

## Microgreen Supply Chain Analysis for the Pre-Harvest Stage

D. Wiafe and J. Talley

Morgan State University  
1700 E Cold Spring Ln,  
Baltimore, MD 21251, USA

Corresponding author's Email: [jessye.bemletalley@morgan.edu](mailto:jessye.bemletalley@morgan.edu)

**Author Note:** Dajon Wiafe has research experience in supply chain management. He took courses on differential equations, linear programming, and economics. He has a strong interest in the logistics and financial issues that must minimize cost but maximize profit. His current research interests consist of applications in marketing, supply chain, and simulations. Jessye Talley has research expertise in stochastic and deterministic modeling of supply chains using stochastic programming, Markov chains, differential equations, linear programming, and queueing theory. She has a strong interest in the safety and defense of food supply chains, humanitarian relief, emergency preparedness and response to address ports, and healthcare. This material is based upon work supported by the National Science Foundation under Grant No. 2000244. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

**Abstract:** Microgreens are young and edible leaves that are harvested after the process of cotyledon. During the cotyledon process plants emerge from the seeds and provide an energy source for the plant to grow. Microgreens specifically have grown in popularity due to their richness in flavors, nutrients, and minerals, and is overall a healthy food for human consumption with a low cost. The project's overall goal is to gain knowledge of microgreens and analyze a supply chain that will allow the least possible degradation and provide high quality foods to the consumers. Perishable products deteriorate over time. Some examples of perishable products are fruit, vegetables, meat, and human blood. Management of the perishable product supply chain is complex because of the low demand, high deterioration, short shelf-life span, but overall meets the requirements of customer satisfaction. The first phase of this project seeks to understand the flow of information and products through the supply chain. We will focus on the pre-harvest process flow. The pre-harvest stage will consist of the microgreens being grown at the production stage. Using a cause-and-effect diagram we will determine which areas of the microgreen supply chain need to be improved. This information will help to develop the base case simulation model for our research.

*Keywords:* Microgreens, Supply Chain, Pre-Harvest Stage, Production Stage

### 1. Introduction

Microgreens are considered baby plants, and they are about 1-3 inches in size. In recent years, suppliers have found new methods to grow microgreens in order to secure a safe edible plant that meets the customers satisfaction. Some of the methods are aquaponics, hydroponics, and soil. Microgreens are harvested in 7 to 21 days after germination. Many factors with respect to producing microgreens, such as equipment, growing methods, advertisement, time management, transportation, growing systems and growing mediums.

There are different types of microgreens from the Brassicaceae family to the Asteraceae family. The Brassicaceae family consists of broccoli, cabbage, and radish while the Asteraceae family consists of lettuce, endive and chicory. Dills, carrots, and celery are a part of the Apiaceous family. The Amaryllidaceae family are garlic, onions and leek. Each family has its own specific trait. Carrots and dills specialize in Vitamin A and are a rich source of antioxidants (Petre, 2016). We are specifically considering broccoli. For example, the Brassicaceae family are beneficial for human consumption due to the high vitamin E levels and have more sulforaphane compared to regular broccoli. Broccoli is one of the most produced microgreens because it can be easy to grow in indoor farming. This result can help prevent heart diseases and cancer. Eating microgreens helps lower risk of many diseases such as heart disease, diabetes, and cancer. Microgreens compared to mature greens have shown that the nutrient levels in microgreens are ten times higher found in mature greens (Petre, 2016). There are a lot of

health benefits associated with these plants. Microgreens are mainly used by chefs as flavor enhancements and the demand is high from the chefs because this crop is used for their business. These plants are inexpensive to grow and are one of the most profitable crops you can grow. They grow in a small space and sell by the pound. North America is one of the largest contributors for microgreens because of their farming practices and are producing them at a large scale. Hydroponic farming generates the highest revenue in the north region because of the lack of pests, uses less water and produce bigger harvest. In a supply chain the products are shipped from the farm to the restaurants. The restaurants rely on the farmers to produce a fast and efficient microgreen that will satisfy the customers' wants.

There are a lot of studies about microgreens. In this study, we will focus on the pre-harvest process flow that will help us determine what needs to be improved in the production stage using a cause-and-effect diagram. In this diagram it will focus on prices used for microgreens. And four main factors of that will include transportation, manpower, advertising, and equipment. This research aims to address some of the following questions:

1. How many factors are affecting the microgreens profit?
2. What are some factors that can affect the profit of microgreens?
3. How can transportation be a factor that can impact a producer profit of microgreens?

The remainder of this paper is outlined in as follows. Section 2 will provide a summary of the literature. Section 3 presents the methodology used to solve the problem. Section 4 shows the results. And then the conclusion is summarized in section 5. Lastly, the references are in section 6.

## **2. Literature Review**

Timmer (2009) discusses the behavior of supermarkets and how it impacts society. Such as farmers, retailers, and wholesalers. There are two main ways the behavior of the supermarket influences society, which includes finding a way for food prices to “internalize” the full environmental costs of production and marketing. Bennicasa et. Al (2019) explains why it is a healthy food for human consumption. Sprouted grains are made from whole grains that have started to germinate. It offers 7 nutritional benefits compared to unsprouted grains. Weber (2017) explain how broccoli microgreens can be a good source of minerals that can be grown easily and consumed by individuals. Microgreen broccolis are easy to grow without impacting the environment.

## **3. Methodology**

A cause-and-effect diagram is a visual tool used to logically organize possible causes for a specific problem or effect that are displayed in detail (Figure 1). The possible causes that are considered for this method are manpower, materials, methods, machines, and measurements that can contribute to the main problem. The manpower refers to people that are needed to address the problem. Materials represent the provision or supplies needed to address the problem. Methods are the procedures needed to address the problem (Juran, 2018).

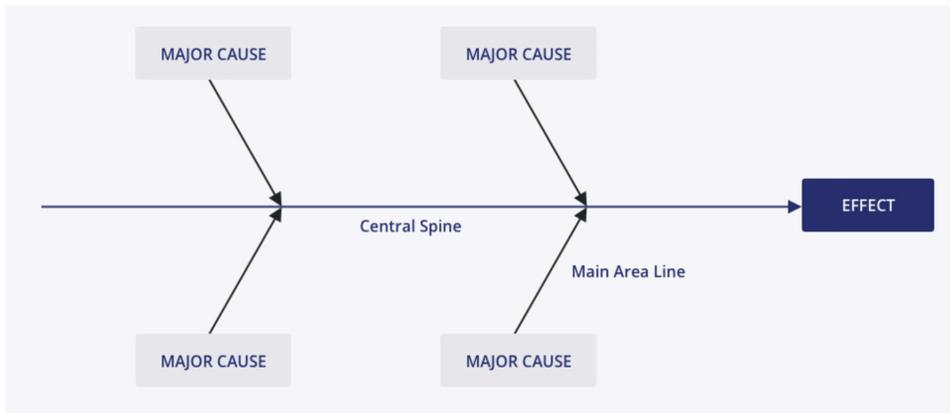


Figure 1. General Cause and Effect Diagram (Juran, 2018)

#### 4. Results

The cause-and-effect diagram that has been presented demonstrates one of the issues demonstrated with microgreens (Figure 2). One of the concerns that may occur with dealing with microgreens is being able to maximize the profits of microgreens. For example, the factors that disrupt the maximum profits of producing microgreens are the equipment, marketing, suppliers, and transportation. These four factors can affect the profits of microgreens because it takes money to market your product, without good marketing the consumer will never know about the product. Which will lead to no one buying the product. Another factor is the price of the equipment. You must have the right equipment to successfully grow microgreens at a high level that will meet the consumer needs. Transportation is another factor, since you must take into consideration the gas the truck has to consume in order to successfully transport the goods from one place to another. You must keep the truck maintenance and have a reliable truck driver. This goes deeper into being able to have a fast transportation system because microgreens have a high deterioration rate. The quicker you can deliver the product the less money you will lose out on because the microgreens would not be rotten or spoiled. Which will cause the quantity and quality to decrease. Last, the supplier. The amount of money that it will cost to have the manpower or employees, and the actual cost of all the microgreen seeds are a contribution of affecting the profits of microgreen seeds.

#### Cause & Effect Diagram

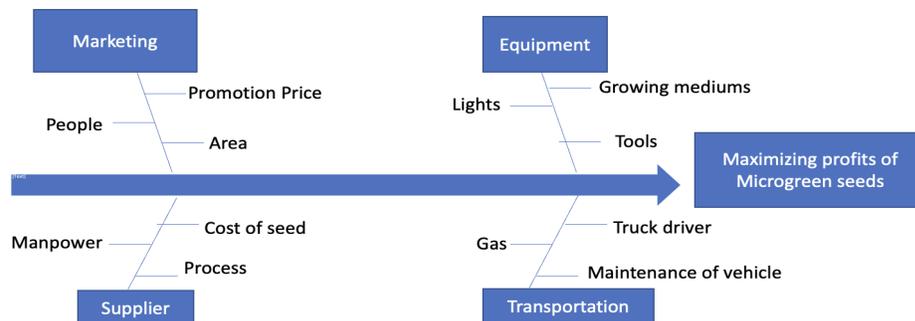


Figure 2. Microgreen Cause and Effect Diagram

## 5. Conclusion

This paper gives an overview of microgreens and factors that contribute to production of microgreens. It also shows how a cause-and-effect diagram is used to analyze the effects on microgreens. It also discusses how there is less information about microgreens shared in certain social classes in society. Using the cause-and-effect diagram highlighted the need to consider other factors when distributing products. Analyzing and preventing these factors can minimize cost and maximize profit. If these factors are to be eliminated the profit from microgreens will be higher.

## 6. References

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