assessing business opportunities** resulting from climate change
- **Development of** measures to build resilience and exploit the most promising opportunities
- **Analysis and evaluation of** proposed measures, selecting the most adequate
- **Implementing and monitoring** these measures and installing a risk management system



Figure 3

Risk matrix⁸² - Exemplary risk matrix - Flood-prone area



4

Various tools exist to support each process step. The most important one is the risk assessment, as all subsequent steps are based on the meaningful identification and prioritization of risk.

In order to define the impacts that a company has to face resulting from climate change, a risk assessment needs to be conducted which includes the identification of affected physical assets as well as business operations.

Step 1: Inventory of the past and projected climate phenomena in a certain region. This inventory includes the probability of occurrence of a climate change phenomena and the potential impacts that they have (see figure 3).

Step 2: Using an assessment grid to assess sensitivity and evaluate risks. Assessment grids are split into categories such as infrastructure and operations, finance and markets, and stakeholders and are used jointly with the climate inventory. Below, an exemplary assessment grid is presented (table 3) and explained.

Step 3: Developing and assessing business opportunities resulting from climate change. Tools used for this step are usually connected with the climate impact inventory of Step 1. For each relevant climate phenomenon,

corresponding product and process innovations are developed.

Step 4: Development of measures to build resilience and exploit the most promising opportunities. The approach is similar to Step 3 – for each climate phenomenon, potential adaptation measures are defined.

Step 5: Analysis and evaluation of proposed measures, selecting the most adequate. The opportunities defined before are rated according to criteria like resources necessary, availability of knowledge, potential competitive advantages, etc. The proposed adaptation measures are rated according to their feasibility and effectiveness.

Step 6: Implementing and monitoring these measures and installing risk management system can be done by way of a project implementation plan.

4.2 Risk Assessment Grid: Methodology for Companies

The assessment grid below (table 3) seeks to cover climate change impacts on all important determining factors of businesses, namely building/location and processes, logistics and stocks, employees and community, government and regulation, and market and finance (see table 2). The answers to these questions allow drawing conclusions on the most pressing climate-related issues for an enterprise, thus preparing the ground for a full risk-assessment and the subsequent development of an adaptation strategy.

Table 2		Assessment grid categories – company level				
Infrastructure and Operations			Stakeholders		Finance and Markets	
Building & Location	Processes	Logistics & Stocks	Employees & Community	Government & Regulation	Finance	Market

The first category, **infrastructure and operations**, deals with direct risks to physical assets and business operations. It identifies impacts on the production facilities of a company, including its buildings, infrastructure and manufacturing processes. Flexibility and security of logistics and stocks are also assessed. Risks in this category can best be dealt with through anticipatory planning. For example, just-in-time delivery of products to clients can become a serious problem if an extreme weather event occurs, but can be buffered by additional stocks-keeping at different



production sites or outside the premises.

Stakeholder assessments include employees, neighbouring communities and government frameworks. The impacts of climate change on **employees** can be substantial – for example, rising temperatures leads to lower productivity. The **neighbouring community** can be affected by climate change impacts on a company, e.g., toxic effluents in case of an extreme weather event. **Regulations** on different policy levels resulting from or related to climate change impacts can concern use of resources like water and energy. The assessment includes potential opportunities arising from government funding schemes, financial assistance for investments in new technologies.

The assessment of the **finance and markets** category assesses indirect impacts like changes in consumer behaviour or the financial outlook in times of changing climate. To assess the financial resilience, potential cash-flow problems and liabilities are of importance, as well as confidence of investors and the cost of insurance. Regarding the market side, the necessity of changes in the product portfolio or accessibility of products is assessed.

Table 3		Assessment grid for climate impacts	
	Impact on		Critical Points
Infrastructure and Operations	Building/Location	1	Are existing buildings resistant enough to withstand climate change impacts (changing climate, extreme weather events)?
		2	How sensitive is the company location regarding climate change impacts?
		3	Is infrastructure in direct proximity of the premises resilient regarding changing climate and extreme weather events?
		4	How linked is the company with neighbouring companies? (resources, infrastructure, joint efforts)
		5	How linked is the company with the community? (resources, infrastructure, joint efforts)
	Processes	6	How sensitive are manufacturing processes in terms of uncertain energy and water supply?
		7	Is the water supply secure?
		8	Is the energy supply secure?

	Impact on		Critical Points
Infrastructure and Operations	Processes	9	How sensitive are manufacturing processes to higher temperatures?
		10	How sensitive are manufacturing processes in case of extreme weather events?
		11	Is it possible to reduce water and / or energy consumption?
		12	Are there any measures to provide the processes with energy in case of energy supply outage?
		13	Are there any safety measures to prevent outflow of dangerous or pollutant substances?
	Logistics and stocks	14	Is the availability of raw material and auxiliary material affected by climate change impacts?
		15	Is there enough flexibility in transport and delivery of goods in case of climate change impacts?
		16	Is there any possibility to reduce raw material and product miles and/or reduce complexity of value chain?
17		Is the storage of goods secure in case of changing conditions (e.g., higher temperature) or other climate change impacts (e.g., flooding)?	
Stakeholders	Employees and Community	18	Do working conditions deteriorate due to climate change impacts?
		19	Do living conditions of workers deteriorate due to climate change impacts?
		20	Are there any impacts on productivity caused by temperature rise or extreme weather?
		21	Has the community been affected by climate change and/or the companies' actions in the past?
		22	How severely is the community (estate population and surrounding communities) affected by climate change, and by the company's adaptation or maladaptation?
		23	Are there any possibilities to help adapt and/or raise stability of energy/water supply in the community (estate population and surrounding communities) in a joint effort?
	Government and Regulation	24	Have past direct climate change impacts already affected regulations that your company has to comply with?
		25	Do projected climate change impacts affect existing regulations?
		26	Are there any regulations that you anticipate or expect to become more stringent in the future?
		27	Is your company affected by any existing government programmes (e.g., National Missions) or funding streams?
28		Are there any government programmes regarding adaptation to be anticipated that are of relevance to your company?	
Finance and Market	Market	29	Is there any falling or rising demand of products observable or to be expected due to climate change?
		30	Is there any need of action regarding sensitivity of product quality, e.g., to higher temperatures?
		31	Are there any impacts on product accessibility?
		32	Is there any opportunity to extend or change the product portfolio to climate change impacts?
	Finance	33	Are there any problems regarding short-term cash-flow and financing by climate change impacts?



	Impact on		Critical Points
	Finance	34	Are there any problems caused for long-term investments by climate change impacts?
		35	Is it likely that your company's liabilities caused by climate change impacts increase? (e.g., flooding resulting in toxic discharge)
		36	Are insurance premia likely to be raised due to climate change impacts and/or are the existing insurances still adequate?

4.3 Sensitivity Assessment: Sector-Wide Methodology

Businesses can also draw important conclusions in terms of their own competitiveness from a sector-wide assessment of climate change impacts. In this case, it is the sensitivity of a sector rather than its risks that is assessed, as exposure is always locally specific. As illustrated in the sensitivity assessments of the Indian textiles and the metalworking sector presented in chapter 6 and 7, for a sector-based analysis several adjustments to the assessment grid have to be made. Most importantly different technology levels of companies in one sector have to be accounted for. Technology levels are highly diverse in the MSMEs sector, and they affect different dimensions of the assessment: The vulnerability of production facilities strongly depends on the technology level of a company. Furthermore, the technological level affects sensitivity in the processes dimension, e.g., for companies relying on manual labour, decreasing labour productivity is reflected in lower process efficiency. Sensitivity at the level of logistics and stocks is also affected by the technology level. For instance, storage facilities of companies with a very low technology level will provide little protection from heat or heavy rains. Finally, technology level impacts sensitivity to changes at the level of markets and governmental requirements. On community and labour issues, instead, it is not possible to make a sector-wide analysis. Similarly, the impacts on the financial situation of a company are too specific to validate sector-wide analysis.

An example of how to account for diverse technology levels of companies within a sector is presented in chapters 6 and 7, where we distinguish between three technology levels:

- Inefficient, old/obsolete technology, largely man powered
- Efficient, technology upgraded, mix of man/machine powered
- Highly efficient, recent technology, mainly machine powered.

The sensitivity in each dimension relevant to the sector level assessment

can then be analysed in a differentiated manner for each technology level (see table 4)

The overall sensitivity at sector level then depends on the specific set up of the sector in terms of technology levels, e.g., the share of companies with low, medium and high levels of technology in the particular context studied.

Table 4		Assessment grid categories – Sector level			
Technology Level	Factories & Premises	Processes	Logistics & stocks	Markets & regulatory requirements	
Level A					
Level B					
Level C					

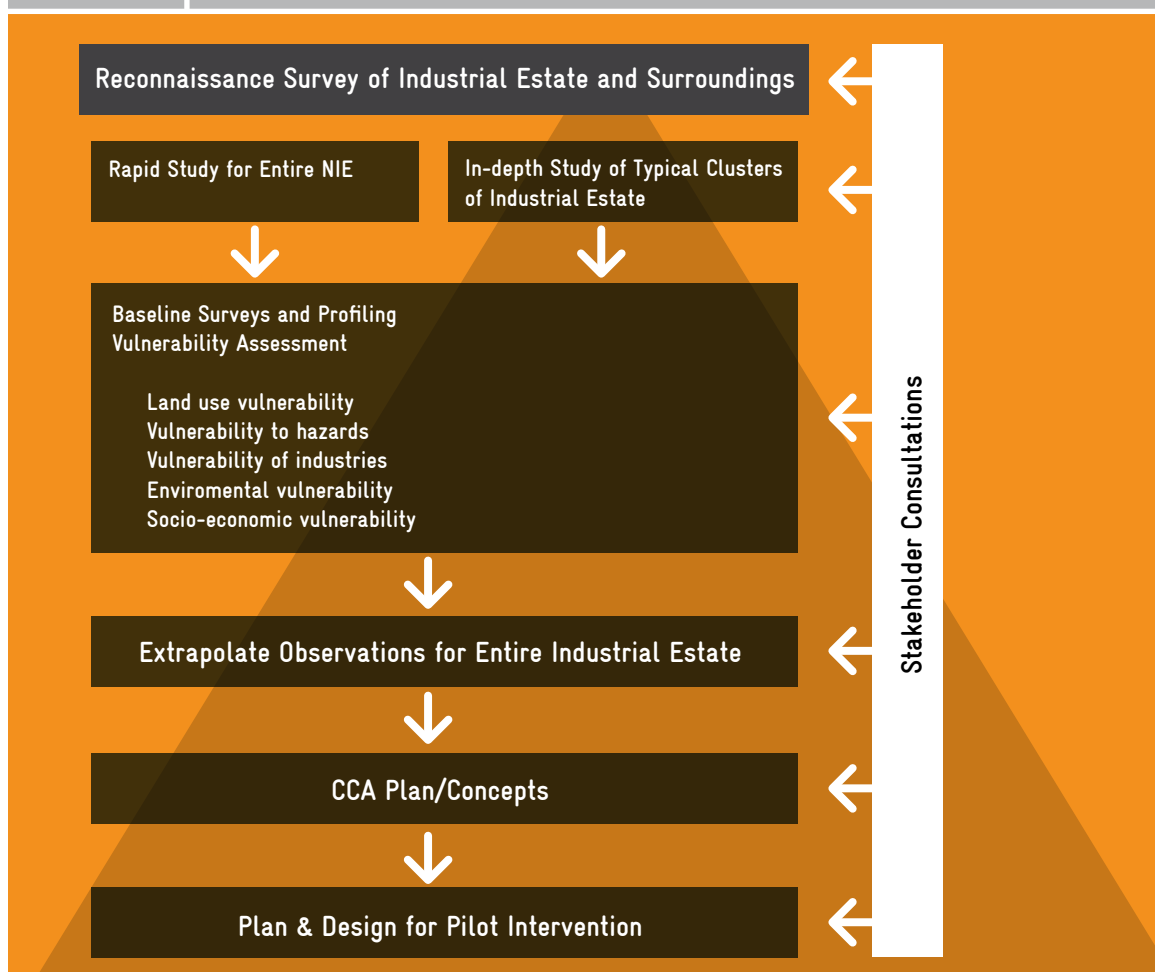
4.4 Risk Assessment: Industrial Estate / Cluster Methodology

Businesses also figure in as actors in adaptation plans on the level of industrial estates/clusters. These can either be drawn up by associations, or by local policy-makers, or in a joint effort. The assessment grid presented above can be used as a starting point for gathering information for an analysis of an industrial estate / cluster and for its adaptation plan. An assessment on this level should also include stakeholder consultations. Through these, the environmental and socio-economic vulnerability of the area as well as land use issues can be addressed in addition to specific business impacts. Based on this type of thorough and comprehensive analysis an integrated climate adaptation plan for the industrial area can be developed. The key steps of such an approach are presented in figure 4. Conducting assessments at the level of industrial estates/ clusters has been demonstrated to be of particular use in the cluster-based Indian context.



Figure 4

A sample approach to developing an adaptation plan⁸³



4.5 Adaptation Measures by Companies: Typology and Best Practices

4.5.1 Adaptation Measures – Typology

Adaptation measures by businesses can be distinguished along different characteristics. There are three types of strategies which companies can use to cope with the effects of climate change.

- **Protective strategies** are measures taken to protect against climate change impacts, both in the form of gradual change such as rise in temperature and shore erosion as well as extreme weather events such as flooding.
- **Accommodating strategies** include increasing a business' ability to cope with the impacts of climate change, e.g., by drafting of emergency plans, or by seeking insurance.
- **Retreat strategies** focus on reducing the exposure to climate change impacts. This can be done by relocating, changing the product portfolio, simplifying of the value chain, etc.⁸⁴

Another important distinction is between technical and non-technical solutions. Adaptation technologies can be defined as “the application of technology in order to reduce the vulnerability, or enhance the resilience, of a natural or human system to the impacts of climate change”.

Technical solutions (“grey measures”) can be further divided into high- and low technologies:⁸⁵

High-tech measures include all measures that involve the installation of state-of-the-art machinery and equipment (e.g., cooling devices, drip irrigation techniques, etc)

- **Advantages:** Technical solutions can be designed to meet specific needs, and then are highly effective for achieving these targets; may increase competitiveness (higher efficiency: e.g., less resource use, less waste).
- **Disadvantages:** Technology is often unaffordable for small businesses, requires specific skills in development and maintenance.

Low-tech measures include measures on a more basic level, like incremental improvements in infrastructure or low-tech adjustments on existing processes to reduce expected risks (e.g., construction of a flood wall, improvements on waste management)

- **Advantages:** relatively cost-effective, easy to implement and maintain.
- **Disadvantages:** No technology upgrade, only medium-term solutions, little side-effects to resource-use.

In addition, technological innovations to either adapt to predicted changes or to meet new demands are of importance. This may include products which realise a “halo effect” – MSMEs that demonstrate their awareness of climate change risks through the development of new products or processes may appear as low-risk customers to insurance providers and banks.⁸⁶

Non-technical approaches as cited in a report by the European Environment Agency⁸⁷ include ecosystem-based adaptation options, or “green measures” and behavioural and managerial approaches, so-called “soft measures”. Green and soft measures specifically aim at decreasing the sensitivity and increasing the adaptive capacity of human and natural systems, hereby building resilience. Green measures of companies make use of ecosystems, e.g., grasslands surrounding industrial areas for seepage, or the planting of mangrove trees to avoid erosion. Soft measures of



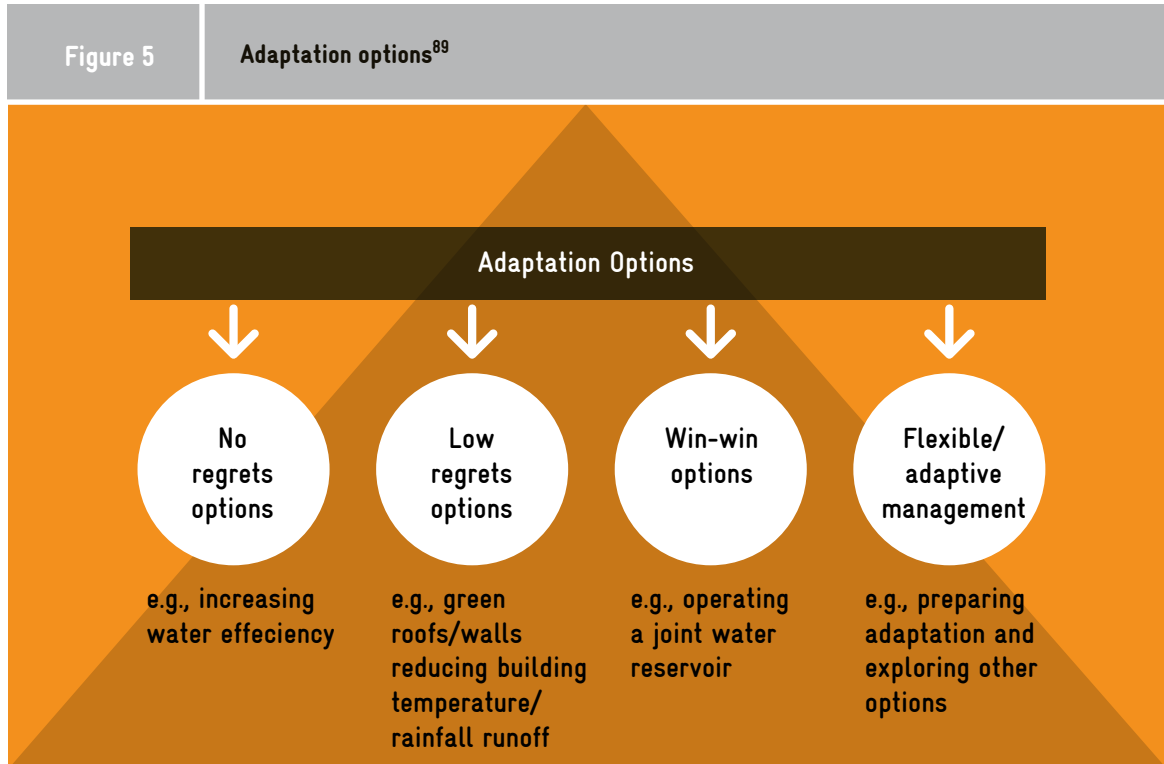
companies include capacity building and drafting of adaptation strategies which involves consultation with stakeholders. The advantage of this approach is the relatively low cost of these solutions in comparison to technological adaptation measures, because often existing funds and other resources only have to be redirected to implement green or soft measures. In contrast, technology-based measures typically require additional funding for research, implementation, and operation. Smartly combining technical and non-technical solutions in one strategy allows businesses to reap the rewards of both types of approaches. Table 5 gives an exemplary overview on such a mix of adaptation measures in different areas of a business.

Table 5	Examples of adaptation measures	
Impacts on	Gradual change of climate – heat: food processing, Ahmedabad	Extreme weather event – flood: chemicals, Faridabad
Buildings/ Infrastructure	Improve secure and increase water sources used by plant	Secure most important/expensive machinery from floods
Processes	Water recycling system to reduce dependency on water resources	Assure that no leakage occurs in case of flood
Logistics and Stock	Build heat-resistant roof for storage depot	Emergency plan for keeping up supply to market
People	Collaborate with community for water	Emergency plan for occurrence during workday
Market	Product characteristics reflect Climate Change impacts	Regionally diversify buyer base of products
Finance	Seek credit line for increasing energy efficiency	Insurance policy for extreme weather event

4.5.2 Best Practices: Adaptation Measures by Corporations

There are a number of potential adaptation options for climate impacts, and a mix of measures is most effective for risk reduction and realising opportunities. Which mix of options is optimal is specific to each case and depends on a number of factors, including feasibility in light of existing capacities and constraints, and specific costs and additional benefits. The identification is complicated by the fact that climate change is a dynamic process, and accurate predictions are difficult to make.

For MSMEs, identifying viable options is particularly relevant, given their often limited resources; in order to learn how to make adaptation measures work they can take cues from those Indian corporations that are already tackling climate change challenges. These corporations seek to not only tackle climate change impacts by way of their adaptation measures but also realise additional benefits. Four types of options can be differentiated (see figure 5):⁸⁸ no-regrets options, low-regrets options, win-win options and flexible/adaptive management options.



No regrets options are measures delivering benefits under current climate conditions, and thus are not dependent on projected changes in climate. Typically these are activities to enhance efficiency in the use of resources



like water or energy, resulting in cost savings which eventually cover initial investment costs. Companies which are strongly linked to the natural resource base or have long/complex value chains most effectively make use of these options, as they already experience considerable climate impacts. An example of a no regrets adaptation option from the Indian context is provided in box 5.

Box 5

No regrets option – Water management at ITC Ltd.

ITC Limited is a conglomerate headquartered in India inter alia active in the tobacco and food business. A large proportion of ITC's raw materials are agriculture-based and hence changes in climate directly affect business operations. ITC's water conservation, watershed development and rainwater harvesting projects contribute significantly to improving the sustainability and profitability of its agri-related businesses.⁹⁰

Low regrets options are measures for which the associated costs are low, while potentially, great benefits result. Benefits depend on the accuracy of the projected climate change and the timing of implementation. Combining adaptation measures with scheduled maintenance work can create synergies and considerably reduce costs. For example, constructing new drainage systems with higher capacity than currently necessary prepares companies for heavier rainfall, but does not lead to much higher costs in case the projection was wrong. An example of a low regrets adaptation measure from an Indian company is presented in box 6.

Box 6

Low regrets option – Resource conservation at Mahindra

Mahindra Ltd. is a multinational conglomerate headquartered in India with its core businesses in the automotive and farm equipment industries. In the framework of its sustainability and climate change strategy, the group has introduced a range of initiatives for water, energy and waste reduction. In many instances it hereby made use of synergies with other scheduled infrastructure/maintenance related activities. For example, at the Mahindra Autosector plant at Kandivali the underground water pipelines had to be replaced, and the company made use of the opportunity for rendering the water system more efficient, replacing the old system by overhead pipelines, installing automated control systems for water pumps, and installing occupancy sensors to stop inefficient water flows.⁹¹

Win-win options are measures which minimise risks or realise opportunities and have additional social, environmental or economic benefits. An example is the improvement of risk management systems of a company, resulting in better preparedness. Creating flood plains near factory buildings not only contributes to reducing flood risks, but supports biodiversity and enhances the recreational value of the area

for the community. Also, developing new products that enable others to better adapt to climate change challenges can be considered a win-win adaptation measure. One such example from India can be found in box 7.

Box 7**Win-win options - Weather insurance for small farmers**

The ICICI Lombard General Insurance Company formed a partnership with BASIX, a Hyderabad-based microfinance institution, in 2003 to develop rainfall index insurance contracts for small farmers in Andhra Pradesh. They assessed weather impacts on the agricultural sector to develop a new insurance product, conducting research concerning prices and technologies and installing weather monitoring stations. The insurance helps farmers cope with the impacts of climate change such as crop losses due to heavy rains, and through their research activities they enhance the availability of weather and climate-related information. At the same time, they have managed to establish a successful business model, by now having clients in more than 10,000 villages in seven Indian states and employing a staff of almost 1300 people.⁹²

Flexible or adaptive management options refer to measures that leave room for future modification. These enable business to flexibly respond to the changing climate and to new possibilities resulting from new technologies. Given the uncertainty of climate change projections, this considerably reduces the financial risks of adaptation measures. An example for a flexible technical adaptation measure is to build water reservoirs in a way that allows for augmenting their capacity at a future point in time. Flexible responses also include non-technical measures, including managerial ones; for example regularly consulting with stakeholders to identify climate-related issues, as described in the case example on Ambuja Cements below (box 8) is flexible in that its efforts can easily be reduced or increased depending on the (climate-related) circumstances.

Box 8**Flexible adaptation – Stakeholder engagement on water challenges at Ambuja Cements**

Ambuja Cements is a major Indian cement company. Through the Ambuja Cements Foundation company regularly engages with the communities surrounding the company plants and mines to help improve their living conditions. A key field of engagement is support in water conservation and management. By bringing together the technical know-how of the company and traditional knowledge of the communities, it has implemented a number of adaptation-related projects, including dam construction in Himachal Pradesh and Rajasthan, pond renovation in Rajasthan, water harvesting in Andhra Pradesh, and mitigation of salinity ingress in coastal zones of Gujarat. Through this collaboration with communities, the company not only enhances its reputation and reduces the communities' vulnerability to climate change, but also keeps track of adaptation challenges in the areas it is active in, and can adjust its own adaptation measures to changing conditions.⁹³



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5 Objectives and Methodology of the Sector-based Sensitivity Assessment and the Case Studies

5.1 Objectives

The primary objective of the following sensitivity assessment and case studies of two key MSME sectors in the Indian economy is to ground the above analysis in reality, linking the macro-issue of climate change to the actual challenges faced by the MSME sector. The sensitivity assessment at sector level is conducted to demonstrate the specific impacts which already observable trends and anticipated developments have on particular industry sectors. The case studies further illustrate the need of comprehensive risk assessment and showcase that, sometimes unknowingly, MSMEs already face and respond to climate change impacts.

5.2 Methodology of Sector Selection

In order to select sectors that are particularly sensitive to climate change, a sector assessment of 24 pre-selected sectors was conducted. The pre-selection of the sectors was based on two considerations, namely their relative share of MSMEs in India, and the overall importance of the sector in India. Most of the 24 sectors are eligible for green credit lines by the Small Industries Development Bank of India (SIDBI), which targets the most important MSMEs sectors.

The sectors were then assessed by way of a scoring system from 0 to 5 according to five selection criteria:

- Dependence on energy
- Dependence on water
- Sensitivity along the value chain
- Strategic implications
- Environmental impacts.

5.3 Background on Selection Criteria

5.3.1 Assessment of Energy and Water Use

The level of energy and water consumption is directly linked to a company's climate change sensitivity because the availability of both resources depends heavily on external conditions, albeit in different ways. While water supply may be affected by gradual changes in climate or by extreme weather events in a direct way, energy provision is mainly affected indirectly through price hikes and limits in availability. Energy and water use was assessed separately.

5.3.2 Assessment of Value Chain

The sensitivity of a product's value chain depends highly on the sort of inputs required. If the inputs are themselves sensitive to changing climatic conditions, e.g., agricultural products, interruptions of supply and price hikes can be expected, and are observable even today. Also the complexity of value chains needs to be taken into account – the further value chains reach geographically and the more process steps a product necessitates, the more likely it is that climate change impacts will have an effect– be it in transportation, or during previous manufacturing steps. Impacts in this regard include both extreme weather events and gradual changes.

5.3.3 Assessment of Strategic Implications

Gradual changes such as rising temperatures can have an impact on production facilities and operating processes, but also market demand of products may shift; furthermore, product characteristics may need to be altered to reflect changing circumstances.

5.3.4 Assessment of Environmental Impacts

Extreme weather events can result in the release of waste and effluents into the environment. This can pose a threat to communities depending



on its toxicity, biodegradability and amount of released substances. In order to reflect the importance of this criterion, its assessment value was weighted double – thus measuring one third of the entire assessment value.

5.4 Results of Impact Assessment per Sector

For the purpose of the study, industry experts and companies from Ahmadabad and Faridabad in the metalworking, textiles and chemical sectors were interviewed. In order to analyse the sensitivity of the chosen sectors and companies in a structured way, an assessment grid was used which is explained in more detail below.

The case studies presented in the second part of the study cover two MSMEs from Faridabad, India, one from the textiles industry and one from the metalworking sector. They illustrate the impacts of climate change on these businesses as well as describe how the companies have so far evaluated and responded to these challenges.

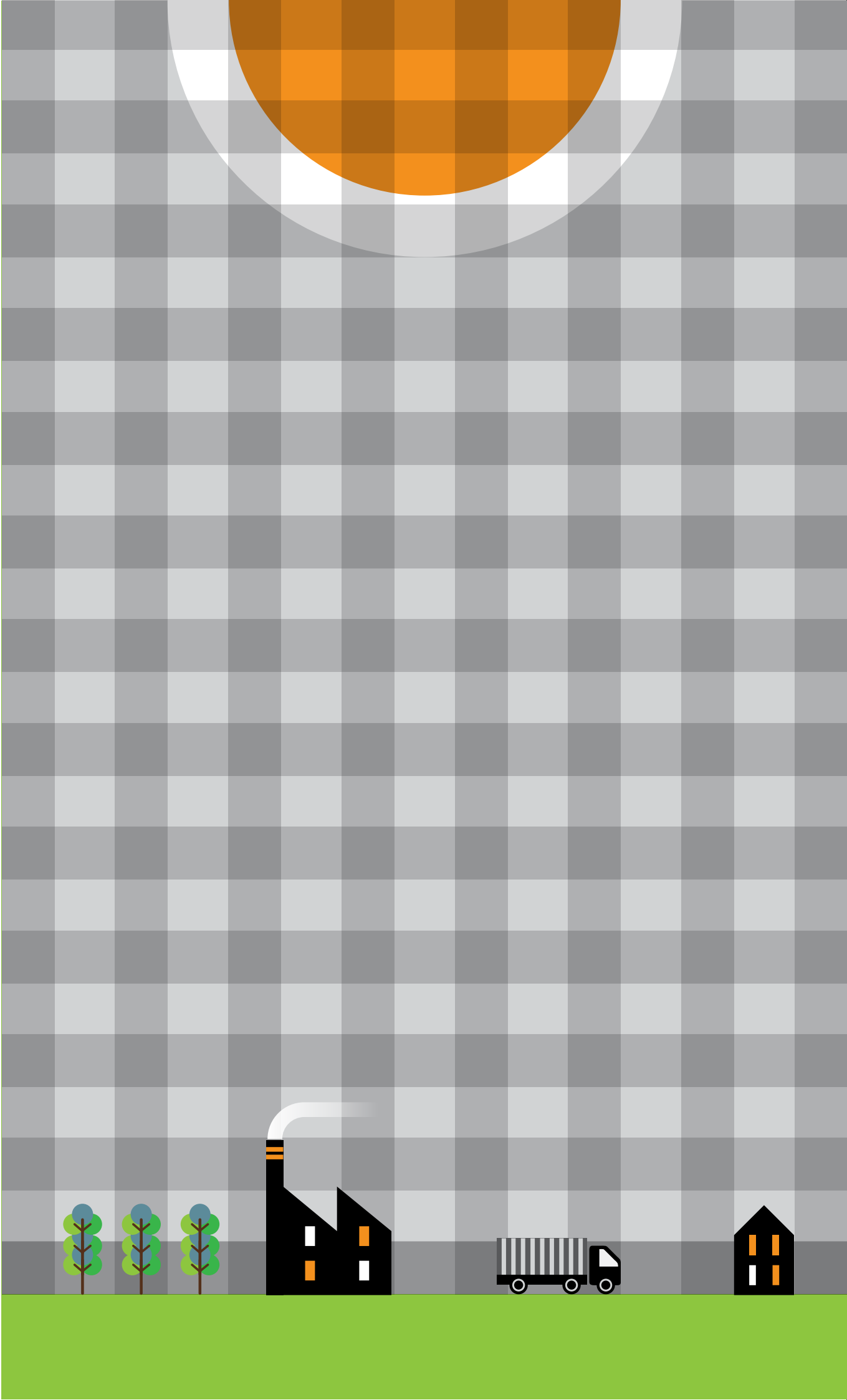
The interviewed MSMEs all reported to have experienced repercussions from climate change impacts, though none of them stated these as their most pressing problems. Surprisingly, while direct impacts were thought to have led to rather limited challenges in the past, such as interruption of transport, higher frequency of power cuts, indirect impacts, including a change in demand for textiles due to warmer climate was reported as more alarming. All enterprises experienced significant drops in profitability in the summer months, either due to more frequent power cuts and associated increased energy costs and decreased productivity of workers, or both.

Table 6 shows the results of the risk assessment conducted in the 23 pre-selected industry sectors. A detailed description of the scoring criteria applied is provided in table 7.

Table 6		Sensitivity and impact severity of various sectors						
	Water Use	Energy Use	Supply Chains	Strategy	Total	Impacts on Environment	Total	Result
Brick tiles manufacturing	2	3	3	1	9	0	0	9
Ceramic & glass industries	0	4	2	1	7	0	0	7
Construction	2	3	5	5	15	3	6	21
Chemicals and chemical products	3	4	3	1	11	5	10	21
Distilleries	5	4	0	0	9	3	6	15
Drugs & pharmaceutical	1	1	3	2	7	4	8	15
Dyes & Intermediates	2	1	1	2	6	5	10	16
Electrical machinery and apparatus	3	2	2	3	10	2	4	14
Electronics and parts manufacturing	2	0	2	1	5	3	6	11
Electroplating	4	3	2	0	9	4	8	17
Light engineering & auto parts	3	3	4	2	12	2	4	16
Food & beverage units	3	2	3	3	11	1	2	13
Foundries	1	5	2	0	8	3	6	14
Leather tanning and finishing	5	0	4	0	9	4	8	17
Lime Kilns	2	2	2	0	6	1	2	8
Machinery and equipment	3	2	3	1	9	2	4	13
Metal working	3	5	4	2	14	2	4	18
Pulp/ Paper	5	3	3	3	14	4	8	22
Recycling	3	3	3	1	10	3	6	16
Rice mills	2	2	3	0	7	2	4	11
Sewage and refuse disposal, sanitation and similar	5	4	4	2	15	5	10	25
Sponge iron plants	3	3	2	0	8	2	4	12
Textiles	4	2	4	3	13	4	8	21



Table 7	Detailed description of the assessment	
Assessment Water/Energy	0	Moderate for some enterprises, rising costs/shortages of some effect on overall output in the long-run
	1	Moderate for most enterprises, rising costs/shortages have an effect on overall output within 5 years
	2	Somewhat high: high impacts for some, moderate for most; rising costs/shortages of considerable effect on overall output within 3 years
	3	High: high impacts for most enterprises, rising costs/shortages of high effect on overall output within 3 years
	4	Very high: high impacts for all enterprises, rising costs/shortages severely endanger most enterprises within 3 years or sooner
	5	Severe: high impacts, survival of all enterprises at stake in case of rising costs/shortages within 3 years or sooner
Assessment Value Chains:	0	Inputs from not more than 5 suppliers, no agricultural produce necessary; production of end product; simple logistics; easily available alternative sources
	1	Inputs from not more than 7 suppliers, no agricultural produce necessary; production of intermediate product but simple logistics; easily available alternative sources
	2	Inputs from not more than 7 suppliers, no agricultural produce necessary and production of intermediate product and somewhat complex logistics
	3	Inputs from more than 7 suppliers; agricultural produce necessary but simple logistics
	4	Inputs from more than 10 suppliers; production of intermediate product OR highly complex logistics
	5	Inputs from more than 20 suppliers; OR use of agricultural produce and highly complex logistics
Assessment Strategy:	0	Climate change impacts of little effect on production facilities and operation processes; no effects on characteristics and demand of products
	1	Climate change impacts of some effect on production facilities and operation processes; little effect on characteristics and demand of products
	2	Climate change impacts of direct effect on production facilities and operation processes; some effect on characteristics and demand of products
	3	Climate change impacts of direct effect on production facilities and operation processes; characteristics of products need to be reassessed; demand of products likely to change in the long-term
	4	Climate change impacts of high effect on production facilities and operation processes; demand of products likely to change within 5 years
	5	Climate change impacts necessitate change of production facilities and operation processes; demand for products likely to change in next 3 years
Environmental Impacts	0	No use of toxic/environmentally harmful substances; no impacts to be expected in case of extreme weather event
	1	Little use of environmentally harmful substances; marginal impacts to be expected in case of extreme weather event
	2	Use of some environmentally harmful substances; some environmental impacts to be expected in case of extreme weather event
	3	Use of some toxic and environmentally harmful substances; some environmental/health impacts to be expected in case of extreme weather event
	4	Use of environmentally harmful substances and/or moderate use of toxic substances, great environmental/health impacts to be expected in case of extreme weather event
	5	Intensive use of toxic and environmentally harmful substances; severe environmental/health impacts to be expected in case of extreme weather event





6 Sensitivity Assessment and Company Case Study in the Indian Textiles Sector

6.1 Sector Characteristics: The Textiles Sector

The Indian textiles sector has a prominent position in the national economy and is an important export industry (see box 9), comprising the spinning, weaving and finishing of textiles and the manufacture of wearing apparel (see figure 6). Sub-sectors include the synthetic fibre industry, the woollen textiles industry, the silk industry, and the jute industry. While synthetic fibres are increasingly used, India's textiles sector is still predominantly cotton-based, using domestic cotton as well as from Pakistan and China.

The textiles sector in India is characterised by one of the most fragmented supply chains in the world – from raw material procurement to different process steps and shipping handling, production logistics are complex. The average manufacturing and delivery lead time from fabric buying to shipment of apparels comes to 45–60 days and in most cases extends to 80 days.⁹⁴

While the mill sector is mainly organised, and accounts for a major part of exports, in other process steps, small-scale/unorganised units prevail. These use traditional and oftentimes inefficient production methods.⁹⁵

⁹⁶ Because of its low labour costs, most of the processes in the Indian textiles sector are done by manual labour, even in medium-sized companies. Only few manufacturers use state-of-the-art technology and machinery, which is usually imported. The environmental footprint of the textiles industry is large as well – as one of the most chemically intensive industries it is the biggest water polluting sector after agriculture.

Box 9

Key figures – textiles sector⁹⁷

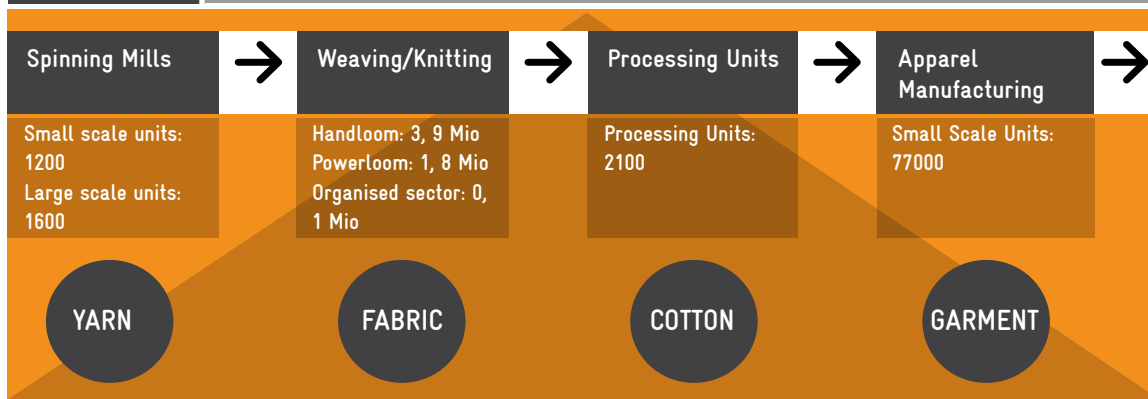
Contribution to national GDP: 4%

Contribution to industrial production: 20%

Contribution to exports: 11%

Employment: 21 Million in organised sector (plus ~ 14 million in unorganised sector; 47 million in related sectors)

Figure 6

Indian textiles sector value chain⁹⁸

6.2 Sensitivity Assessment in the Textiles Sector

6.2.1 Key Processes in the Textiles Sector (Cotton-Based)

The process chain in the textiles sector is linear in that each step is followed by a foreseeable subsequent step (see figure 7). A company's process chain can include one single process step or integrate the entire chain. Even though the outcome of process steps is the same, their set-up can differ hugely depending on the technology level used.

The chain can be divided into six major steps:

- Purchase of cotton
- Pre-treatment of cotton yarn (sizing and warping)
- Weaving
- After-treatment of cotton cloth (de-sizing, alkaline boiling, bleaching)
- Dyeing
- Apparel making – cutting, stitching, finalizing

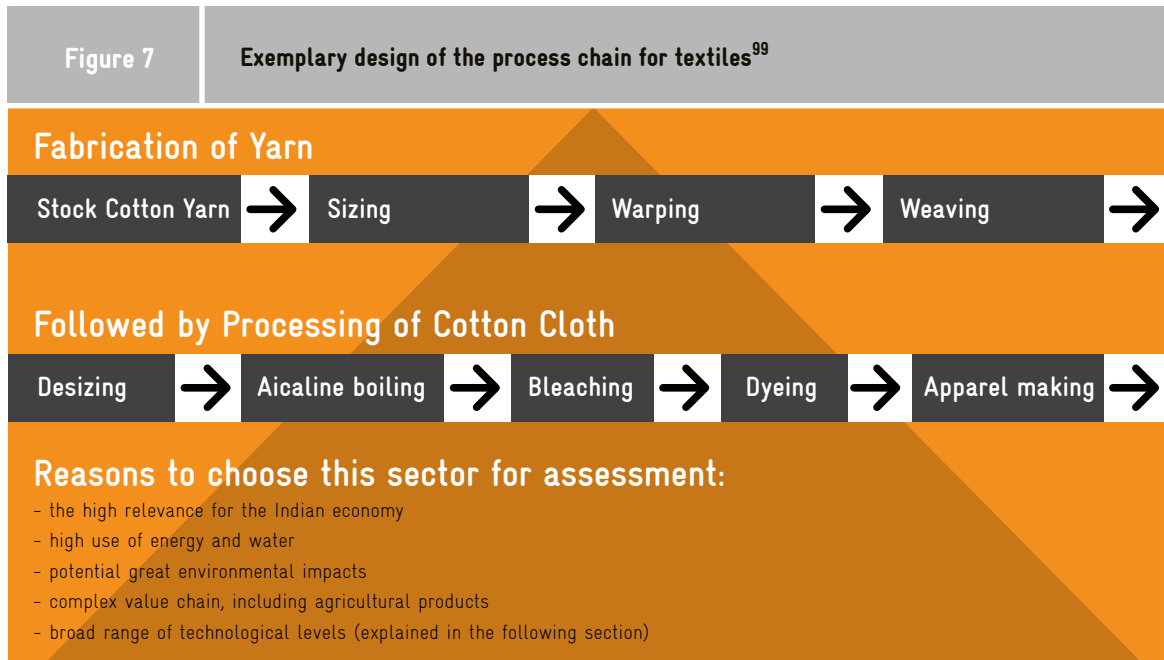


Sizing of the warp yarn is essential to reduce breakage of the yarn and thus avoid production stops on the weaving machine. Sizing improves the abrasion resistance of the yarn as well as its quality.

The after-treatment implies de-sizing, alkaline boiling and bleaching. By adding surfactants and complexing agents to the water, sizing agents are removed from the cloth. Other undesirable substances are removed by alkaline boiling. The cloth has to be bleached as pre-treatment for dyeing. Bleaching needs a temperature of 60 – 98 °C and a highly alkaline pH of 12 –thus energy is required to control the temperature. In all three after-treatment steps, alkali waste water with a high concentration of chemicals has to be discharged.

During pre-treatment, weaving and after-treatment a considerable amount of water and energy is needed. Furthermore, the primary input, cotton yarn, as an agricultural product is highly sensitive to climate change impacts.

The subsequent process steps are dyeing and the apparel-making itself which involves cutting, stitching, finalizing and packaging of the finished clothing. Dyeing is highly water intensive and often results in toxic discharge which needs to be treated. The energy use is dependent on the degree of mechanisation; however, in hot climates, also for manual labour energy is required to keep the temperature low to assure productivity. A lot of water is needed for the washing of the final products, which is particularly relevant for exporting businesses to countries which require pre-washing of garments.



6.2.2 Categorization of the Technology Level within the Textiles Sector

To assess a company's sensitivity to climate change impacts, it is necessary to analyse its processes and inputs, which are mostly determined by its technology level.

Three technology levels can be distinguished:

- Inefficient, old/obsolete technology, largely man powered
- Efficient, technology upgraded, mix of man/machine powered
- Highly efficient, recent technology, mainly machine powered.

Level A summarizes companies with a very traditional way of production. The fibres are mainly man-made and textiles are produced by handlooms. The pre- and after-treatment of yarns or cloths are also made by hand in tanks or basins. The water need is met by both extraction from individual bore wells or intake from adjacent water bodies. Polluted unusable water is discharged untreated. Cutting, stitching, and finalising are entirely done by hand. Facilities and premises are very basic, without any temperature regulation.

Level B summarizes companies with partially automated production processes. Weaving for instance is made by power looms, treatment still by hand or simple devices. Water supply is met by the extraction from individual bore wells or piped water supply. Polluted unusable water is coarsely treated and discharged. Production is organized in process lines with relatively high efficiency. Cutting, stitching, and finalising are partly automated, e.g., by sewing machines. Facilities and premises are old, but



sufficient to withstand common climate irregularities. Fans and a basic ventilation system exist.

Level C summarizes highly efficient companies with state-of-the-art technology. Production processes are mainly machine powered. Water and energy supply are stable by way of updated infrastructure and use of these inputs is highly efficient. Polluted unusable water is internally treated up to reusable quality. Facilities and premises are well insulated and internal temperature is regulated.

6.2.3 Sensitivity Assessment of Each Level

The sensitivity to climate change impacts varies with the technology level of a company, both regarding the extent and the specific areas of sensitivity. The sensitivity at various technology levels is assessed in four areas:

- Facilities / company premises
- Processes
- Logistics and stocks
- Market



Sensitivity of Level A companies

Level A textiles companies have facilities are highly sensitive to climate change. Buildings are not secured against climate-related impacts and infrastructure like roads or sewerage is often in a bad condition. Therefore, extreme weather events cause immense damage to company facilities, severely limiting production capacities or prohibiting production altogether. Gradual changes, such as temperature rise, are often not dealt with at all.

Concerning processes, Level A textiles companies are not as affected as other companies by cuts in energy supply as they mainly rely on processes that are not mechanized. However, Level A companies often rely on only one energy source and if a crucial process step requires energy, a power cut could lead to an overall of standstill of operations. Depending on their place on the value chain, textiles companies can be highly sensitive to changes in supply of water. Level A companies typically derive water from sources which are extremely sensitive to climate related impacts (surface water, groundwater) and alternatives often do not exist. Also because of their simple facilities and reliance on manual labour, sensitivity to temperature rises and heat waves is very high:

Level A companies have no possibility to handle rising temperatures and increasing humidity, with employees being fully exposed to heat impacts. Often, extreme weather events such as heat waves and droughts will leave no possibility for production to continue.

Level A companies of the textiles sector are highly sensitive to climate impacts also in the field of logistics and stocks. Supplied material can show high sensitivity to climate change impacts, especially if the company uses wool and cotton, as Level A companies often rely on few suppliers. Suppliers are usually located in the vicinity and are therefore equally affected by climate-related impacts on the area. Usually, stocks are not protected against high temperature or flooding. Also, means of transport and infrastructure for logistics is typically in poor conditions and are therefore easily affected or damaged or by extreme weather events.

Finally, Level A companies are highly sensitive to climate-change related changes in the market. Given the very limited diversity of their product portfolio and production methods, they have little or no flexibility in responding to changing market demand or regulatory requirements. Regarding their financial state, Level A often lack the resources to overcome even a short period of negative cash-flow; loans and investments are difficult to secure for these companies for lack of a guarantees and higher risks associated with them.



Sensitivity of Level B companies

Concerning facilities, Level B companies in the textiles sector can cope with bad weather events of a moderate nature, e.g., heavy rains over a short period of time. Still, in the long term improvements are needed to maintain resilience in light of more enduring and intense weather extremes.

The operational processes of Level B companies in the textiles sector are highly sensitive to climate impacts. These companies are relatively dependent on supplies both of energy and water, which are heavily affected by climate change. However, most Level B companies have the resources to use alternative supplies in case of interruptions, including diesel generators or water tanks. While basic ventilation systems allow for managing moderate temperature rises, Level B companies cannot shield off employees from high temperatures and humidity levels, particularly during heat waves.



In Level B companies, logistics and stocks are less sensitive to climate change impacts than in Level A companies. In case of cotton and wool, material input can be strongly affected by climate related impacts; but resources are not exclusively sourced in the vicinity, but also from more remote areas. Because Level B companies have a network of suppliers and the resources to come up with flexible solutions to urgent problems, the logistic chain is relatively stable. This reduces climate related risks concerning the supply chain. Stocks are well protected against high temperatures and flooding.

Since the production is more diversified than in Level A companies, companies at Level B can respond to changes in market demand to some extent, but overall flexibility remains limited.

➔ **Sensitivity of Level C companies**

The modern facilities and premises of Level C companies ensure to withstand even long term bad weather impacts.

Concerning production processes Level C companies in the textiles sector are particularly sensitive to impacts on energy supply. However, through efficient technologies and the provision of short term alternatives, risks are minimised. The same holds true for sensitivity to water related climate impacts. Through enhanced water efficiency, water reuse systems and diversified water sources, overall sensitivity is reduced and short-term shortages can be managed. Employees can be shielded off from high temperatures during heat waves in most instances, while negative impacts of heat on production only occur during extreme heat waves.

The sensitivity of logistics and stocks is low in Level C companies. Inputs are purchased from a variety of sources, and the logistic chain builds on modern transportation and infrastructure, thusly protected against external shocks including weather / climate impacts. Stocks are completely sheltered from any outer influences. Level C companies' sensitivity to changing market requirements varies across companies. While all Level C companies are able to respond to market changes to some extent, the exact degree of response capacity depends on the flexibility of the machinery employed. For Level C companies, funding for further investments, including further adaptation measures can be secured relatively easily.

An overview on the most important results of the sensitivity assessment of Level A, B, and C companies in the textiles sector is provided in table 8.

6.2.4 Conclusion: Adaptation Options for the Textiles Sector

The Indian textiles sector is very much dependent on water resources and the highly climate-sensitive input cotton. In the following, several adaptation measures are lined out that address these two key issues. In order to increase the resilience of companies of this sector to climate change, a technology upgrade that increases water efficiency and the use of synthetic fibres is recommended, especially for level B and C companies. Increasing water efficiency can be considered a no-regrets adaptation measure if it is financially viable. A technical adaptation measure which can be considered a low-regrets option is the use of synthetic fibres which require less water in dyeing and bleaching processes. This will be of particularly profitable in case the cotton price rises. A flexible adaptation measure would be to install machinery during the next scheduled upgrade that can process both natural and synthetic cotton. A win-win adaptation measure would be the close cooperation with surrounding communities on watershed management.

Regarding change of demand, textiles and particularly apparel-making are directly connected to change in climate. For example, if rainfalls become stronger and more intense, consumers demand more water-resistant textiles that keep water out for longer. Also, the later onset of winter months and thus the later need of warmer clothing in India necessitate a business and product strategy that acknowledge this fact. These trends present an opportunity for producers to adapt their product portfolio, anticipating changing customer demand before their competitors do. As India's textiles market needs to react both to Indian climate change and that of its import partners in the West, flexibility is of particular importance.



Table 8		Sensitivity assessment of companies at each technology level – Textiles sector		
Technology Level	Facilities	Processes	Logistics and Stocks	Market
A	Highly sensitive to climate change, as not secured against impacts; extreme weather events leads to immense damage. Infrastructure often in bad condition.	Little dependence on energy supply, high dependence on water supply. Water supplied from insecure sources. No possibility to handle rising temperatures. Employees fully exposed to high temperature and humidity. In case of bad weather impacts, often no possibility for production to continue.	Supplied material shows high sensitivity to climate change influences. Source of material from vicinity. Stocks not protected against high temperature or flooding. Logistic chain in poor conditions.	Little or no flexibility in responding to changing market requirements.
B	Protected from moderate (short period) bad weather impacts, in the long term improvements are needed.	Relatively high dependence on energy and water supply. Both show very high sensitivity to climate change influences. In case supply is interrupted no or little alternatives available. Influences on processes caused by rising temperature difficult to manage. Employees exposed to high temperature and humidity.	Supplied material shows high sensitivity to climate change influences. Resources also sourced remotely. Stocks protected against high temperature or flooding. Logistic chain relatively stable.	Flexibility according changing market requirements is limited.
C	Modern facilities and premises are secured to withstand even long term bad weather impacts, interfaces are secure.	Very high dependence on energy supply. Sensitivity of energy and water supply are minimised and alternatives exist for short period. Employees mostly protected against high temperature and weather impacts. Rising outside temperatures manageable, having only a minor effect on production.	Supplied material show little sensitivity, source depends on price. Many possibilities for material purchase. Stocks totally protected from any outer influences. Logistic chain with safeguarded structures.	Flexibility on changing market requirements depending on flexibility of machinery

6.3 Case Study – Impacts and Adaptation in an Indian Textiles Company

The case of a Textiles Company, Faridabad, India (see table 9) clearly demonstrates that climate change impacts are already affecting Indian MSMEs, and furthermore, they will likely exacerbate existing challenges, like logistics, energy supply and seasonally changing levels of productivity.

Table 9	Company profile case study 1
Location/ Climate Change Impacts	Faridabad, Haryana. About 40 km from New Delhi. The region has experienced several periods of hotter days (heat waves) in summer in the past years; monsoon seems to start later, increasing number of hot days. Winters seem to get warmer, too. Unusually heavy rainfall over several days occurred in fall 2011.
Products/ Clients	Simple apparel (Women's, Men's, Children), knitwear, decorated apparel for export – sold directly to European/Canadian retailers (including Next, FCUK)
Turnover	N.A.
Employees	170
Capacity	10 hour shifts, 7days/week; up to 700.000 garments per month; 70 days from design to delivery (app. 15 days transport)
Technology Level	B – partially automated production processes. Water supply is met by both pipes and ground water. Polluted unusable water is coarsely treated and discharged. Production is organized in process lines with relatively high efficiency. Cutting, stitching, and finalising are partly automated, e.g., by sewing machines. Facilities and premises are old, but sufficient to withstand common climate irregularities. Fans and a basic ventilation system exist.

6.3.1 Value Chain

The company studied uses cotton as well as wool for its production. For cotton, the company buys woven yarn and then administers the dyeing in units based in Tirupur, Tamil Nadu. The dyed yarn is then transported to Ahmedabad by truck, where it is further processed into fabric. Finally the fabric is transported by truck to the manufacturing unit in Faridabad, where all subsequent process steps take place.

The journeys between Tamil Nadu and Ahmedabad as well as Ahmedabad and Faridabad take a considerable amount of time – up to 15 days. Furthermore they can delay the entire production line if the trucks are held up. Due to the tight scheduling of apparel manufacturing, there are no alternative products that can be made in the meantime. Also due the fact that lead-up time is sought to be kept low for the clients, this complex value chain can be a competitive disadvantage for the company in question.

6.3.2 Process Chain within Manufacturing Plant

The process chain within the manufacturing plant involves five distinct steps: cutting, stitching, quality control, pre-finalisation and packaging (see figure 8). All process steps are predominantly done by manual labour – in the case of stitching and packaging, workers use sewing machines and packaging machines.

Figure 8

Process chain within manufacturing plant¹⁰⁰

6.3.3 Assessment of Recent and Anticipated Climate Change Impacts

The location and buildings of the company are not particularly affected by the major climate change impacts of its location (heat / flood).

However, regarding the company's **operating processes**, heat is a great issue in summer months. Even though fans are used, worker's productivity drops considerably once the temperature rises above 35°C, and up to 30% when the temperature is higher than 38° C. As production is mainly done by hand using automated sewing machines, the productivity drop directly translates to loss of profits. If temperature is higher than 35°C, special fabrics need to be taken care of in air conditioned rooms. Because of the fans for the workers and the air conditioning for the fabric, the energy bill in summer months is considerably higher than during other seasons. Communal energy supply in this part of Faridabad is sketchy and even more so in summer months. This is why the company has a generator running on diesel installed. However, this generator cannot supply enough energy for full operation of processes and the price of diesel makes it uneconomical. Water is not a core issue for this factory, but may become one in the future as there are plans to install a washing system to further comply with the standards of their clients. There are no toxic effluents or waste generated in the process steps of the manufacturing unit in Faridabad. The dyeing units in Tirupur are closely monitored so as to comply with the standards the international clients necessitate.

Concerning **logistics and stocks**, the price of cotton is an important determinant of profitability, as it cannot completely be passed on to clients. The price development of its raw materials is turn directly linked to the changing climate. The company has a range of suppliers and thus is buffered from extreme weather events harming harvests locally. The company seeks to further diversify its sources and thus secure supply by sourcing cotton and wool from different geographic regions in India,



Pakistan and China. During times of heavy rain, the transport between the production sites further down the value chains can be delayed. Thus there are plans of shifting the process steps of dyeing and fabric making entirely to the Faridabad plant, to minimise the exposure along the value chain.

With regards to **community issues**, there were no challenges mentioned as the plant is located in an industrial area. The company has already experienced the effects of environmental **legislation**, which led to the closing of Tirupur dyeing units in 2011. The company had to shift the dyeing to Ludhiana in order to continue production. While there is no change in legislation because of climate change expected in the short term, this experience has demonstrated how quickly government activities translate to challenges in production and productivity.

Regarding its **market**, as the company sells its products to European and Canadian clients, it has to prove its compliance with environmental and social standards; this is why the dyeing process of yarn is administered by the company, in order to assure that standards are met.

Concerning the **financial** situation and potential effects of climate change, so far none was observed. The company is insured against flood risk and the premium has not risen in recent years.

Analysis: The company is already affected by climate change – not only due to its close connection with cotton harvests and the price of cotton. Its spread-out sub-contractors as well as its relatively long route of transport make it vulnerable to extreme weather events occurring in different parts of India. While the exposure of its buildings/geographic location is not particularly high, the company still already experiences profit loss from gradual climate change impacts such as heat waves and the higher frequency of hot days. Because its processes being largely man-powered and requiring ventilation and some of its garments also requiring air conditioning to avoid handling stains, its electricity bill is considerably higher in summer months. Additionally, worker's productivity is much lower during these months.

These factors are already on the radar of company managers. There are two key issues that were identified as important:

- 1 The vertical integration of previous steps of the supply chain to reduce transport risk and assure that quality standards of its clients are met.



This managerial or “soft” adaptation measure, if financially viable, can be considered a low-regrets adaptation option – it reduces the company’s exposure and simultaneously solves quality issues.

2 The use of solar panels to complement the communal energy supply in summer months.

This technical adaptation measure is of the “no-regrets” variety – even if climate change impacts do not worsen, being more independent from the cost of energy and less dependent on the communal supply improves the company’s strategic outlook.



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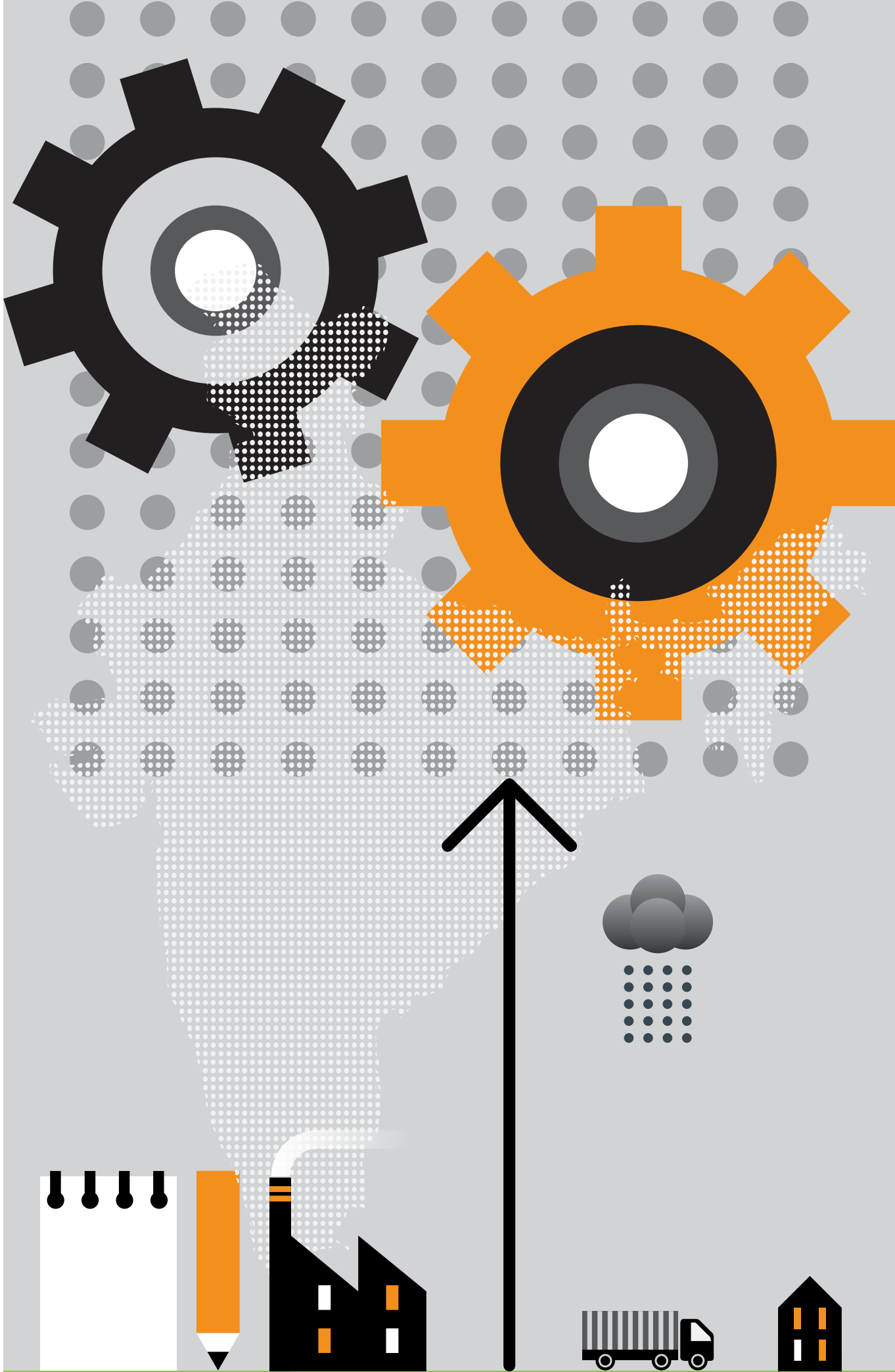
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99 Source: adelphi.

100 Source: adelphi.





7 Sensitivity Assessment and Company Case Study in the Indian Metalworking Sector

7.1 Sector Characteristics: The Metalworking Sector

The metal sector of which the metalworking sector is part of includes activities such as the manufacturing and casting of metals, the manufacturing of metal products. Especially the sustained growth in India's automotive sector is driving the demand for both steel and aluminium and the manufacturing of metal products (see box 10 for key figures on the metal sector). Metalworking is one of the key sub-sectors for MSMEs as well as steel re-rolling and foundry.¹⁰¹ The small component manufacturers who are the sub-suppliers to the engineering, automobile and defense sector mostly do not use up-to-date technologies but oftentimes rely heavily on manual labour and inefficient production processes. The demand for metal and the manufacturing of metal products will increase considering the fact that India is becoming a manufacturing outsourcing hub for all major industries worldwide. Thus manufacturers seek to invest in more sophisticated and flexible machines for better productivity and quality of products to meet the more stringent international standards.¹⁰²

7

Contribution to national GDP: 3%

Contribution to industrial production: 16%

Contribution to exports: 4% Metal, 25% engineering goods

Employment: 13 Million in organised sector (plus ~ 4 Million in unorganised sector; 20 million in related sectors)

7.2 Sensitivity Assessment in the Metalworking Sector

7.2.1 Key Processes in the Metalworking Sector

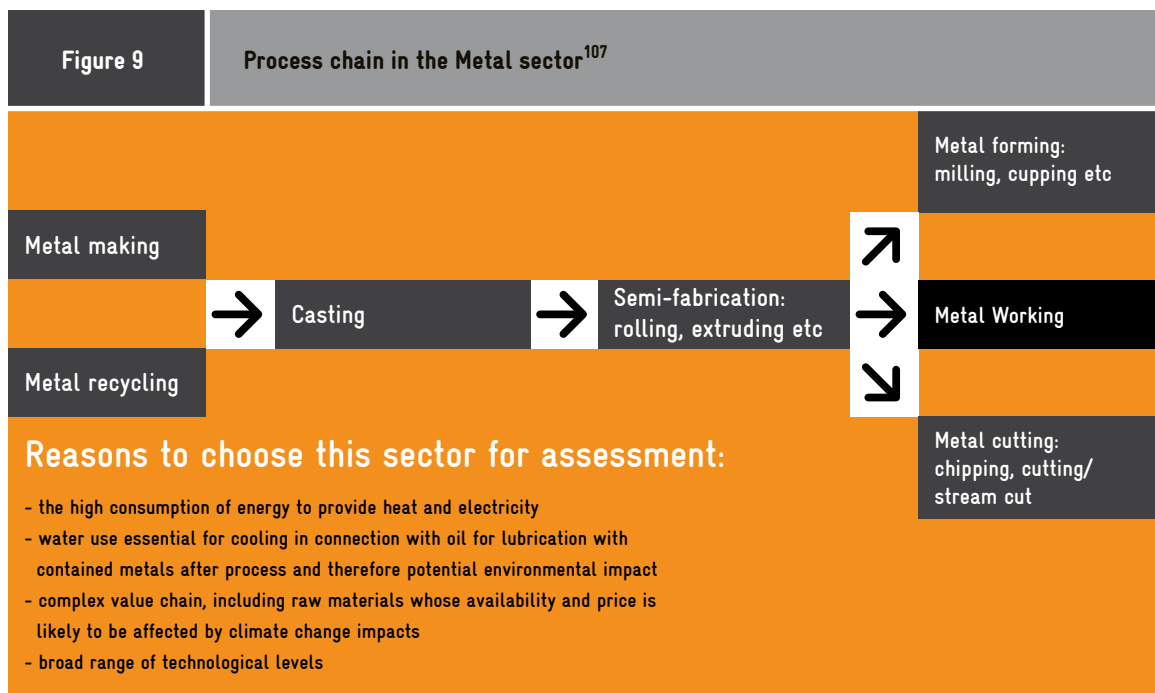
Metal making, metal recycling, casting and semi-fabrication are highly energy intensive processes. Metal working can be divided in metal-forming and metal-cutting (see figure 9).

For the purpose of the study, we will focus on metal working, as it is highly relevant for the Indian economy, and dominated by MSMEs. In most cases for metal-forming the raw material has to be heated to reduce tensions while forming. The forming force is provided by special machines for the respective application or by hand with corresponding attachment devices. Metal-cutting can be done manually using very simple tools as well as by high tech computer numerically controlled machines (CNC).^{104, 105} In both manufacturing processes metalworking fluids (MWFs), namely coolants and lubricants are needed. They are typically a combination of water, lubricant, and additives formulated as an emulsion or dispersion where the water serves as the coolant and the lubricant serves to reduce friction between metal and tool.¹⁰⁶

7.2.2 Categorization of the Technology Level within the Metalworking Sector

The categorization into 3 levels is made as in the case of the textiles sector:

Level A summarizes companies with very simple manufacturing methods. In India, especially metal forming is done by companies that are mainly of this category. The water need is met by extraction from individual bore wells or intake from adjacent water bodies. Polluted unusable water is discharged untreated. Facilities and premises are very basic without any temperature regulation.^{108, 109}



Level B summarizes companies with partially automated production processes. Use of relatively dated machinery is common. Water supply is met by both pipes and ground water. Polluted unusable water is coarsely treated, partly reused and partly discharged. Production is organized in process lines with a relatively high efficiency. Facilities and premises are old but sufficient to withstand common climate irregularities.¹¹⁰

Level C summarizes highly efficient companies with state-of-the-art technology. Production processes are mainly machine powered. Water and energy supply are secure and both inputs are efficiently used. Polluted unusable water is internally treated up to reusable quality. Facilities and premises are well insulated and internal temperature is regulated.

7.2.3 Sensitivity Assessment of Each Level

As in the sensitivity assessment for companies in the textiles sector, sensitivity of companies with varying technology levels in the metalworking sector is assessed in four areas:

- Facilities / company premises
- Processes
- Logistics and stocks
- Market

 **Sensitivity of Level A companies**

Given the age and bad condition of facilities, Level A companies in the metalworking sector are highly sensitive to climate change impacts, with extreme weather events like storms or heavy rains leading to immense damage.

Concerning the manufacturing processes, Level A companies rely on old machinery and production methods, rendering them highly dependent on energy and water supply. Water sources mostly consist of surface water and groundwater, both very sensitive to climate change influences. Level A companies have no possibility to handle rising temperatures. Therefore, employees are fully exposed to high temperature and humidity levels. In fact, extreme weather impacts like extended droughts and heat waves often force Level A companies to completely stop their production.

At the Level of logistics and stocks supplied material show little sensitivity to climate change influences. However, stocks are not protected against weather impacts. Also, material is purchased from suppliers in the vicinity who experience the same regional climate and weather changes. The chain of logistics is typically in poor condition and is therefore strongly affected by extreme weather events.

Given the limited diversity of production equipment, Level A companies have little or no flexibility in responding to changing market requirements.

 **Sensitivity of Level B companies**

The facilities of Level B companies are well protected from moderate (short period) bad weather impacts. However, improvements are needed to ensure resilience in the long-term.

Regarding the manufacturing process, Level B companies are highly dependent on adequate supply with energy and water, both of which are very sensitive to climate change influences. Few simple, short-term alternatives exist, if water and energy supply from conventional sources is cut off. Given the more diversified water sources (via pipes and potentially some water reuse), Level B companies can cope with water-related climate impacts slightly better than companies at Level A. While moderate temperature rises can be managed, during periods of particular heat and humidity employees are strongly impacted.



Concerning logistics and stocks, Level B companies show moderate sensitivity to influences from climate change. Supplied material is little sensitive to climate change impacts, and stocks are well protected against high temperature or flooding. The supply chain is more diversified than in Level A companies, involving both nearby suppliers and resources from more distant areas. The logistic chain is relatively stable.

Given the more diverse, but still highly specialised nature of the production machinery and methods, Level B companies show some flexibility in adapting to changes in market demand, but their overall ability to respond to major short-term and fundamental long-term shifts is limited.

→ Sensitivity of Level C companies

As Level C companies possess modern facilities and premises, sensitivity to weather impacts is low. Facilities incur no or little damage even during longer periods of challenging weather conditions. However, if damage occurs its destructive potential and financial repercussions are much greater than in Level A and B companies.

Regarding the manufacturing processes, Level C companies are marked by a very high dependence on sufficient energy supply. Gaps in supply can be compensated for a short period of time. Despite the sometimes huge water intensity of manufacturing processes in the metalworking sector, Level C companies are little dependent on external water supply as they reuse large amounts of their process water. Thanks to advanced insulation and air conditioning, employees are well protected against high temperatures and bad weather impacts. Rising outside temperatures are easily manageable and therefore have no negative impact on production.

In the area of logistics and stocks Level C companies are well protected from climate change impacts. Supplied material shows little or no sensitivity. Level C companies purchase material from a broad variety of sources. Stocks are fully protected from any outer influences. The logistic chain of Level C companies is safeguarded against external shocks including weather- or climate-related impacts.

Given the intensity and up-to-date technology of their machinery, all Level C companies are to some extent able to flexibly respond to changes in market requirements. However, the exact extent of response capability depends on the specific set of machinery employed.

An overview on the most important results of the sensitivity assessment of Level A, B, and C companies in the metalworking sector is provided in table 10.

7.2.4 Conclusion: Adaptation Options for the Metalworking Sector

The metalworking sector is likely to be affected by extreme weather events rather than gradual changes in climate. This is due to the fact that its inputs, processes and products are not particularly sensitive to gradual changes in climate; transporting raw materials and finished products however is at risk by extreme weather events because of their heavy weight and bulkiness; furthermore, “just-in-time” production plays a big role in the metalworking sector. This means that a single rupture in supply may end a business relationship and even put an MSME out of business if investment in machinery and raw material for a particular project has been made.

The metalworking sector is highly dependent on energy. To increase the resilience of companies of this sector to warmer temperatures and rising energy prices, a technology upgrade that increases energy efficiency is decisive to assure long-term competitiveness; additionally, investing in alternative energy sources is an important issue. Increasing energy efficiency is a no-regrets adaptation measure, while investment in alternative energy supplies needs to be financially viable; this could be promoted by incentive schemes, e.g., for solar energy. A low regrets adaptation measure would be the taking up of insurance for extreme weather events. A win-win adaptation measure would be the close cooperation with employees on working conditions and emergency plans in case of an extreme weather event.

Regarding change of demand, metalworking is not directly connected to change in climate. As a large part of metalworking products are automobile and machinery components, the metalworking sector is directly connected to economic growth. Therefore, a diversification of manufactured products and clients, as well as a large geographic distribution of clients is likely to be advantageous.



Table 10		Sensitivity assessment of companies at each technology level – Metalworking sector		
Technology Level	Facilities and Premises	Processes	Logistics and Stocks	Market
A	Highly sensitive according to climate change influences, bad weather impacts leads to immense damage	High dependence on energy and water supply. Water supply with high sensitivity to climate change influences. No possibility to handle rising temperatures. Employees exposed to high temperature and humidity. In case of bad weather impacts often no possibility of work proceeding.	Supplied material shows little sensitivity to climate change influences. Source of material from vicinity. Stocks not protected against high temperature or flooding. Logistic chain in poor conditions.	Little or no flexibility in responding to changing market requirements
B	Protected from moderate (short period) bad weather impacts, in the long term improvements are needed.	Very high dependence on energy and water supply. Both show very high sensitivity to climate change influences. In case of lack no or little alternatives given. Influences on processes caused by rising temperature difficult to manage. Employees exposed to high temperature and humidity.	Supplied material shows little sensitivity to climate change influences. Resources also from remote surroundings. Stocks protected against high temperature or flooding. Logistic chain relatively stable.	Flexibility in light of changing market requirements is limited.
C	Modern facilities and premises withstand even long term bad weather impacts, interfaces to auxiliaries are secure.	Very high dependence on energy supply. In case of lack, alternatives are given for short period. Sensitivity of energy and water supply depending on external requirements. Employees protected against high temperature and bad weather impacts. Huge water use in process, but little dependence on water supply. Rising outside temperatures easily manageable and not influencing production.	Supplied material shows little or no sensitivity, source depends on price. Many possibilities for material purchase. Stocks totally protected from any outer influences. Logistic chain with safeguarded structures.	Flexibility in light of changing market requirements depends on flexibility of machinery.

7

7.3 Case Study – Impacts and Adaptation in an Indian Metalworking Company

The case of a Metalworking Company in Faridabad, India (see table 11) shows that even if climate change impacts are relatively minor, they directly reflect on turnover and profitability, but can also have positive effects in case there is a competitive advantage.

Table 11	Company profile case study 2
Location/ Climate Change Impacts	Faridabad, Haryana. About 40 km from New Delhi. The region has experienced several periods of hotter days (heat waves) in summer in the past years; monsoon seems to start later, increasing number of hot days. Winters seem to get warmer, too. Unusually heavy rainfall over several days occurred in fall 2011.
Products/ Clients	Sheet metal manufacturing, e.g., of automobile parts and for consumer durables (clients include Honda, LG, Whirlpool, Xerox)
Turnover	RS 1200 Mio.
Employees	120
Capacity	10 hour shifts, 7 days/week
Technology Level	B – partially automated production processes. Use of rather dated machinery is common. Water supply is met by both pipes and ground water. Polluted unusable water is coarsely treated, partly reused and partly discharged. Production is organized in process lines with a relatively high efficiency. Facilities and premises are old but sufficient to withstand common climate irregularities. ¹¹¹

7.3.1 Value Chain

The company manufactures sheet metal products for the automobile, two-wheeler and consumer durables industry, using machinery largely imported from Germany. The metals for the production are shipped from several semi-fabricators from various parts of India. The finished products are transported to various assembling factories in India and Asia.

7.3.2 Process Chain within Manufacturing Plant

The process chain within the manufacturing plant involves several steps: cutting, drawing, various kinds of forming/shaping, including machining and turning, and joining/assembly according to the specific requirements of the customers.



7.3.3 Assessment of Recent and Anticipated Climate Change Impacts

The **buildings and their location** are not particularly exposed to climate change impacts. The street infrastructure and energy supply has always been less than optimal, and the situation could be detrimentally affected by climate change impacts.

So far, no great effect on **operating processes** was observed except for decreasing productivity in summer months; this is also because heat is used in several process steps which do not cool down in summer months. Furthermore, in summer months the energy supply is sketchier; generators have to be used in summer months, which directly affect profits. As energy is a determinant factor for the profitability of the company, price developments are watched very closely. The company managers expect energy produced from renewable to be at par with coal-based energy within the next 5 years and are already considering ways of setting up alternative energy sources. Water supply is problematic, but so far greater industrial activity in the area is perceived as a greater pressure than impacts connected to climate change.

Logistics and stocks have so far not been directly affected; the company keeps large stocks of metal and could continue working in case of transport problems.

As in the case of the textiles company, the **community** is not directly affected, as the plant is located in an industrial area.

No directly relevant **government action** regarding climate change is anticipated.

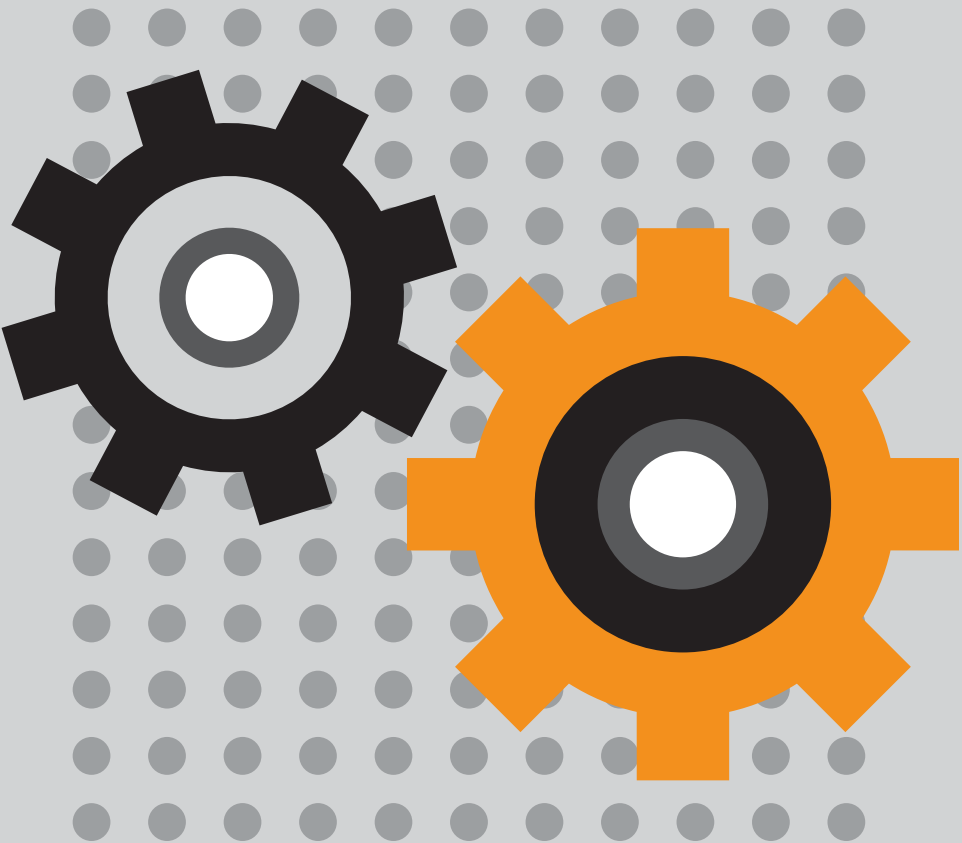
Market demand has so far already been reflective of climate change impacts. In 2011, the company profited from the floods in Thailand, supplying additional batches of products to one of their customers whose Thai suppliers were on hiatus due to the floods.

So far, no impacts on company **finances** have been observed – the company is not insured against flooding and does not plan on doing so. The managers expect solar panels to be a viable option financially for complementary energy supply within 3–5 years because of rising fuel prices and are closely observing whether new options for financing solar energy become available.

Analysis: The company is faced with several challenges, especially regarding energy and water supply. While climate change impacts as such are not identified as a pressing issue by the management team, its connectedness to existing challenges in the supplies of these essential inputs is recognised. The company managers plan on further exploring options for alternative energy. This aside, there are no considerations to further adapt to climate change impacts; company managers are confident that they can adjust as needed, as the company has demonstrated its flexibility and ability to respond to changed circumstances in the past. Because the company has actually profited from a possibly climate-related event, the flooding in Thailand, company managers are not wary of indirect climate change effects.

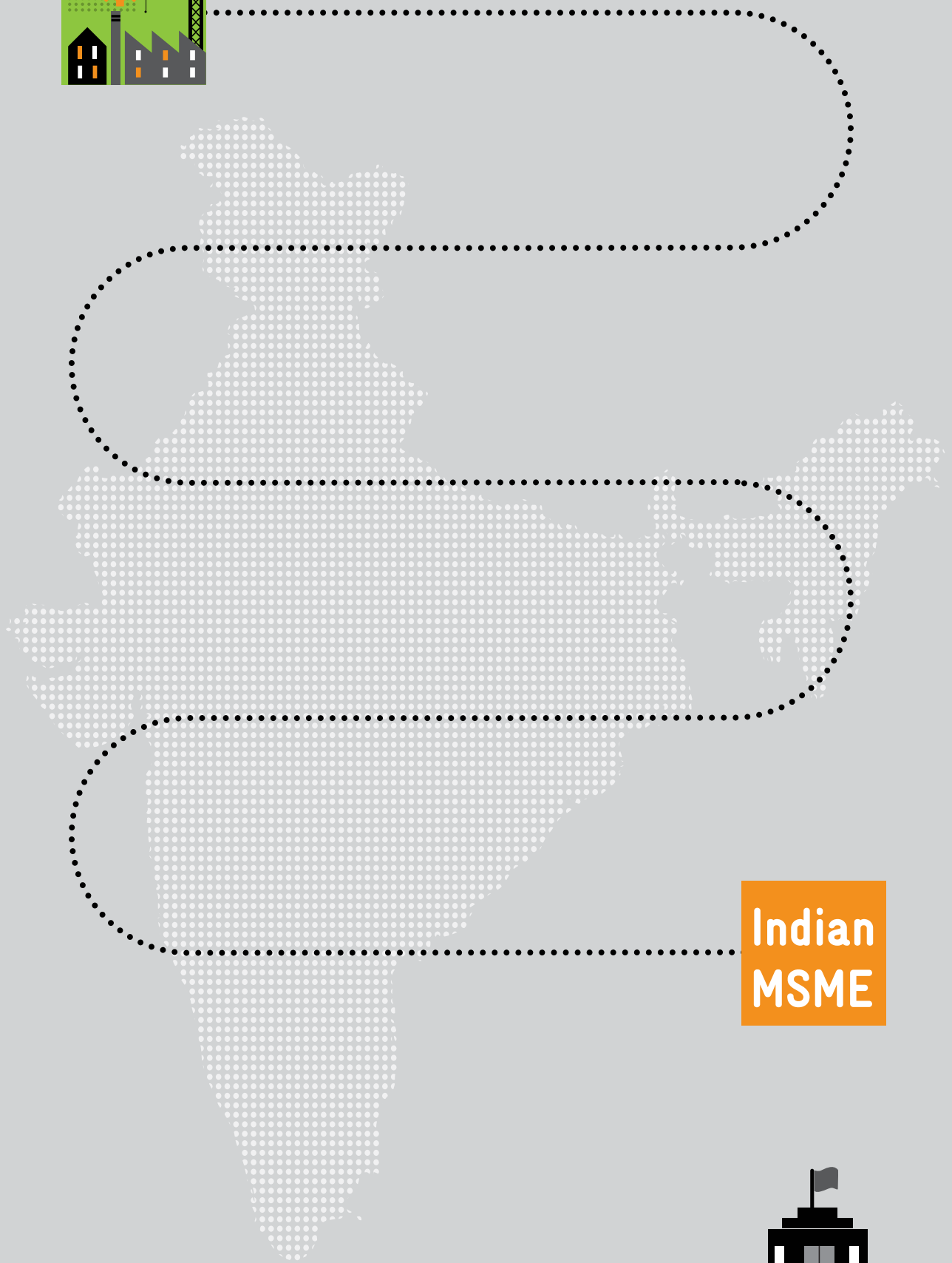


- 100** Source: adelphi.
- 101** Government of India, 2007. Mid-Term Review, Energy Efficiency in Steel Re-Rolling Mills. Available online at: <http://erc.undp.org/evaluationadmin/downloaddocument.html?docid=1344>.
- 102** Department of Heavy Industry (DHI), 2008. Final Report on the Indian Capital Goods Industry. Available online at: http://dhi.nic.in/indian_machine_tools_industry.pdf.
- 103** Reserve Bank of India (RBI), 2011. Productivity, Efficiency and Competitiveness of the Indian Manufacturing Sector. Available online at <http://www.rbi.org.in/scripts/PublicationsView.aspx?id=13366>
- 104** DHI, 2008. See supra note 55.
- 105** Beitz, Wolfgang, and Grote, Karl-Heinrich, 1997. *Dubbel - Taschenbuch für den Maschinenbau*, 19. Auflage, Berlin: Springer Verlag.
- 106** Clarens, Andres; Zimmermann, Julie and others, 2008. Comparison of Life Cycle Emissions and Energy Consumption for Environmentally Adapted Metal Working Fluid Systems, University of Michigan. Available online at: <https://confluence.engin.umich.edu/download/attachments/1605717/Innovationssession6MWF.pdf>.
- 107** Source: adelphi.
- 108** DHI, 2008. See supra note 55.
- 109** Government of India, 2007. See supra note 54.
- 110** DHI, 2008. See supra note 55.
- 111** DHI, 2008. See supra note 55.

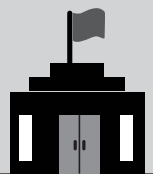


7

Sensitivity Assessment and Company Case Study in the Indian Metalworking Sector



Indian
MSME





8 Conclusion and Outlook

The study outlined climate change impacts on Indian MSMEs, presented approaches to climate risk assessment and to the development of adaptation measures. It highlighted the catalytic role of climate change for existing trends in India, speeding up and maximising already existent pressure points in the Indian economy, including resources and infrastructure. Furthermore the study provided insights on the social dimension of adaptation and its importance for responsible business practices, thereby defining the role of business and in particular MSMEs in adapting the Indian society and economy at large.

This factual and conceptual background was complemented by a sensitivity assessment of two key sectors, based on interviews with businesses and key experts, as well as two illustrative case studies of MSMEs' experiences with and reactions to climate change impacts. While these analyses allow drawing first conclusions on the importance of supporting Indian MSMEs in adapting to climate change, more empirical research is needed to analyse and quantify the overall outlook of the Indian economy towards climate change impacts.

Furthermore, even though starting points for support measures were identified, a detailed review is required of how MSMEs can be supported in their adaptation efforts most effectively.

In the interviews conducted for the study, MSMEs have stated their willingness and time-honed ability to adapt to changing circumstances – but climate change impacts may occur more

quickly and more strongly than their past experiences might lead to think. Their awareness for the catalysing and maximising effects of climate change must thus be raised, and the necessity and potential impact of comprehensive, sustainable and long-term support measures by associations and policy-makers needs to be further explored.

As pointed out above, the need for adaptation resulting from climate change has an inherently social character: no business adaptation strategy can be successful if it fails to consider the adaptive capacities of the social surroundings – be it nearby communities or business partners – and the impacts of adaptation measures on one's neighbours. Therefore enhancing the capability of Indian business, in particular MSMEs which are strongly rooted in their communities, is a key vehicle for strengthening the adaptive capacities of Indian society as a whole. Tying the issue of adaptation to core subjects of responsible business practices demonstrated that climate change can be understood as a driver for more responsible business behaviour. To realise this potential, however, a crucial step is to develop cooperation both between the public and private sector, and the private sector and civil society for solving the demanding challenges of climate change – and as demonstrated above, particularly in India this strongly requires the participation of MSMEs.



8

Conclusion and Outlook



About GIZ

Working efficiently, effectively and in a spirit of partnership, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH supports people and societies worldwide in creating sustainable living conditions and building better futures. The services delivered by GIZ draw on a wealth of regional and technical competence and tried and tested management expertise.

It is owned by the German Government and works in the field of international cooperation for sustainable development. GIZ is also engaged in international education work around the globe. It currently operates in more than 130 countries worldwide.

GIZ in India

Germany has been cooperating with India by providing expertise through GIZ for more than 50 years. To address India's priority of sustainable and inclusive growth, GIZ's joint efforts with the partners in India currently focus on the following areas:

- Energy- Renewable energy and energy efficiency
- Sustainable Urban and Industrial Development
- Natural Resource Management
- Private Sector Development
- Social Protection
- Financial Systems Development
- HIV/AIDS-Blood Safety

About SIDBI

SIDBI is the principal Financial Institution for the promotion, financing and development of Micro, Small & Medium Enterprises (MSMEs) in India. SIDBI reaches out to the entire value chain (Micro Finance to Missing Middle to SMEs) by extending Promotional and Development support. It addresses the gaps in MSME eco system by offering bouquet of financial support to MSMEs covering (a) Refinance to entire gamut of financial support Institutions including banks, State entities, Micro Finance Institutions (MFIs), etc., for onward lending to MSMEs (b) Direct assistance in niche areas. SIDBI is committed to contribute to the expectations on national goals as also Millennium Development Goals (MDGs). It continues to customise its product offerings as also processes so as to sustainably contribute to emergence of globally compliant competitive Indian MSMEs. Its international partnerships has enabled it to assimilate best practices and adopt it for Indian MSMEs. SIDBI and GIZ have been partners in a multi-agency, multi-activity Project on Financing and Development of MSMEs (MSMEFDP). MSMEFDP has been creating an enabling and sustainable environment for the growth and development of competitive MSME sector in India.



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