A Sustainable Approach Using Machine Learning and Artificial Intelligence in the Food Industry

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Abstract: The food processing and handling industry is the most significant business among the various manufacturing industries in the entire world that subsidize the highest employability. Artificial intelligence (AI) is the theory and design of computer systems capable of performing tasks normally requiring human intelligence. With increased competition and growing demand in the food industry, the industry has begun to use artificial intelligence technologies to maximize profits and discover new ways to reach and serve consumers. Artificial intelligence has been successfully implemented in applications such as sorting fresh produce, supply chain management, monitoring food safety compliance, efficient on-site cleaning systems, predicting consumer preferences, and developing new products with greater efficiency and savings in time and resources. The article focuses on travel and the application of machine learning and artificial intelligence in various sectors of the food industry and provides an insight into the future prospects of machine learning and artificial intelligence in the food industry.

Keywords: Machine Learning, Artificial intelligence, Food industry, Food processing.

I.   INTRODUCTION

Artificial intelligence (AI) is an imitation of human intelligence and behaviour in machines that are programmed to act and act like humans and repeat their actions. Artificial intelligence can be defined as any device that has the same developments as human brains in terms of problem solving and knowledge. The purpose of consuming artificial intelligence is important for obtaining knowledge, reading and believing. Artificial intelligence is used in unique industries including healthcare, finance, automotive, and food business. Basically, the AI modes are Weak AI and Strong AI. Weak AI tends to do simple, project-oriented things, while strong AI tends to take on more complex responsibilities. The special feature of AI is that it tends to slow down and make moves that might be better for achieving a specific

motive. Machine knowledge is a subset of artificial intelligence which states that a computer can automatically analyse and modify new data without human intervention.

Food processing is the transformation of raw materials consisting of natural animals and plants into food, or from one form of food into other forms that may be more appropriate to the dietary behaviour of today's people. Therefore, food processing is closely related to the first-class life of today's people and the economic improvement of the whole society. Food processing consists of various factors (for example, food processing, modification, and processing), which require a number of physical and chemical modifications to the raw materials (Smith et al., 2011). However, due to the increase in environmental pollution, humans are concerned about the safety of each food asset and food processing procedures. During the process, it is very important to ensure that the leftovers of the raw materials are preserved and that toxic and harmful substances are not added to the food. Therefore, food processing is costly to the food scientists, the food company, and the customers.

When we discuss the food industry, we usually we don't consider technology in the food sector. But in today's food industry, age plays an important role in food processing and transportation strategies. Using juicing, we find food via packages on our smartphones and get manufacturer data from that as well. Technology within the food company also makes it possible to improve product shelf life, design different types of packaging, and facilitate product preservation in a satisfactory and safe manner. With the use of generation, manufacturing costs are reduced and food exceptionalism is greatly increased. The Fourth Industrial Revolution or Industry 4.0 consists of using artificial intelligence in the production of food and beverages. Artificial intelligence has already penetrated many sectors of the food and beverage industry. Machine learning is reshaping the company in terms of food delivery chain management, new product optimization, predictive replenishment, and food safety compliance. Food manufacturing is a process in line with the company. To survive in the competitive environment, you want to replace your era, discover new possibilities to improve your operations and maintain a greater awareness of generating innovation. AI can make fast, smart decisions based primarily on what it discovers from complex calculations and log analysis.

Artificial intelligence and the study of systems in the food industry helps to improve and computerize the technology that is implemented in the industry, save money and greatly

reduce human error. Restaurants, bars and coffee shops such as Starbucks, in addition to food processing, have also endorsed artificial intelligence and information technology. Safe and accurate product manufacturing lines can be achieved with first-class speed and consistency compared to humans using the enterprise AI technology framework.

All over the arena, AI is being used in supply chains as well, and AI is being used in every end-to-end procedure, from manufacturing method to supply chain system in sports such as scaling, inventory control of product ranges, etc. in this paper , We can talk about artificial intelligence, system knowledge, the evolution of artificial intelligence and machine learning, artificial intelligence packages in the food industry, the current scenario of artificial intelligence in the food industry, artificial intelligence in food safety, benefits and difficult situations. Artificial intelligence in the food industry, the impact of artificial intelligence in the food industry, and the future possibilities of artificial intelligence in the food industry.

II. LITERATURE SURVEY

The use of artificial intelligence is not limited to these materials only. It can also be useful in food processing, garage, and food shipment. Smart devices, including robots and smart drones, can also play an absolutely significant and significant role in devaluing packaging. You can even help deliver food products, complete a challenge in a dangerous environment, and also deliver very good products. The important functions of artificial intelligence in the food industry can be broadly categorized into two areas: one is the management of food safety and the other is the management of palatable food. Keeping in view all components of AI in the food industry, this review presents a literature search on machine learning and AI in the food industry.

Lili Zhu et al. [2021] Food quality and safety is a major issue for the whole society, as it is the basis of human fitness, social improvement and stability. Ensuring tasty, protected meals is a complex approach, and all degrees of food processing must be considered, from cultivation, harvesting, and storage to preparation and consumption. However, these techniques are regularly hard work in depth. Nowadays, vision enhancement devices can greatly help researchers and industries improve food processing efficiency. As a result, the imaginative and prophetic system has been used extensively in all parts of food processing. At the same time, image processing is a crucial component of the imaginative and prophetic system. Image processing can benefit from device proficiency and deep learning models to

efficiently understand the type and quality of meals. Then, a follow-up design in the machine's imaginative and visual apparatus can handle responsibilities including sorting food, detecting bad spot locations or foreign items, and removing impurities. In this paper, we provide high-level insights into traditional deep learning and device mastering techniques, as well as the imaginary and visual system. Strategies applied in the field of food processing. We offer cutting edge curricula and demanding situations, destination developments.

Khan et al. [2021] Food safety refers to preparing, transporting, and storing meals to avoid foodborne illness and damage. From farm to manufacturing facility and manufacturing facility to fork, food items may additionally meet numerous fitness dangers. Therefore, food protection is critical each monetarily and morally. The implications of failing to comply with meals protection requirements are varied. The requirement for accurate, short, and nonpartisan pleasant assessments of these capabilities in food merchandise maintains to upward push with extended needs for nutritional materials and first-rate necessities. Computer vision gives an automated, non-destructive, and economic approach to achieving those targets. A significant study has verified its effectiveness for fruit and vegetable assessment and class. It stresses the important additives of photograph processing technology and a survey of the most present-day advances throughout the food area. This article outlines the essential components of a pc vision machine. In order to keep away from foodborne ailment and ensure food security, speedy and powerful detection of pathogenic microorganisms is important for public protection biomonitoring. Over the years, microorganism detection strategies have developed.

Tyagi et al. [2021] Food is one of the indispensable components of human existence, which makes the pleasure of food one of the main factors in choosing its intake. In order for the food to be preserved satisfactorily, it must be taken care of from the first real step as the first order is affected, i.e., warehouses. Food safety and protecting your stores are major concerns, as many people lose their lives due to malnutrition. A robot that can ensure the protection of food and warehouses could be one possible solution, since taking care of large warehouses is a tedious task and sometimes the food given in the warehouse is omitted and as a result, it is contaminated. Warehouse protection against intruders can also be achieved by bots, in any circumstances where it is very difficult for humans. This robot will be economical and efficient and will also ensure protection, keeping the food intact and making sure it is okay.

III. AI AND ML ROLE IN FOOD INDUSTRY

Sustainable work is critical to overcoming present concerns, expected difficult situations (e United Nations, 2015) and meeting customer demand for sustainability in a food trading company (e United Nations, 2015). By discussing the introduction to this paper by focusing on how "sustainable food and agricultural systems cannot be achieved without additional efforts", The Future of Food and Agriculture supports the call for sustainability. Since customers play such an important role in the exchange, and more sustainable solutions will fail without market appeal, the style perspective can be seen as an impediment for companies in the food industry seeking sustainable development. Table 1 shows where AI and machine learning can be implemented in the food industry to improve meal quality while keeping food industry issues at bay. The uses of artificial intelligence are not limited to these. Food processing, garage and transportation can benefit from it. Smart technology, including smart robots and drones, can also help reduce packaging costs. You will also help transport food, get work done in danger areas, and provide good items. Regardless of whether artificial intelligence is employed or not, it is very important to talk about the modern structure and state of food safety and quality facts at this level. Internal and external data on food safety and quality are divided into two companies. External data, including product recalls, foodborne disease outbreaks, relevant digital health data, and finished product testing, is a useful resource in building a more complete picture and is actively compiled through outreach by government and not-for-profit groups.

It should come as no surprise that the food industry is the most important part of the global economy. We need our meals to be fresh, easy and healthy, and as stakeholders we want to discover effective results for meal production, food discovery, customer issues, consumer alternatives, supply chain control, etc. It's no wonder then, that statistic is exploding technology and big statistics in various fields due to its widespread use. As a result, many FoodTech companies are using systems learning and artificial intelligence (AI) to solve problems. Data analysis tools can also be a useful resource for optimizing your marketing activities. You can also change the way you sell your brand and discover consumer pain factors that you can use to your advantage by taking a deeper look at your target market's behavior. You can also research what things sell well and why customers prefer them over other things on your list with the help of studying revenue statistics. You can introduce and promote new things from there or you can highlight things that require extra attention. This

approach pairs well with AI-powered contactless menus, which have grown in popularity since the outbreak began.
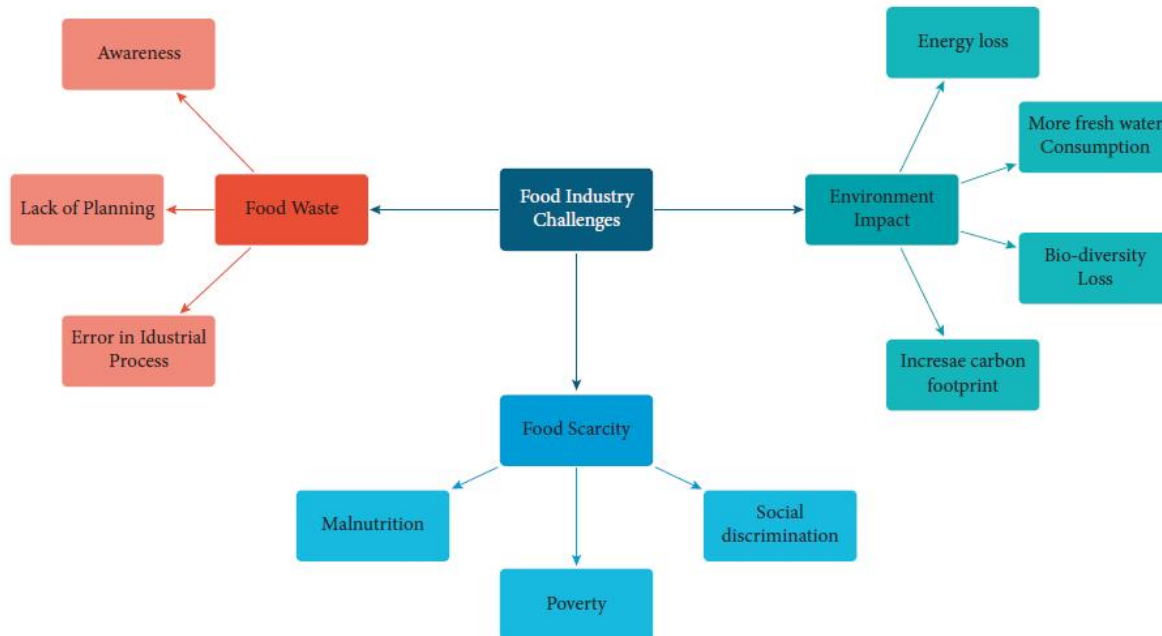

Fig.1 Food industry challenges

IV.   SUSTAINABLE DEVELOPMENT IN FOOD INDUSTRY USING AI AND ML

In this research work, to obtain information and perform analysis, a scientific procedure is used. In the first stage, data collection is completed. Pilot research is being done in the second phase to better keep the current situation close within the region. This study data was compiled from expanding sources using key phrases, titles, and abstracts, as well as a specific time frame. These stats can be compared to help you find connections and growth opportunities in a more sustainable business direction. Additionally, we'll provide advice based on the results of radical research, as well as reasonable arguments based entirely on your grocery store's current country.

Data Collection using Different Research Platform.

To understand the present uses of AI and ML in food industry, we have collected data from the research publication platforms such as IEEE explorer, Elsevier, and Springer, which are taken into consideration. Figure 2 shows the various publications based on the uses of AI and ML in food industry topic. The data base platform has more research than shown, but only those are considered which are related to our research topic.
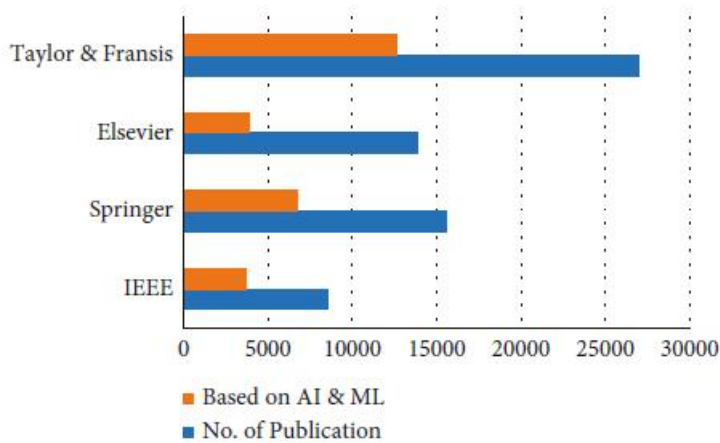
Fig.2 Research publication on different data bases.

Through Abductive Methodology

This paper's methodology is examined and investigated using abductive research methodology, which is a systematic technique to developing new theories based on a combination of diverse components of the research and data gathering process, including both theoretical and empirical research. Before performing knowledge for the existing status of the topic, the abductive approach was used to be able to _nd general ideas and principles without making assumptions about where the article should start.

Furthermore, the method is to examine from several angles, with a focus on food industry segmentation and artificial intelligence, with a selection made by examining the prospective strategic aim, qualitative data, and theoretical generalisation. To be clear, the selections are divided into sections in order to achieve a holistic knowledge as well as to build concepts and theories. Existing research and theories are compared to how well they could support the paper's hypothesis in terms of adoption. Like in the previous section, we use research article to collect data, through abductive methodology we yearly digitalisation data in food industry as shown in Figure 3. From Figure 3, it is clear that the%of digitalisation in the food industry has been increased. .is digitalisation process is going to lay a platform for new-generation approach like AI and ML.
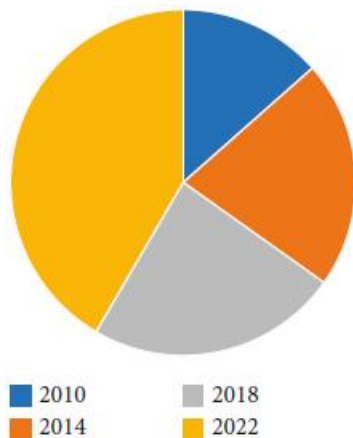
Fig.3 Digitalisation in food industry

Data Mapping.

 In this research, we used data mapping to analyse in which sector of the food industry can be linked with that technique. By mapping, the exact method can be link with the need of the food industry as shown in Figure 4. It shows the different stages in the food industry and which technique it can use to get the best results. Like, for the demand forecasting ANN, moving average can be used as AI and ML tool for forecasting category

Finding of This Research Paper

Recent research has revealed that the food industry should benefit from AI in several ways. As a result, this article will draw attention to how AI can help food industry professionals become more sustainable, without the promise of growth, but with qualitative studies that can help bring the topic closer to creating and implementing solutions. The age of AI includes possibilities that can have a huge technical knowledge base to grow with, which is why we focus on possible solutions rather than implementation. To be clear, the experiment promoted by this study is just a place to start, but it will pave the way for similar research. In addition, according to the conclusions of the literature evaluation, the AI capabilities that can contribute to this sector consist of areas from a management and operational point of view.

By collecting and analysing records, we have divided the food industry into four categories, as shown in Figure 5. The first category is smart agriculture. Artificial intelligence has many important uses in the food sector, including soil monitoring, automated farming, and predictive assessment.

Intelligent Transfer is the second category. Artificial intelligence is changing the transportation business. It has already been used in some sectors, as well as assisting cars, trains, ships, and planes, as well as smoothing traffic patterns. It has the potential to transform all modes of transportation, as well as the food industry, into safer, greener, smarter, and more efficient means. AI-assisted autonomous navigation can also, for example, help eliminate human errors that cause so many traffic accidents. However, these opportunities include real risks, along with unintended consequences and abuse, such as

Such as cyberattacks and distorted transfer decisions. There are also work outcomes, as well as ethical questions about the responsibility of artificial intelligence for decisions made in the absence of people.
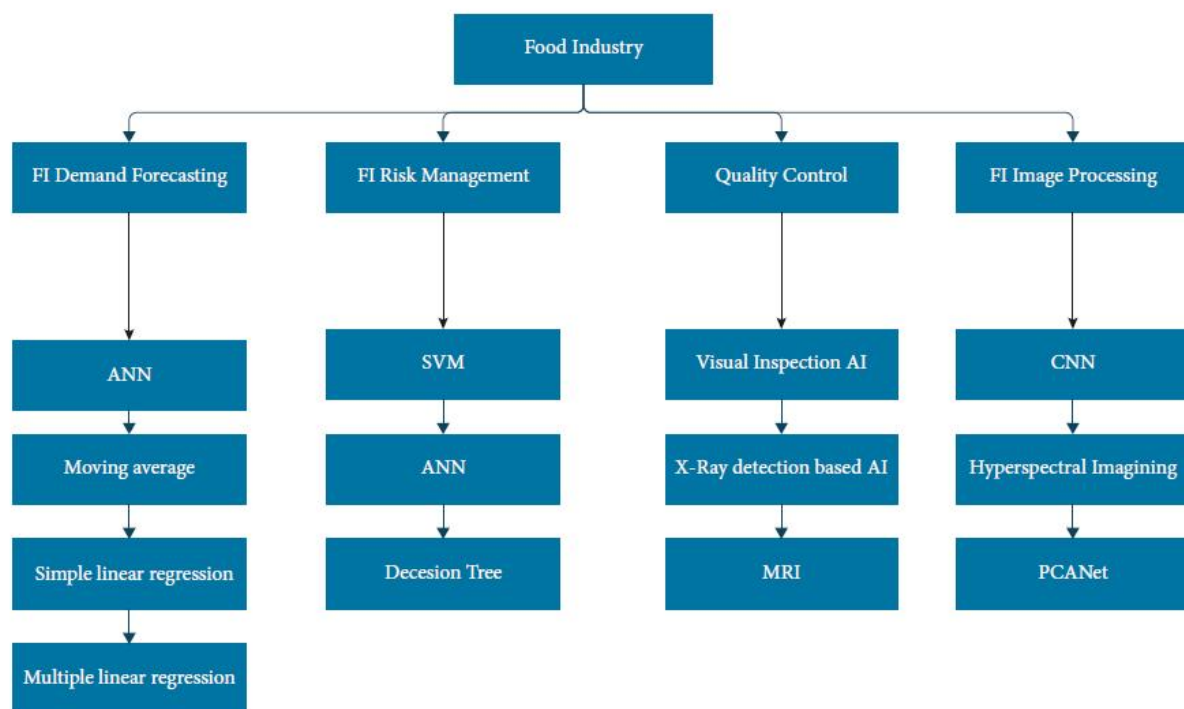

Fig.4 Mapping of different AI and ML techniques

V. RESULTS AND DISCUSSIONS

Following a review of the literature in the food business, it is clear that the food processing and manufacturing industry requires a large amount of investment. System-based AI can more easily diagnose numerous faults in food production than human based systems. It has also been noted that researchers are heavily involved in this field. Globalisation presents

hurdles in food processing chains, resulting in several impediments due to a lack of automation, taking health and safety as one of the primary issues into consideration. Once sensors are attached to the microcontroller, output spikes are produced by the microcontroller, resulting in a low-cost and user-friendly platform for a range of artificial neural robotics applications. It has the potential to be extremely beneficial in the food industry. In the agro-based business, AI-based sensors that focus on agricultural production, yield forecasting, detection of diseases, and features that are available have integrated machine learning and big data to give better information for decision-making and movements.
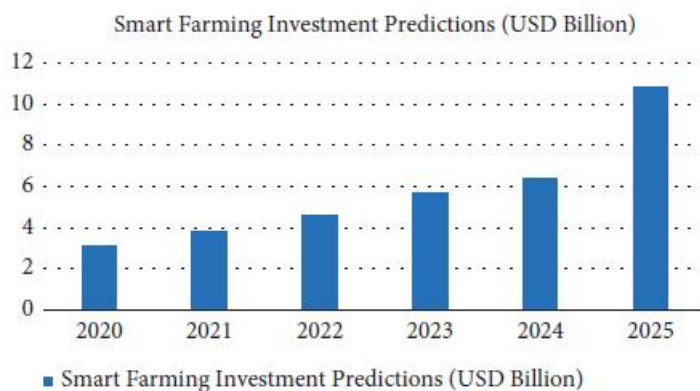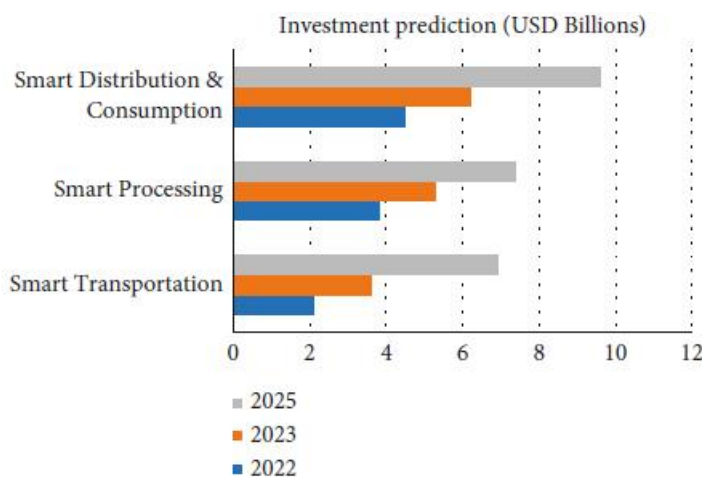

Fig.5 Prediction of smart farming investments

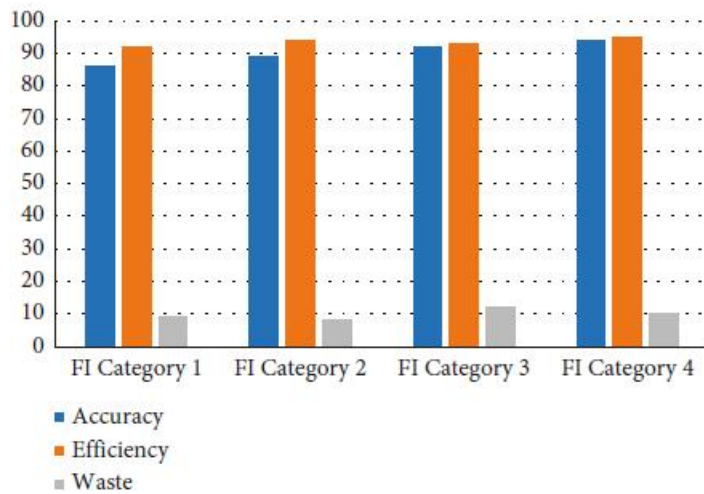Fig.6 Future investment prediction in FI

Fig.7 AI and ML category-wise possibilities for enhancing the FI

DISCUSSION

From the reviews and present practices, it is clear that global challenges like food waste and environmental damage are pressuring businesses to take action. On the contrary, the challenges from a micro perspective show that there are some existing barriers preventing local industry from responding to global demand to the extent that it should, both in terms of more profitable business solutions, external stakeholders, and the global socioeconomic and environmental challenges that humanity is confronted with. Artificial intelligence, as this thesis has already mentioned, is a technology with a wide range of prospective solutions that could help to meet the current demand in the local food industry for sustainable development. Following a thorough examination of the literature, we identify a few topics that merit additional investigation. On an applicability basis, certain less well-known AI methods can be evaluated for enhanced supply chain, safety, cleanliness, among other things. Furthermore, AI and ML applications have various obstacles, such as lowering the workforce, which results in unemployment. Its execution necessitates both financial commitment and a competent team

VI.   CONCLUSION

This work proposes to the reader the way to move from the traditional approach to the more modern and advanced automated system within the food area. Although a variety of technologies have been installed to meet the difficult situations that have arisen in the food sector, the knowledge of artificial intelligence and the device has opened a truly international potential to enjoy the contemporary era. Different multidisciplinary AI systems are subject to

evaluation of many metrics representing cool look, texture, standard customer acceptability, etc.) capable and allowing the operator to predict future conditions over the years. These strategies can be seen as a boon in terms of filling the remaining void with the help of a variety of failures within the food area. Drone generation could become a milestone in food supply chain management over time. Sensors are taking an increasing part of the way food is targeted. In fact, the food industry has been able to reap real better and greener results from artificial intelligence and big stats.

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