Climate change, private sector and value chains: Constraints and adaptation strategies

Working paper

PRISE
Pathways to resilience in semi-arid economies

Research for climate–resilient futures

Climate change, private sector and value chains: Constraints and adaptation strategies

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This Thematic Review has been produced as part of a series of preliminary papers to guide the long-term research agenda of the Pathways to Resilience in Semi-arid Economies (PRISE) project. PRISE is a five-year, multi-country research project that generates new knowledge about how economic development in semi-arid regions can be made more equitable and resilient to climate change.

Front cover image:
Reaping millet corn, Pakistan

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Acronyms

AR5	Fifth Assessment Report
ASALs	Arid and Semi-Arid Lands
AWC	Arab Water Council
BSR	Business for Social Responsibility
CAADP	Comprehensive Africa Agriculture Development Programme
CJBS	Cambridge Judge Business School
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GIZ	German International Cooperation
ICT	Information and Communication Technology
ICTSD	International Centre for Trade and Sustainable Development
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
MFI	Microfinance Institution
MSEs	Micro and Small Enterprises
MSMEs	Micro Small and Medium-Sized Enterprises
NGO	Non-Governmental Organisation
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
PRISE	Pathways to Resilience in Semi-arid Economies
PwC	PricewaterhouseCoopers
SALs	Semi-Arid Lands
SIDA	Swedish International Development Cooperation Agency
SMEs	Small and Medium-Sized Enterprises
TFP	Total Factor Productivity
TRC	Transportation Research Board
UK	United Kingdom
UN	United Nations
UNDP	UN Development Programme
US	United States
WEC	World Energy Council
WEF	World Economic Forum
WFP	World Food Programme
WRG	Water Resources Group

Seaweed farmer
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Introduction

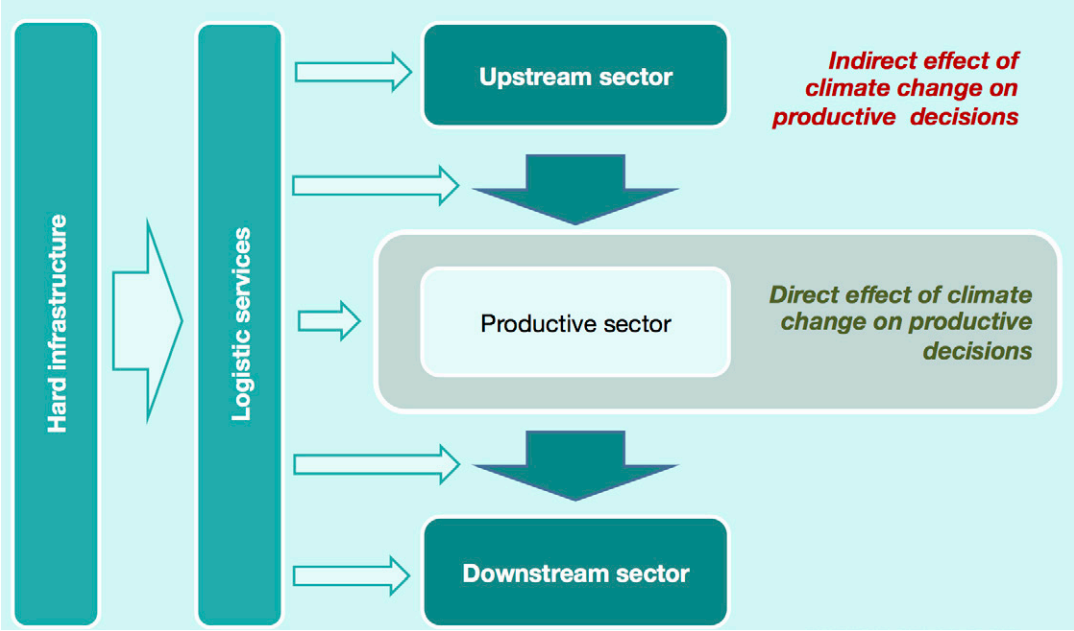
Climate change can have significant impacts on economic activity and value chains in two ways. First, in order to preserve their production capabilities, economic actors have to adapt to changing conditions by means of incremental changes to their production systems and use of resources. Second, climate change may alter production capabilities more deeply, making contemporary economic structures obsolete in a new environment. Overall, these changes will affect economic opportunities, profitability and competitiveness, livelihoods, sources of growth and employment and socioeconomic outcomes.

Understanding how climate change will affect private sector activities and incentives as well as markets is key to understanding the overall economic but also social and environmental impacts of climate change in arid and semi-arid lands (ASALs). The private sector and market work package focuses on private sector actors as key agents of change, with 'private sector' actors defined here in a broad sense, encompassing both smallholder farmers and large multinational companies. Although those actors are heterogeneous and sometimes have very different rationalities, the core constraints (such as limited access to finance, markets or natural resources) influencing their decision-making are often similar. Moreover, these actors are not acting independently from each other; they interact directly or indirectly within value chains or through the use of resources and assets. For instance, they compete on the use of labour, land and water.

This thematic review intends to highlight these interdependencies. The analysis adopts both a transversal and a value chain perspective, highlighting the interactions between sectors and activities, whether horizontal or vertical. Such an approach makes it possible to identify multiple dimensions within climate risks to business models and supply chains, as well as adaptation requirements and their costs and benefits. Such knowledge can help identify new market opportunities for the private sector, and potentially enhance capacity to respond, as well as informing policy frameworks that encourage private sector adaptation and risk management.

Adopting a value chain perspective makes it possible not only to identify the direct effect of climate change on private sector/firms' constraints and behaviour but also to consider an indirect effect of climate change through its effect on upstream (supply) and downstream (demand) sectors, as well as on transversal sectors such as infrastructure and logistics, which are essential for value chains operations to take place. Challenges for the latter will include not only increasing tolerance to climate change but also adapting to new patterns of demand brought about by changes in temperature, water availability and diseases (WEF, 2013).

Figure 1: Pathways to climate change impacts on a productive sector



As such, this thematic review intends to provide background information to make it possible to put together a framework for the analysis of adaptation and resilience at firm and value chain levels. Such a framework can be used to better understand how stakeholders interact as well as to look at the movements and evolutions between and within value chains and sectors, differentiating incremental from transformational adaptation. The Intergovernmental Panel on Climate Change (IPCC) defines the former type of adaptation as 'adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale' (IPCC, 2014a) – this despite changing internal demands and external forces. In other words, incremental adaptation improves the resilience of existing entities (livelihoods, economic activities).

"Transformative adaptation can be technological and behavioural, affecting how individuals and society make decisions and allocate resources to cope with climate change"

Transformational adaptation is defined as 'adaptation that changes the fundamental attributes of a system in response to climate and its effects', in other words improving resilience by changing the way existing entities are organised. More specifically, transformability is usually defined as 'the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable' (Folke, 2010). While transformative adaptation can be technological, it is also behavioural, affecting how individuals and society make decisions and allocate resources to cope with climate change. The institutional environment can influence such behaviour.

A vast literature has looked at the issue of resilience, highlighting the complexity and subtlety of the original 'bounce-back' or 'return to equilibrium' and all other related concepts according to reference points related to space, physical scale or entity – households, communities, resources, production systems – and time – short, medium or long term. Béné et al (2012) classify the multiplicity of definitions in a 3D resilience framework built according to the intensity of change and transaction costs to the adaptation strategy. The first dimension refers to absorptive coping capacity or persistence, which are different strategies to buffer the impact of a shock. From a firm point of view, this means capacity to cope with a shock without changing fundamental production processes. The second dimension refers to incremental adaptation (adaptive capacity or otherwise incremental adjustments) and the third to transformative adaptation (transformative capacity). The authors consider these three levels of action the core component of resilience. Accordingly, when a shock overwhelms coping capacity, then adaptive or even transformative capacity will be necessary, thereby increasing the absorptive capacity of the system in a new stable stage.

Putting it another way, according to Folke et al. (2010),
'Resilience […] is the capacity of a social–ecological system to continually change and adapt yet remain within critical thresholds. Adaptability is part of resilience. It represents the capacity to adjust responses to changing external drivers and internal processes and thereby allow for development along the current trajectory (stability domain). Transformability is the capacity to cross thresholds into new development trajectories.'

Therefore, transformational thinking suggests shocks and extreme events may actually 'open up opportunities for re-evaluating the current situation, trigger social mobilization, recombine sources of experience and knowledge for learning, and spark novelty and innovation' (Folke et al., 2010).

Salt refinery, saline from Janubio, Lanzarote, Spain
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As an analogy to the structural transformation literature, which identifies three modes of productivity change underlying structural transformation, we identify three modes of firm and value chain adaptation to climate change. The first can be considered incremental, and the second and third transformational:

- Within firm reallocation of resource to less vulnerable production systems;

- Adaptation that improves the coping capacity of the sector overall, for instance better cooperation on resource management by stakeholders. This stage is also defined as incremental adaptation which, when scaled up at the sectoral or value chain level with horizontal and vertical cooperation, becomes transformational;

- Moving productive resources (labour and capital) from vulnerable to less vulnerable sectors or value chains or location.

ASALs are particularly vulnerable to climate change. Therefore, it is likely that, in many of these areas, the extent of climate shocks will overwhelm adaptive capacities and the situation will require transformational adaptation. The framework suggested in this thematic review intends to provide tools to analyse the role of the private sector and markets in ASAL resilience to better understand 1) the sources of vulnerability in ASAL regions; 2) whether and what type of adaptation is necessary and how it can be implemented; and 3) what, from the private sector and market point of view, could be the barriers and incentives to transformational adaptation, including taking into consideration potential winners and losers from transformational processes.

To do so, this review looks at the constraints to private sector development in developing countries and how climate change might affect these constraints. It also looks at how physical, political and socioeconomic factors can influence the pathways of impact and the private sector strategy and markets incentives and as a response to of climate change.

Table 1: Constraints to the private sector and the influence of climate change

	Markets/Value Chains	Climate Change
Physical	Remote, rural, poor hard infrastructure	Degraded natural resources (water, arable land), and infrastructure because of drought, floods and erratic rainfalls
Political	Policies influencing allocation of resources constraining national markets, lack of development of the private sector in semi-arid areas; limited political voice	Potential conflict over resources allocation, adaptation and disaster management plans/policy
Socio-economic	Low availability of basic social and economic services and infrastructure, (poor access to credit, inappropriate technologies, limited economic opportunities)	Increasing population (pressure on resources, food security), investment risk from weak adaptation/mitigation to cc,

This thematic review first provides an overview of the literature on the constraints to private sector development and makes a first attempt at identifying how climate change affects these. After looking at the general constraints private sector enterprises face in developing countries overall and then in ASALs in particular, the review assesses the literature on how climate change affects firms operating in these regions and in particular how it influences previously identified constraints.

Then, adopting a value chain perspective, the paper focuses on identifying pathways of impact of climate shocks. In particular, we are building a framework of analysis that aims to identify value chain vulnerabilities to climate change according to the vulnerability of upstream economic activities – production but also logistics and services – as well as potential coordination failures in adaptation strategies that could result in increasing competition over resources and 'resource grab' behaviours. If the latter investigation reveals potential market disruption resulting from increasing pressure on scarce resources as a consequence of climate change, it is also possible that this change in the productive environment will foster market creation and structural transformation.

Accordingly, this thematic review aims at suggesting a framework of analysis looking at whether and how such constraints might affect the adoption and choices of adaptation strategies, incremental or transformational, and the resulting impact on private sector vulnerabilities, resource allocation and economic growth.

The literature reveals comprehensive evidence on smallholder farming and livelihood issues in ASALs but very little on non-agriculture sectors and how climate change might affect them. Therefore, research on private sector activities in ASALs is concentrated on a limited number of sectors usually closely related to agriculture and, to a lesser degree, the extractive industries. Research on entrepreneurial activities in manufacturing and services is limited to a small amount on the tourism industry.

The review is organised in three parts.

Part A

provides an overview of the economic makeup of ASALs and the importance of the private sector for job creation. It then assesses private sector development constraints in developing countries and ASALs in particular.

Part B

looks at the impacts of climate change in ASALs and in particular the indirect impacts of climate change, through three transversal issues and sectors of particular interest in ASALs: water scarcity and infrastructure, including energy and transport. This part also highlights the importance of the institutional environment in a climate change context.

Part C

looks at private sector adaptation strategies and their drivers and barriers, using a value chain approach. In particular, the value chain analysis makes it possible to capture a new dimension of risks and constraints to private sector development and needs but also opportunities for transformational adaptation.

Part A
The private sector in arid and semi-arid lands

1. Overview of the economic makeup in ASALs

ASALs are the focus of the PRISE project. ASAL areas are characterised by low and erratic rainfall, low population density, low development indicators, high poverty incidence, food insecurity, weak institutions and poor infrastructure. As such, populations are subject to physical and economic isolation and high vulnerability to multiple and dynamic socioeconomic and climatic stressors and shocks (Morton, 2007).

In PRISE countries, the populations of ASALs are largely engaged in subsistence farming, with the majority of crop or livestock products consumed directly at the household level and only a small proportion sold at markets. ASALs represent different agro-ecological environments, which support different economic activities and will be subject to distinct challenges. Arid lands suffer extreme water shortages and are predominantly in areas surrounding the equator, whereas semi-arid lands are in both hot and cold climates and do not face the same water scarcity issues. Rain-fed agriculture is possible in semi-arid environments, and grazing land for pastoralism is less marginal and less prone to degradation. Whereas many arid areas are predominantly rural, semi-arid regions are increasingly urbanising.

Arid lands are dominated by pastoralists, who rely primarily on livestock products such as meat and milk to provide food and income. Semi-arid lands are characterised by cereal and root crop farming systems, although irrigation can support a broader range of crops, including millet, sorghum, maize, vegetables, pulses and cash crops such as cotton (CAADP, n.a.; Dixon and Gulliver, 2001). Semi-arid lands therefore present an economic mix of pastoralists (some of whom may also engage in cultivation as agro-pastoralists), smallholder farmers and emerging urban centres.

In Central Asia, semi-arid lands are characterised by extensive cereal–livestock farming systems, with diversification when irrigation is developed (Dixon and Gulliver, 2001). The private sector in ASALs broadly consists of livestock holders and smallholders selling small quantities of products to local markets and micro-level enterprises, with limited linkages with medium or large firms, domestic and multinational.

There are very few small and medium-sized enterprises (SMEs).

Farming systems in ASALs generally follow traditional agrarian structures (Aklilu et al., 2013): land is communally owned, property rights are not well defined and plots are very small (less than 0.5 ha) and allocated through informal tenure. This restricts access to financial systems, which require formal tenure as collateral for credit. Production challenges are a defining characteristic of ASALs, which are often marginal and risk-prone natural environments, with poor soils and increasing competition for resources (Morton, 2007). Risks include climatic variability, floods, drought, pests and disease. Pastoralists systems have to adapt to changing environments: shrinking grazing lands and regulations restricting mobility, owing to political boundaries and animal disease control, in addition to government policies encouraging settlement.

It is also possible to find some larger firms, typically engaged in mining, industry or agriculture, in semi-arid lands. In the case of the Turkana region of Kenya, the recent discovery of oil is leading to significant increased investment in the area: the transformation of the main town of Isiolo, increased road and air infrastructure capacity and planned support to increase tourism to the region[1].

Within semi-arid areas, urbanisation is leading to shifting economic as well as new political and social structures. Whereas previous trends indicated out-migration to non-arid areas, the increasing economic capacity of semi-arid towns and cities is leading to greater internal migration, rather than out-migration, demonstrated by Barbiera et al. (2009) in north-east Brazil.

One consequence of such changes is exacerbated infrastructural shortages, as growing towns struggle to keep pace with housing, road and sanitation needs – with particular constraints on water resources (ODI, 2003). Urbanisation also affects livelihood choices (ibid.), with, for instance, pastoralist households diversifying income sources away from agriculture towards increased reliance on remittances from family members who have migrated to urban areas.

These urban centres are an opportunity for firms to make use of aggregate economies of scale, and to create markets for agricultural and livestock products for the surrounding areas. However, market links are poor. Pastoralists driven to sedentarised livelihoods in these small towns as a result of poverty or government policies are frequently economically excluded, living on the outskirts and exacerbating environmental degradation (Morton, 2007). As such, many people from ASALs remain unable to engage with the private sector.

In summary, ASAL production systems are often characterised by low levels of productivity resulting from various factors including weak market integration, out-migration and shortages of skills (Fitzgibbon, 2012; Parthasarathy (2002)).

[1] http://www.theeastafrican.co.ke/news/Kenya-to-shift-focus-to-arid-lands-for-growth/-/2558/1702734/-/view/printVersion/-/65jp8az/-/index.html

Fresh fish for sale at African beach
© Peeter Viisimaa

2. A heterogeneous private sector with heterogeneous linkages to employment generation and growth

This section provides an overview of the heterogeneity of the private sector and how it participates in economic growth and job creation. The section is focussed on the private sector within the developing country context due to the paucity of data on the private sector in ASAL regions, although where ASAL information was available it has been included in the analysis.

The private sector is the main engine for economic growth and job creation. In Africa, for example, it generates about 80% of gross domestic product (GDP) and 90% of jobs (Business Action for Africa, 2010). The private sector is also a crucial provider of products, services, finance and skills development essential for sustainable and inclusive development. In many developing countries, where state provision of social services is constrained, the private sector can be an important provider of health and education services for poor people.

It is important to note the enormous variety of entities that comprise the private sector: conventionally, firms are referred to in terms of size (staff numbers and turnover), and there is an array of different categorisations. Broadly speaking, firms can be described as large, medium, small and micro in size. Firms can be formal (i.e. registered with government, usually in order to pay tax) or informal (as is the case for many small and micro firms in developing countries). The structure of firms also varies considerably depending on the sector, their business model and governance structure and the context in which they operate.

Micro, small and medium-sized enterprises (MSMEs) account for 70-80% of jobs in Africa (Business Action for Africa, 2010), and the informal sector is responsible for 83% of new jobs in Latin America and the Caribbean and 93% of new jobs in Africa (IFC, 2013), although there are criticisms of focusing development projects on micro, small and informal businesses, given their high failure rate. Using panel data from Ethiopia, Page and Söderbom (2012) found that, when the lower survival rates of small enterprises are considered, job growth for large and small enterprises is essentially the same. Liedholm and Mead (1999) provide a useful classification, organising micro and small enterprises (MSEs) into new-starts, non-growing enterprises, small growers and graduates. Non-growing enterprises, carrying out survival activities, are most common. Graduate enterprises (starting small but growing to 10+ staff) account for only 1% of MSEs. They do, however, account for a quarter of new jobs created by existing MSEs.

There is a recognised 'missing middle' in terms of firm size, access to capital and productivity in Africa (Gelb et al., 2014), which could in large part be filled by small and growing businesses (ANDE definition) or graduate enterprises. In many developing economies, the private sector consists predominantly of smallholder farmers and micro-level enterprise activities (Morton, 2007). Many smallholders have limited linkages with medium or large firms, whether these latter are domestic or multinational, although systems such as collectives and contract farming can improve market access (Merkelova et al., 2008;

"However, to have substantive impact, skills development needs to match job creation opportunities and demand from markets and supply chains development."

Wiggins and Keats, 2013). SMEs offer the potential for livelihood diversification and off-farm employment, and are essential to create value chain linkages between smallholders and national, regional and international markets (Humphrey, 2003; Ellis, 2007)

According to the UN Development Programme (UNDP) (2004), the private sector in developing countries is characterised by 1) high levels of informality; 2) limited SME significance; and 3) limited competitive pressures.

High prevalence of informality: Informal sector enterprises in developing countries represent close to 80% of firms in Sub-Saharan Africa. While informality can provide some benefits by bypassing stifling enterprise enforcement rules and creating jobs and economic opportunities for poor communities (in particular for women, who often face even larger constraint to entrepreneurship), the informal sector also has a number of drawbacks, which can limit growth. Informal enterprises are typically precluded from accessing formal sources of finance, they cannot benefit from contract enforcement through the legal system, workers have limited or no rights and tax avoidance increases the competitiveness of informal enterprises vis-à-vis informal enterprises, which in turn limits government revenues.

Limited number of competitive SMEs: Economic growth and SME growth in an economy are closely related, with SMEs increasingly considered as drivers of growth. However, the limited importance of SMEs in developing countries can be interpreted as both a barrier to private sector development and a hindrance to economic growth. Market entrance and expansion barriers (i.e. access to finance) coupled with widespread informality and limited labour skills play an important role in hindering SME growth.

Limited competitive pressures: In many developing countries, large companies tend to dominate markets, limiting competitiveness. They sometimes take advantage of weak institutional systems in order to maintain their monopolistic position, raising barriers to new entrants and slowing down necessary reforms.

Education and skills: Access to quality education and relevant workplace skills are constraints that are particularly acute in ASALs, meaning the workforce is ill equipped to support private sector development (or even just their own livelihood needs). There is increasing donor focus on skills development and entrepreneurship training, with particular focus often given to female entrepreneurs. However, to have substantive impact, skills development needs to match job creation opportunities and demand from markets and supply chains development.

For instance, investments from multinational mining companies in ASALs will potentially allow for job creation, but the capacity of local people to benefit will be closely linked to the emphasis the state and private sector actors place on social investment to support skills development and the inclusion of local enterprises in supply chains through effective and inclusive local content programmes. Given the low level of education and skills among ASAL populations, even with the presence of larger firms a concerted effort to conduct capacity-building and skills training is often necessary to build a productive labour force. As such, employment opportunities remain limited for ASAL populations.

Indian old man, from semi-arid region in India
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3. Operational constraints of the private sector in developing countries

This section broadly identifies the private sector's main constraints and barriers to growth in developing countries: through the lens of the enabling or operating environment.

The prevailing economic literature broadly defines constraints centred around the notion of the 'investment climate', in other words the business operating environment in which the private sector makes productive decisions. Fiestas and Sinha (2011) summarise these constraints as follows.

Macroeconomic stability: Economic, social and political instability at the macro level can hinder investments as it can cause uncertainty on investment returns and operational stability as well as devalue companies' assets. Therefore, higher levels of instability can lead to lower levels of growth and private sector investment.

Crime and corruption: High crime rates and pervasive levels of corruption increase operational risks and costs. The payment of bribes or the loss of goods through theft and potentially of skilled personnel increase risks and decrease incentives to invest. At the macroeconomic level, research (see Kaufmann et al., 1999 and Mauro, 1995, or Gaviria, 2002, for firm-level impacts of crime) shows higher rates of crime and corruption lead to decreased employment, growth and investment.

Business regulation and licencing: Inappropriate and poorly enforced regulation, as well as high licencing costs and complex procedures (often linked to corruption), can increase operational costs, thereby decreasing revenues and profits, and hinders the international competitiveness of firms. Cumbersome regulatory systems also limit the amount of new entrants to markets, which in turn can limit overall competition and growth. As countries improve their regulatory systems, growth rates tend to increase. A cross-country analysis by the World Bank (2005) shows that improvements across all aspects of the Doing Business indicator lead to an estimated 1.4 to 2.2 percentage increase in economic growth, although better regulation and licencing systems alone are not enough to spur growth.

Institutions and legal systems: Cross-country evidence points to the fact that weak institutions (especially for property rights) and judiciary systems necessary to enforce contracts hinder private sector investment and growth. Dollar and Kraay (2003) show improvements in the quality of institutions can have a positive long-term effect on growth. Firm-level data (Dabla-Norris and Inchauste, 2007; Ojah et al., 2010) show secure property rights and effective contract enforcement incentivise longer-term investments by firms and by investors, which allows firms to grow at a faster rates, helps companies diversify their supplier and customer base and incentivises further foreign investment into the country.

Taxation: High rates of taxation and high tax compliance costs decrease returns and reduce incentives to invest. In this way, high tax rates limit market entrance and enterprise growth – especially for larger and mid-sized firms – whereas smaller firms are less subject to taxation as they can operate to a higher degree of informality (Gauthier and Reinikka, 2001).

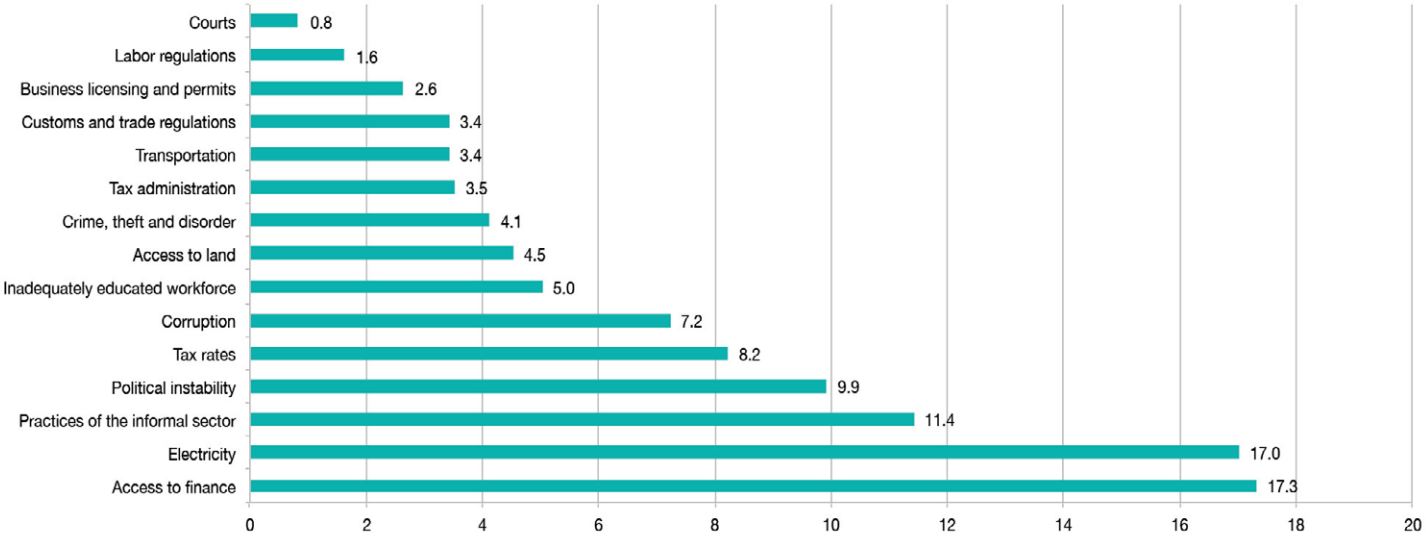
Access to finance: Access to finance for firms is a significant constraint in ASALs. Financial institutions often ask for high interest rates and charges and collateral requirements such as title deeds, which are not always available as land is often communally owned and land property rights are not defined. Moreover, there is often limited information from private sector stakeholders on the types of financial services and products available, which are often not suitable for the needs of ASAL enterprises. Financial sector development is also constrained by limited management skills, limited financial literacy, poor record-keeping by enterprises and limited group management structures. While ASAL communities and enterprises can have access to other sources of finance, these tend to be informal (UNDP, 2010). For instance, although microfinance institutions (MFIs) are often presented as a credit solution in such areas, their interest rates and collateral requirements are still off-putting and perceived to be risky to small businesses in ASALs (UNDP, 2008).

Firms of all sizes need to be able to access sources of finance to start up and grow their business. The nature of finance required varies considerably depending on the size of the firm and its stage of development. In many developing countries, there are increasing volumes of non-returnable finance available to idea and early stage small businesses – but there is a recognised 'missing middle' in terms of investment as firms grow, for example in the provision of loans to medium enterprises between $200,000 and $2 million, as this amount is too large for subsidised or direct state support but does not permit the economies of scale commercial investors require. A growing number of funds are seeking to provide capital to meet the missing middle demand, offering 'patient' capital with longer investment periods alongside business development skills and technical support to firms, sometimes using equity-like assets. An example is AgDevCo, a social impact investing fund manager and agribusiness project developer that invests in funds that support African agribusiness, including one fund in the southern savannah belt of northern Ghana. However, there is a lack of such investments in ASALs as a result of the absence of viable firms to support and build up.

As previously mentioned, 80% of firms in Sub-Saharan Africa are in the informal sector, preventing access to formal sources of finance. While informality is clearly a constraint, formality might not guarantee access to finance either, for reasons previously mentioned (the legal and regulatory systems).

Infrastructure: Access to infrastructure (such as energy, transport, information and communication technology (ICT), etc.) supports firms' productivity, reduces their transaction costs (i.e. through better telecommunications and digital infrastructure), brings down their transportation costs and increases their market access. Limiting the productive capacity of the private sector, limited availability of energy infrastructure is either a driver or an enabler of growth. Infrastructure provides access to productive resources (such as water) and increases production efficiency (e.g. through improved sewage and waste treatment facilities). Greater investment in infrastructure leads to higher levels of productivity (OECD, 2006; World Bank, 2004).

Figure 2: Biggest barriers to firms in lower-income and lower-middle income countries (% of responses averaged across multiple surveys)



Source: World Bank (2014)

Wind turbines in Fuendetodos, Aragon, Spain
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Figure 2 provides information from the World Bank's Enterprise Surveys about the major constraints and barriers as reported by firms in low-income and lower-middle-income countries. Limited access to finance, ranked first, and electricity, ranked second, are the most important barriers to enterprise development in low- and lower-middle-income countries[2].

[2] Using data averaged across multiple World Bank Enterprise Surveys

4. Operational constraints of the private sector in ASALs

The lack of hard but also logistical infrastructure, including services and financial, transport and market distribution systems, and a shortage of economic incentives to develop them represent the core issues constraining the development of the private sector and value chains. In addition, institutional and policy disconnects undermine opportunities for value addition and the provision of business services in ASALs.

Lack of connectivity infrastructure

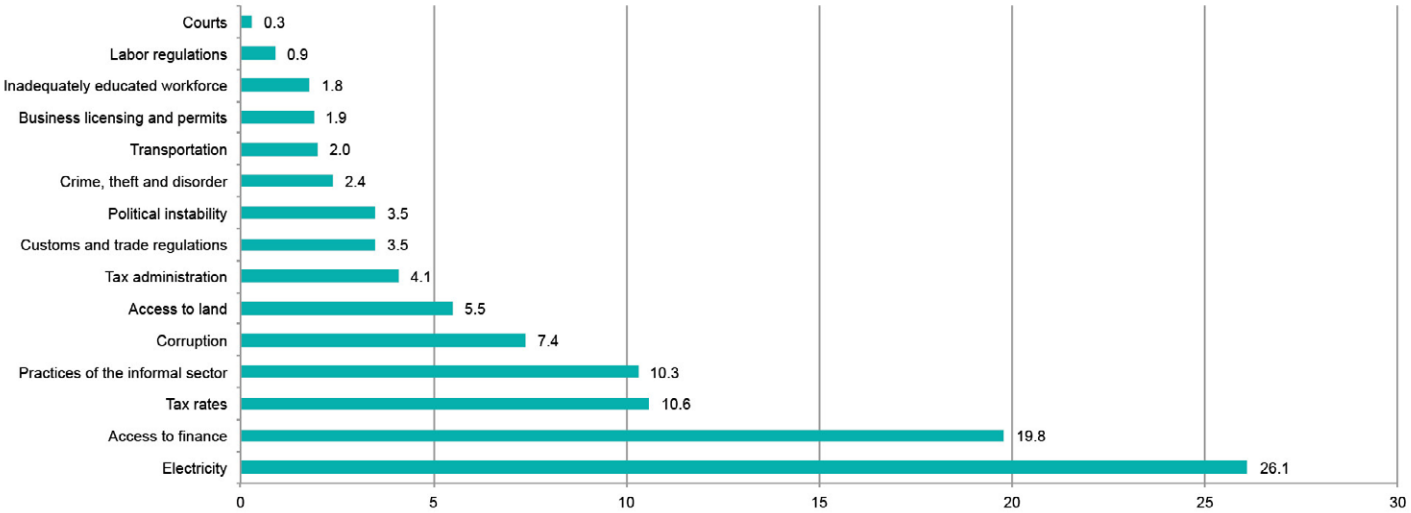
Underdeveloped hard infrastructure (such as roads), inadequate sale points and poor communication systems can make access to markets and market information very difficult (UNDP, 2008). ASAL regions are characterised by poor physical and informational connections to markets. Poor transport infrastructure implies high transport costs, the impacts of which are multiplied when climatic events contribute to the degradation of infrastructure, which can isolate areas for long periods of time.

Data on what limits increased production in enterprise firms in Kenya's ASALs (see Figure 4) show high transport costs and poor road infrastructure are a major barrier to growth, followed by limited access to finance.

Micro and small-scale entrepreneurs in ASALs typically have limited information on national and international markets but also limited information on consumer preferences. Improvements in telecommunication infrastructure can increase access to market information and increase sellers' and buyers' arbitrage opportunities, as well as help speed up transactions between producers and traders by increasing trade efficiency. Improving ASALs' connectivity is a way to increase private sector competitiveness, for example through mobile phone technology to farmers on market prices for crops.

Weak transport infrastructure and a paucity of product storage and transport equipment and in particular the logistic services necessary for trading and transport (i.e. cold storage for fresh and perishable products like meat and fresh fruits and vegetables) limit the market reach of ASAL enterprises.

Figure 3: Biggest barriers to firms in PRISE focus countries (% of responses averaged across multiple surveys)



Source: WFP (2013b)

As an example, ASAL meat producers have to export live cattle to the few existing processing facilities, which tend to be located in (distant) urban agglomerations (Aklilu et al., 2013).

ASALs are often characterised by weak entrepreneur networks (producer organisations or unions that represent their interests), contributing to a higher gap between firm prices and market prices in those regions (UNDP, 2010). Small producers (producing low volumes or irregularly) have less capacity to negotiate, as they have less to sell compared with organised structures such as cooperatives and producer organisations. Moreover, producer organisations are also a way to pool and reduced fixed costs of trading (transaction costs), whether to negotiate contracts for inputs and outputs or to get access to information about prices as well as buyers' production requirements (standards, certifications, etc.).

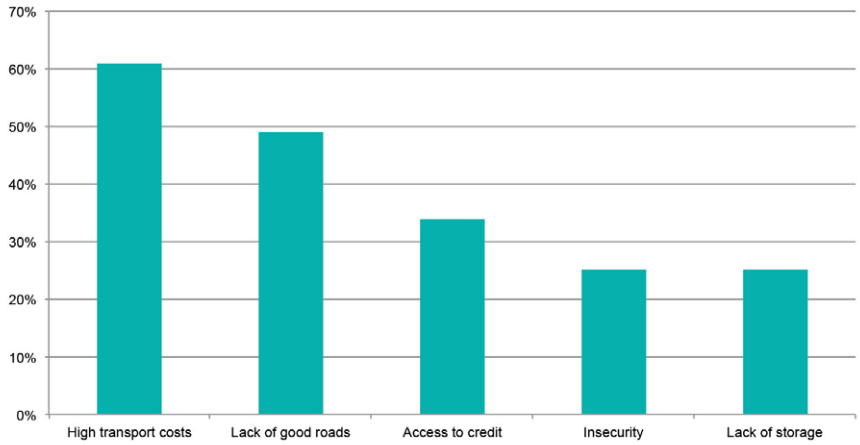
Market distribution systems

Within a nation's market distribution system, remote markets, such as those in ASALs, are indirectly linked to central (national) hub markets through multiple regional and local market hubs (see Figure 5 for an example from Kenya). Remote markets have small catchment areas, for both wholesalers and retailers, usually at the village scale. Producers mainly sell their products locally with minimal or no processing. Very few products reach other local areas or regions, or countries. The corollary is that firms in ASALs tend mainly to source their food locally or from (close) neighbouring regions. There are incentives to trade with domestic or international markets when price differentials and economies of scale make it possible to cover transport and transaction costs. The low population density in ASALs makes it impossible for some areas to be connected, as demand for but also supply of products is not large enough to cover the marginal costs of transportation (Raballand et al., 2010).

Additionally, international supply need is irregular and periodic, whether for food or for inputs for instance fertilisers. Therefore, it is difficult for private sector intermediaries to specialise in one activity or another and to benefit from long-term relationships and scale economies.

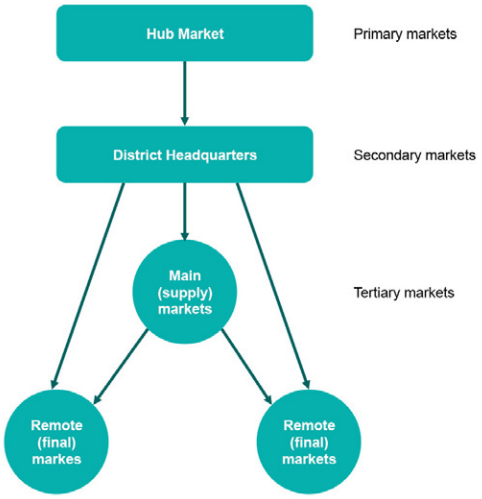
Overall, these constraints reduce incentives for the private sector to invest in intermediary activities and to both import and export goods from and to ASAL areas (WFP, 2013).

Figure 4: Barriers to increased production in Kenya's ASALs



Source: WFP (2013)

Figure 5: Market supply systems in ASALs in Kenya



Source: WFP (2013)

Box 1: Market access in Kenya's ASALs

A report by the World Food Programme (WFP) (2013) looks at market dynamics and financial services in ASALs in Kenya. It finds the main constraints to trade in ASALs are lack of basic transport and market infrastructure; these constraints raise transaction costs (transport costs, access to information, etc.), which results in a more inconsistent supply of food commodities – as well as higher prices – than in other regions of Kenya. The increase in prices is compounded by both tariff and non-tariff barriers to trade, which continue to increase the price of imports to the country – which in terms of food imports into the ASAL regions of Kenya means higher staple food prices for a region still recovering from the effects on food availability of the last severe drought. There is also the issue that most transport links into ASALs were run through wholesalers outside of the ASAL region, which increases the potential for collusion (for increased food prices).

Roadside action,
© Peeter Viisimaa

Business-related services

In addition to a lack of producer organisations, ASAL regions are characterised by poor provision of structures and limited management skills to support business services such as branding and packaging of goods, as well as poor market information on consumer preferences. All this hinders enterprises in ASALs from building their capacity and accessing markets (UNDP, 2010). For instance, lack of access to services such as veterinary health care and agricultural extension services limits the effectiveness of pervasive agro-businesses (UNDP, 2008).

Standard infrastructure can help producers adopt standardisation procedures and facilitate product bulking but also meet domestic and international quality standards, allowing for greater use of quality controls and product assurance, all aimed at increasing product quality but also reducing transaction costs. The main challenges, however, remain 1) the relative fixed costs and incremental costs of such infrastructure, because of limited product processing facilities; 2) lack of access to information, skills and technologies (equipment, processes, etc.); and 3) the investments necessary for product quality improvement and standard compliance costs for the producer in a world of constrained financial services (UNDP, 2010).

Such services are necessary to allow for increased value addition, for instance processing of corn or cassava into high-value flour or starch or wood manufacturing for furniture. They are necessary for processes of commodification, essential for inclusion in local and global value chains.

Research and knowledge diffusion services (e.g. agricultural extension services) that can help identify areas where value addition could be carried out are also limited (UNDP, 2010). High levels of illiteracy also limit the capacity to add value to local products (UNDP, 2008).

As a consequence, a significant proportion of the value added process takes place away from ASAL areas (WFP, 2013): processing companies working with producers in ASALs are often based in the capital or in large cities away from the ASAL region.

Impact of domestic and international policies

High barriers to trade, whether tariff or non-tariff, between countries, can be seen as a way to protect fragile but nonetheless essential private sector activities. However, in addition to creating rents and potentially diverting resources away from more welfare-creating and productive activities, they also increase the cost of inputs, thereby reducing firms' productivity.

But the issue is not only the level of between-country barriers to trade. The volatility of international as well as domestic policies acts as a disincentive and as a barrier to the development of the private sector (Engel and Jouanjean, 2013).

Access to finance

Access to finance is particularly constraining in ASAL areas. Financial institutions in such areas often have high interest rates and charges, with high collateral requirements, such as for title deeds, which are not always available as land is often communally owned and land property rights are not defined. Moreover, there is often limited information from private sector stakeholders on the types of financial services available, and financial products are often not suitable for the needs of the predominantly micro- and small-scale firms operating. Financial sector development is also constrained by limited

management skills, limited financial literacy, poor record-keeping by enterprises and limited group management structures. While ASAL communities and enterprises can have access to other sources of finance, these tend to be informal (UNDP, 2010), for example private individual lenders or unregulated MFIs. MFIs are also important for micro-enterprise, and often presented as a credit solution in such areas; however, their interest rates and collateral requirements can be off-putting and they can be perceived to be risky for small businesses in ASALs (UNDP, 2008).

Institutional failures and governance

A lack of access to land and limited land registration systems can lead to conflict between different land users over the use of natural resources (UNDP, 2008). Limited capacity of people working within development offices in ASAL regions may hinder their capacity to promote the right development strategies for ASAL enterprises, because of either high staff turnover or sometimes inadequate staff skills (Aklilu et al., 2013).

There is also an apparent 'policy disconnect' between production systems in place within ASALs and national policies focusing on land use management and land tenure. National policies focus on the use of land for agricultural crop production, conservation and other non-livestock land uses, as well as leasing traditionally pastoralist land to international firms for irrigation and dryland farming or for wildlife conservation and tourism activities. These policies may not consider the needs of, for instance, traditional pastoralist communities, or their access to grazing land, water or migratory routes, and may reduce their ability to maintain livestock production and access markets (Aklilu et al., 2013).

Overall, the level of private sector investments outside the mining and ecotourism sectors is low within ASALs. In order to attract more private investment, governments need to set up a stable enabling environment, adopting policies (i.e. taxes and incentives, a stable policy environment) that could help improve investments in other sectors, increasing resilience and reducing the risks for private enterprise investments in ASALs (Anderson et al., 2004; Miano et al., 2009; Reddy et al., 2009; Shiferaw et al., 2007). Institutional development, streamlining and reducing the costs of public entities, and technical innovation allowing for increasing knowledge and capacity to adapt technologies to ASAL climates are two major factors that can contribute to successful investments in ASALs (Reij and Steed, 2003).

Examples from the agriculture sector in ASALs

Market access is a big constraint for agricultural producers and small-scale processors. UNDP (2009b) sets out a range of interventions that can potentially address issues related to market access: supporting the transformation of producer groups into business support groups; developing efficient marketing systems; implementing market-oriented production: establishing market linkages with buyers; appointing community technical experts; and making policy linkages. However, these interventions can become wishful if the cost issues mentioned in the previous examples are not tackled.

Experience from Sub-Saharan Africa highlights private sector incentives and capacity to develop an inorganic fertiliser market in semi-arid regions under the right conditions of a profitable agricultural sector generating enough demand, in addition to facilitated access to inputs and imports, with, for instance, undistorted exchange rates. However, the development of such markets in ASALs is constrained by high transaction costs, with traders selling small quantities to large numbers of small farmers and high credit risks related to repayment failure, especially in bad rainfall years. Organising farmers into cooperatives or credit associations can mitigate these problems. However, farmers can also be confronted by contract enforcement issues and free-riding behaviours when no enforcement mechanism exists. Senegal provides successful examples of establishing farmer cooperatives or credit associations together with the introduction of inventory credit that enables farmers to make bulk purchases of inputs and to collectively manage output sales (Ouendeba et al., 2003; Sanders and Shapiro, 2006).

Pastoralism and livestock industries are also important to ASALs, and climate change has a severe impact on them. Deprived by farm expansion of their informal grazing rights and driven out of arid areas by drought, semi-arid regions are increasingly diversifying to partial livestock, partial crop production (agro-pastoral or mixed small farming systems) (OECD, 2008). There is growing domestic demand for livestock products (predominantly meat, but also by-products such as leather goods), but livestock markets are often poorly integrated owing to factors such as distance and transport costs to market, varying animal quality, inability to mitigate climate-related and other shocks and lack of processing facilities within ASAL regions (Fafchamps, 1995).

The market issues are more insidious as they hinder trade and private sector growth along the value chain, from producers to consumers. This makes it difficult for pastoralists and smallholder farmers to graduate from subsistence to commercialised production, and it means national and international firms are unable to establish reliable supply chains or to add value to products in situ.

ASALs often have minimal storage facilities, poor roads, low electrification, limited processing provisions and inadequate market and sales infrastructure. Integrated livestock value chains require refrigerated transport systems, collection centres, market points and slaughterhouses for trade. Without this infrastructure, pastoralists in ASALs struggle to connect with increasing consumer demand for meat and animal products. Therefore, low levels of productivity among pastoralists and smallholders are exacerbated by poor backwards and forwards market links.

“...low levels of productivity among pastoralists and smallholders are exacerbated by poor backwards and forwards market links.”

Part B
The private sector and climate change

"ASALs will experience changes in rainfall patterns as well as an increased occurrence of extreme weather events such as droughts and flooding."

1. Climate change impacts

This section provides a broad overview of the predicted impacts of climate change in ASALs. The following section then assesses the likely impacts of climate change on the private sector by identifying its vulnerabilities and the expected effects of climate change on its operations.

Impact of climate change in ASALs

Although there is a certain degree of variability and uncertainty in climate change projections, there is a general agreement that ASAL regions will experience changes in rainfall patterns as well as an increased occurrence of extreme weather events such as droughts and flooding (UNDP, 2009a). These are likely to exacerbate the pre-existing vulnerabilities of ASALs, which will in turn affect private sector enterprises.

At the forefront of these vulnerabilities is water security. Declining precipitation and increased temperatures will reduce water quantity in freshwater bodies and in groundwater reserves (Oyebande and Odunuga, 2010). While rainfall is expected to reduce in frequency, its intensity is expected to increase, which, coupled with unsustainable groundwater usage, will likely lead to a reduction in the availability of water in ASALs (AWC, 2009).

Increased temperatures will have further impacts on water availability and needs (UNDP, 2009a). In Ethiopia, it is estimated that temperatures will increase by between 1.1°C and 3.1°C; in Kenya, the increase will be between 1°C and 2.8°C and in Tanzania between 3°C and 5°C by 2060 (CARE, 2011). The combination of changes in rainfall patterns and increased temperature could lead to a decline in crop production of between 20% and 50% by 2070 (Sarr, 2012). Extreme heat occurrences not only lead to higher water evaporation rates but also negatively affect people working in the affected regions (FAO, 2012).

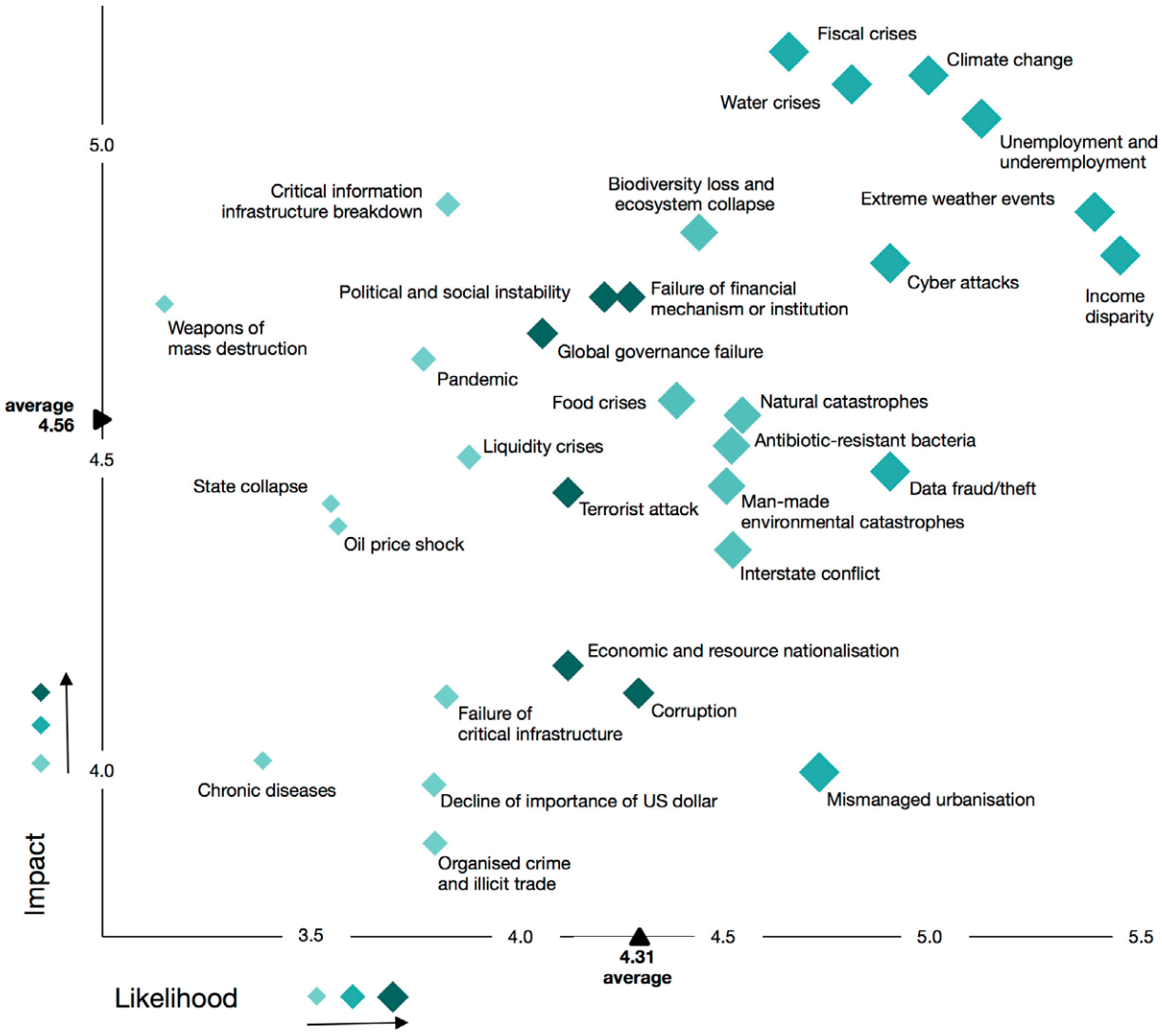
The occurrence of extreme weather events will increase. Drought will have impacts on more areas, affecting water access and associated productivity (Mata, 2008). But while rainfall will decrease in frequency, it is likely to increase in intensity, and as a consequence lead to increasing occurrences of flooding (FAO, 2012).

Consequences of climate risks for private sector activities and development

As previous sections have highlighted, enterprises do not operate in silos; their success is influenced by a multitude of factors that shape their decision-making and business operations. Climate change is a new parameter in strategic planning and will influence investment decision-making processes of forward-looking businesses for the foreseeable future. Businesses that operate in coastal zones will have to take into account the impact of changes in sea level on their infrastructure; enterprises reliant on water, energy, food and ecosystem services will see changes – or even threats – to their supply chains (PwC, 2012), which could negatively impact operations in the long run. The degree to which private sector operations will be affected depends on the vulnerability of business operations at the producer scale but also along the value chain, the type of goods being produced, the concentration of suppliers, the resource use governance shaping the level of coordination or competition between users and more generally the ability of governments to cope with climatic impacts[3].

A survey by CDP (2014) assesses the impacts of climate change on the operations of over 780 private sector enterprises, 270 European Union (EU) companies operating in 20 countries. Even though these companies might not all operate in developing countries, and even less so in ASAL regions, the survey provides a snapshot of the climatic risks as perceived by enterprises. The main survey results show 32% of businesses fear a disruption to their production capacity. The extreme events – increases in the incidence of flooding, droughts or extreme temperatures – can disrupt their supply chains, thus jeopardising their ability to produce outputs. A total of 31% of businesses are concerned those extreme climatic events will increase their operational costs as well as generating new fixed costs to replace damaged assets. Other perceived risks include inability for companies to carry out their business operations owing

Figure 6: Major risks perceived by businesses, 2014



Source: WEF (2014)

to extreme weather incidents (10%), loss of capital (8%) and a reduction in the demand for goods and services (3%), for instance a negative impacts the tourism sector.

In a similar survey by the World Economic Forum (WEF), carried out in 2014, businesses show concern about climate change-related risks likely to have important impacts on their operations. The perceived risks include the impact of climate change, changes in extreme weather events and water crisis risks (see Figure 5).

It seems, therefore, that there is overall a strong awareness from private sector enterprises that climate change will affect their operations. Focusing on ASAL areas, climate change is likely to increase vulnerabilities. Businesses operating in such areas will have to deal with the direct effects of climate change on their operations with increased pressure on resources. Reduced water availability will increase competition in terms of access to land as well as energy, as water scarcity can also potentially be associated with losses in energy production. Climate change is also likely to have impacts on physical transport infrastructure. Finally, changes in household livelihood opportunities may lead to migration and as a consequence reduce labour availability as well as demand.

"Firms operating in ASALs will have to deal with the direct effects of climate change on their operations with increased pressure on resources."

[3] http://www.pwc.com/gx/en/governance-risk-compliance-consulting-services/resilience/publications/business-not-as-usual.jhtml

Impacts on agriculture, pastoralism and rural livelihoods in ASALs

As the first section of this document highlighted, it is necessary here to differentiate arid from semi-arid lands as they present very different agro-climatic systems. ASALs remain predominantly agrarian and characterised by subsistence farming and small-scale processing but also by various scales of cash crop production, including cotton. Resource-poor farmers and herders' livelihoods in the Sahel have always been particularly vulnerable to shocks, from extreme events to family deaths, illness and insecurity. Therefore, the increase in occurrence of extreme event is probably, in the short run, the most important challenge they will face, rather than the long-term trend of climate change itself (Mortimore, 2009).

Changing rainfall patterns are a primary driver of change, altering crop production and causing massive fluctuations in harvests and loss of livestock (Campbell et al., 2002). Those unable to adapt crops and production techniques are particularly vulnerable – this could owe to lack of access to alternative seeds or lack of knowledge of alternative crops and improved production techniques. Crop diversification decreases the risks of the livelihood strategy, but can also be a way to increase wealth when producing high-value products.

The literature identifies a range of new and diverse crops and agriculture sub-sectors as being of potential value to smallholder producers – aloe, gum Arabica, honey, medicinal plants, bamboo, pigeon peas, shea – several of which offer opportunities for micro and small-scale processing close to or at site of production, within low-income communities of semi-arid lands (SALs). However, the extent of their vulnerability to climate change might reduce the amount of potential crops available for such diversification strategies.

Rural households' livelihoods often combine both on- and off-farm activities, whether as workers on other farms or on other activities. In northern Ghana, these activities, especially important during the dry and lean season, include hunting, fishing, non-timber forest product harvesting, local manufacturing, charcoal production, petty trade and wage labour (Dietz et al., 2004; Hesselburg and Yarro, 2006; Whitehead, 2002).

The expected increasing vulnerability of agricultural production as a result of climate change is likely to increase the importance of off-farm activities in rural households' livelihoods as they, in theory, offer opportunities for diversification away from agriculture as it becomes more risky (Stanturf et al., 2011). However, these activities can themselves be affected by climate change, either directly or indirectly, with, for instance, a reduction in demand as a result of migration.

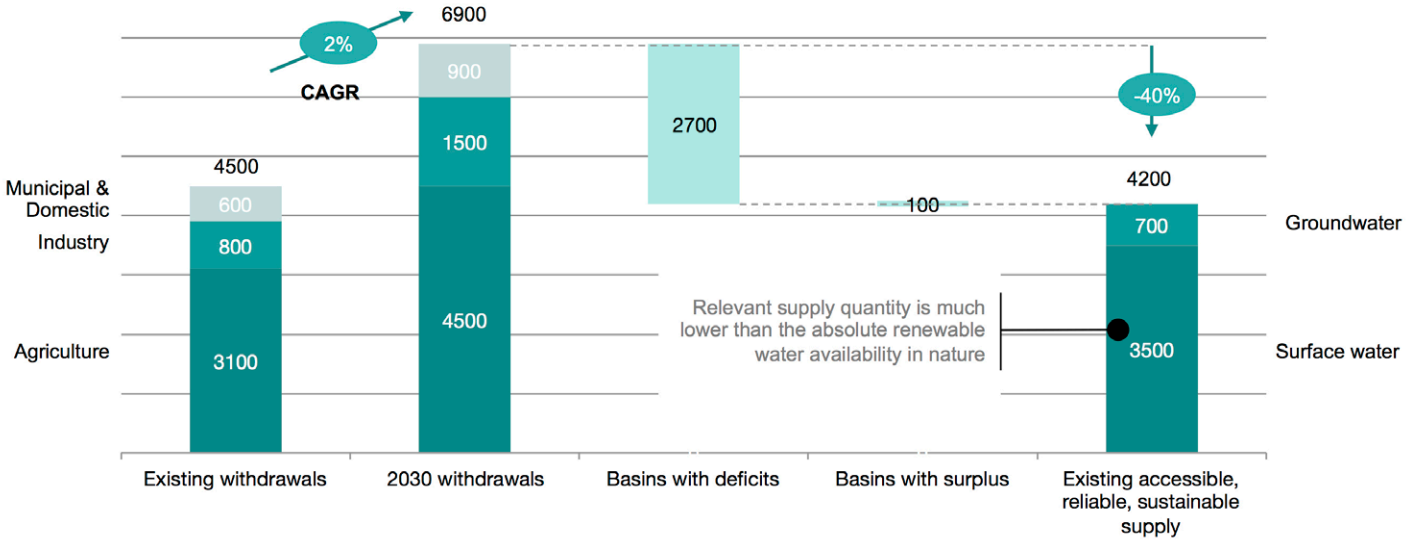
2. Three transversal sectors in ASALs: water, energy and transport infrastructure and services

Water security and climate change

Water-related risks are seen as a major threat, at the global level, to a large number of businesses. The WEF (2014) cites water crises as the third greatest perceived threat to businesses in 2014. Water-related risks can affect production decisions, have negative impacts on a company's licence to operate, increase production costs and ultimately negatively affect company viability. These risks and pressures are bound to increase in the long run: data (Figure 7) from the Water Resources Group (WRG) from 2009 already show a gap between water demand and water supply of 7% in 2009, which is estimated to increase to 40% by 2030[4]. Figure 7 also highlights that the majority of water demand stems from agricultural and industrial enterprises, and demand for water as a productive resource will continue to increase towards 2030.

Research from the IPCC's Fifth Assessment Report (AR5) on climate change impacts shows that in Africa pressure on water resources will be brought up by a combination of overexploitation and degradation of current water resources and a decrease in the availability of water owing to exacerbated droughts (Carabine and Lemma, 2014a). In South Asia, sea level rises will negatively affect coastal areas while higher average temperatures, higher extreme temperatures and greater incidences of droughts will likely affect the quantity of water available in the region (Carabine and Lemma, 2014b).

Figure 7: Water demand and supply deficit, 2030



Source: WRG (2009)

[4] Assuming 2% growth in water use from 2009 onwards and no efficiency gains. 2030 demand is based on GDP, population and agricultural projections from the International Food Policy Research Institute (IFPRI) IMPACT-WATER base case.

Water security will not only directly affect business operations per se. It will also affect the supply chain in which a business is participating. Table 2 highlights the vulnerability of various sectors to climate change-related water risks at different levels of their upstream value chain. It shows that all sectors in the table are confronted with high water risks in at least one level of their supply chain, in particular raw material production and direct operations.

Moreover, as climate change reduces water availability overall, private enterprises face a number of competing pressures on water use, not only in the productive sector but in terms of increased demand from growing populations. Productive use also often raises concerns regarding water quality and contamination, the associated environmental impacts on local ecosystems and, ultimately, the impacts of climate change, which may reduce water availability in particular regions, such as ASALs.

Water security is not only a physical constraint; it also overlaps with financial constraints as it provides a risk to companies but also their financial backers and their other clients (SIDA, 2005).

Therefore, water risks ultimately fall into two subsets. The first relates to risks inherent to a company's ability to function: operational risks, supply chain risks and risks induced by local governments failing to meet local water demands. The second revolves around access to water resources, and includes the declining availability of water, water quality and the policy and institutional setups that influence access to water. The prevalence of these risks can increase if companies do not effectively carry out water resource and usage evaluations or if financial institutions do not properly assess water risks through effective due diligence procedures of their clients (SIDA, 2005).

Table 2: Climate change water risks by sector

Sector	Raw Material Production	Suppliers	Direct Operations
Apparel	●	●	●
Electronics	●	●	●/●
Beverage	●	●	●
Food	●	●	●
Pharmaceuticals	●	●	●
Forest Products	●	●	●
Extractives	●	●	●
Energy	●	●	●

● = High Risk; ● = Medium Risk; ● = Low Risk

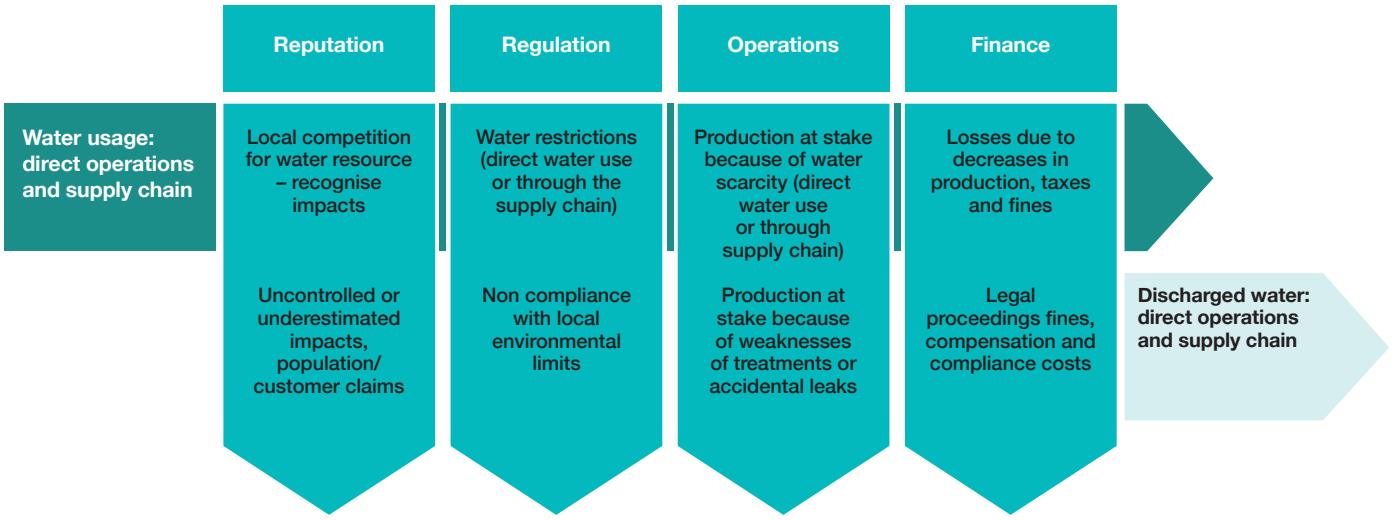
Source: Adapted from Morrison et al. (2009)

Operational risks

At the operational level companies need to be aware of issues such as reputational risks, regulatory restrictions, production interruptions and financial risks (see Figure 8). Manufacturing firms that have operational processes relying heavily on water use are particularly vulnerable to operational risks as water supplies decline (IPCC, 2011). Water insecurity can also increase investment costs for companies as they need to transport more water from areas of surplus to areas of deficit (e.g. ASALs), which then raises the unit price of water and increases production costs (Ernst & Young, 2012).

Supply chain interruptions: If water insecurity affects segments of a company's supply chain, this may have negative repercussions on their operations. For instance, if a meat processing company's supply depends on livestock from ASAL regions, but water supply issues threaten the production of livestock among suppliers, this would have a negative impact on operations, with a market disruption at the level of the traditional supplier. The meat processing company will therefore have to adapt its supplying structure. If such adaptation is too costly and not competitive, the processing company will have to stop operating.

Figure 8: Operational risks for water scarcity



Source: Ernst & Young (2012)

Inability of public or private services to meet basic water needs
Companies that operate in developing countries face a greater number of water-related risks, as inadequate water supply infrastructure for productive purposes intersects with inadequate supply of water to households for basic human needs and sanitation. This has sometimes led to increased public (and governmental) pressures to ensure enterprises that are large water consumers also use their infrastructure to support water distribution to local populations.

Decreasing water availability and reliability
Water shortages increase as demand exceeds supply, because of either natural (climatic) events or other factors, such as population growth and new increases in agricultural water use or any other water-consuming activity.

Where water availability is seasonal, significant disparities in the availability of water could occur, particularly in areas with high population density combined with low water availability (Morrison and Gleick, 2004). In ASAL regions, droughts can lead to severe seasonal or chronic reductions in local water supply (SIDA, 2005) further increasing demand on water supplies from other regions.

Declining water quality
The quality of water is important in many production systems, both in industry and in agriculture and agribusiness. Some industries are particularly sensitive to water quality potentially increasing operating costs, through, for instance, the need to invest in purifying systems. Quality concerns affect both groundwater and surface water deposits and, as the availability of water declines, so does its quality, increasing quality risks and concerns.

Box 2: Water and tourism in ASALs

Schachtschneider (2001) looks at the link between tourism and water use in ASALs, specifically in Namibia. The tourism sector's water usage is relatively limited at the national scale (in 2001 tourism accounted for 1% of total water use against 61% for agriculture), but the majority of tourism resorts are in ASALs, which require sustainable water management practices. Tourism enterprises independently access water sources (through privately drilled boreholes) and such practices have led to an over-usage of the resource in water-scarce regions. Differences in water usage pertain mainly to the size of tourism enterprises, with larger resorts and lodges using between 15 and 175 more water (per guest) than community camps and ecotourism camps.

Energy and climate change
The impacts of climate change on energy availability affect businesses through three channels: direct, indirect and induced. The direct impacts of climate change are through the level of energy supply. For instance, reduced water availability affects hydroelectricity supply. Indirect impacts come from increasing demand for energy for production systems. For instance, increased heat will lead to greater demand for energy for cooling systems. Induced effects occur through changes in the business environment as a consequence of climate change regulations and taxes incentivising businesses to reduce energy consumption on the way businesses use energy.

The effects of climate change on energy supply will most likely be negative in areas dependent on water supplies for hydroelectricity production or for thermal power plant cooling systems, resulting in reductions in energy supplies as water availability declines. Table 3 presents the amount of water required by various energy sources. Biofuels are the most water-consuming source of energy, followed by hydropower[5]. Except for hydropower, relatively low volumes are needed for renewable energy sources. However, regardless of consumption, energy production processes require water to function optimally. Increasing water scarcity will therefore reduce production capacity and have a negative impact on energy production.

Increasing temperatures, both ambient and water temperatures, have a negative impact on the efficiency of thermal power plant cooling systems. Sea level changes can also negatively affect power plants and energy infrastructure in coastal areas.

[5] Although hydropower uses rather than consumes water

Extreme weather events could damage energy infrastructure for both generations (and especially so for nuclear power plants, where damage to critical safety assets would also pose a severe safety risk) as well as transmission (i.e. heat damage to pipes or wind damage to power lines). Changes in weather patterns could also negatively affect renewable energy sources as decreased rainfall would reduce the availability of biomass for energy production while changes in cloud cover could have negative impacts on both solar- and wind-powered electricity generation (WEC, 2014; Wilbanks et al., 2008).

Table 4 summarises some of the expected impacts of climate change on energy. These impacts can have effects on private sector operations in terms of both inputs and outcomes.

In terms of inputs, the first effect is reduced energy and electricity supply to enterprises. A study by Escribano et al. (2009) found quality of infrastructure had a strong impact on total factor productivity (TFP): as quality decreases so does TFP. The study found quality of electricity supply had the highest impact on enterprise productivity, with the impact increasing in poorer countries. Similarly, Arnold et al. (2006) find unreliability of electricity supply has a significant negative impact on a firm's TFP. According to Attigah and Mayer-Tasch (2013), reviewing the importance of

Table 3: Water consumption by energy source

Energy Source	Total water consumed per megawatt hour (m3/MWh)
Solar	0.0001
Wind	0.0001
Gas	1
Coal	2
Nuclear	2.5
Oil	4
Hydropower	68
Biofuels	178

Source: Morrison et al. (2009)

Table 4: Expected impacts on energy as a result of climate change

Sector	Temperature	Precipitation	Wind	Extreme Events	Water Availability	Sea level Rise	Other
Biofuels	Impact on agricultural inputs	Impact on agricultural inputs	-	Crop & infrastructure Damage	Impact on inputs (i.e. irrigation)	Impact on coastal sites	
Renewables	Increased evaporation in water reserves	Decreased hydroelectric potential	Changes to wind and wave energy potential	Wind turbines and solar energy infrastructure damage	Decreased hydroelectric potential	Impact tidal energy systems	Cloudiness can affect solar PV
Energy Extraction	-	-	-	Damage to offshore oil and gas infrastructure	-	Impact on offshore oil and gas infrastructure	-
Energy Conversion	Less efficient thermal generation				Reduced cooling water availability	Damage to coastal power stations and refineries	
Energy Transmission	Lower capacity of power lines			Damage to power lines and fuel pipelines			

Source: Adapted from IPCC (2011; 2014)

electricity for productive purposes, the majority of studies agree on the existence of a positive correlation between electricity consumption and firm productivity.

However, the importance of energy as a bottleneck to economic development and of the impact of electrification on productivity has been mixed in the literature. Fan et al. (1999) show that, in India, agricultural research and rural transport infrastructure have a higher impact on agricultural growth than electrification. Fan and Zhang (2002) find similar results for agricultural productivity in China, while Fan et al. (2004) show that, in Thailand, energy supply has the second largest productivity impact after agricultural research. Allcott et al. (2014) show how electricity shortages affect manufacturing productivity in India, a country where poor energy infrastructure is a cause for endemic blackouts. The study finds electricity shortages affect all Indian manufacturers and reduce average revenues by 5% and, not surprisingly, they tend to have a greater negative effect on companies that do not have backup power generation than on companies that have access to their own generative capacity. Fisher-Vaden et al. (2008) provide a similar analysis for China, showing manufacturing companies have reallocated resources away from electricity-intensive uses into alternative uses by changing labour practices and materials used, as well as moving away from electricity to other sources of energy.

Overall, climate change is likely to affect private sector activities and growth through impacts on their supply systems. Reduced supply will likely lower productivity revenues and profits, decreasing specific production or productive systems' resilience.

However, the impact will largely depend on the energy intensity of the productive system. Smallholder farmers, for example, are likely to feel the impact of reduced energy supply less than large manufacturing companies, with the impact on the latter also depending on their energy intensity. Research on energy use in ASALs is extremely limited; hence the real impacts can only be inferred through the use of other literature.

Box 3: Water–energy nexus in ASALs

Existing stresses on water availability resulting from the physical dynamics of energy production are exacerbated by the inherent lack of water in ASALs. This means there are two main factors in play when looking at water and energy production in water-scarce regions. The first is the issue of water allocation, as energy production competes with other sectors for scarce water supplies, which often results in steep opportunity costs either through reduced energy production or through reduced water consumption in other sectors and associated reductions in production. The second factor is the fact that ASALs are prone to droughts. Competition for water between different users increases at the expense of users who have legal claims to water, hence droughts can also significantly reduce the availability of energy as thermal plants cannot operate effectively and hydroelectric plants produce less (or no) energy (Hewlett Foundation, 2003).

Transport and climate change

Poor road infrastructure already limits market access in ASALs. Such infrastructure can be susceptible to the impacts of climate change. Changes in precipitation levels can lead to increases in road and infrastructure maintenance levels as well as potentially destroying whole tracts of road and rail; there could be demand for cooling in vehicles from higher temperatures and increased risks to road safety because of infrastructure problems and natural disasters, as well as increasingly unreliable passenger and freight services owing to weather events and delays arising as a result of infrastructure issues (CJBS et al., n.d.).

There are also considerable opportunities for firms from the transport sector – for example to improve the energy efficiency of vehicles. However, such investments are costly, and considering the constraints to investment previously highlighted, it is currently unlikely that firms in ASALs will be able to directly engage in this.

Increased heat levels can lead to a softening of road surfaces and expansion of railway tracks, thus decreasing their durability and viability. For coastal area ASALs, rising sea levels can pose a significant threat to transport infrastructure while rural areas may see decreased market access owing to the degradation of already limited transport infrastructure.

This is especially the case for unpaved roads, which are particularly susceptible to climate change impacts. Flooding also damages roads and railway infrastructure, and causes severe damage to vital transport infrastructure such as bridges, in turn reducing accessibility (IPCC, 2014). This is especially where there are no transport system redundancies that can be used when particular segments are inoperable (TRC, 2008).

Impacts on the quality of infrastructure can also have a negative knock-on environmental effect. If extreme weather, either droughts or heavy rainfall, ruins existing roads making them impractical, drivers may choose to create their own driving paths, which in ASALs negatively affect the already fragile local environment. The problem is reinforced when land tenure is not effectively enforced, leading to the liberal use of otherwise potentially productive terrain as ad hoc roads (Keshkamat et al., 2011).

Overall, the literature shows climate change will have an impact on transport infrastructure, with the impacts on road (and potentially railways) having the greatest effect on firms in ASALs. Enterprises can expect already limited transport systems to further degrade, further compounding their access to market constraints.

Table 5: Expected impacts on transport owing to climate change

Sector	Temperature	Extreme Events	Water Availability	Sea level Rise	Other
Transport Infrastructure	Road softening due to increased heat	Damage to roads, railways and bridges	-	Damage to coastal infrastructure	
Transport Operations	Increased road maintenance costs and increased air conditioning use in vehicles	Impact on safety and reliability of operations	Decreased capacity for inland navigation	-	Changes in movement of agricultural products and settlement patterns

Source: Adapted from IPCC (2011; 2014)

3. Climate change impact on productive assets and the institutional environment

Institutions and legal frameworks can impact and likewise also be affected by the effects of climate change. Climatic impacts can affect the productivity of land, either positively or negatively, which means regulations and policies such as on land rights and land use management can affect access to more or less productive land and increase resilience against climate change impacts (Bockel et al., 2011). Incentives can also play an indirect role as they can either incentivise or disincentivise companies to invest in ASALs. They can also be used to control how private entities use natural resources, especially in a situation of increased scarcity and competition for resources, and in particular water, owing to the impacts of climate change.

Regulation is also important in order to mitigate climate change impacts on water. It addresses usage and demand by the private sector as well as other users and particular households, in order to mitigate declining water availability (AWC, 2009). Institutional capacity is fundamental in the context of ASAL resource management (Reij and Steed, 2008).

Institutional measures can support the use of innovative production mechanisms such as less water-intensive agricultural techniques that are likely to increase resilience to climate change. In addition, effective institutions can help maintain vital transport infrastructure: in Zimbabwe, ineffective institutions were blamed for degradation in infrastructure, which was further impacted by climate change (Brown et al., 2012). Such regulations require institutions that can manage the impacts of climate change and are flexible enough to respond to these impacts when they occur (AWC, 2009). Institutional strength is also important in institutions they can bolster partnerships between the public and private sector. Such partnerships can play a role in the development of ASAL value chains (Sharma et al., 2013).

Box 4: Water scarcity and institutions

Changes to water policy, such as stricter regulatory regimes or changes in water tariffs and liability laws governing water pollution and contamination, can increase operating costs and potentially negatively impact business operations. Ineffective water management systems and institutions contribute to water risks through the mismanagement of water resources, ineffective political allocation of water resources and inefficient monitoring and regulation of water use and allocation rights (SIDA, 2005).

Therefore, while regulations can have a cost of implementation for the private sector, they can also be beneficial to private sector activities as they provide a framework for the use of resources and thereby increase the level of knowledge and reduce risks for companies. For instance, regulations can reduce companies' reputational risk arising from competition between production process water consumption and households' consumption or pollution or secure their access to resources.

Land use can be a fundamental part of a firm's operation, either directly or through its suppliers in the value chain. Decreasing levels of land access have been exacerbated by increased levels of land degradation resulting from the impacts of climate change. Increased climate volatility will likely cause a decrease in the availability of arable land in Africa, with predicted declines of 9-20% in the levels of viable arable land for production by 2080 (FAO, 2008).

Land use management regulations and land management policies can influence the level of impact of climate change on land as well as the availability of natural resources. For example, promoting reforestation on arable land or even shifting from one type of crop to another can change the availability of water (Montenegro and Ragab, 2012) or the effect of policy aiming to limit land access for pastoralism in ASALs (i.e. reducing their mobility), degrading land (ICTSD, 2007) that may already be negatively affected by climate change.

The negative impacts of climate change, such as reduced agricultural productivity, coastal flooding and extreme weather events, may spur people living in already precarious situations to migrate towards less vulnerable regions (Brown, 2008). Such migrations would, potentially affect the private sector in ASALs, through reductions in the availability of labour as well as decreasing demand. Policy can help maintain populations in ASALs through the encouragement of rural investment or by encouraging seasonal migration between urban and rural areas (Raleigh et al., 2008).

Part C
Private sector strategies for adaptation and resilience

Ear of rice © TommyIX

"How do enterprises respond to the risks that climate change poses?"

1. Drivers of private sector adaptation

The previous sections have highlighted the general risks for business that climate change poses. The following provides an overview of how enterprises respond to such risks. Table 6 provides an overview of climate change risks by type of company – that is, companies that produce goods, those that produce goods and services and those that specialise in services – as well as a comparison of risks in different economic sectors, showing broad similarities of risk across the different categories. So how do companies respond to these risks?

Before looking at potential firm adaptation strategies, it is also useful to assess what other drivers spur enterprises to adapt to climate change. A report by Acclimatise (2009) attempts to categorise and understand the drivers that spur firms into taking action in order to adapt to climate change impacts.

Table 6: Climate change risks by sector

Goods producing sectors	**Manufacturers**	**Physical risks** – Disruption to operations due to extreme weather events; Damage to infrastructure; Restrictions to production due to rising temperature; variations in water quality and in water availability
	Agriculture and mining businesses	**Physical risks** – Extreme weather events increase physical risks to business operations; Risk of overflow of storage due to increased rainfall; Resource extraction could be limited by sea level and water availability **Supply chain and raw material risks** – Water scarcity affects production **Product demand risks** – Changes in quality, quantity and type of agricultural products **Logistics risks** – Risks to the transport corridors and transport hubs from where raw materials are processed and exported.
Goods and services providing sectors	**Retailers and distributors**	**Physical risks** – Damage to products during transportation due to extreme events **Supply chain and raw material risks** – Interruption, inefficiency or delays in supply chain; Difficulties with water scarcity and increased flat prices **Reputational risks** – Decrease in product quality affecting reputation and consumers' satisfaction
	Transportation	**Physical risks** – Extreme weather events causing delays, supply disruptions and losses of goods; Access to transport routes affected by flooding, permafrost thawing and mass movement, subsidence due to drought
	Utilities	**Physical risks** – Disruptions of supply due to flooding or extreme events; Business interruption due to extreme weather **Supply chain and raw materials risks** – Reduced output due to water scarcity impacting hydropower and power plants using a thermal plant cooling system **Product demand risks** – Demand effects due to temperature changes **Regulatory risks** – Increasing pressure to conserve water in water scarce areas.
Services providing sectors	**Financial businesses**	**Financial risks** – Risks in investment portfolio where investments are made in areas with climate vulnerabilities; Increased risk of customer default
	Information businesses	**Physical risks** – Disruptions of operations due to extreme weather events; Difficulties in transportation
	Real estate businesses	**Physical risks** – Delays and disruptions in construction projects; Damage to buildings and drainage problems; Additional costs due to temperature changes increasing cooling loads **Regulatory risks** – Changes in building and design requirements **Financial risks** – Loss of value due to climate change impacts
	Other service businesses	**Product demand risks** – Tourism industry affected in its infrastructure and by changes in tourism demands caused by different climatic conditions

Source: Agrawala et al. (2013)

Regulatory and legal drivers: Changes in the rules and regulations (in support of climate change) that govern enterprise functions can be an impetus for enterprises to alter their activities, either to conform to existing legal regulations or to allow companies to operate in other markets with tighter climate regulation. Companies can also choose to prepare for any future changes; those that do not take timely adequate action may risk 'late' adaptation costs (as they are forced to comply) or may lose their licence to operate in particular markets. Examples of business responses to climate change regulation from Canada and Germany (Eberlein and Matten, 2009) show that, where government strictly mandates regulation, there is less space for voluntary responses by enterprises, but the process to set these regulations often involves enterprises (or their representatives) throughout all its stages.

Cost drivers: Operational costs will change – in part because of external factors such as responses to actions taken by external actors (other companies, government or company stakeholders). Internal factors such as changes to energy and water supply for enterprise operations, changes in commodity prices owing to the impacts of climate change, disruptions in the supply chain, etc. can also alter costs. Where companies deem these changes to be detrimental, they will implement adaptation actions that will counteract these costs.

Box 5: Adapting to compete

Climate change adaptation strategies that focus on energy and resource efficiency can be a source of competitive advantage for firms that implement them. These advantages include:

- Improved product efficiency;
- Improved natural capital management;
- Signalling that the firm implements sustainability practices, increasing access to markets and potentially increasing market share;
- Adhering to international mitigation practices and increasing competitiveness against firms that do not adapt.

Source: Ellis et al. (2013)

Market drivers: Future changes to customer needs and behaviours may alter the viability of products and services firms offer. While some sectors vulnerable to climate change might become non-viable, or become in need of deep and sometimes costly processes of restructuring, new market demand can appear or be created, hence the opportunity to develop new sector or activities. Therefore, climate change can also be an opportunity and provide an impetus to shift away from vulnerable sectors or production systems and technologies. In agriculture, for instance, firms might invest in new drought-resistant seeds and crops. Changes in incentives (e.g. declining costs of production technology leading to mass production; lack of energy access in remote rural areas) may also allow for the adoption and development of markets for new technologies, for instance solar lanterns.

Companies need also to understand the impact of climate change on unstable economic and social environments within vulnerable countries in order to be able to assess the direct and indirect impacts of climate change on these markets. Those companies that are able to increase climate resilience and appear to be more sensitive to climate change issues could gain a competitive advantage over companies that do not.

Stakeholders: Enterprise stakeholders, including investors, suppliers, government, local communities and non-governmental organisations (NGOs) will place pressure on firms to implement climate change adaptation strategies, both to address potential risks and to embrace new market opportunities as they become more aware of these risks and opportunities. There may also be stakeholders with vested interests in not adapting to climate change, such as suppliers who rely on highly polluting or resource-intensive production processes, who may see operational costs increase (or market shares decline) through the adaptation of such strategies (Ellis et al., 2013).

Governance and management: The accumulated effects of the above drivers will lead to increased pressure on enterprises (by government and other stakeholders, such as investors) to show their governance and management structures are capable of implementing climate change adaptation strategies.

Box 6: Stakeholders and firm adaptation in India

A study carried out on Indian firms suggests companies prioritise stakeholder expectations dependant on their location, geographical spread, the industry the firm operates in and the degree of product diversification the company is involved in. For example, manufacturing company stakeholders believe (to a greater extent than in other sectors) companies within the industry should implement practices of adaptation to climate change. Similarly, there is greater pressure by stakeholders on companies with limited vertical integration (i.e. depending on external resource suppliers or distributors) vis-à-vis more vertically integrated enterprises. The results suggest stakeholder pressure varies according to the perception of stakeholders as well as their requirements – that is, stakeholders who perceive a firm to be in a climate change-sensitive sector or stakeholders (such as suppliers) who would benefit from climate adaptation strategies across the value chain.

Source: Prasad and Sri (2008)

Agricultural production in semi-arid regions in Tanzania
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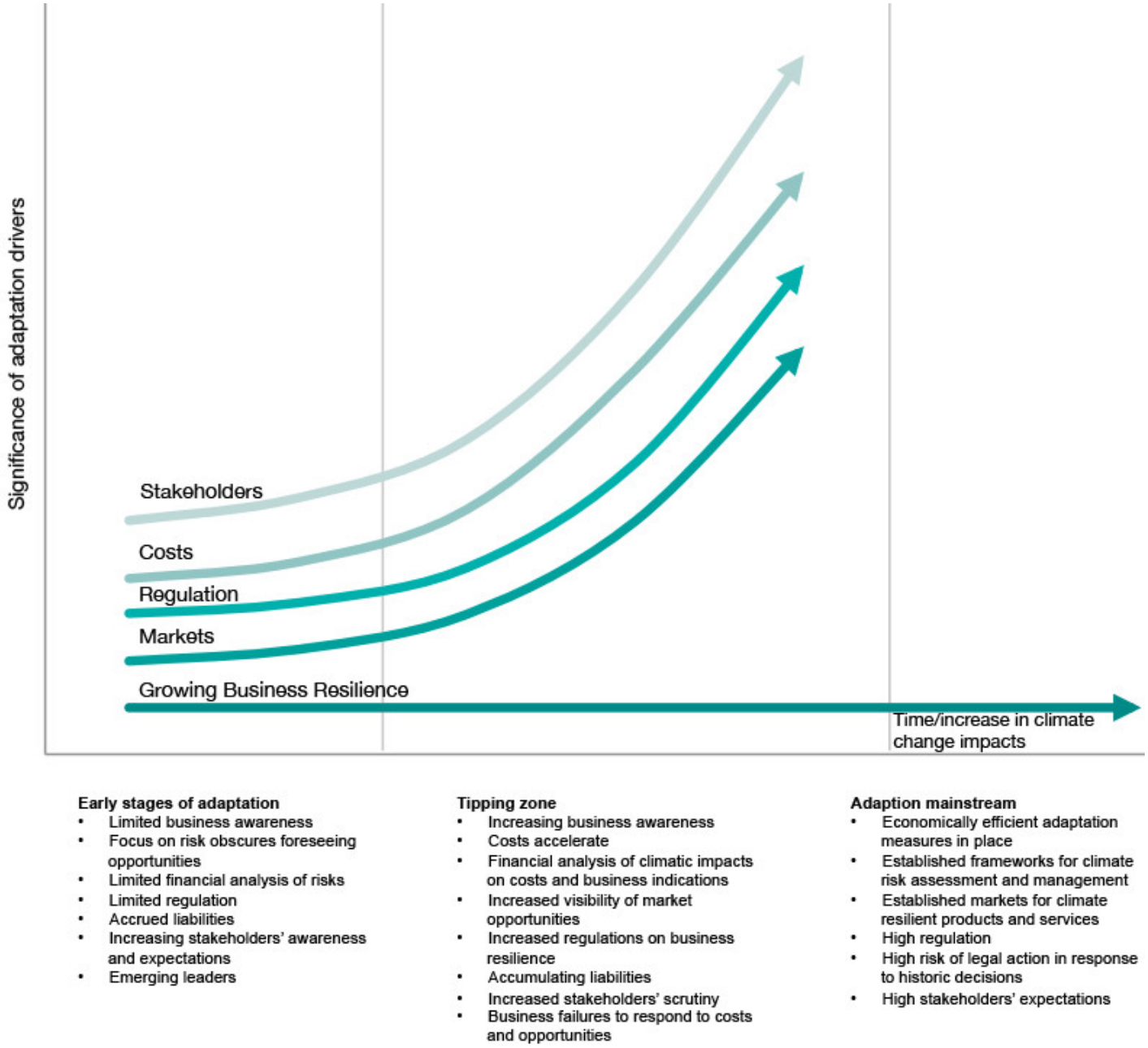
Figure 8 shows how the pressures from these drivers change over time. For example, increasing enterprise resilience and implementing climate change adaptation strategies will become more mainstream as information systems improve, understandings of risk grow, regulatory systems are put in place, costs of non-compliance climb, greater opportunities from adaptation are identified, etc. This essentially means that, as time passes, firms will (or should) increasingly adapt their operations to become more resilient.

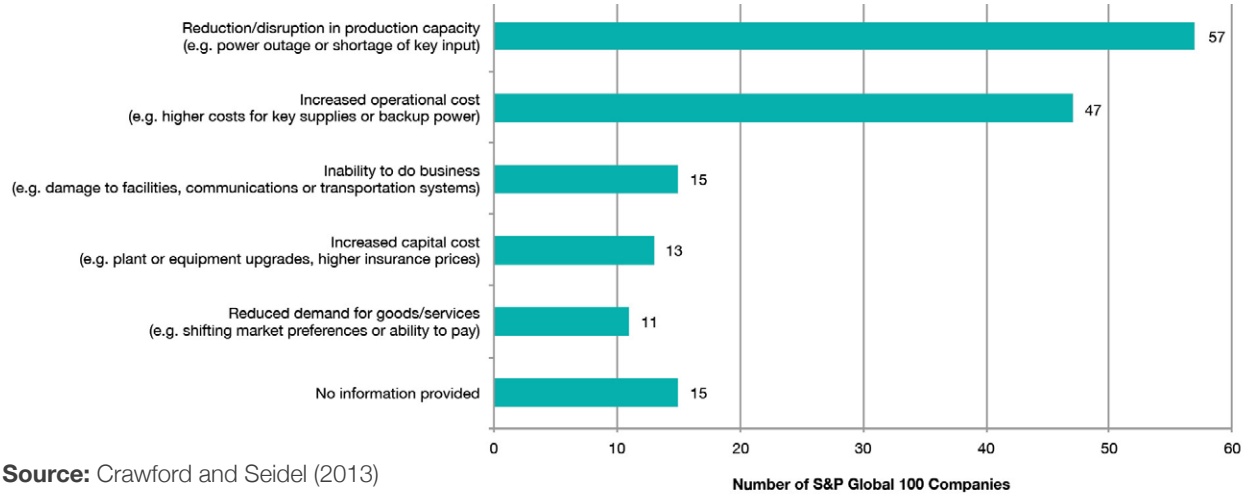
A recent report looking at the adaptation drivers and responses by Global S&P 100 (Crawford and Seidel, 2013) shows the most important drivers (Figure 9) of adaptation action are the risk of disruptions to productive capacity and increases in operational costs (see Figure 9 for the top five expected climate impacts on enterprises).

Figure 9: Shifting impetus for enterprises to adapt to climate change



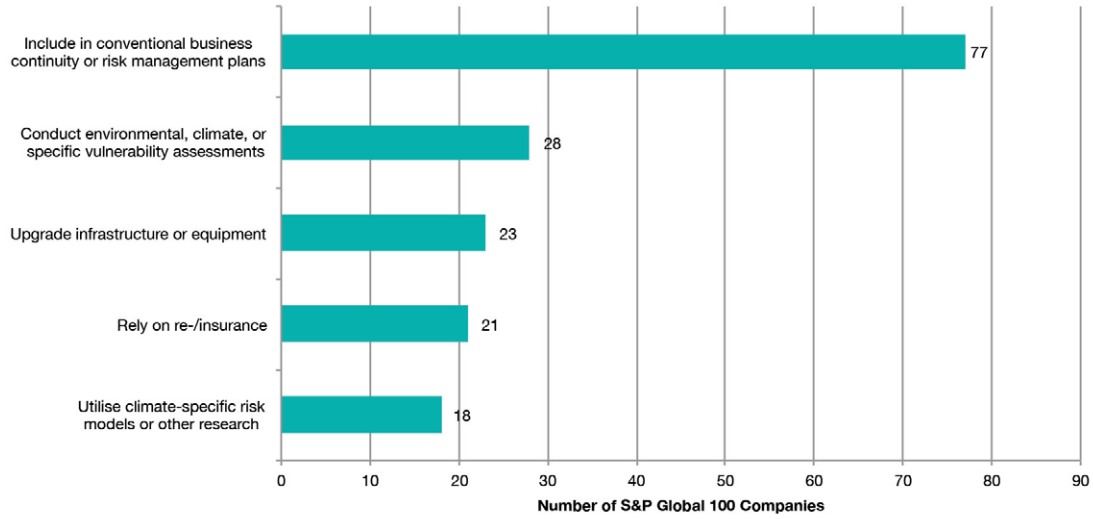
Source: Acclimatise (2009)

Figure 10: Top 5 climate change expected impacts for companies



Source: Crawford and Seidel (2013)

Figure 11: Top five climate risk management activities



Source: Crawford and Seidel (2013)

The major responses have thus been to include climate change adaptation strategies in enterprise business and risk plans and (to a lesser extent) carry out operational risk assessments (see Table 7 for some examples).

Table 7: Examples of risk management plans to address climate change impacts

Company	Risk Management Plan
BBVA	128 Business continuity plans implemented in 25 operational countries. Plans are aimed at ensuring that operations are prepared for any potential activity interruption due to extreme weather events caused by climate change.
Bayer	Flexible production system to ensure operational safety and continuity as well as continue to serve customers even in case of emergencies. The company's global manufacturing and supply chain allowing them to shift products amongst different sites in the event of negative climate impacts.
BP	BP uses an operating management system that incorporates environmental and social practices required in order to assess the potential impacts of climate change related events.
ABB	The company uses a comprehensive enterprise risk management process which addresses potential climate risks. The process considers risks such as heavy precipitation, floods, water availability and disease outbreaks.

Source: Crawford and Seidel (2013)

Including climate change adaptation – especially in terms of climate risks – into existing corporate risk evaluation strategies may seem an effective method of using existing company resources and can help companies prepare, by setting up alternative production or storage areas, etc. They may not be particularly effective, however, as companies are still suffering the negative impacts of climate change (see Table 8) as the plans cannot estimate the wide range (and severity) of impacts (Crawford and Seidel, 2013). In addition, even though firms may undertake climate risk evaluations, only a fifth of these actually follow through by implementing the required adaptation strategies (GEF, 2012).

Table 8: Examples of extreme weather impacts on enterprises (US$)

Sector	Company	Impact
Insurance	Munich RE	$350 million in claims from flooding in Australia (2010/11)
	The Hartford Group	$745 million in claims for natural catastrophes in 2011
Manufacturing	Dow Chemical Company	$181 million increase in operation costs due to Hurricane Gustav (2008)
	Honda	$250 million loss due to floods in Thailand (2011)
	HP	7% revenue decline due to floods in Thailand (2011)
	Holcim	$8.2 million costs for flooding in Thailand and Australia (2012)
Utilities	Constellation Energy	Reduction of $0.16 in share prices due to having to buy power at peak prices caused by surge in demand due to heat-wave in Texas (2011)
	Dominion Resources	Shut down operations at nuclear plant (US) in 2012 due to increase in water temperature due to heat-wave
Oil & Gas	Chevron	$1.4 billion loss due to Hurricanes Katrina & Rita (2005)
Mining	Anglo American	8% reduction in copper production due to increased rainfall in Chile (2011)
	Rio Tinto	$245 million loss in earnings due to the impacts of cyclones and flooding in Australia (2011)

Source: Crawford and Seidel (2013)

While the above studies were undertaken through analysis of FTSE 300 (Acclimatise, 2009) and S&P Global 100 (Crawford and Seidel, 2013) companies, the results are still applicable across multiple categories of firms, ranging from multinationals to SMEs (or even small family-owned and -run enterprises) operating in developing countries, as these are fundamental drivers that occur as a result of alterations to the operational environment within which firms work. Even the capacity to recognise the need and ability to respond to these changes is similar (at the most basic level) across all firm sizes – as a matter of available information, the foresight of enterprise 'managers' and the ability (and will) to make required changes – even though available resources (assets, money, skills, etc.) may vary between firms of different sizes.

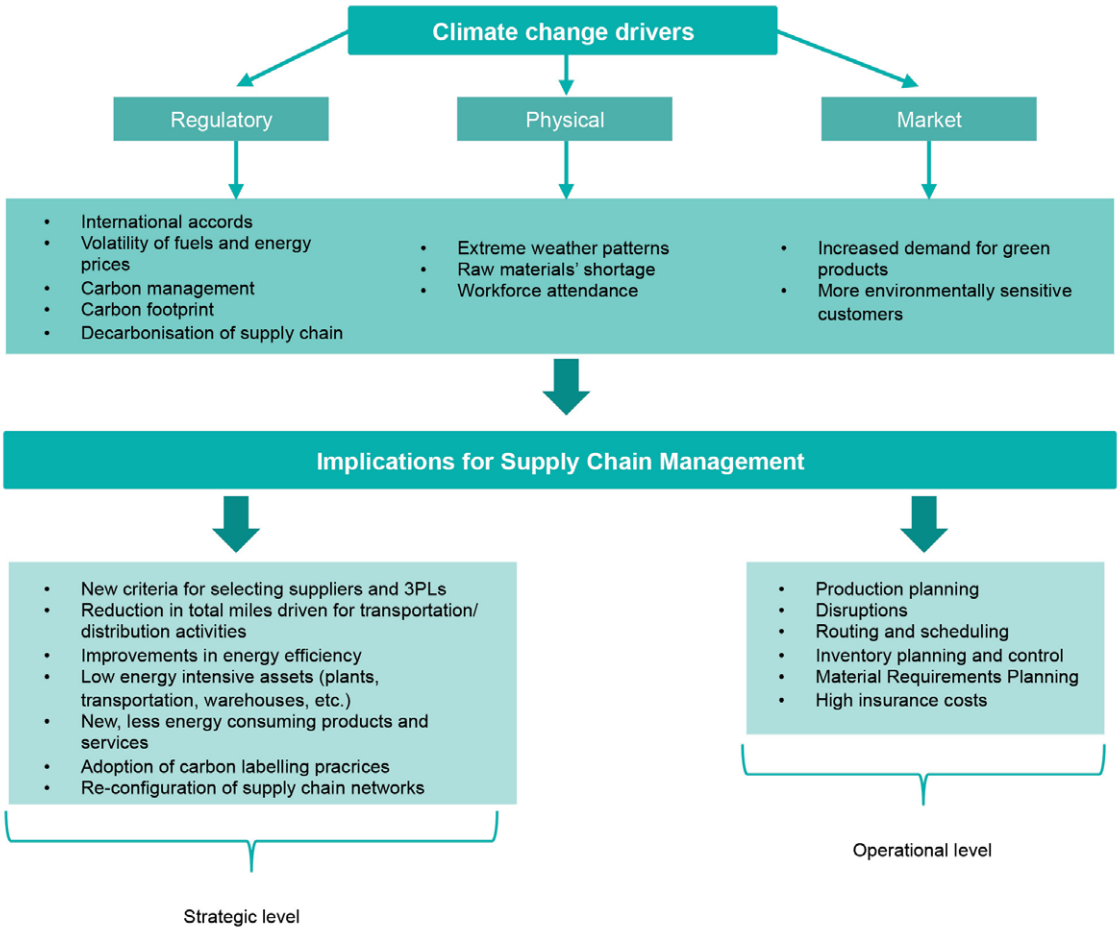
However, awareness of the vulnerabilities at firm level is not enough. Firms need to take into consideration potential weak links or highly vulnerable activity in their value chain and not focus their adaptation strategies by only looking at their own operation constraint, without placing them in a systemic and even holistic framework of analysis. As such, they should not only look at potential weaknesses in their value chain, at both the production but also the services and logistics level, but also to consider potential interactions between their operations and those of other economic and social actors, including potential competition over resources.

The drivers to adapt to the impacts of climate change will determine the adaptation strategies of companies throughout their supply chain at both the strategic and the operational level (Dasaklis and Pappis, 2013). This means companies need to take into account climatic impacts across all aspects of their supply chains (see Figure 12) – that is, from choice of suppliers to the transportation and logistical systems that link operations with and within the supply chain, production systems, energy systems in use, etc.

The impacts of climate change on supply chains can be bi-directional – that is, there are ripple effects both forward in a supply chain and backward (Hallegatte, 2014). The forward effects are when suppliers can no longer provide goods to their clients (because of extreme weather impacts), blocking production processes at the client end. Backward linkages are when clients no longer require supplier inputs, because of either disruptions in client productive capacity or changes in market demand caused by climatic impacts.

A report by Oxfam (2012) discusses climate change risks and supply chain management and finds that, quite often, larger companies at the end of a supply chain do not face the same risks as smaller producers at the beginning of a supply chain. That is, smallholder farmers face much larger climatic impacts than the companies they sell their goods to. While companies may be aware of the risks members of their supply chain face, there is limited risk assessment and coordinated action aimed at addressing these (Oxfam, 2012; PwC 2013).

Figure 12: Climate change drivers and implications for supply chain management



Source: Dasaklis and Pappis (2013)

2. Categorisation of the private sector adaptation strategies

Evidence from the literature looking at multinational companies

Kolk and Pinkse (2005) catalogue enterprise responses along six major categories (see Table 9). These categories place enterprise responses according to the type of adaptation response they are undertaking, ranging from the cautious planner firms to the various climate adaptation explorer categories. The categories highlight that companies have differing focuses in terms of their adaptations strategies. Some focus on their own internal operations, others on the wider supply chain.

Table 9: Enterprise adaptation typologies

Typology	Description
Cautious Planners	Such enterprises are preparing to undertake climate action, but are not engaged in implementing any adaptation measures, in effect they are considering adaptation actions.
Emergent Planners	Companies that have set up processes to develop comprehensive climate adaptation strategies. These companies are at the early stages of adaptation strategy implementation.
Internal Explorers	Strong internal focus using a combination of targets and improvements to production processes.
Vertical Explorers	Focus on adaptation measures within their supply chain as well as on their own internal strategies.
Horizontal Explorers	Focus on the exploration of adaptation strategies within markets that are outside of their own business operations, sometimes partnering with other organisations in order to achieve their goals.
Emission Traders	Firms which seek to indirectly mitigate carbon emission effects by buying or selling carbon credits from or to other companies.

Source: Kolk and Plinkse (2005)

Companies that operate across different levels face differing strategic choices in terms of their adaptation measures. Kolk and Pinkse (2005) divide these choices into two major aims: companies that are looking to innovate (changing their own technology and processes in order to adapt or mitigate) and those that are looking to compensate (i.e. rely on adaptation and mitigation processes within external companies). The firm's operational level (as described in the categorisation above) then determines which strategy it will implement. For example, a vertical explorer firm that wants to innovate will focus on product development while an internal explorer that wants its own processes to remain largely unaffected will resort to emission trading.

From a climate change adaptation/resilience-building perspective, some of these choices will not be feasible for all firms. For example, internal explorers may not be able to compensate through emission trading if their processes will be directly affected (e.g. by flooding). This means enterprises adapting to climate change will have to rely mainly on innovation measures mixed with supply chain measures in order to adapt to the impacts of climate change.

Figure 13: Choices vis-à-vis aims for firms

		Main Aim	
		Innovation	**Compensation**
Organisation	**Internal (company)**	Process Improvement (1)	Internal Transfer of Emission Reductions (2)
	Vertical (supply chain)	Product Development (3)	Supply-Chain Measures (4)
	Horizontal (beyond the supply chain)	New Product/Market Combinations (5)	Acquisition of Emission Credits (6)

Source: Kolk and Pinkse (2005)

Small-scale economic activities in semi-arid regions of Tanzania, including basket weaving, depend on access to markets
© Rajeshree Sisodia/PRISE

Agrawala et al. (2013) provide a less theoretical approach to firm adaptation strategies, citing six main adaptation (not mutually exclusive) strategies that enterprises can adopt (see Table 10), from the restoration of losses caused by climatic impacts to the prevention of negative effects.

Table 10: Enterprise adaptation strategies

Adaptation Strategy	Description
Preventing Losses	Taking action to reduce the company's exposure to climate impacts
Tolerating Losses	Accepting losses where it is not possible or is not cost effective to avoid them
Spreading or Sharing Losses	Distributing impact burden i.e. through insurance protection
Changing use or activity	Switching either the activity undertaken or the resources used in to those better suited to new environments
Changing Location	Moving operations to more suitable areas
Restoration	Restoring assets to original condition following damages

Source: Agrawala et al. (2013)

Table 11 highlights some examples of enterprise risk management strategies. As the examples show, these can be placed within the multiple adaptation strategy categories found in Table 10.

Table 11: Examples of enterprise risk management strategies

Risk Management Strategy	Enterprise Example
Modify Plans and Operations	Phillips – Established security team to develop/monitor business continuity plans and technical measures aimed at mitigating physical climate risks. Shell - Uses advisors to assess future climate conditions in new projects. BASF – Developed contingency plans to minimise river flooding impacts on operations.
Strengthen/Relocate Infrastructure and Facilities	American Water – Construction of a water treatment plant to improve water supply in operation regions. EMC - Built data centres in non-vulnerable regions Colgate – Closed manufacturing sites that were increasingly exposed to severe weather impacts and relocated them to less vulnerable regions.
Address Supply Volatility	3M – Identified existing operation sites in water-stressed areas and requires that they undertake a sustainable water management and water risk assessment conservation plan. General Motors – Reduced water intensity use in global operations by 15% as well as investing in water treatment plants in areas of water shortage.
Manage Risks Within Supply Chains	PepsiCo – installed water saving systems in certain operational areas and explored the use of drip irrigation systems in order to reduce water usage by their agricultural suppliers.
Expand or Adjust Insurance Cover	Kimberly-Clark – Purchased insurance in order to reduce severe weather risks

Source: Crawford and Seidel (2013)

These strategies can also be aggregated into three types of responses towards climate risk management: implementation of hard adaptation measures, implementation of soft (or 'no regrets') measures and no adaptation action at all.

No adaptation: The decision not to implement climate risk mitigation measures is typically based on risk assessments that may result in the discovery (either correctly or incorrectly) that enterprises may not be susceptible to climate change impacts. Carrying out risk assessments does mean such companies are aware of climate change risks, which could mean they may change their adaptation strategies should future assessments highlight potential risks to operations.

'No regrets'/soft adaptation: Such measures (which Agrawala et al., 2013 find to be in the majority) typically deal with current climate variability concerns or are measures that can be beneficial to enterprise operations with the added benefit of making them more resilient towards climate risks.

Hard adaptation: Some companies take 'greater' action (i.e. larger investments and greater adjustments to production processes) in terms of adaptation. The majority of such companies are those in industrial sectors that are reliant on long-term fixed assets (Agrawala et al., 2013). Long-term reliance on particular resources means enterprises are particularly susceptible to shocks that may alter their availability of such resources, hence they have greater incentives to ensure long-run operations are not disrupted.

SMEs' capacity to adapt to climate change

So far, this section has looked at the capacity for larger firms to adapt to climate change impacts. Within ASALs, especially those in developing countries, the private sector is concentrated mainly in MSMEs, which account for 70-80% of jobs in Africa, for example (Business Action for Africa, 2010). The majority of micro-enterprises in ASALs are individual and family farms, which have been extensively studied in relation to their vulnerability and constraints on adaptation to climate change. However, micro-enterprises are usually part of subsistence strategies, and their scope as engines of economic growth in ASALs is limited, in large part because of their limited assets and their difficulties in accessing markets owing to remoteness (e.g. Dercon, 2006). By contrast, the role of SMEs in the economic growth of ASALs is less well studied, as is their capacity to adapt to climate change.

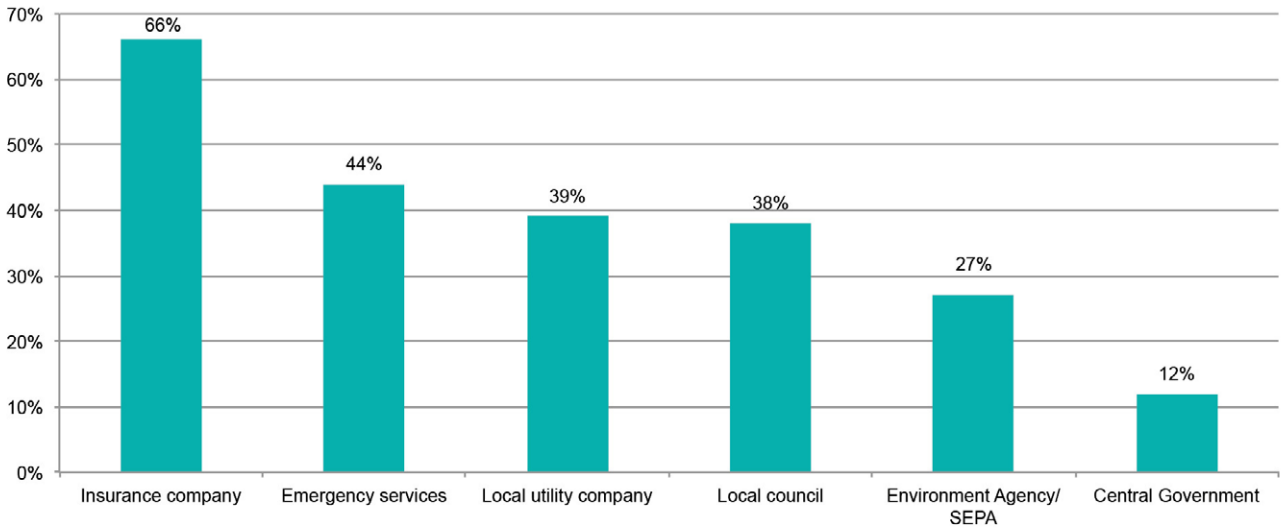
The CCC (2006) states that the main risks from climate change to SMEs take the form of increased costs and reduced revenues through threats to physical assets and increased costs from compliance with climate change adaptation and mitigation regulations. These, then, are largely similar to the risks and drivers highlighted in the sections above. Where SMEs are an important part of a national (or local) economy, these impacts (and associated drivers to adapt) can be important in terms of the overall economic effects of climate change. Where SMEs use out-dated production systems and have limited awareness of the effects of climate, or are in areas where there is insufficient infrastructure

A flooded willow tree next to the River Nene, UK. © Andy B

to shelter firms from climate impacts, they can be particularly vulnerable. On the other hand, the smaller size of SMEs (vis-à-vis multinational companies) means they can implement adaptation practices quicker than large firms and also be more innovative (Vivid Economic, 2006), and can also assure their survival in the face of climatic impacts (GIZ, 2013).

Crichton (2006) highlights the impact of climate change on SMEs (mainly through flood risks) in the UK, stating that most small firms do not receive adequate assistance from government with regard to the impacts of climate change, with more channelled to domestic households. Using a survey targeted at SMEs, the paper shows that UK SMEs found insurance companies were the most useful source of assistance to recover from the impacts of climate change-related extreme weather events such as flooding. This finding, though limited to UK firms, provides an indication of how business services can provide adaptation avenues to smaller enterprises that may not otherwise have the necessary resources to do so.

Figure 14: Main source of assistance to SMEs affected by severe weather events in the UK (% of respondents)



Source: Crichton (2006)

Table 12 highlights the requirements for small firms to be able to adapt to climatic impacts. It shows the capacity of SMEs to adapt is based on five key characteristics: the firm's asset base (the capacity to use its pre-existing assets to adapt to impacts); the institutional environment it operates in (and its capacity to shape access to adaptation capital and assets); the information available to a firm (that can allow it to respond adequately to climate change); the capacity for it to innovate; and the flexibility of SME governance systems (which can determine how quickly or well SMEs can adapt).

Table 12: Small firm capacity to adapt

Adaptive capacity at the local level	
Characteristic	**Features that reflect a high adaptive capacity**
Asset base	Availability of key assets that allow the system to respond to evolving circumstances
Institutions and entitlements	Existence of an appropriate and evolving institutional environment that allows fair access and entitlement to key assets and capitals
Knowledge and information	The system has the ability to collect, analyse and disseminate knowledge and information in support of adaption activities
Innovation	The system creates an enabling environment to foster innovation, experimentation and the ability to explore niche solutions in order to take advantage of new opportunities
Flexible forward-looking decision-making and governance	The system is able to anticipate, incorporate and respond to changes with regards to its governance structures and future planning

Source: Frank and Buckley (2012)

3. Barriers to private sector adaptation

Understanding the adaptation strategies of firms is only one aspect of the discussion; the other important aspect is to understand what prevents firms from adapting to climate change. The potential barriers to adaptation are as follows.

Lack of reliable climate projections: Limited information and awareness on climate-related risks reduce the incentive for firms to adapt. While long-term global or regional information on the potential impacts of climate change can provide a wide view of potential risks, firms operate on the local level, hence they require localised information on medium- to short-term impacts in order to correctly assess impacts on their own operations (GEF, 2012).

Limited information: While larger enterprises may have the resources to conduct detailed assessments of impacts on their supply chains, smaller firms rely on public source of information, which may not always be available. Companies in countries where information is tightly regulated by the government, or in developing countries where information systems may be incomplete, are especially limited in terms of access to information (GEF, 2012).

Limited financial and human capacity: Firms may not have the financial capacity to implement adaptation measures, even if in the long run the benefits financially outweigh the costs. In addition, there may be limited expertise to identify and implement adaptation measures (Agrawala et al., 2013; UNGC, 2011).

Limited awareness: Companies affected by climate change-related shocks have a different perspective on the potential impacts compared with those that until now have never experienced any. Limited experience of managing climate impacts can reduce firm incentives to implement adaptation measures, thereby increasing their vulnerability, especially for firms evolving in areas which historically not extreme weather shock prone did not realise that the climatic shifts would affect them (Agrawala et al., 2013).

Lack of incentives: Firms may also decide there are limited incentives to adapt. For example, where enterprises have spare capacity or are able easily to move operations (i.e. where there is greater operational flexibility), they may decide either to absorb losses or to alter production facilities, dependant on impacts. The policy and regulatory environment plays an important role in stimulating firm adaptation, by either encouraging or requiring adaptive measures (Agrawala et al., 2011), although they can also hinder implementation where they do not facilitate adaptation processes or where they do not properly allocate natural resources (UNGC, 2011).

Box 7: Accounting for uncertainty

There are a number of different ways to account for climate uncertainty in decision-making processes. These methods include Adaptive Management (where modifiable strategies are chosen that can be adapted as more information is gained), Scenario Planning (multiple plausible scenarios are formulated, their implementation dependent on the achievement of real world conditions) and Resilient Strategies (where possible future circumstances are identified and strategies that could work well across all the circumstances are implemented).

Source: http://climate-adapt.eea.europa.eu/uncertainty-guidance/topic2

Drone amongst worker bees
© NinaHenry

Risk and uncertainty: Uncertainty is a particularly problematic issue for businesses that want to plan in the long term. On the one hand, uncertainty means businesses can set aside adaptation planning for a perceived future where more information 'may' be available (Sussman and Freed, 2008). On the other, uncertainty also means companies do not know what adaptation measures they should be implementing (Agrawala et al., 2013).

Short- vs. long-term horizons: The business planning horizons of some companies may be too short to feasibly include the medium- to long-term impacts of climate change (Agrawala et al., 2013). In addition, many adaptive investments usually see their benefits realised on a 20-30-year horizon, which may be too long for firms (especially smaller ones) where immediate cash flows are more important to operations than long-term impacts (UNGC, 2011).

Private cost vs. public benefit: Certain companies may be averse to sharing the benefits of their adaptation and sustainability investments with third parties that had no role in the investment where such investments would result in some kind of public good. This issue stems from a limited understanding of the direct and indirect impacts and benefits from more climate-resilient communities to private sector operations (UNGC, 2011).

Undervaluation of natural resources: Not all ecosystem services are properly accounted for by the private sector within their operational accounting procedures; this means ecosystem services (preservation of natural resources and environments) that may be affected by the effects of climate change are either not valued or undervalued. This means sustainability measures are not implemented, leading to a detrimental overuse of the resource in the long run (UNGC, 2011).

Part D
Conclusion and research gaps

This thematic review has attempted to provide an overview of private sector development challenges and adaptation strategies in a world of climate change. An overview of the literature shows a scarcity of information on ASALs, mainly because such areas are often rural, with pastoral and agro-pastoral systems and a poorly developed formal private sector. However, increasing urbanisation may change the dynamics of such areas.

Therefore, this review has assessed the literature at a broader scale but focuses on ASAL-specific issues whenever possible. It first looked at general and climate change-specific constraints, both at firm level but also in three transversal sectors of particular importance in ASALs. Then it analysed the range of private sector adaptation strategies and constraints to adaptation. Although the literature provides evidence mostly at the multinational level, this overview tries to identify concerns specific to SMEs.

- There are multiple constraints affecting the private sector in developing countries. These affect the investment climate companies operate in and limit their capacity to grow. In developing countries, the most important constraints are access to finance and access to energy. Other constraints entail the state of the business enabling environment encompassing the regulatory, tax and policy regime governing private sector activities; infrastructure; and the need for macroeconomic as well as political and social stability, including the rate of crime and corruption within the country.

- ASAL-specific constraints are similar to the more general developing country constraints; however, there is greater emphasis on access to markets and on transport infrastructure. Firms in ASALs have limited market access given their remote location and poor transport infrastructure, impeding companies from effectively trading in other parts of their country or exporting regionally or internationally.

- The effectiveness of ASAL firms is further impeded by limited access to finance and a lack of business and business development services that can help firms add value to their products. Policy disconnects reduce the capacity to improve production in ASALs, as policies intended for less water-scarce regions are not relevant to ASALs.

- Firms strongly believe climate change will impact the private sector. Global private sector surveys show companies are concerned about the operational impacts of climate change in particular, including potential disruptions to production systems and associated supply chains through changes in production capabilities, or loss of capital because of the destruction of infrastructure and access to natural resources such as water because of extreme weather events.

- Water scarcity will likely increase as a result of climate change. Firms will face a number of operational risks, such as reduced quantity and quality of water and increased competition for water resources, which will likely ultimately lead to interruptions in enterprise supply chains and reductions in productive capacity.

- Energy security will likely decline as a result of climate change. Decreased water availability will reduce hydroelectricity as well as decreasing the efficiency of thermal power plants. Sea level rises and extreme weather effects can damage energy infrastructure. Both issues will lead to decreased energy supply in situations where energy is already limited. Studies show limited access to energy generally inhibits firm growth, although this is largely dependent on the sector and energy intensity of enterprises.

- The impacts of climate change on transportation systems such as roads and railways will likely result in degraded transport systems as such hard infrastructure is damaged by increased heat and the effects of extreme weather events. Degraded transportation systems will likely lead to further decrease market access, which, in turn, will limit the capacity to grow of ASAL firms.

- The degree of impact of climate change on private sector activities and value chains will also be affected by the business environment, the institutional and legal setup and the regulatory systems they promote. Policies and institutions determine access to land, infrastructure and natural resources; incentivise changes in production; and channel production towards specific goods. Combined with the impacts of climate change, the effects can be either beneficial or detrimental depending on the strength, capabilities and flexibility of their governing institutions.

- Firms need to take into consideration potential weak links or highly vulnerable activity in their value chain and should consider their choice of adaptation strategy taking into account their operations as part of a systemic framework.

- Firms should also consider their operations in a more holistic way with, for instance, potential competition over resources with other economic actors.

- Existing drivers for adaptation fall into multiple categories, including the need to protect assets or respond to potential shocks or gradual changes in supply chains and the regulatory environment. Responses to these drivers are shaped by individual enterprise concerns and requirements but can vary depending on their outlook. Firms operating in the short run will be more interested in protecting existing processes; forward-looking firms will likely invest in transformative shifts in their operations.

The literature has thus highlighted some potential impacts on enterprises operating in ASALs. There are, however, still a large number of research gaps that could be further explored, including:

- Bolstering research on the constraints for manufacturing and service sector companies in ASALs and the interface with climate change impacts is needed. Research on the operations and constraints of manufacturing and service sector companies within ASAL regions is close to non-existent: current research focuses almost exclusively on the primary industry, with most of its attention on the agriculture and livestock sectors as well as some limited research on mining. A few analyses also look at tourism.

- Because of the nature of economic activity in ASALs, as well as the fact that ASAL regions often cover only part of a country's surface, research on private sector development, market access and use of productive resources focuses mostly on the agriculture sector. Therefore, we have not been able to identify a strong body of research focusing on off-farm private sector development in the context of climate change in ASALs.

Further research could look at:

– Energy and water requirements for non-agricultural firms in ASALs and the impact of climate change on energy supply;

– Barriers to accessing markets and to productive resources for manufacturing and service sector firms operating in ASALs.

- Value addition of goods for both agricultural and non-agricultural firms is an important step to enhance growth and resilience; however, research on value addition in ASALs is limited. There is scope to further conduct research on the potential to incorporate value addition processes in ASAL regions, given pre-existing transport constraints (and associated costs) and the potential impacts of climate change on transport infrastructure.

- What are the strategies for the supply of inputs and production according to identified constraints (local, imports, vertical integration, etc.)? How do climate change trends and increasing shock affect these strategies?

- What are the available adaptation strategies in ASALs according to the institutional environment and the opportunity costs of alternative strategies (e.g. change of supply with product/ suppliers substitution, change in technology, change of production site, etc.)? Who are the winners and losers?

- Will there be coordination failure in value chains, resulting in increasing resource degradation? Will there be competition over resources and 'resource grab' behaviour?

- Does the way the value chain is organised, from satellite to vertical integration, have impacts in terms of resilience and the adoption of sustainable use of resources?

- Can vertical and horizontal coordination increase resilience? For instance, can economies of agglomeration reduce the sunk costs involved in adopting new resource management and use of resources, or is agglomeration leading to congestion, with overuse of scarce resources, competition over resources and potential resource grab behaviours? How does the institutional environment influence these costs and behaviours?

- More analysis on the impact of transversal issues, in particular infrastructure, is necessary. We need to look at a transversal approach throughout the value chain and identify the most vulnerable stakeholders, including looking at services within the value chain as well as infrastructure and logistics, for instance roads and energy supply but also trucking and energy distribution.

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Annex 1
Conclusions for the digest

The review draws a number of conclusions from the literature analysed:

- Multiple constraints affect the private sector in developing countries. Among these, the major ones relate to the **investment climate**, which limits their capacity to grow, and limited access to **finance and energy**.

- ASAL-specific constraints show greater emphasis on **access to markets** and on **transport** infrastructure. In addition, firms cannot **add value** to their products, and a **policy disconnect** reduces the capacity of firms to improve production systems.

- **Climate change will have impacts on the private sector** through disruptions to production systems, loss of capital and the impacts of extreme weather events.

- **Water scarcity** will likely increase, reducing the quantity and quality of water, increasing water competition and negatively affecting supply chains, leading to reductions in firm productivity.

- **Energy security** will likely decrease in situations where energy is already limited. Limited access to energy will further inhibit private sector growth (dependent on the sector and firm energy intensity).

- Already limited **transportation systems** in ASALs will further degrade owing to the impacts of climate change, reducing market access, thus reducing the ability to benefit from better access to inputs, technologies and output markets, thereby preventing the private sector from scaling up economic activities.

- The effect of climate change will depend on the **institutional environment**. Institutional, regulatory, legal and tax regimes influence private sector stakeholders' behaviour, production systems and use of resources, thereby influencing resilience to climate change and adaptation strategies. This is particularly true in ASAL areas, in which the institutional environment is often weak.

- Firms need to take into account potential **weak links or highly vulnerable activity in their value chain** and should consider

their choice of adaptation strategy, counting their operations as part of a systemic framework.

- Firms should also consider their operations in a more holistic way with, for instance, potential **competition over resources** with other economic actors.

- Existing **drivers for adaptation** fall into multiple categories, including the need to protect assets or respond to potential shocks or gradual changes in supply chains and the regulatory environment. Responses to these drivers are shaped by individual enterprise concerns and requirements but can vary depending on their outlook. Firms operating in the short run will be more interested in protecting existing processes; forward-looking firms will likely invest in transformative shifts in their operations.

There are still a large number of research gaps that this review has highlighted:

- On the operations and constraints of manufacturing and service sector companies within ASAL regions. This could be bolstered through research on the constraints of manufacturing and service sector companies in ASALs and the interface with climate change impacts;

- In ASALs on the constraints non-agricultural firms face in accessing markets and productive resources such as energy and water. Also, on the barriers to accessing markets and productive resources (i.e. raw materials) for secondary and tertiary sector firms operating in ASALs;

- On the potential to incorporate value addition processes in ASAL regions, given pre-existing transport constraints (and associated costs) and the potential impacts of climate change on transport infrastructure.

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Research for climate-resilient futures

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