



MINIMIZING EFFECTS OF SUPPLY CHAIN DISRUPTION

DIVERSIFICATION OF SUPPLY BASE

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Abstract

The COVID-19 pandemic has brought acute awareness to the susceptibility of the global food supply and its dependencies on other interconnected industries. Black swan events, such as the current global pandemic, are considered low probability but highly disruptive to global supply chains. The food supply chain is especially vulnerable. With its complex web of activities, which involve production, processing, distribution, retail, and consumption, the potential for disruption at any given node is significantly increased. These events, coupled with increased climate variability, are reasons to create and implement disruption mitigation programs.

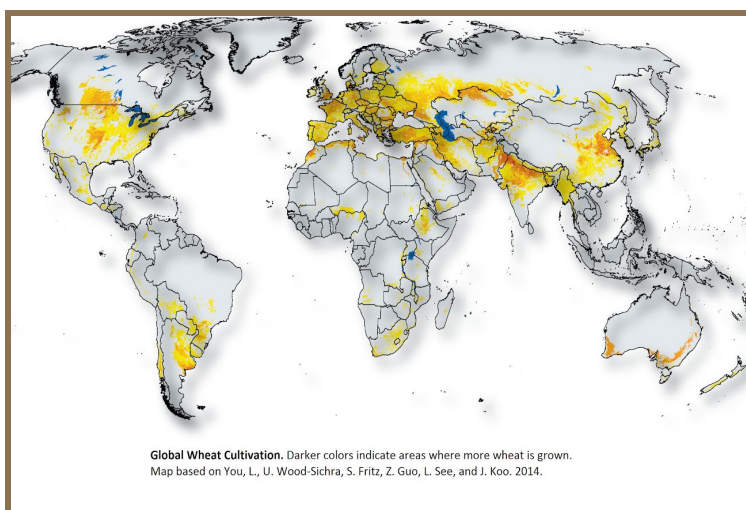
Planning for supply chain disruptions is a key business strategy; doing so not only reduces financial losses, but also serves to enhance a business's corporate social responsibility. By maintaining food availability, preventing job loss, upholding food safety standards, and easing other unforeseen consequences, stable supply chains can reduce impact to communities that are considered food insecure.

One strategy to mitigate supply chain disruption is to diversify the supply base. The agricultural sector is particularly vulnerable to disruptions and heavily relied upon to provide many food staples globally. Creating a complex supply chain that is more resilient to disruptions by investing in the procurement of additional approved suppliers and building industry relationships is just one practice to effectively overcome and prepare for a disruptive event while creating a stable global food supply.

Background

Supply chain disruption in the food industry is defined as any breakdown of a supply chain node between production and consumption activities. This supply chain is dependent on the actors, services and infrastructures that interact with each other at many stages in the chain¹. All of these stages represent a node where weaknesses could develop.

A disruption in the supply chain of a raw agricultural product may have a magnified effect on subsequent portions of the food system. According to The Food and Agriculture Organization of the United Nations (FAO), more than 60 percent of the world's population depends on agriculture for survival². Agricultural commodities are grown and processed all around the world with many being major food sources to billions. Wheat alone is grown on 215 million acres annually to feed 2.5 billion people in 89 countries³. In low- and middle-income nations, such as North Africa and West and Central Asia, wheat acts as a major source of protein and accounts for a significant percentage of calories consumed. If there were a disruption that affected even a small percentage of wheat production, the outcome would result in food insecurity for billions.



Though there are many types of disruptions, agriculture is most affected by natural disasters. Floods, droughts, storms, and earthquakes cause losses in production of crops, livestock and fisheries, while devastating critical agricultural assets and infrastructure.

In studying the effects of natural disasters, the FAO discovered developing countries absorb approximately 22 percent of the economic impact caused by these events⁴. These disasters can be large scale, such as the droughts in sub-Saharan Africa between 2003 and 2013 that caused nearly 24 billion dollars of loss, or of a smaller scale, such as crop exposure to an early freeze, which can affect the crop harvest and further jeopardize the livelihood of the farmer and his family. posed to an early freeze, jeopardizing the crop harvest and the family's livelihood.

Not only does this loss have devastating impacts on the economies of these countries, but it also causes a great deal of food insecurity in regions of low income. In the same study conducted by the

¹ Reddy, V. R., Singh, S. K., & Anbumozhi, V. (2016). Food Supply Chain Disruption due to Natural Disasters: Entities, Risks, and Strategies for Resilience. *Research Institute of Economy, Trade and Industry*.

² Zavatta, G., Perrone, T., & Figus, C. (2014, October 27). Agriculture Remains Central to the World Economy. 60% of the Population Depends on Agriculture for Survival. Retrieved August 13, 2020, from <http://www.expo2015.org/magazine/en/economy/agriculture-remains-central-to-the-world-economy.html>

³ WHEAT in the World. (2017). International Center for Agricultural Research in the Dry Areas. Retrieved July 28, 2020, from <https://wheat.org/wheat-in-the-world/>

⁴ The Impact of Natural Hazards and Disasters on Agriculture and Food Security and Nutrition - Updated May 2015. (n.d.). Retrieved from <http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/280784/>

FAO, it was found that the droughts in sub-Saharan Africa significantly increased the population of those considered food insecure, with an average of 9.6 million people unable to meet basic caloric requirements in the Horn of Africa.

Another indirect impact of disruptions to the global food supply is the potential increase of food safety related deaths and illnesses. As seen in reaction to COVID-19, many entities are stockpiling products and reformulating to accommodate for unavailable ingredients or delays in transportation. This response leads to disproportionate demand with a possibility for lapses in food safety standards, resulting in the need to rely on alternate suppliers in short notice⁵. Disruptions also present an opportunity for rise in food fraud due to reduced surveillance. HorizonScan, an agency that monitors global food integrity issues, has stated; "Since the beginning of the pandemic, nearly 10% of grain-based foods labelled as 'gluten-free' and over 35% of those that do not contain gluten by nature in India have been found to be contaminated with it, some up to 90 times more than permitted levels⁶". Other emerging issues flagged by this agency include a rise in outbreaks and foodborne diseases attributed to pathogenic *Vibrio* species, illegally imported fish and groundnuts into the UK, and an increase in reports concerning aflatoxin in peanuts from the United States.

For these reasons, it should be within a company's corporate social responsibility to identify the vulnerabilities within their supply chain and prepare for unforeseen disruptions in the future. While one entity cannot reverse the effects of natural disasters on developing nations or prevent dishonest suppliers from intentional adulteration, having systems in place to account for these events help to alleviate susceptibilities.

Considering Types of Disruption

The most disconcerting aspect of a disruption is that they are often unforeseen. Therefore, programs need to take all potential disruptions into consideration. Common supply chain disruptions include transportation failures and delays, product discrepancies, price fluctuations, cyber attacks, and natural disasters⁷.



It is important to note that some of these disruptions work simultaneously, or are an unintended consequence of another disruption. For instance, the COVID-19 pandemic resulted in transportation delays. The compacted disruption caused countries to temporarily close their ports or put limits on container unloading. Port operations in India, for example, were minimized in attempts to contain the spread of the virus, causing a backlog of containers and transportation delays⁸.

⁵ Food safety risk during the pandemic. (2020). *Food Science and Technology*, 34(2), 14-17. doi:10.1002/fsat.3402_4.x

⁶ HorizonScan- Global Food Integrity Issues and Emerging Risks. (2020, July 20). Retrieved August 10, 2020, from <http://www.foodchainid.com/technical-services/horizonscan>

⁷ "7 Steps for Minimizing Supply Chain Disruptions Prevention Tips." *The BigCommerce Blog*, 25 Apr. 2020, www.bigcommerce.com/blog/supply-chain-disruptions/#5-types-of-supply-chain-disruptions.

⁸ Schwerdtfeger, M. (2020, April 09). Indian ports begin to clear COVID-19 backlog. Retrieved September 28, 2020, from <https://www.porttechnology.org/news/indian-ports-begin-to-clear-covid-19-backlog/>

Preparation Strategies

Due to the unpredictable nature of most disruptions, it is wise to plan ahead and be prepared. In order to create a robust supply chain disruption program, customization must occur for each business model. Not all preparation strategies are viable and there is no “one size fits all” solution. Finding a balance between running lean and creating a buffer will be different for each entity. However, it should be the ultimate goal in business continuity. An excellent supply chain is described as one that supports, enhances, and is an integral part of a corporate competitive strategy⁹.

Concepts to consider while creating a strategy to mitigate damage due to supply chain disruptions:

1. Conducting a supply chain vulnerability audit

Vulnerability assessments and hazard analysis are required under FDA’s Food Safety Modernization Act¹⁰. While this requirement focuses mainly on potential hazards of raw materials, the same approach can be taken on your supply chain in its entirety.

Perform a risk analysis on your supply chain and identify potential weaknesses. Determine where the weakest points are and plan to fortify these points. How much impact would a disruption have on your business if any node were to be taken out of the supply chain?

Be sure to know all your suppliers by mapping upstream suppliers several times back¹¹.

“After the 2011 Sendai earthquake in Japan, it took weeks for many companies to understand their exposure to the disaster because they were unfamiliar with upstream suppliers. At that point any available capacity was gone.”

It's important from a cost standpoint to make your supply chain efficient; however you can't get very far if your only supply chain is disrupted. Consider the balance between leaning for financial performance and expanding for supply chain resilience.

2. Creating a supply chain emergency plan

Have an alternate plan. Based on your vulnerability audit, create a comprehensive plan in case of emergency. If there was a break in any part of the supply chain, make sure you have a plan “B” for what your company should do.

Emergency operations should exist not only at the corporate or business level, but also at the plant level, with predetermined action plans for communication, protocols for decision making and emergency plans that involve customers and suppliers¹⁰.

3. Building inventory

A deep inventory creates a buffer in the event supply chains are cut off. This could include having more prepared finished goods, supplies or even raw materials.

⁹ Lapide, L. (2014, May 8). How Supply Chain Buffers Can Mitigate Risk - Supply Chain 24/7. Retrieved September 22, 2020, from https://www.supplychain247.com/article/how_supply_chain_buffers_can_mitigate_risk

¹⁰ What is a Supply Chain Vulnerability Assessment? (2019, December 04). Retrieved August 13, 2020, from <https://haccpmentor.com/what-is-a-supply-chain-vulnerability-assessment/>

¹¹ James B. Rice, J. (2020, August 14). Prepare Your Supply Chain for Coronavirus. Retrieved September 22, 2020, from <https://hbr.org/2020/02/prepare-your-supply-chain-for-coronavirus>

For instance, having a deep inventory of products on hand is a great way to create a buffer in times of supply chain stress when transportation fails or prices are volatile. This is an example of the “Variability Buffering Law¹²” commonly used to identify risk management methods.

However, extra storage space is costly, as are the employees who manage the facilities, therefore the pros and cons must be weighed. Does this fit your company’s business model?

4. Linking up with experts

Determine the value of partnering with a logistics expert or investing in risk assessment tools. Having an advisor to preemptively prepare for these events may be more feasible than other strategies, i.e. building inventory.

Alternatively, social media can be used as a tool to identify potential disruptions. Social media allows supply chain participants to monitor events by tapping into collective insights and knowledge¹³.

5. Diversifying supply base

Reduce the concentration of raw materials. A direct consequence of making global supply chains more efficient and lean has been the increase in fragility¹⁴. Diversifying interconnecting industries and creating a web of contacts will buffer your business against disruptions in most cases. This diversification of suppliers is especially crucial for raw commodity importers.

Disruptions occurring at the raw input production level tend to bring significant impact on the whole food supply chain and are therefore crucial. We will be further diving into the why and how of supply base diversification as a strategy to offset the effects of a supply chain disruption in the future.

Supply Chain Diversity

Diversified supply chains are more resilient to disruptions¹⁵. Creating a robust supply base includes adding several new suppliers from regions of the primary origin and vetting suppliers from different origins when possible. This is also known as regionalizing the supply chain.

Of all supply chain disruptions, the most common and devastating for agricultural commodities are natural disasters. These events not only cause extreme physical and fiscal damage, but can ruin financial stability and increase food insecurity. In the future, more natural disasters are expected as a result of climate change and environmental variability. To prepare for these events, it is imperative to diversify your supply base.

¹² Robertson, T. (2019, June 04). What Is Buffering in Manufacturing? Retrieved September 22, 2020, from <https://bizfluent.com/13321264/what-is-buffering-in-manufacturing>

¹³ Rusch, E. (2015, December 18). Using Social Media In The Supply Chain. Retrieved September 22, 2020, from <https://www.manufacturing.net/operations/article/13240905/using-social-media-in-the-supply-chain>

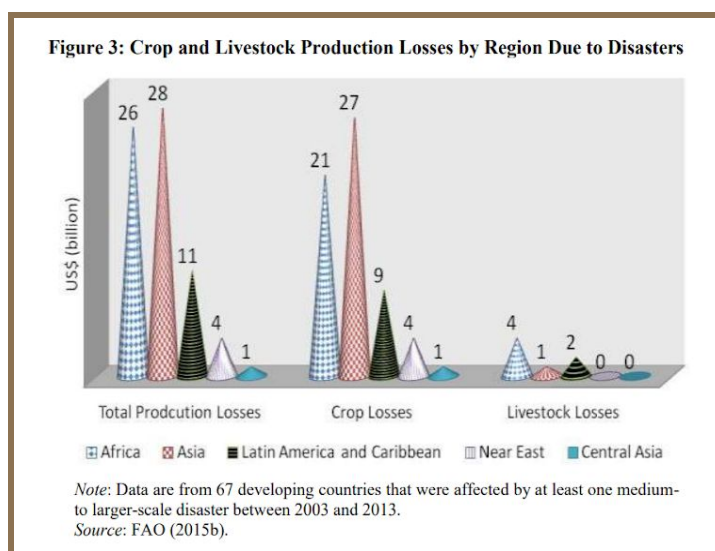
¹⁴ Sodhi, M., & Chopra, S. (spring 2014). Reducing the Risk of Supply Chain Disruptions. *MIT Sloan Management Review*. doi:SLOANREVIEW.MIT.EDU

¹⁵ Lim-Camacho, Lilly, et al. “Complex Resource Supply Chains Display Higher Resilience to Simulated Climate Shocks.” *Global Environmental Change*, Pergamon, 9 Sept. 2017, www.sciencedirect.com/science/article/pii/S0959378017301164.

Why Diversify? Association of Southeast Asian Nations (ASEAN)

The 11 ASEAN member states contain fertile, nutrient rich land which supplies a variety of agricultural commodities globally. ASEAN collectively provides a significant amount of soybean oil (\$2.4 billion), forestry products (\$1.8 billion) and tree nuts (\$1.1 billion) to the United States, while also being responsible for between 75 and 85% of global rubber and palm oil exports¹⁶. While these Asian countries have been successful in achieving economic growth, they are especially susceptible to a variety of natural disasters. Between 1970 and 2014 there were nearly 12,000 natural disaster events globally, of which 42.9% took place in Asia and the Pacific¹⁷. Being a region responsible for a significant amount of global food production yet incredibly susceptible to these natural disasters, importing entities should be aware and have emergency plans and alternate suppliers.

Global awareness of key agricultural production regions and their susceptibility to supply chain disruptions should guide the strategies used to mitigate consequences of these disasters.



Taking these variables into consideration, determine if the agricultural product can be sourced from another supplier within the same region. An unexpected disruption can occur on the supplier level. For example, a climate-controlled storage warehouse used to maintain organoleptic properties of red pepper catches fire, destroying this supplier's entire inventory. This event would be isolated, therefore a nearby supplier would be able to supply the red pepper- unless they were sourcing from the original supplier.

Consider suppliers from different regions and countries as well. An example would be considering agricultural imports from both India and China. If the entire crop of sugarcane in Uttar Pradesh was destroyed by spotted bollworms, with a collection of suppliers based in India, you would be able to source from other states, such as West Bengal.

Similarly, purchasing from several origins is imperative. In the event of a natural disaster that wiped out an entire crop or made transportation impossible, you would have a pre-approved alternate supplier. China is notoriously susceptible to natural disasters, including floods and earthquakes. In this instance, importing from China would be unlikely, therefore the supplier base in India would be called upon. Alternatively, if India experienced a similar disaster, a supplier in China could provide

¹⁶ Myint, J. (2019). ASEAN Business Council: Agriculture. Retrieved August 13, 2020, from <https://www.usasean.org/why-asean/agriculture>

¹⁷ Kim, S., Li, H., & Nam, J. (March, 2015). Overview of Natural Disasters and their Impacts in Asia and the Pacific 1970-2014. United Nations ESCAP. Retrieved August 13, 2020, from <https://www.unescap.org/>

the necessary product. In understanding vulnerabilities of your supply and available alternates, you can create a diverse supply base to buffer against supply chain disruptions.

Building a supply base

The process of onboarding new suppliers requires time, qualified individuals, and financial investment. There are several ways to ensure the auditing is being conducted in a comprehensive yet efficient manner. In order to do this, it is important to understand the working parts of building a diverse supplier base. The following are some tips and guidance on how to obtain and qualify suppliers of agricultural commodity imports.

Familiarize with FSVP

First, when looking to gain new suppliers, you must be proficient in the regulations brought on by FDA's Food Safety Modernization Act (FSMA). This act further outlines several inclusions that are mandated by the FDA, including the foreign supplier verification program (FSVP). The FSVP regulation requires that importers perform certain risk-based activities to verify that human and/or animal food they import into the United States has been produced in a manner that meets applicable U.S. food safety standards¹⁸.

Those most impacted by FSMA's FSVP are those who import goods¹⁹. Importers must verify that food destined for the U.S. is in compliance by developing a program to comprehensively include; potential hazards of a product and if they are controlled, performance of the supplier, verification activities, and periodic reevaluations.

Obtaining the information required by FSMA's FSVP can be collected through documentation requests and in person during onsite audits. A combination of documentation review and onsite observations is an effective way to become familiar with the supplier prior to the onsite audit. This will confirm the food safety and quality programs they provided documents for are in fact in place and working.

Onsite Auditing

In the current global state, onsite auditing is not the most practical option, however it gives an excellent insight to the procedures and inner workings of a supplier. When conducting an onsite audit, it is important to determine and focus on the parts of your foreign supplier verification program relevant to the product being sourced, country of origin and the manufacturing plant. An onsite audit relies heavily on observations and general impressions of a supplier.

¹⁸ Center for Food Safety and Applied Nutrition. "FSVP: What Do Importers Need to Know?" *U.S. Food and Drug Administration*, FDA, www.fda.gov/food/conversations-experts-food-topics/what-do-importers-need-know-about-fsvp.

¹⁹ Center for Food Safety and Applied Nutrition. "FSMA Final Rule on FSVP for Imports." *U.S. Food and Drug Administration*, FDA, www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-foreign-supplier-verification-programs-fsvp-importers-food-humans-and-animals.

Key parts of an onsite audit include developing an understanding of the process flows at the facility and identifying potential hazards. Generally hazards can be sorted into 3 categories: biological, chemical and physical.

I.e.: Is there glass on the floor or chemicals without containment? Are biological hazards being controlled at the facility and are the controls appropriate? If they are not appropriate, can this be controlled upon import?

Additionally, note the hygienic practices of the employees and conditions of the processing equipment. Would anything observed create a hazard or make the product unsafe?

Are they following Good Manufacturing Practices (GMPs)? Are they in uniform if required? Are hair nets required and provided? Is the equipment in good condition with no hanging pieces and flaking paint?

Take detailed notes to refer back to when making a decision to approve a supplier. Take into consideration if these hazards can be controlled upon import. If potential hazards can be controlled upon receipt, the standards held at the supplier's facility may be considerably different.

Documentation Review

In addition to the physical audit, a documentation review must be conducted. Important documents to request include all food safety related programs, but additional programs can also be important.

Take into consideration: Does the supplier have a quality assurance laboratory to perform testing? What analyses are being done? Is the lab qualified to do this testing? For example, if a specific pesticide has been identified as a risk and the supplier claims they are negative or below residue limits per lab analysis. It is important to ensure the lab is qualified to do this testing. Otherwise, the test needs to be performed by a 3rd party lab.

After all audits are complete, discuss your findings among your team and determine a list of top performing suppliers. From this supplier pool, determine rank and divide contracts accordingly. Giving a contract to a supplier maintains these relationships, keeping an option open in times of need.

Relationship Building

The relationship between a supplier and the importing company should be strong and facilitate open communication. After the supplier has been approved, share observations from the audits. Most of the time, the supplier will be open to suggestions and willing to update their programs and practices if required. Food manufacturing standards are different globally and the supplier may need guidance in understanding the elements needed to comply with the regulations imposed in the United States.

Once the product is received, give feedback to the supplier. Commending the supplier if they are providing a quality product shows appreciation and lets the supplier know what you expect in the future. Many are quick to file claims or complain if the product is not what was expected, but don't remember to show gratitude for high-quality products.

Conclusion

The global food supply has become increasingly dependent on foreign imports to maintain the availability and variety of foods we've come to expect today. According to the Natural Resources Defense Council (NRDC), in 2007 the typical American meal had ingredients that on average originated from at least five foreign countries²⁰.



Ingredients and agricultural staples grown globally are consistently available due to advancements in packaging and transportation, increasing the food miles travelled between source and plate. This complex relationship with interconnected industries contains many nodes and actors, creating an opportunity for disruption at any point in the supply chain. These nodes or points of vulnerability should be assessed and fortified to minimize the effects of supply chain disruption.

Freight train carrying grain across Washington State. Photo credit: David Gubler, Creative Commons.

"If the stupendous system of food preservation and transportation which supports us were interfered with... cities with thousands of inhabitants would fade away. We would probably turn into beasts in our frantic struggles to reach the source of supply"- Golden Book Magazine, 1931.

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Additionally, we must take into consideration global climate change and its impact on the future of the global food supply. Climate change is already affecting natural resources in such industries as vegetation, animal husbandry and fisheries. All of which are relied upon for food, fuel, and industrial products²². The earth's climate change has already contributed to heavy rainfall and floods, while other regions experience more frequent droughts. It is predicted that the intensity and frequency of extreme natural events will increase, negatively affecting agricultural production. The impact on production will be amplified up the food supply chain, causing an echo of disruption.

Given the impending situation with global climate change and the potential for other black swan events in the future, it is vital to assert responsibility in creating a diverse and sustainable food system. Supply chains and industry relationships are important for the food system in its entirety. A prepared and resilient food supply chain reduces the risk of increased food insecurity, loss of jobs, economically motivated adulteration and lapses in food safety.

²⁰ Becky Henne, M. (2018, October 04). How far did your food travel to get to you? Retrieved September 28, 2020, from https://www.canr.msu.edu/news/how_far_did_your_food_travel_to_get_to_you

²¹ Freidberg S. Fresh: A Perishable History. Harvard University Press; 2009.

²² World Bank (2010), World Development Report 2010:Development and Climate Change. Washington, DC: The World Bank.