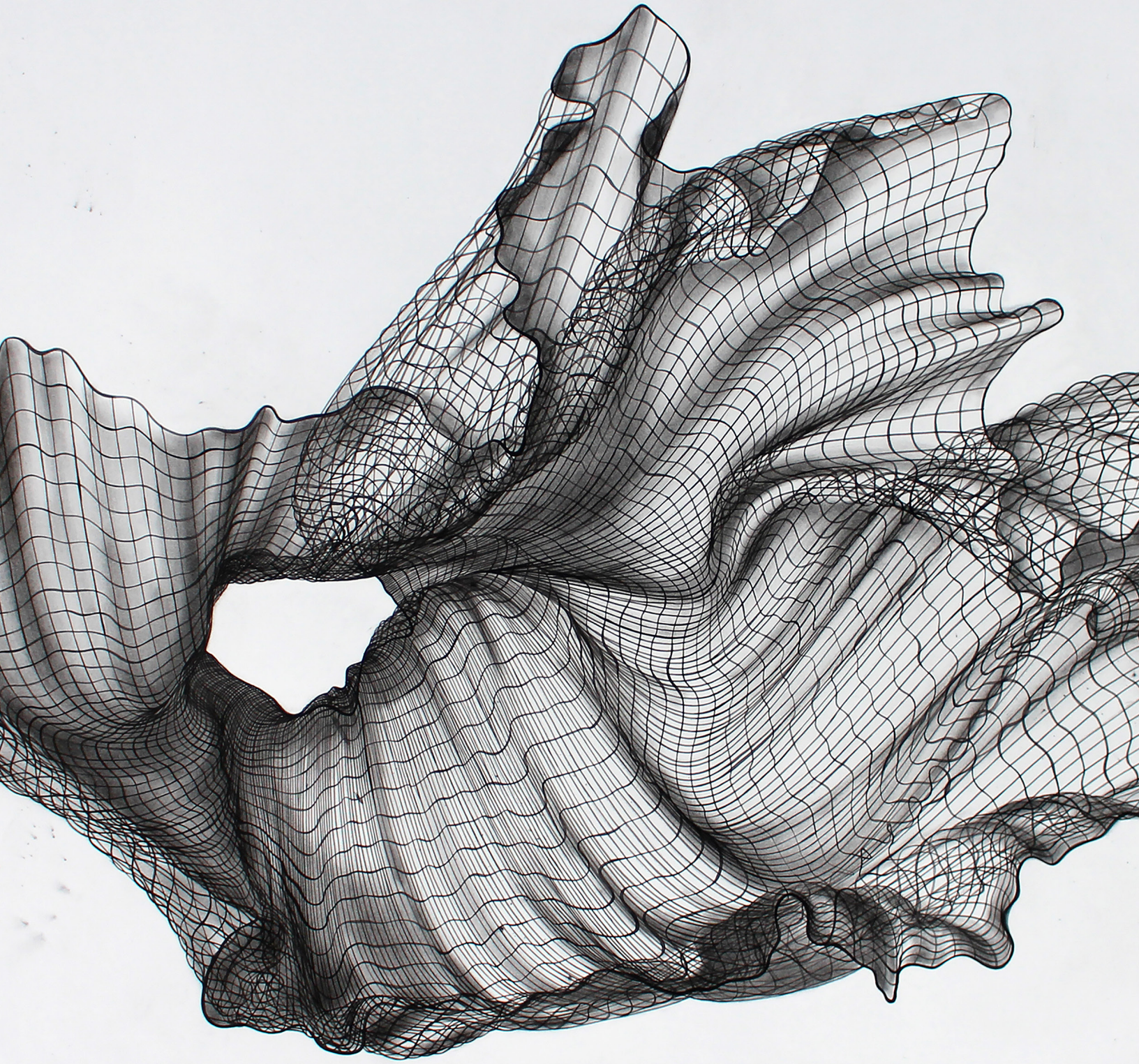
Fifth National Climate Assessment

Focus on Risks to Supply Chains



Focus on Risks to Supply Chains

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Focus on Risks to Supply Chains

Damage to supply chain networks caused by climate change reverberates through people's livelihoods and investments in ways that threaten quality of life and security, often in lasting and inequitable ways. Coordinated efforts can mediate impacts and help communities and companies adapt to these large, interconnected, and recurring risks. However, the pace, scale, and scope of efforts that have been undertaken to transform supply chains are not yet sufficient to meet either current or expected disruptions and costs.

A supply chain represents the entire flow of goods and services, from the sourcing of raw materials to the delivery of a product or service to the customer. Supply chains operate globally across complex and interdependent networks of infrastructure, activities, and resources and include producers, manufacturers, and distributors. Upstream portions of supply chains encompass the range of activities needed to produce the product or service, while downstream portions encompass the range of activities needed to get the product or service to its final consumer. Supply chain management predominantly follows a linear model (take, make, and dispose), but a circular model is emerging that addresses sustainability by adding elements of recycling or refurbishing products.[1] Supply chains depend on the physical transportation of goods and services, as well as on digital networks to provide logistical support, to track movement of goods and services or other important information (e.g., immutable ledgers on investment and financial transactions on blockchain networks), and to deliver goods and services (e.g., telemedicine or remote education). In addition to physical and digital infrastructure, supply chains depend on networks of people to manage and service them.

Climate-driven disruptions to supply chains cascade and compound across multiple systems, underlining the need to understand and manage climate-related risks (KMs 17.1, 18.1, 19.2). These compounding risks include deepening of existing inequities in risk distribution and resource access for overburdened communities (KMs 16.1, 20.1),[2] geopolitical instability and national security vulnerabilities (KM 17.2),[3] and the inability to achieve emissions reductions due to the lack of capacity and provisioning for the electrification of products and services (KMs 5.2, 13.4, 17.3). Climate change also has complex interactions with non-climate global shocks such as the COVID-19 pandemic (see Focus on COVID-19 and Climate Change). Current supply chain vulnerabilities show the need to adapt to avoid future interruptions (KMs 7.1, 11.2, 15.3, 20.2, 31.3).[4,5] Climate-related risks to supply chains threaten the livelihoods of suppliers, distributors, and laborers, as well as infrastructure (KMs 7.2, 21.2, 22.1). In 2021, builders paid more for materials due to West Coast wildfires and an active US housing market.[6] Extreme heat and flooding at ports and transportation hubs has impacted goods movement.[7] Overlooking these risks prolongs economic consequences to suppliers and customers, prompting fundamental shifts in global supply chains, consumption patterns, and competition over constrained natural resources (KMs 8.3, 10.1, 18.1, 19.3, 20.1, 30.1).[8]

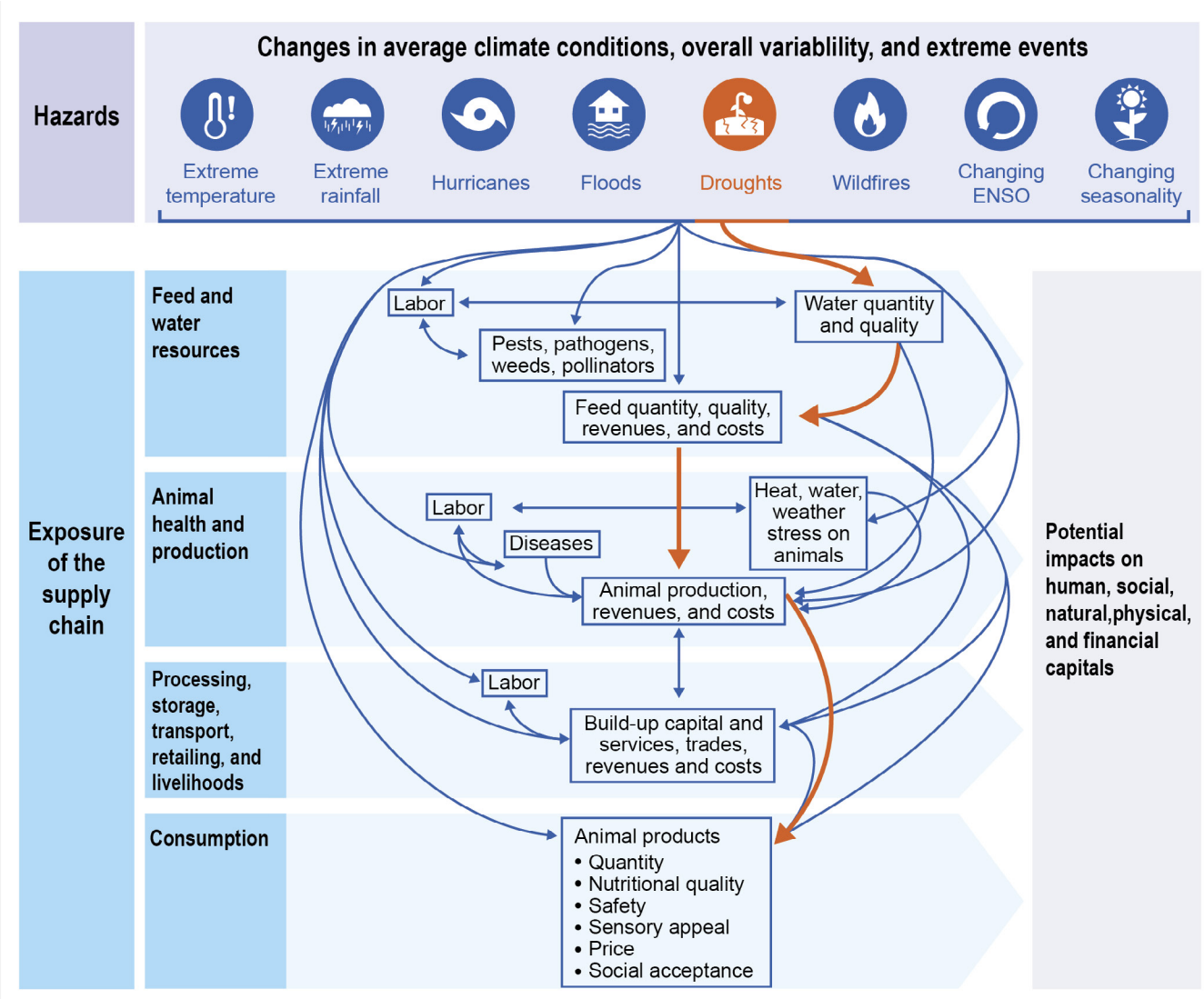
As an example, each stage in the food supply chain, including production, storage, processing, distribution, retail, and household food security, is vulnerable to climate change—from gradual changes in average climate conditions (e.g., precipitation and temperature) to increases in the frequency and intensity of extreme events (e.g., floods, drought, wildfire) and smoke migration (Figure F4.1; KMs 9.1, 10.3, 3.2, 14.2, 28.5, 29.3).[9] Sudden shocks to the food supply chain can have local to global impacts on food security, justice, and human migration patterns (KMs 11.2, 28.3, 29.3).[10,11] Extreme events in other countries raise domestic food prices and limit availability due to global supply chain interdependencies (KMs 6.1, 17.1, 9.1).

The transition to low-carbon energy sources to mitigate future climate change is accelerating demand for the upstream minerals, bulk electric supply goods (e.g., transformers, parts, chemicals), and materials for energy infrastructure and technologies.[12,13,14] Global competition, geopolitical tensions, and supply chain disruptions, along with a national lack of trained workers and inflation-related constraints on investment capital, are shifting materials sourcing (KMs 18.1, 21.5).[15] These disruptions will continue to hinder the global supply chains underpinning development and deployment of technologies for low-carbon and renewable energy generation and supply, as well as the related technologies for emissions mitigation, carbon capture, and electrification critical to achieving net-zero emissions (KM 32.1). Strategies are emerging to secure these critical energy development supplies. These include shifting to upstream sourcing from lower-risk countries near manufacturing sites, assisting countries to bolster mining and refining capacity, building redundant supply chains, and developing alternative materials or processes (Figure 17.2).[3] However, meeting the demand for these inputs may disproportionately harm overburdened and Indigenous communities, fueling inequality, political unrest, and economic loss in US-based investment and interests (KMs 5.2, 16.2, 18.2, 17.3).

Climate adaptation and emissions mitigation will require major transformations of supply chain transportation infrastructure and technologies (Chs. 31, 32).[16] The COVID-19 pandemic showed the sharp demand fluctuations, fragility, and chokepoints of an evolving, multimodal transportation system.[17] This system underlies the supply chain yet increases environmental injustices by siting warehouses and freight ways in overburdened communities (KMs 12.2, 13.4, 15.1, 29.2).[18] Adaptations in digitalization and related technologies (including e-commerce, electric-drive or automated vehicles, and related infrastructure), along with insufficiently localized supply chains, long-standing workforce challenges, and cybersecurity risks, all place demands on and pose risks to supply chain transportation systems. These challenges increase the importance of multisectoral and equity-centered planning and action for transportation (KMs 5.2, 13.2).

Integrated global supply chains will continue to be threatened by climate change and will in turn influence how the Nation responds to climate change. Markets often respond quickly if there are alternate materials or inputs available that are economically viable. Such shifts can present opportunities for disclosure of material risks, informed investment and improved livelihoods in local job creation, domestic economic activity, and innovation across sectors and technologies.[19,20] To protect the quality and security of life for all would require a rapid acceleration of supply chain adaptation measures that increase flexibility and ensure equitable access to goods and services.

Climate Change and Food Supply



Climate change poses challenges to the animal food products supply chain.

Figure F4.1. The figure shows potential climate change vulnerabilities of the livestock food supply chain, including impacts on feed and water resources; animal health and production; processing, storage, transport, retailing, and livelihoods; and human consumption. Blue lines indicate how climate change hazards can impact various sectors of the supply chain either directly or through cascading effects. Highlighted in orange is an example of the cascading effects of drought, where reduced water quantity decreases animal feed quantity, which in turn reduces animal production, resulting in increased food prices for consumers and an increased demand for deforestation-free agriculture and forest products. ENSO refers to El Niño–Southern Oscillation. Adapted from Godde et al. 2021[21] [CC BY 4.0].

Traceable Accounts

Description of Evidence Base and Research Gaps

Extensive evidence and recent lived experience during the ongoing pandemic confirm how supply chains are a core factor in the quality of life and national security of the United States.[5] Multiple examples from across this Assessment show that climate change burdens supply chains and challenges effective, efficient, and equitable provisioning of goods and services. These challenges play out differently depending on a supply chain's sourcing, distribution networks, and many complex factors that are beyond the scope of this discussion.[15] Supply chain climate vulnerabilities are distributed unevenly both globally and within the United States and are known but not well quantified. This uncertainty reflects disparities in the access to materials, technologies, and infrastructure (both physical and digital) that influence decision-making in supply chain management.

It is difficult to predict the expected changes of climate risks on supply chains, as well as human responses due to shocks and stressors. This uncertainty is due in part to the many complex factors that influence the size and composition of supply chains. The degree to which climate change will exacerbate challenges to existing supply chains also depends on the future frequency and intensity of extreme weather events. Finally, there is uncertainty in the choices that businesses and governments make in terms of policy to address risks, build resilience into supply chains, and ensure equitable distribution.[20]

Supply chains enable production of low-emitting energy technologies but are also sources of emissions themselves. Tracking emissions from activities across supply chains is of growing importance both to companies and to investors and disclosure organizations. Discussion of this topic is beyond the scope of this discussion.

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