



**PRISE**

Pathways to resilience  
in semi-arid economies

# Value Chain Analysis for Resilience in Drylands (VC-ARID): identification of adaptation options in key sectors

Step 1

Step 2

Step 3

**VC-ARID synthesis key findings**  
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Research for climate-resilient futures



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**Pathways to Resilience in Semi-arid Economies (PRISE) is a five-year, multicountry research project that generates new knowledge about how economic development in semi-arid regions can be made more equitable and resilient to climate change.**

**PRISE aims to strengthen the commitment of decision-makers in local and national governments, businesses and trade bodies to rapid, inclusive and resilient development in these regions. It does so by deepening their understanding of the threats and opportunities that semi-arid economies face in relation to climate change.**

**The PRISE consortium comprises the Overseas Development Institute (lead), UK; Grantham Research Institute on Climate Change and the Environment, UK; Innovation Environnement Développement en Afrique, Senegal; and the Sustainable Development Policy Institute, Pakistan; with country research partners the Regional Environmental Centre for Central Asia, Tajikistan; Kenya Markets Trust, Kenya; University of Ouagadougou, Burkina Faso; and the University of Central Asia, Kyrgyzstan.**

# Introduction

Climate change threatens development and economic growth in semi-arid lands. Climate-related risks will increase for individuals, businesses and infrastructure and have consequences in all sectors of the economy. Climate change will have significant impacts on economic activity and value chains as economic actors are forced to alter their production systems to maintain their production capabilities under changing conditions.

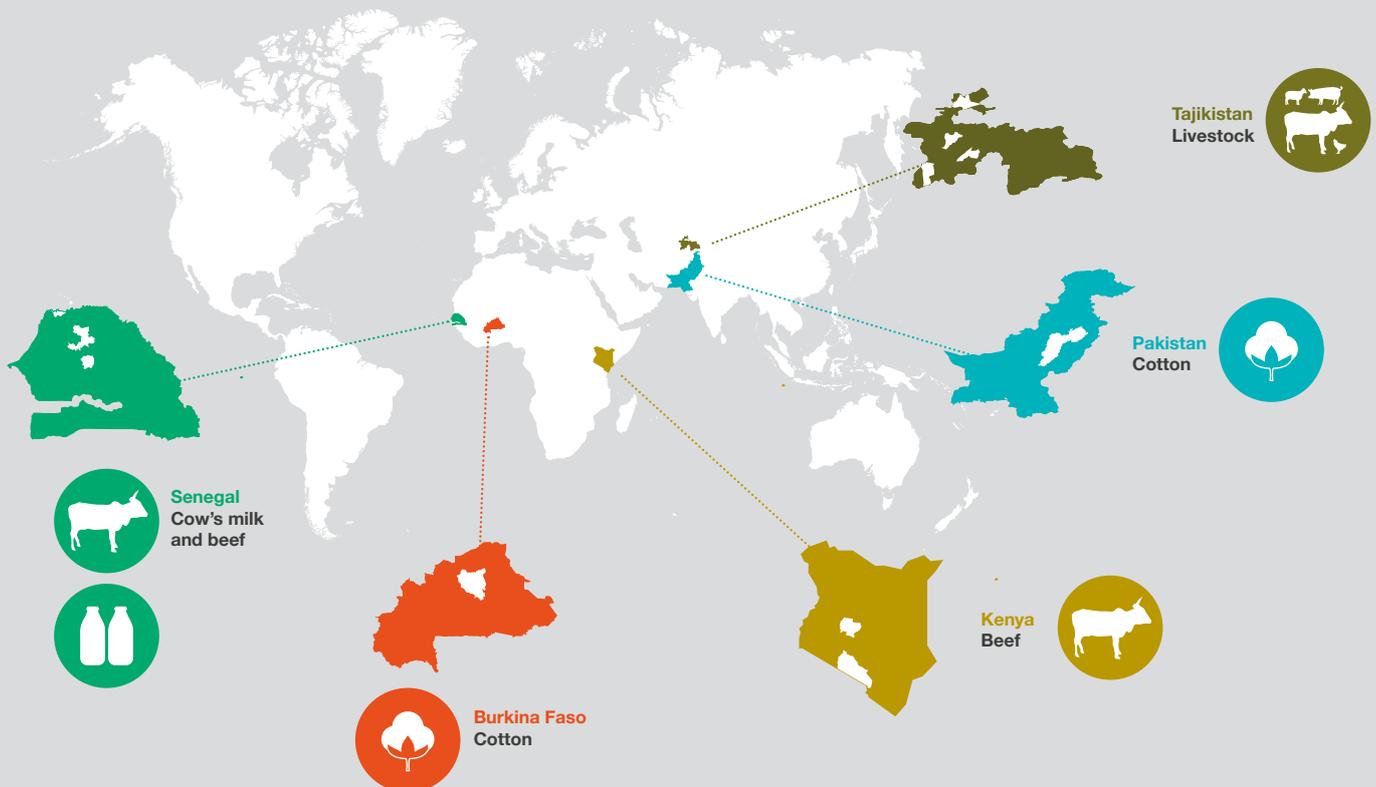
However, climate change can also lead to new possibilities for people and businesses in semi-arid lands, with opportunities to create new products and services, develop new markets and access new funding streams and finance mechanisms. Nonetheless, adapting to the impacts of climate change, and taking advantage of opportunities arising from it, will require action across multiple sectors and from both public and private actors.

VC-ARID tests the hypothesis that there are two pathways for climate-resilient economic development in semi-arid lands. The first option is through upgrading of key value chains, such as cotton and beef (vertical transformation). The second it through diversification within the sectors or into related tertiary sectors, such as milk or tourism (horizontal transformation).

We describe ways to both stimulate growth and support socioeconomic development by better integrating semi-arid lands into national economies through improved market access and enhanced trade. Figure 1 presents the countries and sectors in which VC-ARID was implemented for PRISE.

VC-ARID is an innovative and interdisciplinary approach to value chain analysis in that it takes account of the specific characteristics of semi-arid systems. As such, the VC-ARID methodology integrates key principles that support its application in a territorial – or hotspot – approach as developed within the PRISE programme - please refer to the summary document ‘Reflections on VC-ARID’.

**Figure 1. VC-ARID countries and sectors**



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# Three-step VC-ARID methodology

Across the locations and sectors, VC-ARID follows a common three-step methodology:

## Step 1:

Mapping the value chain

In the first instance, several workshops were convened in six countries to identify climate risks and policy priorities with stakeholders from national and local government, civil society, academia and the private sector. These discussions informed the design of the innovative VC-ARID approach and the selection of sectors for investment. During the implementation of Step 1, key stakeholders in the value chains became active participants in the approach through key informant interviews and focus group discussions. This step also included a literature review.

## Step 2:

Assessing climate risks at each level of the value chain

Climate risk was assessed both qualitatively, through key informant interviews at each level of the value chain, and quantitatively, through carrying out surveys of producers and, in some cases, traders. For the quantitative surveys, a representative sample of the sites was selected with sampling adapted to each context. Information on sampling strategies is provided in the respective country value chain reports. On average 400 producers were surveyed per value chain for Pakistan, Burkina Faso, Senegal and Kenya, totalling approximately 2,300 producers across these six value chains.

## Step 3:

Identifying adaptation and private sector investment options for climate-resilient value chain transformation

The evidence from the previous two steps was shared with stakeholders with the aim of working closely together to generate sets of evidence-based adaptation options that can address climate risk and promote inclusive and climate-resilient economic development in these sectors. Continuing on from the logic of the value chain approach, potential options for climate-resilient value chain transformations were identified first. Then, an assessment of existing and required adaptive capacity was made that can accommodate current and future climate impacts into potential transformations to the value chain, and where public and private sector investment and services can meet these needs. Next, in partnership with stakeholders, priority adaptation options were identified per value chain that were assessed for the potential for transformational change across the value chain and sector as a whole.



Image: Cattle herders in the semi-arid region of Dahra, Senegal, by Rajeshree Sisodia/PRISE

## *Semi-arid lands make a major contribution to national economies*

The livestock sector and pastoralists in semi-arid lands (SALs) of Kenya and Senegal are vital. The livestock sector, based on extensive production systems, represents 5% to 10% of total GDP and 15% to 40% added value in agriculture in the Sahel and Horn of Africa, respectively. In East and West Africa, livestock supports 70% of rural dryland populations and half are exclusively dependant on this key sector (de Haan, 2016).

The sectors are also important sources of trade and, therefore, foreign currencies. Between Burkina Faso and Mali, livestock trade is worth at least £120 million annually and livestock trade in the Horn of Africa was worth an estimated £660 million in 2010 alone (SWAC-OECD/ECOWAS, 2008; Catley, et al., 2013).

The textile sector in Pakistan, which includes cotton produced in the country's SALs, is the largest industrial sector and accounts for around 40% of the country's industrial labour force. Ten million farming families in Pakistan rely on the textile industry. Raw cotton is also the main exportation product, along with mining, in Burkina Faso. As such, the sectors selected for VC-ARID represent a major contribution of national economies and development.

## *These sectors have an important socioeconomic growth potential and have the potential to support transformation*

The sectors selected are dynamic and their potential for growth can drive the socioeconomic development of SALs and the countries in which they are found in the future.

For example, the African Union Livestock Development Strategy for Africa (LiDeSA) 2015-2035 recognises a central role for the livestock sector in delivering a sustained annual agricultural GDP growth of at least 6%. The livestock sector has demonstrated a potential for transformation in terms of employment, food security and ecosystem services (Neely et al., 2009). Demand for livestock products (particularly meat) is increasing globally and especially in the urban centres of Africa and the Middle East driven by rapid growth and economic development.

## *Private sector actors are diverse and coexist within all these value chains, linked both horizontally (competition) and vertically (transformation)*

VC-ARID reveals that private sector actors can range from large spinning companies in Pakistan (such as multinational import-export experts) to mini-dairies run by women in Senegal, to individual transhumant pastoralists in Senegal and Kenya owning several hundred heads of cattle and employing transporters to take their animals to market, to large- and smallholder cotton producers in Burkina Faso practicing agro-pastoralism for both subsistence and cash crops. Individuals, households, groups and businesses of differing socioeconomic status can all be classified as private sector actors participating in the economy, although they may not define themselves as such. These actors coexist within the same sector along the same value chain, being linked by horizontal (for instance competition) or vertical relations (for instance transformation).

However, most of the policy-makers consulted in the studies consider a private sector actor to be a business employing more than one person and registered as a company. This research shows that that individual producers are engaging in a range of activities, including trade, and as such the definition is too restrictive.

This finding is key for adaptation programmes that aim to integrate the private sector. The recognition of the diversity of the private sector is essential to obtain tangible and efficient results, particularly in SALs. Thus, the Global Environment Facility (GEF) fund, and adaptation funds, donors and policy-makers, should apply a broad definition of the private sector to implement an adaptation programme in SALs.

### *There is a disconnect between producers and the rest of the chain*

Producers across all six value chains are often subject to inequitable price conditions and incur transactional costs. This can result in unequal distribution of the added value along the chain. Producers at the lower end get paid much less than they should in comparison to the profit margins for actors at the higher end of the chain. The disconnect indicates that there are opportunities for efficiency improvements along the chain by supporting greater vertical integration (for instance through an improved enabling environment), while retaining the important characteristics of the production system that maintain adaptive capacity.

The disconnect is accentuated only when the production linkage is based in SALs. When geographic marginalisation overlaps with economic marginalisation, the disconnection of producers with the other actors in the value chain becomes a significant barrier to an efficient and equitable share of added value. As a consequence of the disconnection, producers are expected by other sectoral stakeholders to manage most of the risks affecting the sector, while they do not always have the capacity to do so.

### *Challenge to access benefits of the terminal market and international trade and export chain*

In all cases, there are challenges to some extent in accessing the benefits of international trade and export markets. The cotton value chains demonstrate international trade, but this is largely absent from the livestock value chains, with the exception of Kenya's southern rangelands, where some informal trading activity takes place across the international border with Tanzania. As such, there are opportunities to consider in strengthening exports in these value chains.

Upscaling the value chain from national to global can be considered a means of leveraging economic development, exports being key drivers of national economic growth. Provided the disconnect discussed above can be overcome, the sectors can be considered key pillars of future national and semi-arid economies through improved connection to international markets.

At the national level, the benefits of urban terminal markets can be difficult to obtain. In addition to meeting increasing demand, national production rooted in SALs can also be competitive through international exportation. But remoteness, marginalisation and lack of efficiency can prevent economic actors or consumers from harnessing these opportunities, meaning they need to rely instead on expensive imports. It is important to control this trend and ensure the potential for the transformation of these sectors is supported.

### *There is potential for upgrading across all chains*

Across the value chains, there is significant potential to upgrade processing to add value and provide additional socioeconomic benefits, including employment opportunities. The exception is the Pakistani cotton value chain, which has a well-developed textile industry of national economic importance. The implication is that there are significant opportunities for vertical transformation in these value chains, which could address some of the constraints at production and international market levels.

For example, by harnessing the opportunities of urban growth, the Senegalese beef value chain could meet increasing demand through vertical integration. Similarly, renewed interest in high quality, traditional clothing in Burkina Faso is a window to increase the supply of cotton from semi-arid regions, for which there is a consumer preference.

### *Physical and political constraints are key barriers in all chains*

Additional constraints that are common to the value chains to differing extents include poor infrastructure, inadequate provision of financial services, limited access to markets for producers and lack of appropriate regulations. This is reflective of the relatively marginalised position of semi-arid lands in national economies. Clearly, there are significant opportunities to improve the enabling environment for these sectors in ways that are also climate-resilient and inclusive.

## *Informal economic activity is important in all chains*

Informality is an inherent feature of semi-arid systems and acts as a key driver of resilience in these areas. For example, in Senegal a single economic actor can play different roles in the livestock value chain according to the season or the shocks he has suffered. Depending on the production of their livestock, a Senegalese herder can be a producer or an intermediary, facilitating livestock transactions in the market. This flexibility in economic roles is a way of ensuring a source of income under different circumstances. At the same time, herders in Kenya rely on customary institutions that are important sources of resilience during and after shocks (Carabine et al., 2014a). For economic actors, these value chain studies demonstrate the importance of relying on social networks driven by customary norms in order to respond to shocks and perceived changes in climate.

As such, informality can play a key role in socioeconomic stability and cohesion of the actors in the value chain beyond the primary economic role of informal arrangements. In Kenya, the informal butcheries and slaughter slabs provide access to meat for segments of the population with low income who would otherwise be excluded from the market. These links remain critical to the overall value chain, complementing more formal, high-quality production and processing, and thereby demonstrating the importance of multiple chains in supporting the overall resilience of the sector. In this case, informality in the chain plays a key role in food security, poverty reduction and ultimately national economic development.

Informality can facilitate innovation and initiate the transformation of the sector. For example, in Burkina Faso the cotton sector is mainly oriented towards raw cotton exportation. The existence of women who work mainly informally spinning and weaving raw cotton constitutes transformative activities that can drive national transformation of the sector. These informal activities also support women's empowerment and social transformation in a country where gender equality remains a challenge. At the same time, there are drawbacks to wholly informal systems. For example, informality can be a barrier to accessing loans or extension services. It also poses challenges for government agencies that need to generate revenue. As such the multiple roles of informality in the value chains highlights the importance of flexible and tailored formal mechanisms in these sectors.



Image: Cotton harvest - women carrying harvested cotton to be deseeded in Burkina Faso, by Ollivier Girard/CIFOR/Creative Commons License

## Conclusions from VC-ARID Step 2

*Climate change is already having an impact in SALs and these are likely to increase in the future*

There is strong evidence that warming over land across Africa has increased by 0.5°C to 2°C over the past 100 years, and temperatures have increased in most South Asian countries over the same period. Since 1950, data suggests that climate change has changed the magnitude and frequency of some extreme weather events in Africa and Asia, affecting peoples' health, livelihoods and food security (Carabine et al., 2014a and Carabine et al., 2014b; IPCC 2014).

Temperatures in SALs are likely to rise above the United Nations Framework Convention on Climate Change (UNFCCC) global target of a 1.5°C increase, and rainfall will become more unpredictable over the next century. Key risks for Africa in the short and long term include stress on water resources, reduced crop productivity and changes in the incidence and distribution of diseases. For Asia, increased flood damage to infrastructure, livelihoods and settlements as well as food and water shortages are key risks, as is increased heat-related mortality.

In SALs, strong social networks and diverse, multi-local livelihoods are already examples of private adaptation<sup>33</sup> to the natural variability found in the climate and environments of SALs. If these approaches can be harnessed and scaled up, there are real opportunities for inclusive and climate-resilient economic development.

*Producers are the actors of the chains that are the most exposed to climate risk*

In general, climate risk and the direct impacts of climate change on the quality and quantity of production and prices is well understood at producer level. However, there is limited knowledge on how to take private adaptation measures that go beyond coping mechanisms. Where adaptation action is identified, producers have limited capacity to put this into practices. Similarly, in terms of climate change adaptation policy, there is a corresponding disconnect for producers at the higher end of the value chain. It is therefore important to analyse the economic opportunities identified along the value chains, including those relating to transformation or improvements in the enabling environment, in order to inform appropriate adaptation policies. This result depends on the level of vertical integration and the nature of demand in the chain (elasticity to prices and volume). It also highlights the importance of tailoring early warning systems and climate risk management towards producers, recognising the direct and indirect benefits of their activities.

In most of the chains, perceived climatic risks were reported to lead to negative impacts at each step of the value chains. These risks were reported to directly affect the quality and quantity of both inputs and outputs in the production process. Climate-related hazards result in a decline in processing sector activity with associated unemployment and loss of profits. Eventually, the scarcity and poor quality of final products hinder distribution on both foreign and local markets. As producers are the most exposed to climate change in all value chains studied, they are key actors for the proper functioning of the value chain and require specific investment and attention.

*Producers perceive climate change accurately and respond appropriately to shocks, but are less aware of adaptation options and there is a knowledge-action gap*

Most producers surveyed (90% to 98%) perceive climate change accurately. Most of them identify a clear impact of climate change on their production in terms of quantity or quality and the majority (49% to 73%) are taking decisions to respond appropriately to these identified changes. There is good correlation between IPCC observations and projections with the perceptions of producers reported in the surveys.

There is a gap between knowledge and action. Most actors in the chain expect producers to manage this risk, but these actors have the least capacity to do so. For example, cotton producers have limited climate information in order to plan, whereas textile manufacturers are well aware of risks but are not compelled to invest in value chain adaptation. In Senegal, urban livestock producers/traders are more aware of adaptation

options than rural producers, but that does not indicate action. There is a need to support the tailoring of services to close this gap for example financial, climate information and animal health services. Lack of knowledge and financial support are the two main reasons explaining the lack of private adaptation from economic actors along the chain.

### *Wealth is necessary but not sufficient for private adaptation action*

Those who take private adaptation action score higher in wealth indices, but not all those who score high take action. Wealth can also have a negative impact on some adaptation decisions. Therefore, income generation at producer level may not necessarily lead to adaptation action. However, there is an equity dimension, because those with the least income/assets, for instance smallholders versus larger landowners, are often least able to act.

### *Access to extension services as well as individual characteristics, such as education, are key drivers of private adaptation decisions*

Access to extension services plays a key role in explaining private adaptation decisions. In particular, early warning systems (including prices and climate information) and access to loans play critical roles in private adaptation.

The results demonstrate the importance of tailoring information to these specific production systems and the climate and weather-related risks they face. It appears that while services exist in most cases, the impacts of drought and the structure and function of market systems are not well understood and lead to the production of information that is not useful for supporting resilience. If sales and investment in inputs are critical to coping with climate shocks and stresses, then it is also essential that price information be shared using appropriate media for communication, for instance mobile phones. Similarly, if the role of early warning systems is now well recognised, as suggested by the survey results, the challenge of tailoring these to the context of SALs and extensive livestock production systems remains.

The design and provision of tailored financial services is also a challenge in the context of SALs. The access to financial support that considers the characteristics of the economic activity – for instance seasonality and mobility – is a real challenge that could support the resilience of production systems in SALs. The overall sector will benefit from these innovations that need to be supported through an enabling environment that incentivises the financial sector to take risks and invest in innovative, tailored financial products.

In most of the value chains, the decentralisation or devolution experiences lead to a rise in extensive services provided by the public sector (information, water, education) but few improvements in services provided by the private sector. This demonstrates the remaining effort required from decentralised and devolved entities in terms of an enabling environment for supporting such services in marginalised regions.

### *The provision of, and satisfaction with, extension services is critical in private adaptation decisions across the value chains, but there are differences depending on type of service, sector and country*

Questions of satisfaction with extension services have been tailored to the specific context of these value chains. Nonetheless some key services are identical from one chain to another, yet the level of satisfaction reported by actors of these services varies depending on the country or the production system. The comparison of levels of satisfaction is a good point for regional comparison and where there are clearly identifiable opportunities for learning and exchange between stakeholders at regional, national and local levels.

Producers and traders in Senegal show relatively higher level of satisfaction in terms of fodder provision and drugs services, than in Kenya. Interestingly, such services are more commonly provided by the private sector in Kenya compared to Senegal, raising questions about the specific roles of the public and private sectors in the provision of supporting services. Also, the very low level of satisfaction in Kenya's southern rangelands compared to the northern rangelands has created dialogue between devolved institutions and technical and financial partners on equitable service provision at the county level.

Provision of inputs (such as drugs, fodder and water), early warning systems (such as prices, climate information and animal health surveillance), access to markets and land (including mobility) and access to financial services (such as loans and insurance) are considered services for which regional exchange and national discussions are particularly relevant. As such, PRISE has given rise to a regional dialogue between key stakeholders and regional bodies in the Sahel and Horn of Africa on these key issues.

*Climate risks and shocks are key factors driving private adaptation decisions, but that does not mean that they are sustainable over time*

In Kenya, Senegal, Burkina Faso and Pakistan, climate shocks influence private adaptation decisions. The experience of climate- and weather-related shocks in the past has had a significant impact on private decisions at producer and trader levels in most of the value chains. Other actors along the chain also make decisions in response to experienced or anticipated climate risks. The actual private adaptation decisions made by economic actors are diverse and specific to the value chains, depending on the sector and the context (in other words, the 'territory').

Even within the same sector – livestock – there are differences in the most popular decisions, with Senegalese herders preferring the storage and purchase of fodder and feed while herders in Kenya differ in their practices depending on their location. This is likely dependent on the available options. For example, in northern Kenya herders choose to either increase their mobility or store fodder in response to drought risk depending on their ability to move and access fodder and water resources, whereas herders in southern Kenya tend to make changes to their individual herd management as well.

Nonetheless, these private decisions are not necessarily driven by the right incentives nor respond appropriately to climate signals. In this way, decisions at the individual or even community levels without the appropriate enabling environment are not always economically viable, socially acceptable or sustainable over time, in a context of climate change. As such they can lead to maladaptive outcomes. For example, climate shocks may drive pastoralists towards privatisation of communal resources, thereby curtailing mobility, or shift to alternative livelihoods and land uses, like water-intensive agriculture, that are less climate-resilient in the long term. The decision to utilise water resources for crop irrigation in areas where rainfall and groundwater is projected to decline in the near future is not a viable adaptation option, even when made in response to climate shocks. Instead, water management should be organised and optimised at the territorial level. The VC-ARID approach allows for consideration of both private (or individual) adaptation decisions that aim to optimise individual circumstances and adaptation planning.



## Conclusions from VC-ARID Step 3

*There are clear opportunities for climate-resilient economic development in SALs*

Sectors where production is rooted in SALs are vulnerable and exposed to climate risk but there is inherent adaptive capacity that is the basis of climate-resilient economic development. Across all the value chains studied, combinations of horizontal (for example promotion of the tourism-related sector and creation of jobs in services industries such as financial and animal health that support the cotton and livestock sectors) and vertical integration (for example improved quality of livestock and cotton products and transformation of beef and raw cotton into premium cuts and textiles) offer opportunities for increasing productivity within sectors but also diversification into related sectors. However, to be sustainable and inclusive, adaptation options must be socially acceptable as well as economically viable and climate resilient.

The VC-ARID studies demonstrate that there are options for investing in transformation in these adaptive value chains in SALs, which can create employment and revenue and realise growth in the future.

*In SALs, transformation within existing climate-resilient sectors can avoid maladaptation*

In all the value chains, actors reported turning to alternative sources of subsistence and income, for example in Pakistan farmers responded to climate shocks by shifting from cotton to cash crop production. In Kenya and Senegal, herders relied on agricultural production or waged employment to cope with drought impacts. While these strategies are rational responses by individuals and households to manage the risks they face, these may also be maladaptive where they lead to longer term shifts (for instance land use change and environmental degradation or depletion of groundwater resources) (Cochrane and Cafer, 2017).

Taking future climate change into consideration, these impacts may be even greater in the short and long term. Furthermore, the diversification of livelihoods away from production activities that support social- ecological systems and local economies in SALs towards alternatives may be less socially acceptable, environmentally sustainable or economically viable under a changing climate. For example, shifting extensive livestock production towards more sedentary, intensive production of livestock or irrigated crops can be maladaptive. Not only this, but it can erode the characteristics of those systems that constitute the adaptive capacity of communities and economies in SALs if these lead to erosion of customary institutions and norms, are not connected to markets or increase demand on scarce natural resources, particularly water. Investments within climate-resilient sectors offer greater potential for climate- resilience economic development. As such, livelihoods and local economic development programmes should be cognisant of this risk, support the elements of existing adaptive capacity in SALs and avoid potentially maladaptive outcomes.

The potential for maladaptive outcomes exists not only at the household level but also poses risks at the sector and national economy levels. For example, investments in long-lived infrastructure in areas of high climate risk, such as SALs, can lock communities and local economies into maladaptation where they incentivise patterns that undermine the system, such as urbanisation (Jones et al., 2015; Carabine et al., 2015). On the other hand, where local and national governments invest in sectors that are more climate-resilient, for instance extensive livestock rather than water resource-intensive cash crop production, these can potentially constitute adaptation investments with associated benefits for drawing down finance and meeting international agreement obligations.

*The formal private sector is not incentivised to invest in adaptation. Medium to large private sector actors look to producers and/or policy-makers to take adaptation action*

The findings from all value chain studies suggest that the formal private sector is not actively investing in adaptation either at production, processing or sectoral levels. For example, while textiles firms in Faisalabad clearly recognise the cost of climate-related shocks on their supply chains, they do not see the need to invest in protecting these. Rather, they expect producers to bear the risks of climate change and look to the public sector or international markets to provide solutions. Similarly, meat processors in Nairobi are well aware of

the impacts of drought on their business operations and potential for growth, yet they do not invest directly in smoothing supply. In both cases, key informants indicated willingness to invest if the regulatory environment demanded it.

Therefore, adjustments to the regulatory environment are needed to incentivise and draw down investment. However, private and public actors are generally not cognisant of the role the private sector can play in plugging the investment gap. For example, in these value chains, the private sector can provide a demand and a guaranteed market for quality products, even without direct investment. Public investment should be directed towards creating the enabling environment.

### *Private adaptation plus adaptation planning are required for climate-resilient and inclusive economic development*

Most adaptation options require relatively low public investment but significant policy change. At the same time, the private sector is not incentivised to invest so there is an issue of the enabling environment. Medium- to large-sized private-sector actors look to producers and/or policy-makers to take adaptation action and are not cognisant of the role they can play in plugging the investment gap. For example, Small- and Medium-Sized Enterprises (SMEs) provide a demand and a guaranteed market for quality products but no investment in production. Across the case studies, adjustments in the regulatory environment are needed to incentivise and draw down investment. Therefore, public investment should be directed towards creating an enabling environment for private/public adaptation investment.

Moreover, on quality issues, regulation is a key factor. Vertical integration or regulated monopoly are often the optimal way to support upgrading of quality in the value chain. That it is why it is essential for public authorities to implement solid adaptation plans. If contracts are not enforced or if information is asymmetric, public-private partnership or horizontal competition is not sufficient to drive improvements in quality. Each economic actor has a role to play in this option.

### *In SALs, national adaptation action is required, but the local and regional levels are also important for governance and climate-resilient economic development*

PRISE has explored climate-resilient economic development through the lens of the state and the national level. However, it has also recognised that in terms of geography, economic activity or the communities that inhabit them, national borders do not delineate SALs. While this is not a characteristic unique to SALs, this is a key difference to sectors and systems that do fall more neatly within national administrative boundaries. Climate change itself is a challenge that transcends national governments and requires action across scales. VC-ARID has been designed to incorporate these scales of analysis and identify options for adaptation and investment at local, national and regional levels.

Indeed, VC-ARID has revealed in all cases that action is required at local (or production) level where there is inherent adaptive capacity within communities and local economies; at national level where the public sector needs to create the enabling environment for adaptation investments; and at regional level where there are challenges to be addressed (for instance drought impacts or food security) or opportunities to harness (such as international trade).

Actors in all value chains have identified early warning systems as important. These are present in almost all cases with national-level investment, but they are not often appropriately targeted at local communities with the provision of relevant information. In particular, early warning systems are not always well designed to anticipate drought-induced crises, as they are designed in line with agricultural system parameters and do not incorporate the characteristics of drought and SALs.

Regional policy frameworks and coordination are necessary to address the scale of drought phenomena, which have direct and indirect effects. Drought impacts are not geographically restricted to the areas where hydrological drought occur and are 'tele-connected' across regions. For instance, the 2005 food crisis in Niger was precipitated by price shocks that originated due to drought in Nigeria. Early warning and drought management systems should monitor both production and prices, with particular attention on sentinel markets in the region (Araujo Bonjean et al., (2010); Araujo et al., 2012).

An example of frameworks trying to address these issues at regional scale include the Intergovernmental Authority for Development in the Horn of Africa (IGAD) and the Drought Disaster Resilience and Sustainability Initiative (IDDRSI), which addresses natural resources, markets, livelihoods, disaster risk management and peace and security coordinated across institutions in member states. Another is the Nouakchott Declaration in the Sahel, which addresses the mobility of pastoralists across the region. As a result, the PRISE programme in 2017-2018 is convening stakeholders in a regional dialogue between regional bodies in the Horn of Africa and Sahel for cross-regional learning on key value chains, policy frameworks and services for drought-prone areas.

### *From climate-resilient economic development towards transformation*

The findings of the VC-ARID studies have led to the proposal of a new definition of climate-resilient economic transformation that takes into account the important elements of territory, climate risk, variability and informality:

The full range of evolutions undertaken by the economy and society towards sustainable development. This is characterised by a shift towards sectors that boost inclusive and adaptive growth and gains of productivity within sectors. This increase in productivity must be attained without putting extensive pressure on natural assets and without generating negative environmental spillover that cannot be internalised.

This definition offers the opportunity to set forth a broader definition of socioeconomic transformation in Agenda 2030, with real examples of how to empower people, ensure inclusiveness and equality, and mainstream climate adaptation while delivering national and sectoral economic development objectives.



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Image: Women decontaminating cotton near Faisalabad in Punjab, Pakistan, by Rajeshree Sisodia/PRISE