

Chapter 12

Managing Risk in Global Food Supply Chains: Improving Food Security and Sustainability

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ABSTRACT

Supply chains have inherent risk given the number of actors that interface. While there are some chains that have low frequencies of unfavorable events, many continuously face uncertainty. Food production has many uncertainties along the global supply chain. The global nature of the large logistical networks increases its complexity. Two main sources of uncertainty arise: External and internal to the SC. External factors mainly come from nature (such as “El Niño” phenomenon) and from human activities (such as food and nutrition policy and standards). Internal factors mainly come from operations such as a cold chain disruption. Thus, one needs to minimize risk and improve resilience in order to achieve food security and sustainability. It is then imperative that risk management practices be integrated into the supply chain design and management process. This chapter presents an overview of the main risks involved in global food supply chains, as well as some techniques for risk management.

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INTRODUCTION

Supply chains (SC) all have inherent risk given that many actors interface to create the value chain they form a part of. While there are some chains that have low frequencies of unfavorable events, there are many that continuously face uncertainty. The food sector and specially the fresh food segment, have many variables that interact to create many critical uncertainties along the global SC. Many of the food chains are large networks of interacting actors that create a production and logistical network that increases its complexity (see Figure 1). On the upper part of the figure there are two main sources of risk, man-made ones (right side) and those produced by nature (left side). The second layer of flows that stem from the first categorizes each flow into two main groups. For the environmental source, there are risks stemming from biological agents and from geophysical ones. From the human health risks perspective, contamination and handling of food products are paramount risk flows. The environmental risk flows have a stronger effect on the initial stages of the food SC, as is illustrated in the middle section of the figure from top to bottom. This is to say, at the supply side of the chain (e.g. drought and pests). This is not to say that manmade issues don't affect this section, but it is in a progressive scale. On the other end the chain manufacturing and distribution are heavily affected by the potential of contamination (e.g. pathogen contamination at packaging) and mishandling (e.g. disruption in the cold chain). Other external factors that are sources of risk come from the economic and policies that affect the natural and human elements of the food SC (e.g. market volatility and health regulation). Uncertainties arise from the interfaces of these actors. These can be classified in to two large groups: external and internal to the SC.

External factors are those that come from the environment surrounding the SC system. They can also be grouped in two main categories, those coming from nature and those coming from human activities. The ones from nature range from biotic and abiotic sources in the agro-ecological interaction of a given food producer in its primary form (e.g. eggs, fruits, vegetables, legumes, grains, etc.) with its natural surroundings (Miranda-Ackerman & Colín-Chávez, 2019).

Abiotic aspects range from temperature, sunlight, moisture, precipitation, wind, seasonal changes, earth systems events (e.g. El Niño, La Niña), water flows, geophysical phenomenon (e.g. volcanic events, land erosion, mud slide), etc.

This is not an extensive list, to the contrary, it is just the tip of the iceberg, furthermore each one of these aspect have many elements of risk and uncertainty that interact with the PS (PS) to create vulnerabilities.

Biotic factors, on the other hand, have even higher levels of complexity. Biotic aspects are mainly related to the relationships between the different organisms that interact directly or indirectly with the agrofood PSs in all stages of the SC (Guy, Macdonald, Mackenzie, & Burritt, 2018). In the primary production stage, microorganisms in the soil, air and on plant and animal tissue interact with seeds, roots, plants and fruits, which in turn interact with the food products that are being produced.

In an orchard, chicken farm or greenhouse PS, microbiome of fertilizers, insects, organisms in feed, all interact. Two very important risks related to the biotic aspects of food SCs are the quality and quantity of food to be produced in the primary stages. This has a direct effect on food availability, nutrition, health and other important aspects, one of the most important being food security (Dhankher & Foyer, 2018). On the other hand there is the food safety risks related to the biotic factors. These are mainly related to food contamination with hazardous microorganisms to human and animal health.

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