THE SUPPORT OF SCIENCE IN SAFETY FOOD ACHIEVEMENT

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Abstract
Technological development in the field of agriculture does not represent new aspects, portable tools being standardized since few centuries ago. Once with the Industrial Revolution the technology for ginning cotton appeared. In the 1800's sow the grain elevators, chemical fertilizers and the first gas-powered tractor, quickly reaching the 1900's when farmers began using satellites to plan their work.
In various analyzes carried out by authorized bodies like United Nations, it is projected that the words population will reach 9.7 billion by 2050, which will lead to a global agricultural production increased by more than 69% between 2010 and 2050. To meet new market demands, farmers and agricultural companies are turning to the Internet of Things for analytics and grater production capabilities.
The Internet of Things (IoT) is designed to take the future of agriculture to the next level. Smart farming is already becoming more and more popular among farmers, and high-tech farms are quickly becoming the benchmark thanks to agricultural drones and sensors.

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Introduction
The ecosystem functioning is strongly determinate by agricultural land use. The world's population is constantly increasing, so it is very important that arable land is used in a sustainable and efficient way, therefore, smart data management and digitization will play an important role in this.
Farmers can achieve their objectives through smart digitization of agriculture, whether those objectives are economic profitability, social progress, or more environmentally friendly and sustainable operations.
The XXI century came with some high-tech agricultural techniques and technologies helping farmers to improve the efficiency of their daily work. Thus, sensors placed in the field allow farmers to obtain detailed maps of both topographies, resources in the area, or variables such as soil acidity and temperature. They can also use climate forecasts to predict weather patterns over the next time periods. Farmers can use smartphones to remotely monitor their equipment, crops and animals, as well as to get statistics about feeding the animals or the

products they are going to make. They can use all this data to run statistical predictors for their farms whether it is crops or animals.
Equipment such as drones have become an invaluable tool for farmers when it comes to surveying land, performing analytics, or generating real time data for various farm-level administrative purposes.
More than 6 years ago, McKinsey & Company mentioned in a report about big data, that these massive amounts of data will revolutionize the global food chain. They defined precision agriculture by a "technological approach to the way a farm is managed, whereby the individual needs of each piece of land and each crop are observed, measured and analyzed". According to McKinsey, the use of precision agriculture has two parts: "on the one hand big-data and advanced analysis devices, and on the other, robotics – satellite images, sensors, sophisticated weather forecasting programs".
The European Parliament's report on precision agriculture and the future of agriculture in Europe defines the term as follows; "a modern concept of agricultural management that uses digital techniques to monitor and optimize agricultural production process". The key word in this definition is "optimization". Instead of applying an equal amount of fertilizer over all the soil in the field, using precision agriculture, variations in the soil type in the same plot/soil are measured and the fertilizer application strategy is adapted accordingly. This leads to an optimised use of substances for fertilization, a reduction in expenditure and a reduction in the impact on the environment.

1. Literature review

Jinyuan Xu et al. (2022) consider that the term IoT refers to a network in which physical components, such as animals and plants, environmental elements, production tools, and various virtual "objects" in the agricultural system, are connected with the internet through agricultural information perception equipment under specific protocols to carry out information exchange and communication.
Pantasi et al. (2006) posit that AI can be applied to understand yield response to soil variables, identify the factors responsible for yield and quality variation, and determine target yields.
Food standards, built on both public and private regulations, have increased with the evolution of society and the development of technology to meet the increasingly complex demands of individuals looking for solutions for safe food products. Regulations regarding the quality of raw materials, production, services related to production but also the processes of quality management and control are aimed at ensuring quality in achieving the expectations of individuals looking for healthy food (Militaru, et al, 2014).

2. The IoT in the agriculture

All the information that is collected from the plot where the production is made with the help of IoT sensors and the technology used, must be analyzed and presented to the farmer in a synthetic and easily interpretable way, so that, based on all the information received, he goes through in due time all the necessary steps to diminish or even eliminate certain types of problems that arise at the farm level.
In short, the steps to be taken to achieve the objectives at the level of a farm are the following:

- Establishing the types of culture that are most suitable for the use of IoT technology and machine learning in a controlled environment;
- Establishing the measurements to be made in a controlled environment;
- Analyzing the possibility of robotic planting of the crops identified in point 1;
- Data collection and interpretation of field data;

- Establishing all the indicators to be followed during the measurements so that the proposed goal is achieved (eg: pest monitoring, transmission of information in the cloud, interpretation of images taken from the field with the help of machine learning mechanisms, transmission of information to the farmer, etc.);
- The actions that must be performed on the basis of the interpretations performed, preferably automatically, without human intervention (eg: based on the interpretations of the information transmitted from the cloud to the farmer, a certain substance or fertilizer is intervened with a certain substance or fertilizer, etc.);
- Transmission of all the information retrieved and analyzed to the farmer through an application that can be accessed on mobile devices (operating systems with IOS and / or Android);
- Collecting culture from a robotically controlled environment;
- Quantitative and qualitative analysis of the interpreted results;
- All the crop data can be accessed by the consumer, who can also see the vegetative stages during the development of the plant, and all the substances used in the field, scanning the QR code on the product;
- Automatic mixing of solutions according to the disease detected à AI;
- Also, through QR code you can see the real contact details of the manufacturer, information on products such as the date of collection, etc.;
- To achieve the theme with quality schemes, for those who are on ecological are mounted air quality sensors and nitrates and nitrites, formaldehyde.

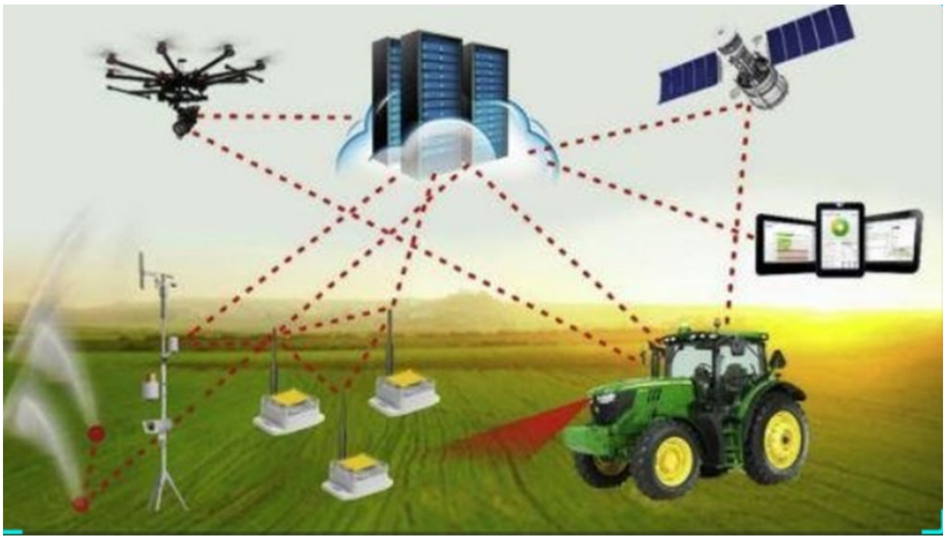

Figure 1. Detabase

Source: www.researchgate.net

According to National Academy of Agricultural Sciences, New Delphi "The Big Data Analytics can play an important role in agricultural research and development. It is time for all to come forward and develop vision for application of Big Data Analytics Customized farm advisory services: Customized farm advisories for planning, management practices and identification of insect pests and diseases are in a pipeline. For example, a farmer is interested to know before sowing what is the best possible yield in his/her field/village, how different it is from the best at state, national and global levels, and why. This gap analysis will enable farmers to understand and plan for higher yields. Generation of sowing schedules and contingency plans; predicting phenology and suggest agronomic measures; crop-specific soil-test based fertilizer recommendations; agro-met advisories will be helpful for location-specific advisories."

Going through the steps mentioned above, we identify both economic benefits (low use of pesticides, use of a low human staff for each stage of the plant growth cycle) and of human health, with a direct impact on the European Green Deal. Thus, pesticides are products used to control pests of plants and agricultural products, as well as to combat biological vectors of human and animal diseases. These pests include microorganisms, plants or animals that compete with man for food. They destroy property, diffuse diseases or represent a calamity. The use of pesticides involves direct risks for both humans and for domestic and wild animals. The risks are higher in hot climates than in temperate climates, but the climatic changes that have occurred bring a new dimension regarding the impact of pests on crops.

However, although there is an abundance of information that farmers can access and interpret, there is still a big problem with the development of digital skills for them. We can see in the accompanying drawing that in just one century it has gone from a plow farming in the early 19th century, to an agriculture based on genetically modified organisms around the '80s, all reaching a new level of development in the last five years by using data that is transmitted by sensors, GPS. weather stations, etc. All this technological advance was not proportionally accompanied by a specific development and training necessary for farmers, who had great problems of accommodation, assimilation and perception of current technologies.

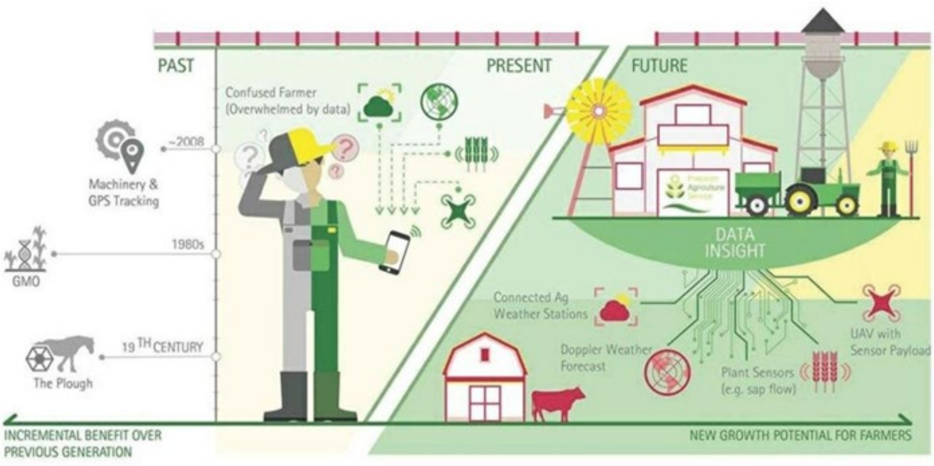

Figure 2. Evolution of digital agriculture

Source: Accenture

Farmers have used a series of new technologies over time, hitting numerous bugs. Thus, they went through situations where they could not process the data's they were collecting due to software problems. The lack of self-made user manuals and training, the lack of staff to provide technical support, was also a major problem for those who they adopted the technology from the beginning in their farms. All these limitations have brought new challenges to technology manufacturers making them develop tools that are much easier to use and to understood and provide the necessary technical support for these tools. There has also been an increase in the number of software and hardware manufacturers, offering farmers more options according to their production and management objectives. This increase in the number of producers of precision farming systems has contributed to the decrease in prices, reducing at the same time the risk of unsustainable purchases.

2.1 Food safety and the new technologies

Food safety is a priority of every state and involves responsibility and awareness from the government level to the producer, retailer and consumer within an economy. Romania has as agricultural advantage its fertile soils for the production of various crops, but currently the country does not have the capacity to exploit them to its full potential. The absence of irrigation systems and the lack of adapted technologies are constantly affecting the production and export sector. Crops fluctuate depending on climate variability, and climate change increases the risk and severity of drought. In addition to the infrastructure of irrigation systems and the poor technology used in agricultural holdings, the fragmentation of agricultural holdings and the training of farmers are also acting in a negative way.

By applying the solutions offered by science, several sensitive plans of the production of safe food for the population can be achieved. The reduction of food waste, which includes both food losses from farmer to consumer caused by the storage and transport environment of products and the amount of waste that occurs mainly at the level of retail sales in the supply chain, is one of the obvious opportunities to increase food security without increasing the environmental load of production.

Information science and technology play an important role in achieving food and nutritional security. Food preservation through stabilization technologies such as drying to reduce water activity, heat treatment or high pressure to reduce microbial activity or fermentation such as direct osmosis, support the preservation of the native value of food and the technologies implemented at logistical level such as cold stores with controlled humidity level and refrigerated transport vehicles, they make them accessible to consumers in an opportune time to be consumed in their best condition. This whole process is an integral part of sustainability and food supply and the reduction of food waste.

In the Age of Digitalization, transparency can also be ensured on the origin of the food we use in our daily diet, so IoT will be a favouring factor for digitalization, production and supply chains. The integration of digital platforms with real-time analytics and sensors for informed decision-making could be combined with the development of a sustainable future and food value.

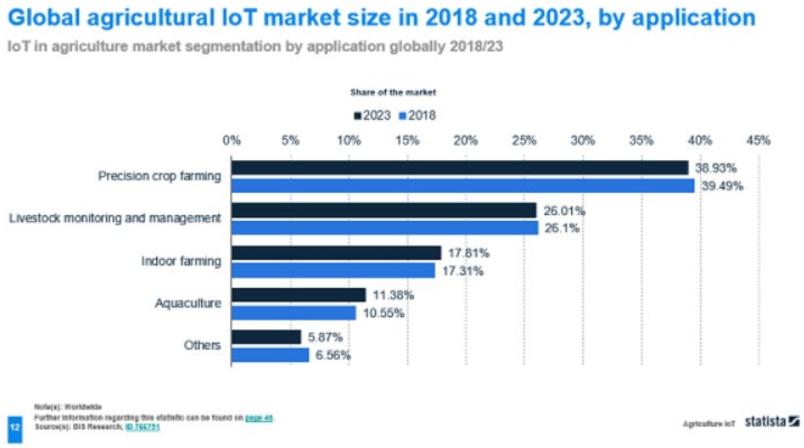

Figure 3. Global agricultural IoT market size in 2018 and 2023
Source: Bis Research, page 2, ID 766751

The food crisis can also be combated by taking into account the foods with complex caloric and nutritional intake, which ensure a healthy diet for the human consumer. It is not the quantity that is important, but the quality. Food security is complicated by the human factor that demands increased food quantity, so there are over 2 billion obese or overweight people. Reducing consumption in this category represents a significant opportunity to increase food security without negative impact on the environment and at the same time reducing the overall burden on individual health due to poor nutritional nutrition. The opportunity to use a systematic approach to nutrition to adapt the food supply chain to enhance the content of the daily diet creates advances in data analysis. We must not lose sight of the fact that advanced surveillance technologies are reliable for large farms, but even small manufacturers can make use of the advances of knowledge through digital platforms for information dissemination, such as Facebook, Instagram or through the existing national application CPAC in which they can load their product offer and users of this application can accurately locate the manufacturer's location as well as the recipe used for obtaining the food good.
eAmbrosia is a legal register of the names of agricultural products and food, wines and spirit drinks that are registered and protected throughout the EU. It provides direct access to information on all registered geographical indications, including legal protection tools and product specifications. It also displays key data and links for apps and publications before geo-indications are registered.
According to the register, as of June 2022, there are 77 food products in Romania that benefit from the EU Geographical Indication (GI), wines being more than 70% of them.
However, while healthy foods and other information can be made available to as many users as possible to make informed food choices, it is equally possible that individuals will not make healthy food choices. For consumers, eating is governed by a complex interaction of other cognitive factors, neural circuits and hormones, sensory properties, feelings of satiety. Thus, it is also necessary to educate individual behaviours and become aware of food choices in order to optimize diet.

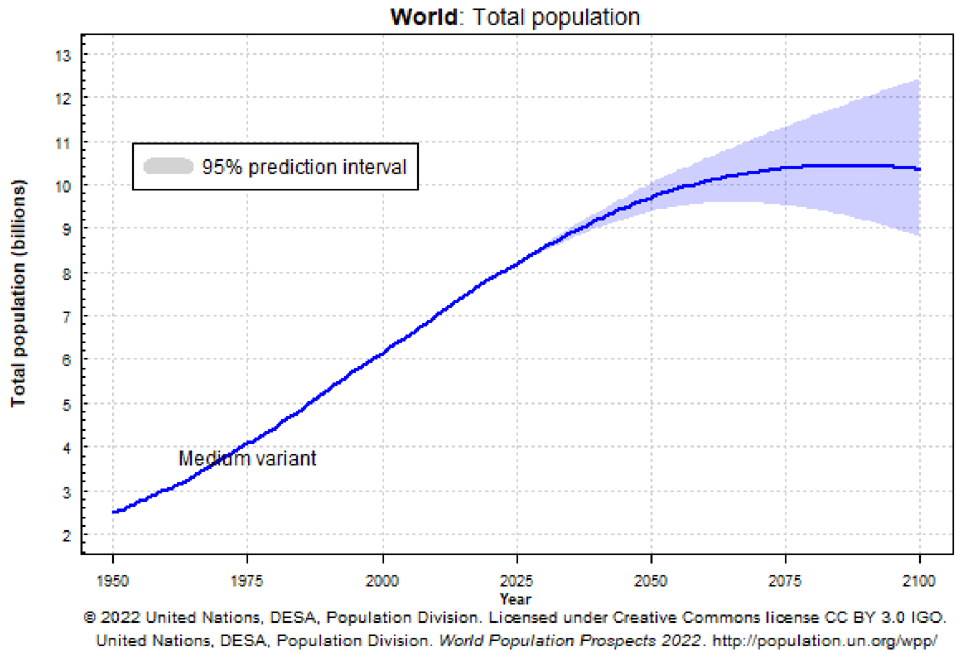

Figure 4. World Population Prospects 2022

Source: http://pupulation.un.org/wpp/

The growth of the global population leads to the need to discover new sources of protein from non-animal resources. Cereals are and are expected to continue to be a major source of vegetable protein. Legumes are an emerging source where you can increase and improve quantity due to new production practices. The plus of these two categories of foods makes them healthy eating alternatives because they are rich in protein, fibre and micronutrients. Seaweed biomass offers another promise as a renewable source of protein, but the production economy is currently limiting the growth of these industries. Insects are sustainable sources of protein for food and feed, there is room for improvement of production systems for edible insects. Insects have been eaten by some populations of Latin America and Asia for several decades, but are still viewed with suspicion by the Western population.

From the inedible parts of plants, with the help of intelligent technologies, an increased yield of the extracted oil to obtain biofuel can be obtained, and from the composted food residues. In order to increase food production in balance with that of the global population, agriculture being the main source of agro-food products for the diet of individuals, it is necessary to expand the land resources used for agricultural production. It is necessary to consider the significant decrease of the groundwater over the years that has degraded the productive environment. Both the removal of forests caused by the urbanization of regions and the excessive export of timber and climate change affect evaporation at the level of the earth's surface. Practices to improve water use will lead to gains in global crop production. This can be achieved by using irrigation techniques and reducing soil evaporation. With the help of technology there are unlocked the path to avoid losses or production potential for the future by maintaining resistance to pests and diseases and food security. Weeds, pests and diseases cause major losses in agricultural production systems. Pests and pathogens of crops and those in the livestock sector are in continue evolution, so technology is necessary to combat them

to ensure current productivity but also to ensure additional productions. The use of genetics specific to each agricultural region, selective reproduction, hybrid seeds are an important factor in increasing yields and reducing chemicals to achieve food security.
Digital programs have the ability to store a huge amount of data that the human mind cannot process with the same ease. Millions of volumes and scientific articles can be embedded in an application that can structure by sectors of interest responses to the aspects encountered in practice, and can be programmed to suggest diagnosis to problems encountered in practice or to prevent risks that may occur in the production chain so minimize the risk of total calamity of a crop.
Collaboration between data science, robotics, artificial intelligence, nanotechnology and agriculture is essential in the desire to achieve food security.

Conclusions

With the aid of digital technology, farmers may get overcome difficulties they face today, improve their output, and raise the value of their businesses. The food security is a complex challenge, requiring focus on both sides, human and planetary health. The integrated systems, transdisciplinary research and innovation are required.
With a better management of food waste, the quantity of food that must be produced decreases, therefore, the footprint on the environment will be reduced, thus also reducing the resources used for food production. IoT plays an important role in minimizing the waste of resources, reducing pollution as a result of food production, as well as reducing food waste throughout the whole supply chain.

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