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# The Climate-Smart Agriculture Papers

Investigating the Business  
of a Productive, Resilient and  
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# Chapter 20

## Climate-Smart Agricultural Value Chains: Risks and Perspectives



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### 20.1 Introduction

Because of climate change, millions of people in sub-Saharan Africa are coping with rising temperatures (IPCC 2007; Jentsch et al. 2007; Engelbrecht et al. 2015) increases in the severity and frequency of droughts and (Jentsch et al. 2007; Allen et al. 2010; Ogalleh et al. 2012; Zhao and Dai 2015) floods (Mason et al. 1999; Frich et al. 2002; Douglas et al. 2008), rising pest and disease incidence, (Cheke and Tratalos 2007; Gregory et al. 2009) and soil degradation (Prospero and Lamb 2003; Brevik 2013). Some regions, such as southern Africa, will likely get drier during the winter season, while others (particularly at higher altitudes) may benefit as increased temperatures create new farming options (Christensen, J. H. et al. (2007)). Yields are likely to decrease substantially for cereal crops sensitive to heat and drought (wheat, maize, rice) but less so for crops with higher heat tolerance (such as millet) (Nelson et al. 2009; Leclerc et al. 2014). Overall, agricultural productivity and incomes have declined for smallholder farmers, pastoralists and fishermen, and are likely to decline further (FAO 2009; Gregory et al. 2009; Thulani and Phiri 2013; Junaidu et al. 2017).

Food security poses a growing challenge for much of the continent. To help people adapt to changing conditions, governments, the private sector and development partners

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have become interested in the uptake and scaling of climate-smart agriculture (CSA). Many of the studies to date have focused on the production end of the value chain—i.e., ways to help farmers grow more food. This limited focus neglects the importance of the harvesting, storage, processing and marketing stages. More researchers now are recognizing that food security is not just an issue of production but also of distribution, access and affordability (Ericksen 2008; Ingram 2011) CSA studies must follow suit.

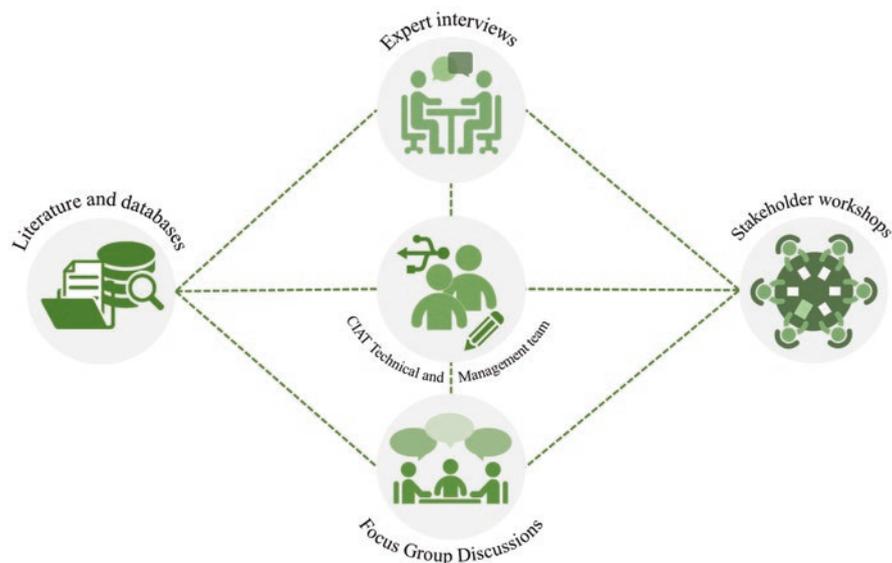
This study argues that successful adaptation requires consideration of how climate change will affect all aspects of the value chain. It draws upon the county climate risk profiles (CRPs), a project of the International Center for Tropical Agriculture (CIAT) in collaboration with the Government of Kenya through the Ministry of Agriculture, Livestock and Fisheries and with funding through the World Bank. Addressing different stages of the value chain—input provision, on-farm production, harvesting, storage, processing and marketing—these CRPs assess actual and potential climate risks. The project's aim is to provide county governments and stakeholders with localized evidence of climate vulnerabilities and possible adaptation responses.

Each climate risk profile is framed around six key analytical stages: (i) overview of the agricultural context in the county; (ii) assessment of climate vulnerabilities across agricultural value-chain commodities; (iii) overview of on- and off-farm adaptation strategies specific to each selected value chain; (iv) analysis of available policies and programs to address climate change impacts on agriculture; (v) assessment of governance, institutional resources and capacity to incentivize uptake of adaptation strategies; and (vi) recommendations for addressing gaps that hinder effective institutional operation and collaboration. To date, profiles of 31 Kenyan counties have been developed.

This chapter presents a case study conducted in Nyandarua County. Our goal is to demonstrate the necessity of including value-chain perspectives in the design and scaling of CSA interventions.

## 20.2 Methodology

This paper draws on data collected and analyzed for Nyandarua County between June and September 2016. Nyandarua is located in the central area of the country and has a population of 596,268 (2009) over a land area of 3245 km<sup>2</sup>. Temperatures range from 12 °C (July) to 25 °C (December), and annual rainfall ranges between a minimum of about 700 mm and a maximum of about 1700 mm spread over two seasons, mostly in the first wet season (January–June), but also in the second (short) wet season (September–December) (GOK 2014). The rainfall decreases from East to West. Agriculture is the main income-earning activity, employing 69% of the people, with crop production (estimated at 17 billion KES) and livestock keeping (7 billion KES) contributing 73% to the household incomes (MoALF 2016). Crop production in the county is mostly rain-fed, small-scale and for subsistence purposes. Malnutrition is a key challenge in the county, with 39% of the population estimated to be affected by food insecurity and 35% of children below 5 years stunted.



**Fig. 20.1** Methodology of the Climate Risk Profiles showing the different approaches used for data collection

Creating the county climate risk profile for Nyandarua involved identifying major value-chain commodities, the key climate risks each faces and the adaptation options available. The study of each county relied on desktop research, climate-data analysis, farmers' focus groups, key informant interviews and a 3-day county stakeholder workshop attended by 30 farmers, service providers and representatives of governments, NGOs and farmer groups (Fig. 20.1). The focus groups brought together six to ten stakeholders representing each value chain. A total of 12 key informant interviews and six focus-group discussions were undertaken, with the goal of identifying stakeholder perceptions regarding: (i) activities along the value chain; (ii) current and potential climate-change impacts along the value chain, (iii) ongoing and potential adaptation options, and (iv) institutions, policies and programmes related to climate change adaptation in the county.

With input from the stakeholder workshop, we narrowed the list of agricultural commodities for analysis down to the four considered most important for food security and livelihoods: cow milk (dairy), poultry, peas and Irish potato. These were chosen based on contribution to food security, productivity, importance to the economy, resilience to current and future climate change, population engaged in the value chain and engagement of poor and marginalized groups. It emerged that at least 61% of the total population in the county are engaged in each of the four chosen value chains, involving all gender groups.

A mix of scientific and participatory approaches were used to identify which climate risks matter most for each commodity. The main climate hazards were identified based on the analysis of historical climate data (1981–2015) and climate pro-

jections (2021–2065) under RCPs 2.6 and 8.5. Climate indicators selected for the scientific assessments and initial presentation at the stakeholder workshop included moisture stress, drought stress, erosion risk, total precipitation, flooding and heat stress. During the stakeholder workshop, participants identified key value-chain activities, the two key climate risks for each value chain (from the six initially presented to them), magnitude of impact of the risk, underlying vulnerability factors (for specific groups of people) and who is most impacted (by geographical scope, age, gender and economic status). Participants also mapped currently available adaptation options and identified gaps in the available options.

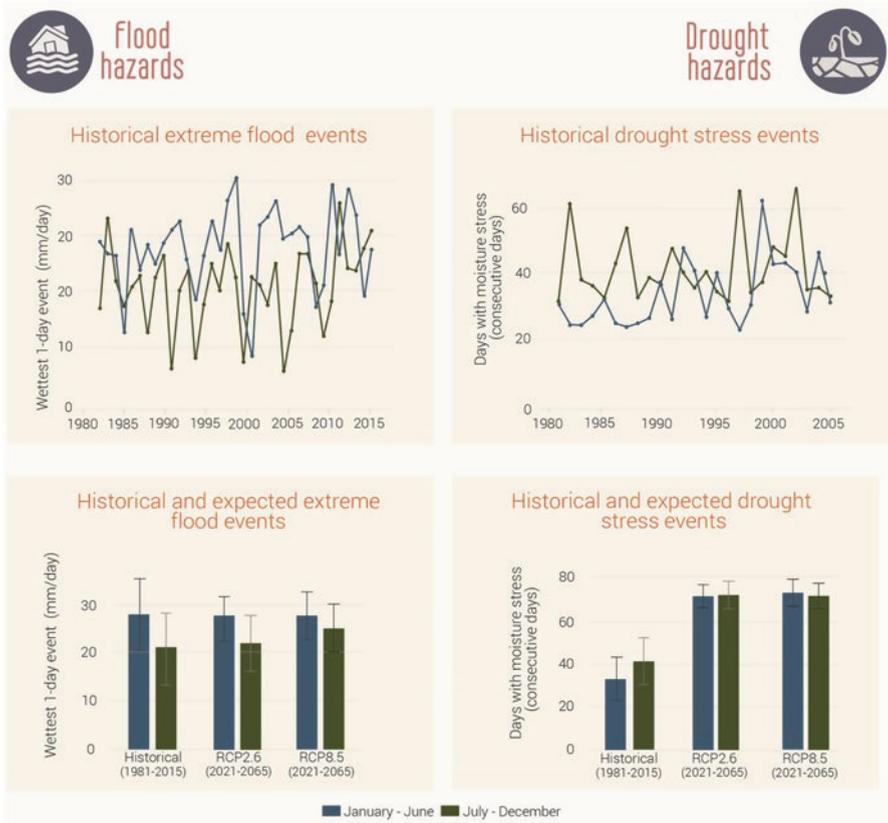
## 20.3 Results

As the main findings were consistent across all four value chains (dairy, poultry, peas, potato), this chapter presents results from the value chains of one crop (pea) and one type of livestock (dairy cows).

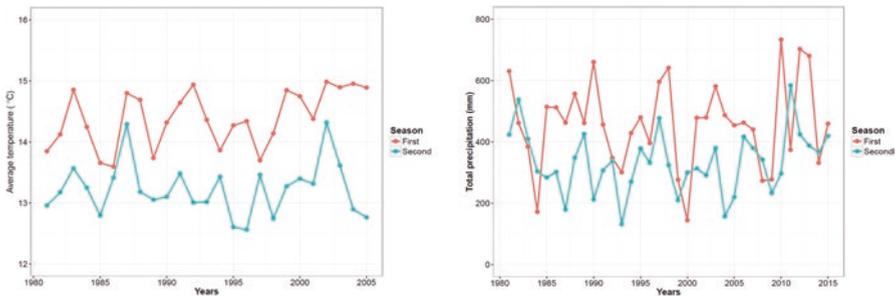
### 20.3.1 *Effects of Climate Change on Value Chains*

Based on the historic and future climate scenarios of the six indicators presented in the workshop, participants identified drought (represented by the number of consecutive days with moisture stress) and floods (represented by the magnitude of the wettest one-day event in mm/day) as the most relevant to the pea and dairy value chains. Historic climate analysis and participant perception agreed that both dry spells and extreme precipitation have been major hazards in the county. Future climate analyses for Nyandarua project significant increases in moisture stress in both seasons, as well as an increase in flood risk mostly in the second season (Figs. 20.2 and 20.3).

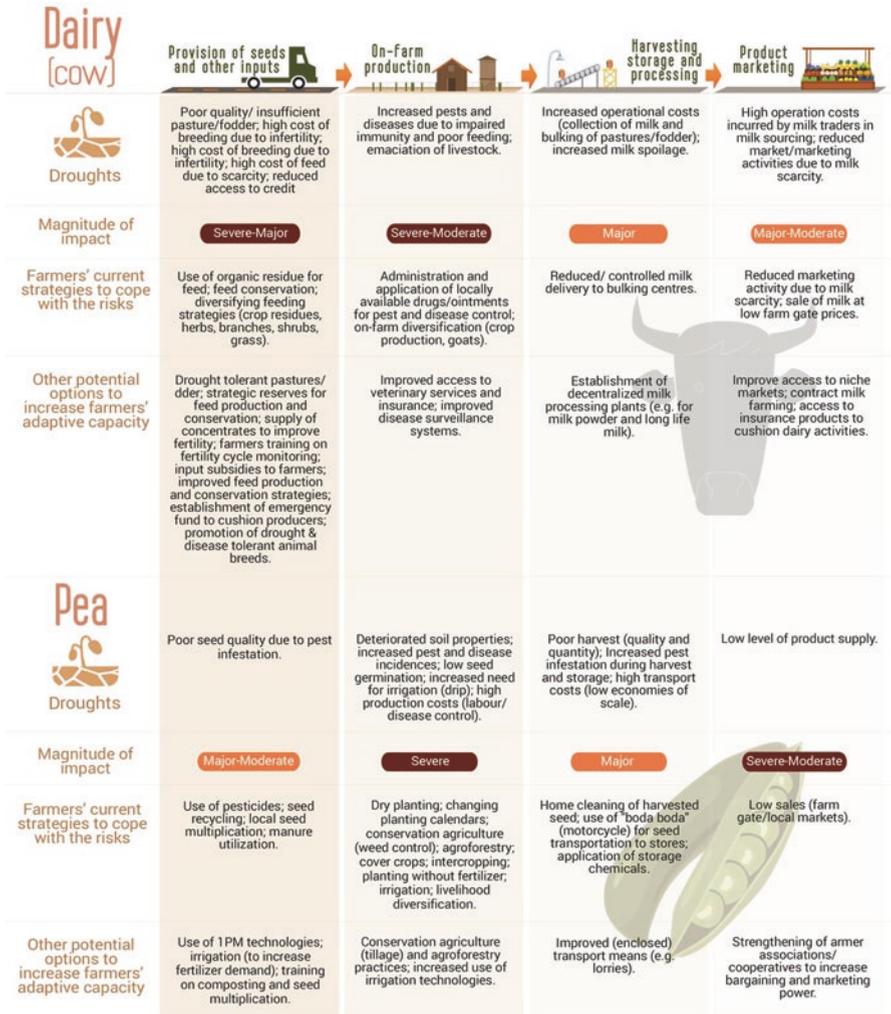
Based on stakeholder discussions, we also linked the perceived impacts of climate hazards to each stage in the value chain (Fig. 20.4). Drought affects all stages of the pea and dairy value chains, although in different ways. For example, while the effect of drought on pea inputs is largely moderate due to a limited availability of quality seed, the effect of drought on dairy inputs is severe, as it results in reduced breeding, poor quantity and quality of pasture and fodder, and increased costs in buying feed. In terms of the production stage, droughts severely affect both pea and dairy: peas suffer from low germination rates, hardened soils and increased incidence of pests and diseases; dairy cattle become emaciated and lose resistance to pests and diseases. In the dairy value chain, stakeholders perceive major to severe impacts from drought, which affects the harvesting, storage and processing stage. Drought also contributes to milk spoilage and increases operational costs in the collection and bulking of milk. Similarly, low levels of milk production can limit farmers' access to markets. Drought most adversely affects production activities in



**Fig. 20.2** Historical (1981–2015) and future projections (2021–2065) of flood and drought events in Nyandarua County, Kenya



**Fig. 20.3** Historical (1981–2015) average temperature and total precipitation in Nyandarua County, Kenya



**Fig. 20.4** Drought impacts and adaptation options along the pea and dairy value chains in Nyandarua County, Kenya

pea: planting requires more time and labor due to hard soils; low germination increases the need for irrigation; and water stress leads to greater crop susceptibility to pest and diseases, low yields and poor quality produce.

In the dairy value chain, floods are perceived as having major to moderate negative impacts on provision of inputs, harvesting, storage and processing. In particular, excessive rainfall leads to destruction of roads, making inputs more expensive and increasing the cost of milk collection. Flooding also leads to damage of milk storage structures. In the pea value chain, impacts of floods on production were

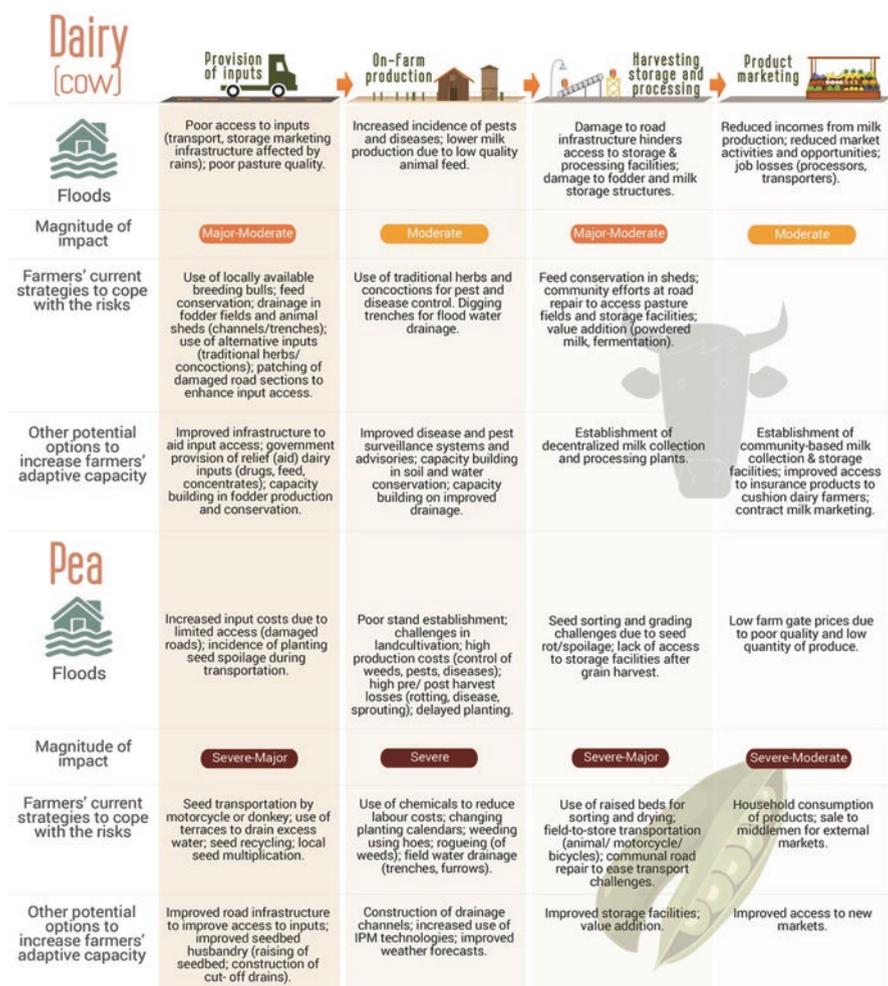


Fig. 20.5 Flood impacts and adaptation options along the pea and dairy value chains in Nyandarua County, Kenya

perceived as severe, leading to delayed planting, poor stand establishment, higher costs for labor and weed management, increased incidence of pests and diseases, and rotting of plants (Fig. 20.5). Apart from affecting on-farm production, floods also affect the transportation of inputs required for production, as roads may be damaged or become impassable. This damage to transport infrastructure can also hinder access to storage facilities, processing infrastructure and markets—consequences that often have knock-on effects for processors, agricultural buyers and their employees.

### ***20.3.2 Options for Adapting Value Chains to Climate Change***

These results show that climate hazards already negatively affect all activities along the chain. The impacts, however, vary by commodity and by stage of the chain, and therefore require different approaches in adaptation. This section examines the coping strategies used currently as well as the longer-term adaptation options.

Actors are already making some efforts to minimize the negative impacts of climate hazards and reduce climate risk, although our study indicates that their adaptation efforts are too heavily focused on production. For both peas and dairy, the number of adaptation options correlates to the perceived severity of the impacts. For example, a higher number of options were available for on-farm production in pea and at provision of inputs for dairy because of the impacts of drought (Fig. 20.4). For floods, the highest number of options adopted by actors is at the provision of input stage for both value chains (Fig. 20.5). Specifically, current adaptation strategies in dairy include feed conservation, fodder diversification (utilization of crop residues, herbs and shrubs for feed), use of herbal medicines, use of locally available breeding bulls, construction of drainage channels, local road repairs, sale of milk at farm gate, and value addition (milk fermentation). Strategies in the pea value chain include change of planting calendar, use of improved varieties, manure application, use of terraces, local seed multiplication, use of herbicides and pesticides, conservation agriculture, agroforestry, planting seedlings in raised beds and use of donkeys and motorcycle taxis for transportation (Figs. 20.4 and 20.5).

Our interviews identified the following potential priority actions in Nyandarua: (i) investing in climate-resilient infrastructures such as roads, irrigation systems, storage facilities and markets; (ii) engagement of the public and private sectors and financial and insurance services to support climate-resilient and inclusive agro-value chains; (iii) improve existing platforms and structures for climate adaptation along the value chain, such as standards, relief services, emergency funds, disease and pest surveillance, climate information services, early warning systems, land-use planning and zonation, agroforestry, soil and water conservation, value addition, collective marketing and climate responsive policies.

### ***20.3.3 Impediments to Adaptation at the Local Level***

The interviews in Nyandarua revealed a lack of understanding of climate change and the options available to adapt to it. Events such as reduction in crop cycle, rising temperatures and changes in length of the growing season were perceived as isolated or non-severe. There was also low awareness of potential adaptation options for managing risks. Similarly, there was a low understanding of the Kenyan government's climate-related policies and how they support adaptation at the local level. Most farmers in Nyandarua also fail to take advantage of the infrastructure and

services (road networks, storage facilities, microfinance, and insurance) that might help them confront climate risks—either because they don't know about these options or because they can't afford them.

Overall, our results reveal the need to strengthen efforts to address climate change in Nyandarua County. It is noteworthy, that the focus is towards adaptation, and there is less attention to the mitigation potential of each adaptation option. CSA approaches have a weak presence, largely due to low institutional capacity and a weak policy environment. The institutions lack adequate guiding principles on climate change suited for the local context. Coordination among institutions also was noted as a challenge. Other institutional challenges included insufficient finances to enable wider project coverage, poor targeting of beneficiaries, poor monitoring and evaluation of the initiatives, and failure to properly engage stakeholders. The climate adaptation interventions that are undertaken have suffered from poor policies and weak implementation. Most significantly, for the purposes of this paper, the institutions focus primarily on the input acquisition and on-farm production stages, therefore missing the advantages of a value-chain approach.

## 20.4 Implications for Development

Our study indicates some strategies for addressing the policy and institutional challenges in Nyandarua County. First, the research project itself may have helped nudge the adaptation process forward. Recent research has recognized that stakeholder platforms can engage diverse actors and foster learning, coordination and fundraising (Wilson 2013; Wenger-Trayner et al. 2014; Ampaire et al. 2017). Further, such platforms can identify adaptation priorities and integrate them into development plans, directly influencing climate policy at the subnational level (Fleming et al. 2014). Our research supports these findings. In Nyandarua County the climate-risk profiling process brought stakeholders together, helped to identify the most vulnerable sections of the community in relation to each agricultural value chain and each hazard, and documented some of the ongoing projects aimed at mitigation. The CRPs can also be shared with stakeholders to help them better understand the climate-risk along different agricultural value chains as well as the best adaptation options. Engagement in the climate-risk profiling process helps experts evaluate CSA practices and determine which are most effective in helping the full length of the value chain adapt to the local context.

Policy can guide climate adaptation at many stages along the value chain. In Nyandarua, however, implementers at the local level appear to be not well informed of policy opportunities and barriers. Another key constraint there is the lack of local climate-change policies, as well as the lack of money and tools to implement national policies at local level. Agricultural development stakeholders and county government authorities plan to use information collected in the CRPs as part of the County Integrated Development Plans (CIDPs). For this to happen, stakeholders at every level must better understand the process of risk profiling and how it can help

local farmers and the local economy. With local buy-in, risk profiling can be scaled out to the full range of agricultural commodities across the value chain. Climate risk profiling was a key input in the design of the US\$250 million IDA-World Bank funded Kenya Climate-Smart Agriculture Project, for which Nyandarua is 1 of the 24 target counties.

Overall, our climate-risk analysis based on a value-chain approach showed that stakeholders are aware of the impacts of climate change along different stages of the value chain, and it revealed opportunities for adaptation in each of these stages. It also showed that value-chain analysis must reach beyond climate risks. Value chains are also vulnerable to pests and diseases; environmental degradation; changes in supply or demand; price fluctuations; logistical and infrastructural risks; financial, monetary, fiscal and tax policies; political risks; and security-related risks. Therefore, there is need for more comprehensive risk analysis in order to protect and build value chains.

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