



Hazards and Risks: What is the Difference and How to Evaluate for Your Operation, a Beginners Guide

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Introduction

The terms hazard and risk are commonly used in life, as well as the food industry. While these two terms are related to each other, they have different meanings. This document is intended to define hazard and risk, and to serve as a guide for produce growers and packers to identify hazards and begin to evaluate risks.

Food Safety Hazards

A hazard is any biological, chemical, or physical agent that has the potential to cause illness or injury. These hazards may be introduced into the supply any time during the growing, harvesting, packing, holding, and shipping of your product.

- Biological hazards include bacteria, viruses, parasites, yeasts, and molds.
- Chemical hazards include cleaners, sanitizers, lubricants, paints, fertilizers, pesticides, allergens, toxins, and petroleum products.
- Physical hazards include organic materials, nails, screws, staples, metals, woods, and plastics.
- A hazard analysis is the process of gathering and evaluating information on hazards, and the situations/instances that may lead to their presence, to assist in determining which hazard(s) impact are food safety and need to be addressed.

Food Safety Risks and Risk Assessment

Risk is the probability of a hazard to occur and cause serious or adverse health effects. Risk combines the likelihood of the hazard to be present, the level of the hazard, and the probability of it to cause illness or injury. There is no such thing as “no risk” or “risk free” or “zero risk” in life, or food safety. The term residual risk is the risk that remains after a food safety system has been implemented. Risk assessment in the simplest form is based on:

- **Hazard Identification** – What are each of the hazards of concern? Could each hazard cause harm?
- **Hazard Characterization** - What does each hazard cause (injury or illness)? How serious is the potential consequence?
- **Exposure Assessment** - Who may be harmed, and at what level of each hazard is the exposure harmful? What is the relationship between the exposure or “dose” to response?
- **Risk Characterization** - How likely is it that people will experience each hazard at an exposure level to cause harm? Is there a vulnerable population that would receive a disproportionate share of the exposure?

(<https://campaignforaccuracyinpublichealthresearch.com/risk-vs-hazard/>).

		Impact				
		Negligible	Minor	Moderate	Significant	Severe
Likelihood	Very Likely	Low Med	Medium	Med Hi	High	High
	Likely	Low	Low Med	Medium	Med Hi	High
	Possible	Low	Low Med	Medium	Med Hi	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium	Med Hi
	Very Unlikely	Low	Low	Low Med	Medium	Medium

Figure 1. Risk Matrix based on hazard likelihood and outcome consequence. Developed by Dane Boers
<https://www.armsreliability.com/page/resources/blog/beyond-the-risk-matrix>.

Hazard ≠ Risk

- Hazard does not equal risk. Understanding hazard and risk allows the industry to make informed- and data-driven decisions. For example, *Salmonella* cells potentially present in a product is an example of a hazards while the risk would be the probability of contracting salmonellosis after consuming the food product (Zwietering, et al. 2021).
- Overall, food safety management systems should apply both hazard- and risk-based approaches to address food safety.



Figure 2. To illustrate the difference between hazards and risks, consider water, gasoline and driving. They are all examples of everyday substances/activities that are hazards based on their potential to cause harm. The potential of harm associated with each of these hazards is elevated when coupled with risky actions such as jumping into water without knowing how to swim, lighting a match near gasoline or texting while driving. Image developed by: Campaign for Accuracy in Public Health Research

Identifying Hazards and Evaluating Risk on Your Farm?

It is important to understand how fruits and vegetables may become contaminated by hazards, and for each hazard to develop a good agricultural practice to minimize risk of the hazard from occurring. As a beginner’s guide, there are five primary ways potential hazards may be introduced on your farm:

1. **Humans** – farm workers, visitors
2. **Water Applications** – irrigation, spray applications
3. **Soil Amendments** – manure, compost
4. **Animals** – livestock, pets, wildlife
5. **Equipment, Buildings and Tools** – vehicles, harvesters, tool sheds

One way to start identifying hazards on the farm is to draw a map of your operation (mapping product routes under your control) and think about the primary ways product may be contaminated. As you create your map or series of maps, remember to outline your entire process, making sure to consider the different stages of production. These questions serve as an example guide to help get you started:

1. **Pre-plant (Bardsley et al. 2021)**
 - What is the prior and current usage of the land and structures?
 - How is the adjacent land surrounding the operation used?
 - Where are plant materials sourced from and will material be used for propagation?
 - Are there characteristics of how this crop is grown that contribute to risk?
2. **Production (Vallotton, et al. 2021a)**
 - What type of soil amendments are being used? How are amendments being stored? How are amendments being applied?
 - What is the source of water? How is irrigation water applied?

- What agricultural chemicals are being used? How are they being handled and stored?
- Is there evidence of wildlife intrusion? Are there working animals on the farm?

3. Harvest (Vallotton, et al. 2021b)

- What type of equipment is being used? Is equipment clean and in good condition?
- Where will produce be placed after harvesting?
- Are workers sufficiently trained on hygiene and have access to bathrooms, handwashing stations, and potable water?
- Evidence of wildlife intrusion (feces, tracks)

- b. Are workers correctly using and disposing of gloves/washing hands?
- c. Is there debris on sorting tables, containers, conveyer belts, etc., around the facility?
- d. Are there niches for pathogens in and on rollers, belts, sponges, welds?

4. Washing and Drying

- a. Is water used in the operation? What type of system is being used (flume, dump tank, etc.)? What is the temperature of the water?
- b. What is the microbial quality of the wash water? Is there buildup of organic debris (turbidity)?
- c. What post-harvest sanitizer is being used?
- d. Is forced air or dry rollers used for drying?

5. Packaging and Storing

- a. What are the materials used for packaging?
- b. How are packaging materials being stored?
- c. What are the storage conditions of finished products (temperature humidity, debris, pest management)?

Identifying Hazards and Evaluating Risk in Your Packinghouse?

While there is overlap in the foundational skills required for identifying hazards and evaluating risk on the farm, the packinghouse environment brings about unique challenges in identifying hazards and managing risk (Vallotton, et al. 2021c). As a beginner's guide, let us consider the packinghouse using the following stages to help us identify potential hazards in your facility:

1. Infrastructure

- a. Is the facility an "open" or "closed" environment?
- b. Is there an effective pest management plan?
- c. Is there standing water in my facility?
- d. Are there proper hygiene facilities and break areas for worker away from the production line?

2. Receiving

- a. How is produce being moved from the field to the production area?
- b. Is there direct contact between raw agricultural commodities and non-food items?
- c. How is produce stored upon arrival?
- d. Is pre-pack cooling required? What is the method for pre-cooling?

3. Handling and Sorting

- a. What materials are zone 1 (direct food contact surfaces)? How hard are they to clean and sanitize?

Importance of Re-evaluating Hazards and Risks

Each operation is unique, and the hazards and risks will be specific to each operation until things change or are modified. It is important to continually re-evaluate hazards and risks on your farm and within your facility. This should be performed annually by your food safety team or individual, and when new practices, processes or activities are introduced, when new products, tools, and/or equipment are added/changed, and or when new information concerning harm becomes available (e.g., food safety issue occurs like product associated with recall or outbreak, etc.). For example, the 2011 *Listeria monocytogenes* outbreak from cantaloupes has been traced back to newly installed equipment thus validating the importance of re-evaluating risk whenever any changes to your operation or product are made (McCollum, et al., 2013).



Figure 3. Visualization of example for re-evaluating hazards and risks to determine if they are still valid or no longer valid. Image developed by dot.alaska.gov for Module 6: Transportation & Public Facilities.

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