

Hunger Zero: Agriculture Optimization Using Modern Technologies

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Abstract— Hunger is a persistent and complex global issue. Inadequate access to food and essential nutrients, especially among children, leads to malnutrition with severe health implications. This paper highlights the significance of the United Nations' Sustainable Development Goals (SDGs), particularly "Zero Hunger," in addressing this challenge. Most of the products that we consume every day come from the agricultural sector, but they are not always of the best quality because they can be influenced by factors such as climate conditions, pests, diseases, cultivation techniques and fertilizers. Here is where the digital transformation in the agricultural sector called Agriculture 4.0 comes into play. The aim of this paper is to address the global issue of hunger. To fulfill this aim, the paper will explore how the agricultural industry can increase its productivity and obtain high-quality food products using Agriculture 4.0 technologies. In order to achieve its purpose, this paper will first address the serious issue of global hunger and the challenges that the agricultural industry faces. Then, it will delve deeper into the proposed solution and discuss the productivity improvement generated by Agriculture 4.0. Finally, the advantages and disadvantages of using technology in the agricultural sectors will be analyzed. This paper aims to raise awareness of the significant impact that agriculture has on the life of every individual and how the quality of agricultural products could be improved by implementing certain changes in the production processes. Throughout the text, information is provided that will influence its readers and offer them a new perspective on something as commonplace as agriculture, but from a more technological point of view.

Keywords: Agriculture 4.0, Internet of Things, Sustainable Development Goals, zero hunger.

Resumen— El hambre es un problema persistente y complejo a nivel mundial. El acceso inadecuado a alimentos y nutrientes esenciales, especialmente entre los niños, conduce a la desnutrición con graves implicancias para la salud. Este documento destaca la importancia de los Objetivos de Desarrollo Sostenible (ODS) de las Naciones Unidas, particularmente el denominado "Hambre Cero", para abordar este desafío. La mayoría de los productos que consumimos cada día provienen del sector agrícola, pero dichos productos no siempre son de la mejor calidad debido a que pueden estar influenciados por factores tales como condiciones climáticas, plagas, enfermedades, técnicas de cultivo y fertilizantes. Aquí es donde entra en juego la transformación digital en el sector agrícola llamada "Agricultura 4.0". El objetivo de este documento es abordar el problema mundial del hambre. Para ello, el texto explorará cómo la industria agrícola puede incrementar su productividad y obtener productos alimenticios

de alta calidad, utilizando las tecnologías que brinda la Agricultura 4.0. Con el fin de lograr su propósito, este trabajo primero abordará el serio problema del hambre global y los desafíos a los que se enfrenta la industria agrícola. Luego, profundizará en la solución propuesta y discutirá la mejora en la productividad generada por la Agricultura 4.0. Finalmente, se analizarán las ventajas y desventajas que implican el uso de tecnología en los sectores agrícolas. Este trabajo apunta a concientizar sobre el significativo impacto que tiene la agricultura en la vida de cada individuo y cómo la calidad de los productos agrícolas podría mejorarse implementando ciertos cambios en los procesos de producción. A lo largo del texto, se proveerá información que influirá en los lectores y les ofrecerá una nueva perspectiva de algo tan común como la agricultura, pero desde un punto de vista más tecnológico.

Palabras clave: Agricultura 4.0, Internet de las Cosas, Objetivos de Desarrollo Sostenible, hambre cero.

I. INTRODUCTION

The problem of hunger is a persistent and complex issue that affects millions of people worldwide. Poverty, conflicts, climate change, and resource inequality are some of the factors contributing to this problem. Additionally, malnutrition resulting from inadequate access to food and essential nutrients has severe implications for health, especially among children. Addressing hunger and malnutrition requires comprehensive approaches that promote sustainable agricultural practices and provide access to adequate and balanced nutrition.

In the agricultural industry, it is necessary to incorporate technological resources to enhance productivity, promote the production of better products, improve nutrition for people and help develop economic growth in the sector. Its most important goal is to improve people's nutrition and thus eradicate hunger in the world.

The United Nations proposes ways to eliminate hunger and poverty through agriculture. These solutions are stated in its second Sustainable Development Goal (SDG) that is called "Zero Hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture" [1].

In addition, there are other SDGs that focus on this topic, like the third SDG which is "Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages" [1]. Improving the quality of food can enhance people's quality of life. Furthermore, the ninth SDG "Industry, Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable

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industrialization and foster innovation” [1] is related to the global issue of hunger as well.

Agricultural production is very important in our life. Most of the products that we consume every day come from the agricultural sector, but they are not always of the best quality because they can be influenced by factors such as climate conditions, pests, diseases, cultivation techniques and fertilizers.

How can those factors be addressed? By conducting data analysis, collecting information about the climate changes, soil conditions, etc., precision agriculture can be achieved.

Here is where the digital transformation in the agricultural sector called Agriculture 4.0 comes into play. This is a strategy introduced by the German government in 2011, with the purpose of establishing a production model where real time interactions occur among people, products, and devices during the production process [2].

Agriculture 4.0 uses many tools, such as drones, sensors, satellites, artificial intelligence, big data, and more. It can be said that it is an interconnected devices system that improves the efficiency and productivity of agricultural practices and contributes to more sustainable farming methods. Agriculture 4.0 works towards a common goal: ensuring a smarter and more responsible future of food production.

The aim of this paper is to address the global issue of hunger. To fulfill this aim, the paper will explore how the agricultural industry can increase its productivity and obtain high-quality food products using Agriculture 4.0 technologies. Agriculture 4.0 is closely related to the electronics engineering career path due to the implementation of electronic technology for the optimization of the agricultural process.

In order to achieve its purpose, this paper will first address the serious issue of global hunger and the challenges that the agricultural industry faces. Then, it will delve deeper into the proposed solution and discuss the productivity improvement generated by Agriculture 4.0. Finally, the advantages and disadvantages of using technology in the agricultural sectors will be analysed.

This paper aims to raise awareness of the significant impact that agriculture has on the life of every individual and how the quality of agricultural products could be improved by implementing certain changes in the production processes. Throughout the text, information is provided that will influence its readers and offer them a new perspective on something as commonplace as agriculture, but from a more technological point of view.

II. QUALITY CONCERNS IN AGRICULTURE

The world's population is projected to reach 8 billion by 2025 and nearly 10 billion by 2050. This presents a significant challenge as there will be a substantial increase in the demand for food, both in quantity and quality. To meet these needs, global food production must increase by 60% to 70% [2]. However, current agriculture faces a crucial problem in terms of low productivity and lack of optimization in production systems.

Low productivity in agriculture is a major issue primarily due to the underutilization of new technologies in the production process. The emergence of Agriculture 4.0 and

the use of artificial intelligence offer promising solutions to improve this situation. However, the lack of adoption and utilization of these agricultural technologies in current practices leads to significant consequences. It results in production losses, low-quality food, economic losses, and delays in harvesting. These problems not only affect farmers but also impact on the fight against global hunger. The adoption of artificial intelligence and optimization in Agriculture 4.0 are key aspects to enhance agricultural productivity, ensure food quality, and reduce economic losses, ultimately benefiting global food security [2].

III. PROBLEM APPROACH

As stated in the introduction, the incorporation of various technologies in the agricultural sector will bring improvements in production processes, in terms of time and product quality. Agriculture 4.0 uses tools based on the *Internet of Things* (IoT) in order to optimize the process of cultivating the land through real-time monitoring, data storage and automated evaluation. Among the technologies to be briefly described below are IoT, sensor technology, robotics, cloud computing, and Big Data.

In relation to the Internet of Things, it is a network of interconnected physical objects and digital devices. IoT has found widespread applications across various fields, including industrial production, healthcare, and, notably, agricultural production encompassing crop, soil, and water management, as well as climate monitoring.

As the IoT paradigm is further explored, the critical role of sensors needs to be recognized. The advancements in sensor technology, marked by the introduction of new materials and techniques, miniaturization, enhanced computational capabilities, and cost-efficiency, have played a decisive role in Agriculture 4.0.

Conventional environment sensors designed for measuring parameters such as temperature, humidity, light intensity, heat, and gas concentrations have achieved a high level of development. Moreover, they have found widespread application in protected agricultural settings [3].

Within the domain of agricultural applications, sensors are deemed indispensable, serving as data acquisition tools for vital botanical and environmental parameters, all while effectively managing spatiotemporal variables. According to [2], these variables exert a substantial influence on agricultural production in two fundamental dimensions: remote sensing and Wireless Sensor Networks (WSN).

Firstly, remote sensing is a data collection technique which uses devices that transmit information from distant locations. These data-gathering tools encompass satellites, Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), as well as tractors and hand-held sensors [2].

Secondly, Wireless Sensor Networks have revolutionized various agricultural processes in recent years. WSNs serve three primary functions: sensing, facilitating communication among network components, and employing hardware, software, and algorithms for computation [2]-[3].

Furthermore, Wireless Sensor and Actuator Networks (WSANs), a derivative of WSNs, incorporate "actuators": physical devices like lamps, irrigation sprinklers, or valves designed for environmental interaction. Consequently,

WSANs enhance the operational efficiency and productivity of select agricultural production systems [2].

Another technology that must be addressed is robotics. As mentioned in [2], in recent years, robots have been used to automate some practices in the rural sector, such as crop exploration, water supply and pest control.

Moreover, robots offer significant advantages as they possess the capability to move across extensive land areas and autonomously execute agricultural tasks. This potential holds substantial promise for enhancing agricultural management practices [2].

Agricultural robots also play a crucial role in Agriculture 4.0. An agricultural robot is described as “a mobile, autonomous, decision-making, mechatronic device that accomplishes crop production tasks (e.g., soil preparation, seeding, transplanting, weeding, pest control and harvesting) under human supervision, but without direct human labour” [4, p. 6].

Agricultural robots mainly focus on three main functions: weed eradication, pest and disease surveillance, and harvesting of specialized crops. Agricultural robots present potential cost-saving opportunities by decreasing labor demand for tasks such as weeding and harvesting, minimizing the use of inputs such as pesticides, and mitigating yield losses resulting from late detection of pests and diseases [4].

Finally, cloud computing is a commercial infrastructure that provides hardware, software, and storage services for various IoT applications [2]. Additionally, according to [2] this infrastructure provides:

- Cost-effective storage services for images, videos, and texts;
- Smart information systems that transform data into knowledge and subsequently make decisions based on quantitative analysis;
- A secure platform for the development of agricultural IoT applications.

However, cloud computing has some limitations. For example, IoT applications generate large volumes of data, causing them to respond very slowly because they depend on network latency [2].

It is also important to highlight the role of Big Data, which is not considered a technology but rather a process of analysis and interpretation of large volumes of data, allowing companies to use them as a basis for their decision making. Using real-time and historical data from various sources, it is expected to revolutionize agricultural management and operations, leading to better business models. In addition to optimizing production performance using historical data, big data analytics also offers possibilities for more complex scenarios [2].

IV. ADVANTAGES AND DISADVANTAGES OF THE USE OF TECHNOLOGY IN AGRICULTURAL SECTORS

The incorporation of new technologies in agriculture has generated a lot of benefits for the farmers and industries, as well as some limitations. Below, the advantages will be explained.

One important advantage is the fact that modern machines can reduce the physical efforts of farmers. Using modern technologies such as robots, help farmers make less effort, which is a great benefit in terms of health and well-being for humans [5].

Moreover, [5] indicates that these technologies improve efficiency and productivity by reducing work time in agricultural sectors. The use of sensors, cloud computing, etc., makes processes faster and more effective compared to manual labor carried out by farmers.

Robots are useful in automating tasks like sowing the seeds and supplying water to crops. As stated before, thanks to mobile robots, farmers do not need to monitor whether the crops need water [5].

Furthermore, the use of technology results in higher-quality products. Robots work faster and in larger quantities than traditional work done by humans [5]. This results in increased product quality, demand, and pricing.

One of the most important improvements is the introduction of online trading and e-commerce. This technological resource offers farmers the opportunity to sell their products to more people around the world [5].

Agriculture technology implementation also faces some disadvantages. These drawbacks are explained further down.

One notable drawback of these technologies is the high maintenance cost. While these technologies facilitate the different works in agriculture, maintaining them can be expensive. Farmers must pay for the maintenance of the machines, as well as buy spare parts in case their robots break down [5].

Another significant concern is unemployment. It is a worrying trend that low-skilled employees are losing their jobs due to contemporary technologies [5]-[6].

A final important disadvantage worth mentioning is the farmer's lack of practical knowledge and their underestimation of these technologies. This drawback may lead to a situation where farmers acquire advanced equipment but do not know how to use those machines properly [6].

V. CONCLUSION

In summary, this article addresses a global issue, namely hunger, and how technology, particularly Agriculture 4.0, can play a vital role in its resolution. It highlights the challenges of hunger, emphasizes the importance of the United Nations' Sustainable Development Goals, and introduces Agriculture 4.0 as a strategy to enhance productivity and quality in the agricultural sector.

The document delves into concerns about the quality of agriculture, including the need to increase productivity to meet the growing demand for food. It underscores the current low productivity and limited use of technology in agriculture, while pointing out the potential of Agriculture 4.0 and Artificial Intelligence to tackle these issues.

It describes how Agriculture 4.0 utilizes various technological tools, such as IoT, sensors, robotics, and big data, to optimize agricultural processes. It also mentions the advantages of sensors and robotics in data collection and the automation of agricultural tasks, as well as the role of Big Data in IoT applications.

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Finally, the pros and cons of implementing technology in the agricultural sector are explored. Benefits like reduced physical effort, improved efficiency, and product quality, as well as opportunities for online trade, were highlighted. However, it also recognizes challenges like maintenance costs, concerns about unemployment, and the need for proper training for farmers.

In conclusion, this article provides a comprehensive view of the global hunger problem and underscores the importance of harnessing technology and innovative practices to address this issue and enhance the quality of food production around the world.

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