# Artificial Intelligence Law And Policy: Food Security And Sustainable Development Goals



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## Introduction

One of the sustainable development goals of the United Nations is to achieve zero hunger by 2030. However, the current estimates show that approximately 690 million people, constituting 8.9% of the world population, are hungry, and the number of hungry people worldwide has increased by 60 million people in the past five years (UN, n.d.). Given the recent trends, especially in the aftermath of the COVID-19 global pandemic, the number of hungry people would cross 840 million by 2030 (UN, n.d.). To meet the growing demand for food for the world population, it is essential to increase the amount of food production, and the food production amount cannot be increased without implementing highly innovative technology like artificial intelligence. Artificial intelligence plays an important role in ensuring food security by optimizing the use of resources and minimizing food losses during agricultural production. The application of artificial intelligence enhancing cultural production involves the collection of large amounts of data, which puts the privacy and security of farmers at risk. In 2014, an extensive survey of farmers was conducted by the American Farm Bureau, and the result revealed that 78% of farmers were concerned about how their data can be used and who can access their data (Janzen, 2019). However, at present, there are no legal frameworks for ensuring the safe usage of farmers' data. Not only user privacy, but the application of artificial intelligence has also highlighted some other ethical issu0es associated with data ownership and data accuracy in predictive analysis. This paper will discuss the issue of artificial intelligence and food security and how the ethical issues associated with the use of artificial intelligence impact food security.

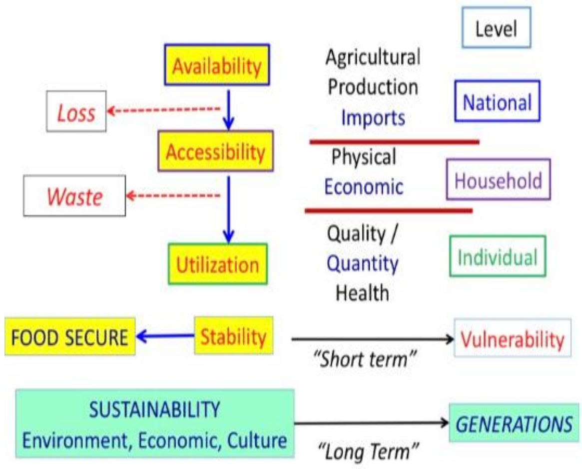
## What is Artificial Intelligence?

Even though artificial intelligence is one of the most advanced technologies of the present time, there is no accepted or common definition for artificial intelligence. The Obama administration unity port released in 2016 defined artificial intelligence as a computerized system that displays behavior commonly considered as requiring intelligence. Artificial intelligence has been defined by others as a system with the capability of solving complex problems rationally or implementing required actions to execute its goals in the real-world circumstances encountered. Microsoft defined artificial intelligence as a set of technologies with the ability to perceive, reason, learn and assist in the decision-making process for resolving problems as efficiently as can be done by human beings (Microsoft, 2018).

Recent developments in artificial intelligence technology combine several technologies including algorithms, machine learning, deep learning, neural networks, and natural language processing, among others. Many artificial intelligence systems implement algorithms, which refer to the information used as input for processing data or executing some targeted tasks. Machine learning is an algorithm that can process data and make predictions without depending on pre-programmed configurations. Deep learning is a subset of machine learning that uses algorithms to perform two significant tasks that were earlier performed by human programmers. These tasks include defining the features in a dataset for analysis and deciding how to utilize those factors to make an accurate prediction. Artificial intelligence is capable of solving problems that cannot be solved by humans on their own because solving those problems involves large amounts of data and a huge number of options. Therefore, the potential bias and human errors can be rectified by the implementation of AI technology. For instance, an AI-enabled automobile can avoid drunk driving accidents (Glancy et al, 2016). Similarly, an AI-enabled risk assessment program can eliminate racial bias in criminal sentencing decisions. The implementation of deep learning and machine learning techniques involves huge computational power and the generation of huge amounts of data. However, AI is not without problems because in the end the algorithms are programmed by human programmers and so some of the human biases are passed on to the programs and this bias is reflected in the decision-making process implemented by the AI-enabled machines. An AI system responsible for allocating police resources in areas with high crime rates may replicate past biases in policing patterns. Thus, past decisions infected by human biases can reflect in future decision-making processes of AI even though AI technology can introduce objectivity into such decisions. Additionally, not only AI can replicate human errors or biases, but it can also introduce new types of errors or biases. AI may also struggle to make ethical decisions that can easily be processed by human beings, such as deciding to choose between hitting a baby stroller and a shopping cart. Therefore, it is important for regulators, judges, and policymakers to figure out these biases and how these biases can emerge in data-driven processes.

## Food Security

Food security, as defined by the Food and Agriculture Organization (FAO), refers to a situation in which all people have social, physical, and economic access to safe, nutritious, and sufficient amounts of food at all times to meet their nutritional needs and food preferences for leading a healthy and active life (FAO, 2008). There are four dimensions associated with food security, including the availability of food at the national level, accessibility of food to households, utilization of food at an individual level, and stability of food that impacts all the levels. Most recent developments on food security stress the importance of sustainability, which is the fifth dimension of food security. Sustainability includes indicators at regional or supranational levels of biodiversity, ecology, and climate change, and economic as well as sociocultural factors (Berry et al, 2015).




(Peng and Berry, 2018)

Food security involves the pathway from the production of food to its consumption. The chart amber highlights the links among the four dimensions of food security. Food is produced or imported at a national level and mid accessible to households for individual utilization. Accessibility involves physical infrastructure and transportation system and also the food purchasing power of consumers. Accessibility also involves food preferences, sociocultural factors, and their impact. Stability brings a short-term time dimension to the concept of food security. An important aspect of food security is the importance of preventing food losses during agricultural production, post harvesting, and distribution process and food waste during processing and consumption. In the household and community (HLPE, 2014).

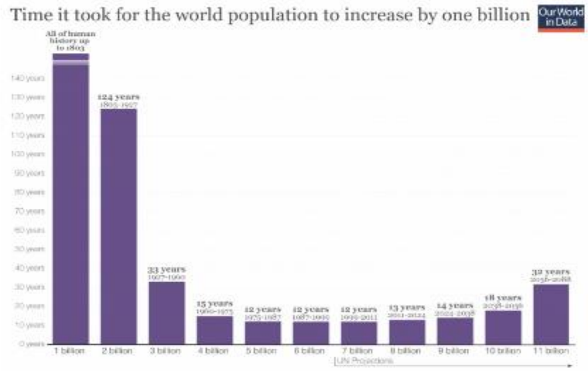
The fifth-dimension sustainability refers to the economic, cultural, and environmental factors involved with food production and accessibility so that the future generations' access to food does not get impacted. A sustainable diet has been defined as one that is respectful and protective of biodiversity and ecosystems. Sustainable diets ease economically fair, culturally acceptable, nutritionally sufficient, safe, healthy, and accessible. A sustainable diet optimizes natural as well as human resources (FAO #1, 2012). A sustainable food system makes sure that social, economic, and environmental factors involved with producing food security and nutrition for future generations do not get compromised.

Sustainability to food security is impacted by climate change. However, the activities involved with the production and processing of food attribute to approximately 20% to 30% of all greenhouse gas emissions, thereby contributing to climate change (Garnett et al, 2016). There is a trade-off relationship involves with guaranteeing food security and reducing food security associated greenhouse gas emissions, and therefore, an integrated and systematic approach should be undertaken to satisfy both short and long-term requirements of food security and nutrition while reducing the negative environmental impact associated with food system (Garnett et al, 2016).

## UN Sustainable Development Goals in A Nutshell

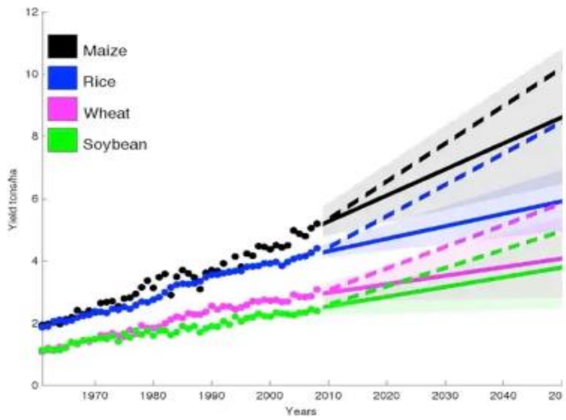
One of the sustainable development goals of the United Nations is to achieve zero hunger by 2030 ensuring access to food by all people, specifically including impoverished people in vulnerable situations. As per the sustainable development goal of the UN, agricultural productivity and earnings of small-scale food producers should be doubled by 2030 through the implementation of sustainable food production systems and resilient agricultural practices, which will also contribute to the maintenance of ecosystems, thereby reducing the harmful impact of agricultural activities on climate change (UN, n.d.).

## Artificial Intelligence and Food Security




(Roser et al, 2019)

As can be seen in the above graph that by 2050, there will be 10 billion people to be fed in the world, but the food production is not increasing sufficiently as can be seen in the graph below:




(Plumer, 2013)

The increased amount of food production is only possible through the transformation of food systems by utilizing resilient, sustainable, and inclusive technology, such as artificial intelligence. Artificial intelligence plays an important role in transforming food systems and addressing nutrition and food insecurity. In the agricultural sectors, the implementation of artificial intelligence can optimize food production by automating some of the agricultural activities, such as planting and harvesting that were earlier carried out by human agricultural workers, thereby boosting up productivity, improving working conditions, decreasing time and labor involved with food production, and utilizing natural resources in a more efficient manner (FAO #2, 2020). AI technology is used primarily in three major areas of farming, including predictive analytics, agricultural robotics, and soil and crop monitoring (FAO #2, 2020). Progress made in these areas can contribute, especially in the context of climate change, natural resource depletion, and population growth, to water and soil conservation, which are essential for sustainably achieving food security.

In the agricultural industry, precision agriculture is an important technological development because it makes the production of crops more effective and efficient. The practice of precision agriculture comprises an integrated use of various tools, some of which have the capability of collecting large amounts of data called big data from the farmers. The practice of precision agriculture has different benefits as it allows farmers to make better decisions and manage their crops better to increase crop yields. Precision agriculture enhances agricultural production by reviewing agricultural data from previous years and taking cues from the lesson learned (Ferris, 2017). Through the use of big data, a farmer can review the past performance of the farms to enhance crop production. It also allows farmers to produce more food for consumption using fewer re-sources, which adds sustainability to the agricultural practice. Another benefit of precision agriculture is that food loss during agricultural production can be minimized as agricultural products can be applied only when and where they are needed.

Artificial intelligence tools play important role in precision agriculture practices. Through the implementation of artificial intelligence and agricultural big data analytics, agribusinesses focus on developing data-driven agricultural solutions (Bennett, 2015). For this purpose, different types of data including rainfall and climate, crop growth patterns, nutrient level in soil, soil moisture, and irrigation, among others are retrieved by using AI technology (Kamilaris et al, 2017). For the retrieval of these types of data, various sources, including surveys, weather stations, static historical datasets, satellite imagery, geospatial data, farm equipment sensors, farm sensors, climate sensors, radiation sensors, and GPS-based field maps are used (Tzounis et al. 2017). This data gathered by using the abovementioned sources is especially useful for maintaining food security.


**Figure 1:** Types of Agricultural Data Retrieved

(Ryan, 2019)

The implementation of artificial intelligence helps during the planting stage of agriculture in the maximization of crop yields, reactance to diseases, unfavorable climate conditions, and poor health of animals. The use of AI technology especially helps farmers in managing their farms via prescriptive farming (Antle et al, 2015). As for the estimation made by Monsanto, data analytics will multiply the global crop production by $20 billion annually (Ryan, 2019). Because of the potential benefits associated with the implementation of AI technology in agriculture production, traditional agricultural businesses have shifted towards the use of data analytics to emerge as agricultural technology providers who sell prescriptive analytics to farmers. The farmers with the help of data gathered by the agricultural technology providers on specific attributes related to agriculture make decisions, which increases the efficiency of agricultural production. For example, the Field Scripts® program of Monsanto Collect data from the farmers and combines the information with the agronomic knowledge of Monsanto, and then presents recommendations to the farmers (Sykuta, 2016).

The WaPOR Project implemented by FAO uses remote sensing technology that provides an insightful view on the quantity of food that can be produced per unit of water and such information provides policymakers with improved information on agricultural practices, thereby helping them prioritize areas for optimal usage and make better decisions. Farm beats is a data-driven technology launched by Microsoft that through the use of drones and sensors target precise use of water and pesticides where it is required (Lian, 2019). AI technology combined with satellite imagery has helped organizations and governments in developing a granular understanding of the effect of some specific shocks on agriculture and has also helped in predicting crop yields (Lian, 2019). AI technology has also been used to develop credit risk scoring systems to assist farmers without collateral or credit history to receive loans from financial institutions.

## Ethics and Artificial Intelligence

The Rome Call for artificial intelligence ethics is a document that has been signed by Microsoft, the Pontifical Academy for Life, FAO, IBM, and the Ministry of Innovation, which is a part of the Italian government in Rome on 28th February 2020 for the promotion of an ethical approach to AI. The objective of Rome Call is to promote the feeling of shared responsibility among different stakeholders, including government organizations, international organizations, institutions, governments, and the private sector for the creation of a future in which technological progress and digital innovation keep the interest of the mankind at the center (The Call, 2020). The six fundamental principles of the Rome Call include transparency, inclusion, responsibility, impartiality, reliability, and security and privacy. These six principles state that AI systems should be made transparent. The needs of all human beings should be taken into account while designing AI systems so that everyone can benefit from the outcome. The developers and designers of AI systems should behave transparently and responsibly. The systems should be free of bias so that human equality and dignity can be protected, and no one can be discriminated against by the systems' algorithms because of sex, race, color, religion, language, national or social origin, and property, among others (The Call, 2020). The AI systems should be able to operate reliably and should respect user privacy. The regulations and principles associated with AI systems should be protective of people, especially the underprivileged and the weak.

Some of the ethical issues identified with the use of AI technology and agriculture include privacy and security, data accuracy and recommendations provided based on algorithms, data ownership, digital divide, environmental protection, and animal welfare (Ryan, 2019).

## Data Privacy

Even though anonymity is maintained while collecting information regarding individuals, still the use of big data in agriculture may lead to some negative consequences. Especially farmers in countries with weak data protection regulation may suffer negative impacts from the data gathering by a third-party agricultural technology provider. For example, only eight out of the 55 sub-Saharan African nations have data protection legislation in place (Taylor, 2017). In the absence of strong data protection laws, the third-party vendors that collect data for prescriptive analysis can sell the data to outsiders and this data can be misused by corrupt market traders, competitors, and even corrupt governments. At present, very few laws or regulations are in place for protecting the data privacy of agricultural data. It is believed that the data collected in the agricultural sector does not have the same security and privacy concerns as that of other sectors because the data gathered from farmers is not sensitive data, such as information regarding healthcare records or banking data or children (Ferris, 2017). Still, farmers provide a good deal of personal details about themselves, such as names, property types, locations, income levels, and valuation of the property along with other details of the farms. These are all personal information, which is highly sensitive. Furthermore, through the use of drones and other types of data-retrieving technologies, data can be stolen from third-party vendors, thereby leaking the personal details of the farmers (Schönfeld, Heil and Bittner, 2016). Apart from the personal details of the farmers, some information such as the sales and crop yields generated by a farm is also more sensitive information than information on the rainfall levels, and therefore, this information can also be misused. For this reason, it is important to maintain the data security of farmers.

## Ownership of Data and Intellectual Property

There remains a common fear among farmers that the data shared by them to third parties can be misused or can be disseminated for wrongful purposes. This information then can be used against the farmers for obtaining further specific information regarding the farm, which would allow traders to purchase the farm for a less amount. Therefore, one of the most concerning issues with the use of artificial intelligence in agriculture is related to data ownership (Kamilaris et al, 2017). There remains a lack of transparency over who owns the data and who can use the data for monetizing. Farmers also feel concerned that their information may be used for selling unnecessary equipment back to them (Ferris, 2017). For example, firms like Monsanto may convince farmers to purchase specific equipment, seeds, or sprays and make a profit from higher sales of seeds and the cost of their service. Due to the lack of transparency or the absence of laws regarding who owns the data, farmers, especially small-scale farmers are the victims of large-scale agricultural technology providers, such as Monsanto. Even though these big firms insist that the data is owned by the farmers, in reality, these big farms having royalty-free licenses over these data so that the information shared by the farmers can only be used by these big firms (Sykuta, 2013). For the protection of intellectual property rights and investments in artificial intelligence and data analytics, the big farms bind the farmers in contractual obligations. Resultantly, if the farmers want to share the same information with a different agricultural technology provider, then they will commit a breach of contract (Sykuta, 2013).

Furthermore, data retrieved from the farmers are not even accessible to some farmers themselves because many farmers do not have the technological capacity to interpret such data and since farmers cannot obtain this knowledge without receiving basic training on data analytics, they remain dependent on the agricultural technology providers (Schönfeld, Heil and Bittner, 2016). The implementation of did analytics has also imposed a lot of restrictions on the freedom of farmers. For example, big firms like John Deere have established policies that prevent farmers from fixing or repairing their machinery as it may temper with the intellectual property or copyrights of the big firm, thereby potentially putting the farmers at the risk of economic penalties because of a breach of contract.

## Data Accuracy and Recommendations

It is believed that even though the implementation of artificial intelligence technology in agriculture aims at improving the efficiency of the decision-making process, machine learning itself is not suitable for the purpose because the algorithms or only fit for small datasets and cannot analyze large datasets efficiently (Zhang et al, 2014). Because of the inability of machine learning to analyze large datasets effectively, the prescriptive recommendations provided by the agricultural technology providers lead to negative outcomes for the farmers because the decisions they make are based on inaccurate data. For example, if the weather data is in accurate and this inaccurate data used as an input for creating a plant growth algorithm, then it will lead to false growth predictions (Ryan, 2019).



As mentioned earlier, the increased need for food for human consumption in the future will require an increase in food production by approximately 70%. The increase in food production is possible only if weather conditions remain suitable for agricultural production. Global warming has increased the phenomena of droughts worldwide, affecting m-ore than 20% of the agricultural areas in the world. Resultantly, there is less food produced than is needed for human consumption. In the first 17 years of the 21st-century, the green production in the world was 3 to 6% below the level of consumption (Kogan et al, 2018). In all of these years, drought was the primary reason for food insecurity in the world. Even though the prevention of drought is not possible, if its probability can be detected early, then damages to the agricultural production could be predicted before the harvesting period so that food assistance can be availed on time to avoid hunger (Kogan et al, 2018). Because of this reason, detection of drought early and estimating agriculture production losses a few months before harvesting can ensure food security. The implementation of AI technology, in this regard, can help in giving warning signs for drought conditions so that the farmers remain prepared for contingency management. However, if the prediction of drought and associated agricultural production losses are inaccurate, then it will lead to counterproductive outcomes.

Another potential ethical issue with the use of artificial intelligence is that the data can be interpreted differently by the farmers and by the agricultural technology providers who are collecting the data and providing recommendations to the farmers. In the end, the data needs to be analyzed contextually to enable an unbiased decision making process but since the interpretation differences and the biases involved with the interpretation are not factored into the prescriptive analysis, it may end in lost resources (Lokers et al, 2016). The inaccurate recommendations provided by the agricultural technology providers to the farmers may cause poor livestock, last harvest, and negative earnings. However, the question that remains is if artificial intelligence and data analytics provide inaccurate prescriptive recommendations to the farmers, then who will be accountable for the inaccuracy and how this problem can be solved.

## Laws and Policies Associated with Artificial Intelligence

The issue with the use of AI technology arises with accountability. For example, if an autonomous vehicle makes an error in decision-making that leads to an accident, then who will be accountable for the accident, the owner of the autonomous vehicle or the vehicle manufacturer? There is a well-defined body of law touching upon the legal liability of the manufacturers and operators of traditional automobiles. Negligence theory is enacted for any type of lawsuit against the driver of automobiles. The theory of strict products liability comes into play for any type of lawsuit against the manufacturers of a product. However, these traditional rules and regulations do not apply to artificial intelligence, and therefore, special rules are required for AI-oriented cases.

Most countries have laws for civil liability in case of unreasonable or negligent behavior that leads to harm or damage caused by defective products. In the USA, any type of question involving liability is a matter of common law, which is further enhanced by statutes that vary from one state to another. The principle of strict liability for defective products is widely implemented in the USA. On the other hand, Europe shifted towards implementing a strict liability for defective products in 1977 with the establishment of the Council of Europe Convention on Product Liability as regards personal injury and death (Dempsey, 2020). The European Union embraced a product liability directive in 1985 to implement laws of strict liability for defective products (Dempsey, 2020). In Japan, the Product Liability Act of 1994 holds manufacturers liable for any type of injuries and losses caused by defective products (Godo, 2018). When it is not clear if an accident has been caused by equipment defects or by the errors of a human operator, evidentiary rules are implemented for apportioning blame (Godo, 2018).



For artificial intelligence, new statutes or the existing rules for traditional products need to be modified. In the current circumstances, courts try to fit artificial intelligence into the existing legal frameworks. The courts have implemented traditional legal frameworks to conceptualize liability associated with AI enables products and apportion the liability among machines, their manufacturers, and owners. In the global platform, rules defining liability for products may vary, but the implementation of the concept of strict liability for defective products has been witnessed in many court cases involving defective products. Under the strict liability for defective products, product manufacturers are held liable for any type of defects found in the design or manufacturing of the end products or if the manufacturers fail to provide reasonable warning of the risks involved with the usage of such products.

In the case of autonomous vehicles, so far courts apply the traditional rules of negligence theory and strict products liability. The implementation of evidentiary rules is not always possible because of the difficulty involved in establishing if a human operator or an AI robot caused the accident. It is predicted that as driverless cars will become more common and the users will become more efficient in using driverless cars, any type of accident will lead to claims against the manufacturers and the defective product designs. However, the problem that will arise is finding an explanation for various complexities involved with the operation of a driverless vehicle. For example, should autonomous vehicles be programmed in a way that always obeys speed limits, or is not equipping them with sensors blocking their operations by intoxicated drivers a defect in product design? Further complications will be added when the product defects in question are related to the software malfunctions and in such cases, if a software glitch causes an accident, then who will incur the blame, the software product manufacturer or the vehicle manufacturer?

In the USA, as of 2019 September, different laws have been adopted by 36 states on autonomous vehicles but these laws do not modify products liability laws to address the issue of autonomous vehicles exclusively. For example, a Florida law signed in 2019 allows a fully autonomous vehicle on roads regardless of the operator is a human being or physically present within the vehicle (Dempsey, 2020). The Florida law specifies that the automated driving system will be considered the operator of the driverless vehicle introspective of if the person is present in the vehicle physically. Several state laws have recommended further studies on the safety associated with autonomous vehicles, whereas a few states have permitted the regulatory bodies to implement safety standards. For instance, the California Department of motor vehicles is required by a California statute to adopt safety standards and performance requirements for driverless vehicles. New rules have been established by the California Department of motor vehicles in 2018 allowing manufacturers to collect deployment permits or driverless testing if certain high-level certification requirements are satisfied by them (CDMV, 2018). Federal policymakers, such as the Department of Transportation, have undertaken a non-regulatory approach by implementing some voluntary guidelines for the promotion of innovation and support to the state-level policy development.

Autonomous vehicles are just one of the AI-enabled products and processes with safety and health concerns. There are several types of AI-enabled products in use today, including AI devices delivering medical diagnostics and treatments, drones, consumer-facing AI systems, and the use of AI technologies in financial markets, such as high-frequency trading. All these different types of technologies come under different types of regulatory agencies that are responsible for covering specific rules applicable to that industry. For example, the AI technologies used in healthcare falling under the regulation of the Food and Drug Administration (FDA). Similarly, the Federal Aviation Administration (FAA) regulates the use of drones (FAA, 2018). Because of the involvement of different types of agencies in controlling the usage of different types of AI-enabled devices, a cookie-cutter approach cannot apply to all AI-enabled devices. Therefore, distinct regulations need to be established for specific industries using artificial intelligence.

The agriculture industry, justice like other industries, does not have any specific laws as sweated with artificial intelligence. Since precision agriculture practices involve the gathering of large amounts of data, which compromise the user privacy of farmers, data privacy is of huge concern in the agriculture industry. Due to the recent outcry associated with user privacy, the issue of data protection law is gaining a lot of momentum in general. Several incidents involving security breaches that impacted high-profile companies with unauthorized third parties gaining access to confidential consumer data have sparked the interest of the regulators in support of data protection. However, at present no regulatory system exists in the USA specifically addressing data protection and user privacy in the agriculture industry. Therefore, the existing legal framework for agricultural technology providers is restricted to only the existing general state and federal level data protection and data privacy laws. Some voluntary principles, such as the Privacy and Security Principles for Farm Data, have been established by various parties within the agriculture industry providing a framework for the use of data of the farmers (Ferris, 2017). Recommendations suggested by these principles include that transparency should be maintained as regards the data collection and explicit and affirmative consent of the farmers should be taken before such data is collected. The transactions between the farmers and the firms should be based on contracts written in ways understandable to both parties. Furthermore, how the data collected from the farmers will be shared with third parties and whom the data will be shared with should be disclosed and prior consent should be taken from the farmers before sharing their data with third parties (Ferris, 2017). Any third party that receives the data of the farmers should be accountable to the same privacy standards as mentioned in the contracts between the farmer and the firms. The companies that signed into these voluntary principles need to adhere to these guidelines white establishing business interaction with the farmers. Even though these voluntary principles provide some guidelines, they are not as effective as a regulatory framework because, in the end, these principles are voluntary.

## Conclusion

In conclusion, food security refers to the access to a nutritious and sufficient amount of food at all times by every member of society. With the increased global population, the amount of food required to feed people is also on the rise. Therefore, food production needs to be increased, and food production cannot be increased without the help of sophisticated technological tools, such as artificial intelligence. The implementation of artificial intelligence combined with big data analytics can help in making predictions about adverse weather conditions and provide other essential information that contributes to better decision-making. However, some ethical issues concerning the use of artificial intelligence include user privacy, data ownership, and data accuracy. The use of artificial intelligence could lead to inaccurate predictions if the data used is incorrect, and in the event of inaccurate predictions, the negative consequences will be more severe, affecting food security negatively. Similarly, concerns associated with farmers' privacy and the lack of a regulatory framework to ensure farmers' privacy may prevent the farmers from sharing important information with ease, which could affect the predictive analysis, resulting in inaccurate predictions and food insecurity. Even though one of the six principles of Rome Call is to maintain transparency in the design and use of artificial intelligence tools, the lack of transparency as regards the data ownership for small-scale farmers at the mercy of big agricultural technology providers, who can impose a lot of restrictions on the farmers' freedom and again drag the farmers into a lawsuit over breach of contracts. The application of general federal and state-level laws is not sufficient to address all the ethical concerns associated with the use of artificial intelligence and leaves a lot of room for contention. Therefore, sustainable agricultural practice cannot be achieved unless well-defined regulatory frameworks specific to the agriculture industry and the farmers are introduced.



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