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Potential Solution Methods for Safer Food Supply Chains

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ABSTRACT : *Food safety is paramount to the security of every individual, society, and culture. Different techniques have been used across the world to promote food safety throughout each part of the supply chain of food products. This includes personal actions taken by individuals and homes to protect and preserve end item food. It also comprises of organizational, corporate, and legislative actions taken by food suppliers and legislative bodies as it is related to food production and handling processes. This article addresses some key proposed solution methods for addressing food safety issues. The discussion also alludes to undesired outcomes on farming operations due to legislative actions taken to address general issues in society.*

KEYWORDS *Radio Frequency Identification Technology, Farming Supply Chains.*

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I. INTRODUCTION

Throughout history various processes have been used to protect the population through and preserve food. This article discusses some of the recent methods developed to promote better food handling activities. While processes and legislation can benefit societies and populations, this is not guaranteed. Negative impacts on smaller farms and farming supply chains are greater than the negative impact on larger supply chains. The impact of policies on small farms is discussed. First, one of the more recent processes proposed through legislation is the Food Safety Modernization Act (FSMA). Next, the use of Good Agricultural Practices (GAP) for food contamination prevention is examined. The use of traceability technology (specifically Radio Frequency Identification, RFID) in reducing the impact of food recalls is covered.

II. FOOD SAFETY MODERNIZATION ACT

The Food Safety Modernization Act (FSMA) is sweeping legislation designed to protect the American public by focusing on preventing illness rather than responding to outbreaks after people are already sick. The Act was passed in 2011 to address the fact that there are over 48 million illnesses per year in the U.S. that are caused by food, and these could largely be prevented with better manufacturing, packaging, distribution, and holding practices. All activities surrounding FSMA are designed to improve food safety and protect the public. Nevertheless, probably the most significant component (rule) for food processors is the Preventive Controls for Human Food. Next, the three most significant rules of the FSMA for food safety and moderate to small sized farming supply chains are briefly discussed.

III. FOOD CONTAMINATION PREVENTION (GOOD AGRICULTURAL PRACTICES)

Dr. Luke Laborde, Author of "Keep Fresh Produce Safe Using Good Agricultural Practices (GAPs)", educates his readers on how to prevent contamination and any airborne illness from passing to farmers growing produce. Throughout the article he talks about *microbial*, which is "a bacterium causing disease or fermentation". He also gives his audience many pointers on how to practice "Good Agricultural Practice" and gives tips on daily farming activity that some may have not been aware of.

Dr. Laborde, a professor of Food Science at the institution of Penn State states:

> "Pennsylvania fresh produce growers can be proud of the wholesome and nutritious fruits and vegetables they grow. Unfortunately, recent foodborne disease outbreaks traced to fresh produce have caused consumers to question the safety of our fresh food supply. Most produce-related illnesses have been traced to crops grown in other parts of the United States or in other countries. But microbial contamination can happen anywhere -- even in Pennsylvania."

Though farmers can be very proud of the hard work and progress they have made with their production, the lack of attentiveness farmers give to looking into the inner condition of their product and making sure that it is handled with proper care has helped form a bad relationship between some farmers and their customers.

Due to the lack of "Good Agricultural Practice", for so many years there have been outbreaks of many diseases from food contamination. It is stated in the article that:

> "These and other pathogenic microbes cause over 75 million people to get sick each year. Most cases are not very serious, but the very young, the elderly, and people with impaired immune systems can become seriously ill and sometimes even die."

Though some cases may be minor, a farmer's biggest accomplishment or goals should be product quality and pureness.

Dr. Laborde states that, "There is no way to know for sure how much foodborne illness originates on the farm, but the number of illnesses traced to fresh produce has grown faster than any other type of food." This shows that we need to be more cautious about how food is monitored and handled to minimize this problem, especially if there is no direct trace of where this problem arises from.

The Government has passed the GAP standards for keeping consumers safe and allowing farmers to stay up to date in their businesses. Dr. Laborde states:

> "Rather than waiting for a bad situation to occur and then fixing the problem, GAPs are about learning where food safety hazards can occur and taking preventive steps before a product leaves the farm. GAPs protect the public from harm and your farm business from the economic consequences of food contamination."

This GAP procedure will not only help farmers with their production, but also provide greater insight into the farmers' overall supply chain business operations.

Dr. Laborde shares with his audience numerous tips farmers can follow to properly carryout GAP. They are as follows:

Harvest:

Use field sanitation practices.

- Keep harvest equipment and tools clean and in good repair.
- Check harvest machinery to see if fluids are leaking or if there are loose or damaged parts.
- Protect exposed glass on equipment with plastic or wire fixtures.
- Use harvest containers and tools that are easy to clean.
- Clean containers before each use and repair or discard damaged ones.
- Remove as much dirt as practical from produce before moving it to packing areas.
- Handle produce carefully to avoid bruising and damage and do not overfill containers.
- Remove harvested produce from the field quickly and protect it from sources of contamination.

Promote good hygiene practices for produce harvesters and handlers.

- Do not allow workers who show signs of diarrhea, vomiting, fever, sudden yellowing of the skin, or infected wounds to handle fresh produce.
- Prohibit eating, chewing gum, and tobacco use in growing areas.
- Dispense drinking water in single-use cups or by fountains -- not in common cups or dippers.
- Make sure workers use the toilet facilities provided.

- Teach them when to wash their hands before starting to work -- after each break, after handling unsanitary items such as animals, manure, or decayed produce, and after using the toilet facilities.

Post-Harvest:

Use only potable water for transporting, washing, waxing, or cooling harvested produce.

- Change water in tanks regularly to prevent buildup of soils.
- Add a sanitizer to tank water and monitor concentration and pH as necessary.
- Install vacuum breakers on hoses and maintain air gaps to prevent backflow of water.
- Keep tank water temperatures at least 10°F warmer than internal produce temperature to avoid uptake of microbes into the produce.

Minimize opportunities for contamination and microbial growth during shipping.

- Inspect trucks for cleanliness and pre-cool refrigerated vehicles before loading them.
- Load carefully to avoid damage to the product.
- Lock or seal the truck door to keep secure.
- Keep records of where each product was grown and when it was packed and shipped.

If utilized properly, these tips could help farmers to substantially improve their food safety guidelines of hygiene, growth environment, and more. Farmers applying these tips will be able to promote healthy and safe growth for their products by reducing bad habits in handling food and minimizing possibilities for food contamination. Next the potential importance of using traceability technology for food safety is briefly discussed.

IV. Food Traceability

Author of "RFID: A Taste of Traceability Technology", Tom O'Boyle introduces his readers to the rising commodity that will be very beneficial to farmers and markets. O'Boyle list the different types of Radio Frequency Identification readers, what they do and the ones he believes are more useful and efficient depending on the buyer. In this article O'Boyle also addresses the setbacks farmers and markets go through when they are faced with recalls and food contamination. He states how this can all be solved or minimized by using Radio Frequency Identification.

Farmers and markets for years have always experienced food contamination and recalls due to a various amount of reasons. It is stated in the article that, "In addition to potentially harming consumers, the average recall costs a company $10 million, according to the Grocery Manufacturers Association. To mitigate risks, keep consumers safe, comply with increasingly strict industry regulations, and assuage (if not prevent) recalls, more food and beverage manufacturers are investigating innovative technologies." The demand for food has increased dramatically, which also means that there is more of a possibility for food to become contaminated resulting in large amounts of money wasted nor money gained from the food produces. Situations like this hurt companies and farmers extremely because it will cause untrustworthiness between the consumer and supplier.

O'Boyle states the following:

> "A central piece of complying with industry regulations like the Food Safety Modernization Act, or FSMA, is data collection—food and beverage companies must collect, access, and utilize the necessary data to track and trace products throughout the supply chain. RFID provides these capabilities, and then some."

With the new acts, regulations, and rules that have been passed for food companies and farmers, RFID readers will help them to pass and properly carry out these rules and regulations or keep farmers and companies aware of the status of their products.

In the article O'Boyle talks about two different types of Radio Frequency readers, but out of the three it would seem as if one of them especially would be very vital and essential to the current research. O'Boyle goes on to state:

> "A technology within the ever-evolving Internet of Things, or IoT, Bluetooth Low Energy (BLE) tags are not only less expensive than active tags, but they are even easier to deploy – requiring a simple connection to a Bluetooth – enabled device, like a smartphone or a mobile computer."

This version of the RFID device allows more flexibility and more range for the consumer to have an update on their product, from expiration, its environment, etc. All versions of the RFID readers are valuable and convenient depending on the type of farmer and their product, it will allow them to reach the goals they set for their products and decrease the level of contamination.

The second type of Radio Frequency readers are the Wi-Fi based tags, these are seemed to be one of the most commonly used tags in the work place. It states in the article:

> "The other key type of RFID tags is active, or Wi-Fi-based, tags. Unlike passive tags, active tags draw from their own internal power supply to transmit signals to standard wireless access points. This provides real-time location information for tracking high-value, high-impact, mobile assets. A good use case for active RFID tags is tracking large machines or pieces of equipment. While active tags are costlier than passive tags, they have a much greater read range—up to 300 feet."

The Wi-Fi tags seem to provide more flexibility and features that can keep you updated with your product. For this research being conducted, this would be very helpful because it would allow farmers to locate the product that needs any attention.

Radio Frequency Identification readers are shown to be big contributors in other workplaces and could also be a big contributor to farmers if implemented in their regular growing plan. This device is more efficient and has shown that it will give the consumer so much flexibility and less stress through the stages of growth of their product.

Produce safety has become a very imperative task for food companies and farmers. Overtime the Food Department Association has passed many laws, rules, and regulations for food handlers to follow. In this article, Lupo points out the two key provisions of the "Produce Safety Rule", which are the "Agricultural water quality and testing" and "Biological soil amendments" that the FDA wants farmer to follow in order to prevent any type of contamination to the food they sell.

The Produce Safety Rule is associated with the Food Safety Modernization Act, but only goes more in depth about the soil and water used to grow the products. Lupo states: "The rule establishes, for the first time, science-based minimum standards for the safe growing, harvesting, packing, and holding of fruits and vegetables grown for human consumption."

As stated above, this rule is somewhat similar to FSMA but only using more science based approaches that are believed to help on a positive way and minimize any harm from each stage of handling food to when it is presented to the consumer.

The first key provision listed in the article is the "Agricultural water quality and testing". This one step believed to be overlooked or harmless because just looking at water and tasting it, it could be hard to tell if it is safe for one to intake. The article states:

> "Based on the presence of generic *E. coli*, which can indicate fecal contamination, the rule establishes two sets of criteria for microbial water quality; No untreated water or water with detectable generic *E. coli*is allowed for uses such as washing of hands, food-contact surfaces or produce during or after harvest, through which the pathogen could be transferred to produce directly or indirectly. Alsofor agricultural water that is directly applied to growing produce (other than sprouts), FDA set criteria based on two values: the geometric mean (GM), of 126 or less colony-forming units (CFUs) of generic *E. coli."*

This process wants to ensure that the farmer or company is paying attention to all factors in their water that can cause contamination to their produce, which is why they would strongly suggest them to test samples of their produce to protect the consumer.

The second key provision listed in the article is "Biological soil amendments". The soil the produce is grown in also plays a major part in whether food will be safe to eat or not. Lupo states in this step the different types of soil that have been used, but what would be best to use to get the best results.

> "Although FDA focuses on biological soil amendments of both animal origin and human waste, FDA would never allow the use of human waste on produce," Acheson says. As such, this article discusses only those of animal origin. FDA states that raw manure must be applied so that it does not contact covered produce during application and so post-application contact is minimized.

As stated it is believed that animal manure is best solution when growing produce and will minimize bacteria that may reach the food being grown.

Though the FDA encourages and enforces farmers to carry-out these Produce Safety Rules, food establishments also believe that the rules made by the FDA should be followed in order for growers to sell their product in their stores, Lupo states:

> "Walmart created a rule that all food suppliers who wanted to sell in its stores would have to be certified to the Global Food Safety Initiative (GFSI) standards. "We saw that suppliers were trying to do the right thing, but many were doing different things," said Walmart Vice President of Food Safety Frank Yiannas. The requirement put many suppliers well on the road to FSMA compliance — even exceeding compliance in some areas. Additionally, as found by a Walmart study which analyzed the impact of GFSI certification on product recalls, "The results suggest that a food manufacturer that achieves a GFSI-recognized certification is significantly less likely to experience a food withdrawal or recall."

It is great exercise for food companies or stores to incorporate these types of bargains to make sure that they are getting the best product and guarantee safe products for their consumer.

V. Impact on Small Farms

In their article, Stephens et al (2020) state:

> "The significance and severity of the pandemic, and its likely impact on agriculture worldwide, calls for substantial reflection in both the short- and long-term. We need to understand the immediate consequences for the global network of agricultural and food systems on which we rely so heavily. We should track unexpected risks, weaknesses and systemic shifts to understand short-term effects as well as those that may be long-lasting or permanent."

COVID-19 has had a major impact on the agriculture business since the call for quarantine. This has resulted in all countries being on lock down and enforcing a no "exit or enter" policy for personal transportation and most goods. This has impacted many farmers because this has left them with large amounts of supply and a fluctuating demand due to the pandemic and its effects on its consumers.

The authors state that:

> "Of immediate concern is the disruption to food systems and impact on food security (Torero, 2020). Food distribution channels of almost all countries across the income spectrum have been highly disrupted, with strong negative consequences for the most vulnerable".

Most have experienced a major decrease in income because of the low demand on crops and international business, crops going bad after a period time, farmers not being able to go out and sale to local farmers markets or other sources of sale because of enforced quarantine and also concern from consumers if the product could be contaminated or not, and also people being hospitalized due to contracting the coronavirus.

> "The agri-food sector is highly connected internationally. Ports that shut down or reduce activity, vastly reduced freight capacity on commercial flights for agricultural goods, and other broad global supply chain disruptions due to the COVID-19 crisis (Ivanov, 2020) have the potential to limit critical access to agricultural inputs and markets. This may negatively impact agricultural productivity for current and future seasons."

The pause on the international sale appears to have had a trickledown effect from big to small farms. A possible explanation is that since big farms have not been able to sell the majority of their crops internationally, they have been forced to find business elsewhere in order to keep their farm afloat. This has reduced business for

smaller farms because now the total number of consumers that are in need of these crops are limited and many citizens are out of job, which means less money circulating in the agriculture business.

VI. CONCLUSION

Any action taken or process implemented for food safety outcomes must always prioritize first the overall safety of the population for whom the food is intended. In parallel, the welfare and sustainability of the farmers and their businesses that supply the food to the public must also be a priority when considering and initiating food safety measures. Whether the processes are implemented through legislation (as is the case with the Food Safety Modernization Act) or technology (as is the case with Traceability Technology), any efforts made to improve current conditions must be sure not to create an overall negative impact on either food consumers or food suppliers. Further research in these areas, should focus on the practical impacts, negative or positive, of the measures discussed in this article.

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