

# IoT Evolution in Romanian Agriculture

Șerban Daniel-George<sup>1,2</sup>, Lungu Emanuela<sup>1,2</sup>, Trifan Daniela<sup>1</sup>,  
Turek-Rahoveanu Maria Magdalena<sup>2</sup>

<sup>1</sup> Agricultural Research Development Station of Braila, Braila,

<sup>2</sup> "Dănearea de Jos" University from Galati, Domneasca Street, 47, Galati,  
Romania.

Presented at **International Conference on Trends & Innovations in Management, Engineering, Sciences and Humanities, Dubai, 19-22 December 2023 (ICTIMESH-23)**.

<https://doi.org/10.37082/IJRMPS.ICTIMESH-23.15>



Published in [IJRMPS](#) (E-ISSN: 2349-7300), [ICTIMESH-23](#)

License: [Creative Commons Attribution-ShareAlike 4.0 International License](#)



## Abstract

Agriculture plays a crucial role in Romania's economy, which accelerates the search for ways to maximize production yield and profit. The latest technological breakthroughs in communication have translated into a more advanced and efficient agricultural sector that now has a greater online presence than ever before. Therefore, the new challenges facing agriculture are not just environmental ones, as in the past, when weather was a more powerful variable. The new challenge is posed by a fully technological world. In this paper, we explore various applications of IoT in agriculture and examine their evolution in Romanian agriculture.

**Keywords: Smart Agriculture, IoT, Internet of Things, Digital Transformation**

## Introduction

The Internet of Things (IoT) is the next major economic and social innovation after connectivity. IoT allows any physical object (thermostat, bicycle helmet, etc.) or virtual object (representation of an object in a computer system) to be connected to other objects and to the internet, creating a network between objects and between people and objects. IoT can combine the physical and virtual worlds into intelligent ecosystems that perceive, analyse and adapt to our environment to make our lives easier, safer, more efficient and friendlier. Significant growth in the number of connected IoT objects, at an average annual rate of over 20% by 2022, will be fuelled by a wider range of use scenarios (cases) and falling prices of connected devices/things.

In agriculture, the Internet of Things or IOT represents a wide range of new emerging technologies. These technologies help to collect and measure data, with this data being accessed by farmers remotely via cloud storage services. What used to be someone's job to go and take moisture level measurements is now provided by a sensor. An example of information that can be collected is soil moisture, chemical levels, dam levels and animal health - as well as monitoring fencing vehicles and weather. The Internet of Things is a class of things, containing devices, technology, software and a wide range of internet-

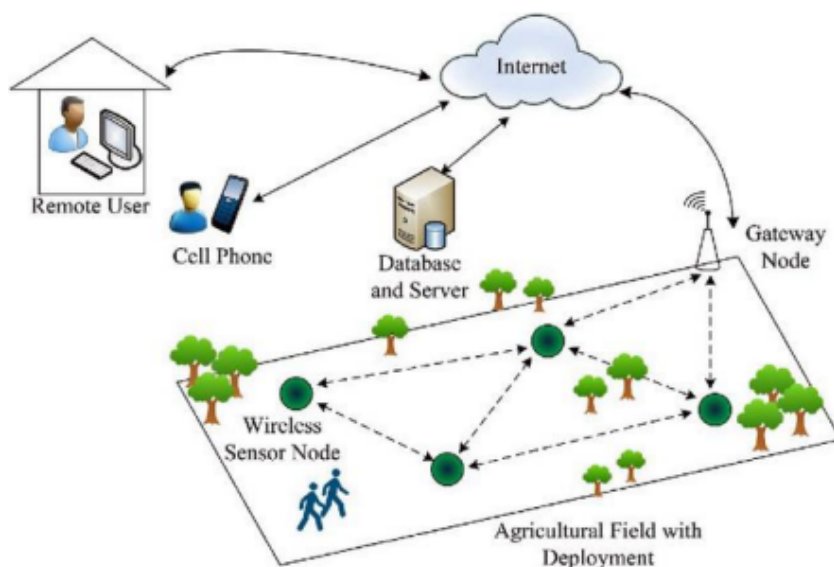
powered solutions, in this case for agriculture. This paper will present the most important findings on the Internet of Things in agriculture and try to argue the use case for each of them. As the world and not only agriculture is changing with the advancement of technology and the software industry, but this paper will also address the concerns, arguments for the use of new technologies and try to highlight their differences and advantages. The ability of farmers to modernise could be the way to overcome the current food crisis and environmental changes, as the technologies listed below attempt to pursue a business model that is waste-free while being environmentally friendly and sustainable.

### IoT Evolution in Romanian Agriculture

The rapid evolution of the IoT-based system has redesigned the agricultural environment from existing traditional methods and created new ways to study this field both qualitatively and quantitatively. This drastic evolution and this recent study on combining agricultural technology with IOT could improve the field of agriculture, thus increasing production with reduced labor and land use [1].

According to the World Health Organization (WHO), globally food production is expected to increase by 50% by 2025. This motivates the use of modern technologies in all stages of food production, processing and preservation, including the transport system from seed to consumer. Farmers are observed to follow the old traditional method of growing crops. Climatic conditions are unpredictable. Sometimes farmers suffer financial losses due to heavy rains or drought, which is where IoT technology comes in, with which these unpredictable situations can be monitored in advance [1].

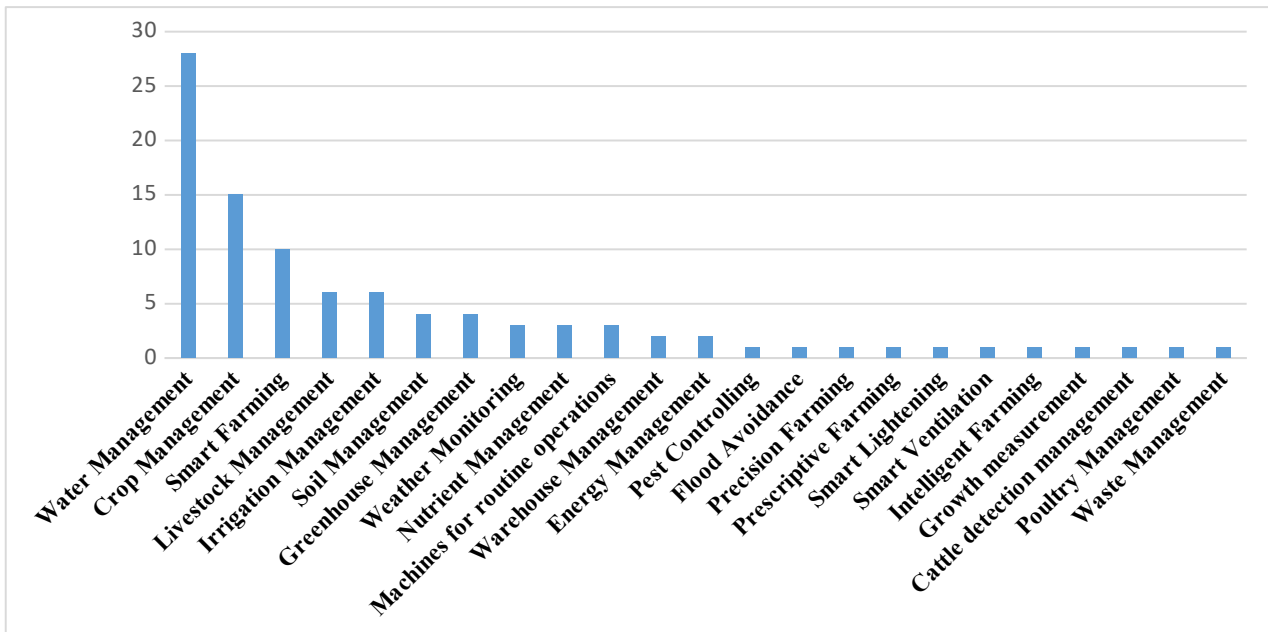
**Figure 1: IoT-based Agriculture Field**



Source: Usha K.P., Anand D.G., Chandrakanth H.G., Evolution of Internet of Things (IoT) & its impact on Smart Agriculture Environment, 2021, p. 2, <https://eudl.eu/pdf/10.4108/eai.7-6-2021.2308614>

As can be seen in the figure below, according to the results of a survey conducted in 2016, 23 sub-verticals were identified and the most important area was water management (28.08%). As IoT depends on collecting data from sensors, it is necessary to collect a large amount of data to identify or predict accurate results. This study indicates that many researchers focused on environmental temperature (24.87%), humidity (19.79%) and soil moisture (15.73%) as environmental measurements [2].

**Figure 2: Different Agricultural Sub-verticals Considered for Increasing Efficiency and Productivity**

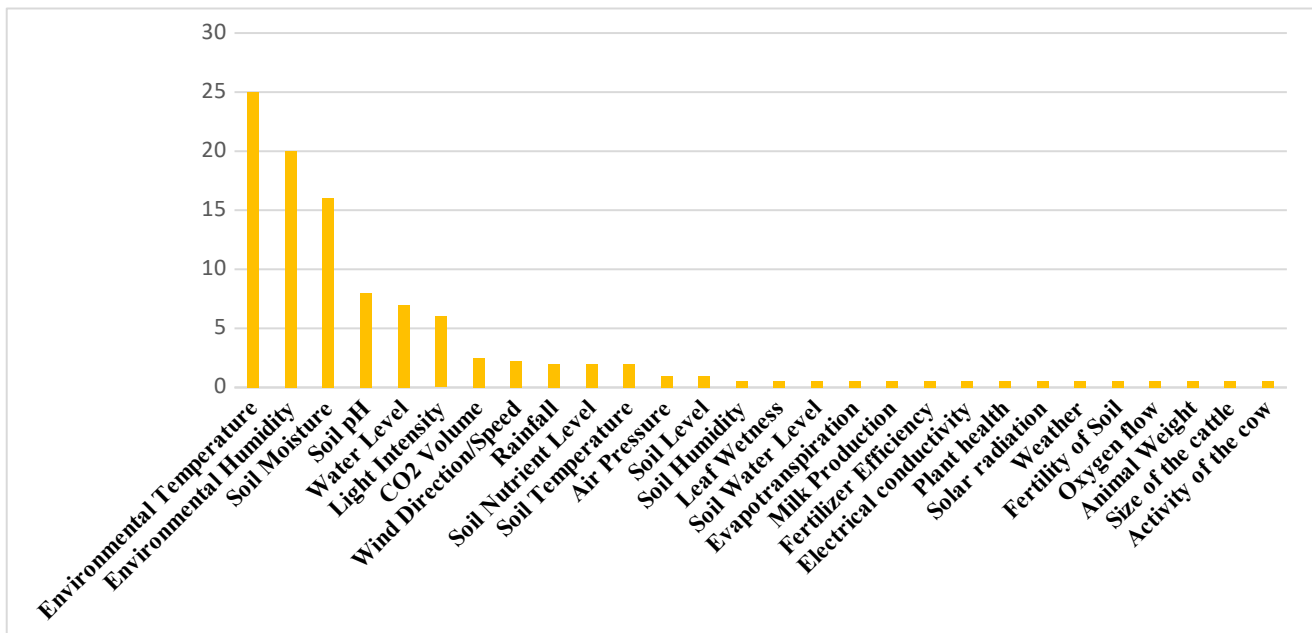


Source: Madushanki A.R., Halgamuge M.N., Wirasagoda S., Syed A., Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review, International Journal of Advanced Computer Science and Applications, Vol. 10, No. 4, 2019, p. 13,

[https://www.researchgate.net/publication/332762725\\_Adoption\\_of\\_the\\_Internet\\_of\\_Things\\_IoT\\_in\\_Agriculture\\_and\\_Smart\\_Farming\\_towards\\_Urban\\_Greening\\_A\\_Review](https://www.researchgate.net/publication/332762725_Adoption_of_the_Internet_of_Things_IoT_in_Agriculture_and_Smart_Farming_towards_Urban_Greening_A_Review)

Based on the same study, as shown in Figure 3, 28 types of data were collected for measurements, with temperature and humidity being considered the most important parameters for agriculture and farming. The data were collected from 60 scientific publications published during 2016-2018 [2].

**Figure 3: Use of Sensory Data Based on Agricultural Activities (%)**

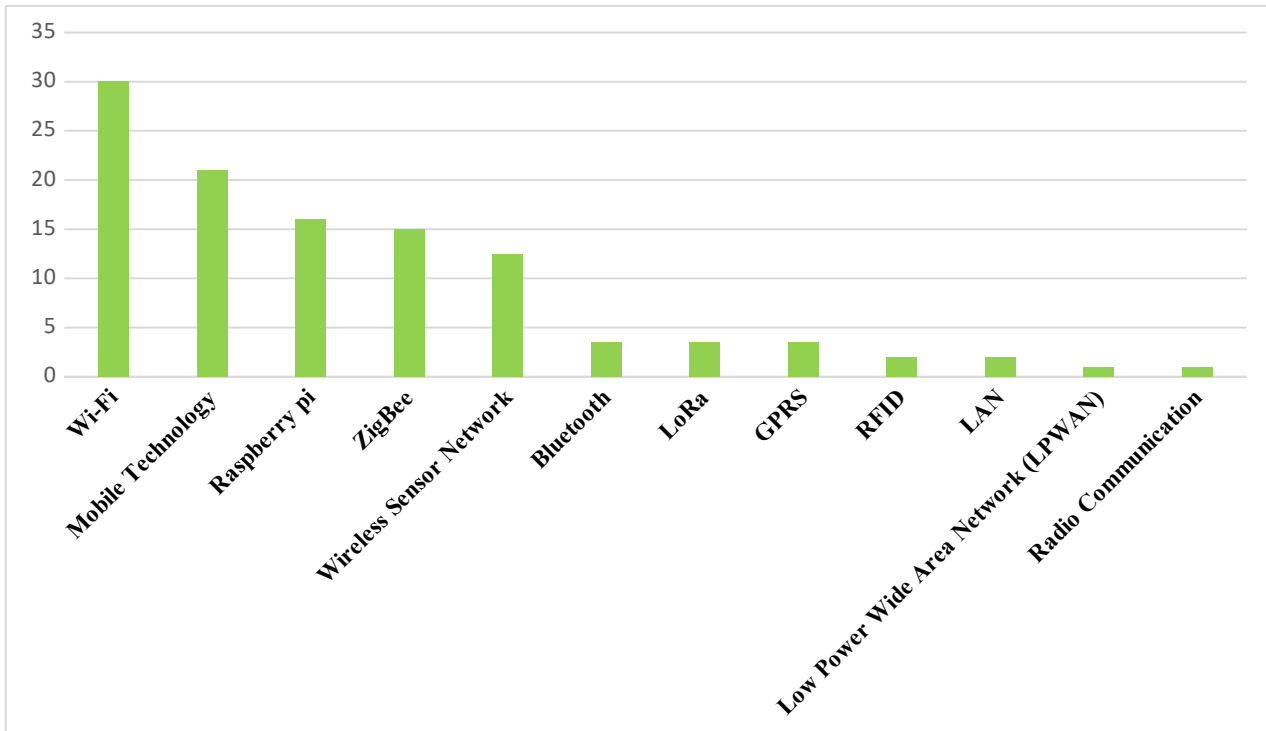


Source: Madushanki A.R., Halgamuge M.N., Wirasagoda S., Syed A., Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review, International Journal of Advanced Computer Science and Applications, Vol. 10, No. 4, 2019, p. 14,

[https://www.researchgate.net/publication/332762725\\_Adoption\\_of\\_the\\_Internet\\_of\\_Things\\_IoT\\_in\\_Agriculture\\_and\\_Smart\\_Farming\\_towards\\_Urban\\_Greening\\_A\\_Review](https://www.researchgate.net/publication/332762725_Adoption_of_the_Internet_of_Things_IoT_in_Agriculture_and_Smart_Farming_towards_Urban_Greening_A_Review)

As shown in Figure 4, we classified all the technologies used in the 60 articles. This study identified Wi-Fi as the most used technology (30.27%), followed by mobile technology (21.10%) for both agriculture and livestock. ZigBee, another data transfer technology, is also used, but to a lesser extent [2].

**Figure 4: Most Used Technologies Based on 60 Articles (%)**

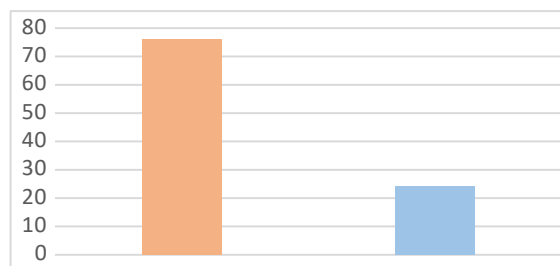


Source: Madushanki A.R., Halgamuge M.N., Wirasagoda S., Syed A., Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review, International Journal of Advanced Computer Science and Applications, Vol. 10, No. 4, 2019, p. 14,

[https://www.researchgate.net/publication/332762725\\_Adoption\\_of\\_the\\_Internet\\_of\\_Things\\_IoT\\_in\\_Agriculture\\_and\\_Smart\\_Farming\\_towards\\_Urban\\_Greening\\_A\\_Review](https://www.researchgate.net/publication/332762725_Adoption_of_the_Internet_of_Things_IoT_in_Agriculture_and_Smart_Farming_towards_Urban_Greening_A_Review)

According to Figure 5, the use of IoT was higher in the agricultural sector than in the livestock sector (agriculture - 76.1%, farms 23.8%).

**Figure 5: IoT Usage (%)**



Source: Madushanki A.R., Halgamuge M.N., Wirasagoda S., Syed A., Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review, International Journal of Advanced Computer Science and Applications, Vol. 10, No. 4, 2019, p. 14,

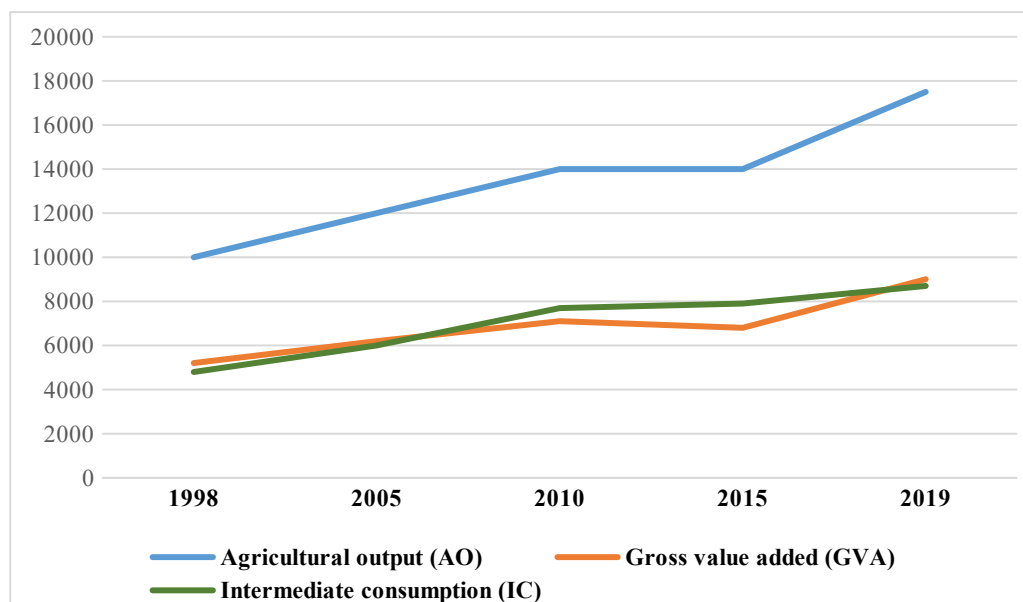
[https://www.researchgate.net/publication/332762725\\_Adoption\\_of\\_the\\_Internet\\_of\\_Things\\_IoT\\_in\\_Agriculture\\_and\\_Smart\\_Farming\\_towards\\_Urban\\_Greening\\_A\\_Review](https://www.researchgate.net/publication/332762725_Adoption_of_the_Internet_of_Things_IoT_in_Agriculture_and_Smart_Farming_towards_Urban_Greening_A_Review)

Despite technological advances in the field, agriculture is highly dependent on human input. Farmers still tend their land, harvesting crops and preparing fields for the coming season. But these age-old activities have taken on a whole new twist, with the internet of things collecting data alongside farmers in the field. With IoT in agriculture, farmers can reduce waste and increase productivity. Armed with data and automation, farmers are better prepared to tend, harvest and replenish their crops [3].

Over the past decade, connected agriculture has become a mainstay of the industry. According to some estimates, between 10% and 15% of farmers use IoT technologies [3].

Analysing the evolution of agricultural production, intermediate consumption and gross value added over the last 22 years in Romania, before and after the digitisation of processes in agriculture, an increase in the value of these indicators can be observed throughout the period analysed, even if there are significant variations from one year to the next [3].

**Figure 6: Evolution of Agricultural Production, Gross Value Added and Intermediate Consumption in Romania (mill. EUR)**



Source: Feher A., Stanciu S., Iancu T., Adamov T.C., Ciolac R.M., Design of the macroeconomic evolution of Romania's agriculture 2020–2040, Land Use Policy, Vol. 112, 2022,

<https://www.sciencedirect.com/science/article/pii/S026483772100538X>

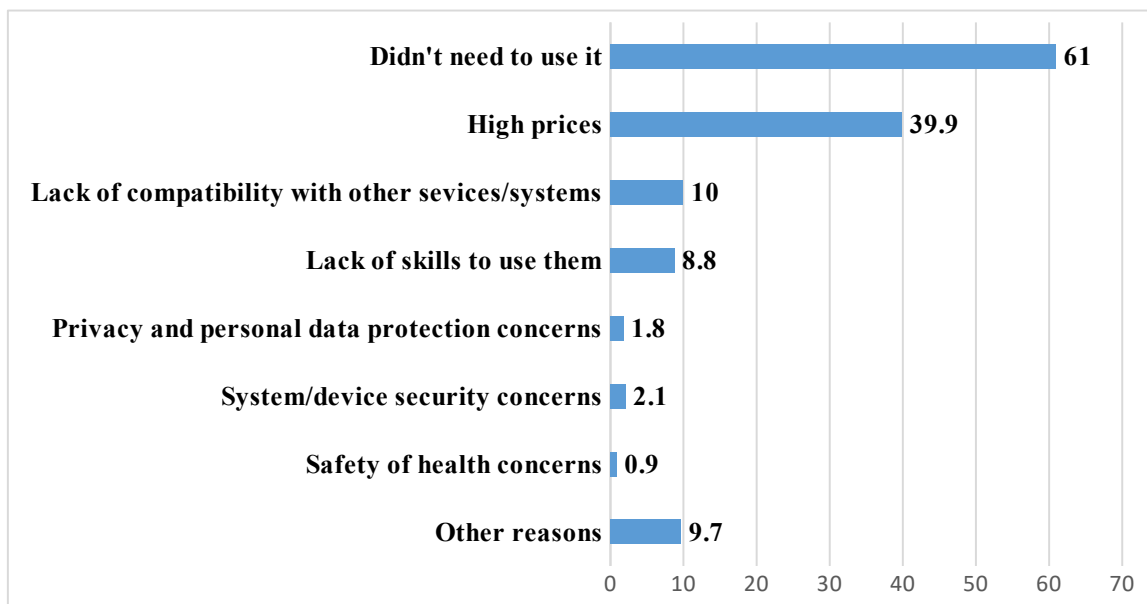
However, in the Romanian context, technology represents both a threat and an opportunity. Given that Romania's agricultural system contributes only 4.5% of GDP, compared to 25% for the IT industry, there seems to be a tremendous opportunity for growth. But the associated problems are complex. On the one hand, the country's predominantly small-farm structure, fragmented land ownership and low level of mechanisation are tangible barriers to rapid system change. On the other hand, farmers cite the growing shortage of available labour as the main obstacle they face to staying in business, a challenge where digitisation and automation are obvious solutions [5].

However, these are not universal solutions. The rural workforce may be in decline, but paid employment opportunities are fundamentally important for many rural households, and automation is replacing the kind of repetitive tasks that generate valuable, if small, rural incomes [5].

The agricultural sector needs to enter the digital age because of the growing demand for agricultural products. The introduction of new technologies helps farmers to manage their farms in a sustainable way. Innovative technologies can range from IT solutions to cropping systems. The introduction of new information and communication technologies in the agricultural sector could contribute significantly to its future viability and to the quality of life of farmers and consumers. Innovations will improve the quality of crop production, the quality of animal health, but essentially the quality of farmers' lives [5].

A survey by Statista Research Department found that the main reasons why Romanians working in agriculture do not use IoT are that they do not need to use the technology and that it is very expensive.

**Figure 7: Reasons for not using Internet of Things (IoT) Devices in Romania in 2022 (%)**



Source: <https://www.statista.com/statistics/1394854/romania-reasons-for-not-using-internet-of-things-iot-devices/>

In conclusion, it can be said that IoT technology brings a quite big contribution to agriculture in Romania, but there are some obstacles to its implementation, such as costs or lack of necessary information, which can help Romanians to make the decision to implement. Solving this problem requires the support of Romanian institutions and associations, along with European experience in this sector. Some examples of such measures and solutions for the development of the Romanian agricultural sector are: the implementation of LEADER measures; the establishment of the National Rural Development Network and the implementation of the National Rural Development Programme; support for the working groups set up within the European Innovation Partnership; the organisation of national and international conferences to accelerate the transfer of research results into practice [5].

## References

- [1] Usha K.P., Anand D.G., Chandrakanth H.G., Evolution of Internet of Things (IoT) & its impact on Smart Agriculture Environment, 2021. <https://eudl.eu/pdf/10.4108/eai.7-6-2021.2308614>
- [2] Madushanki A.R., Halgamuge M.N., Wirasagoda S., Syed A., Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review, International Journal of Advanced Computer Science and Applications, Vol. 10, No. 4, 2019. [https://www.researchgate.net/publication/332762725\\_Adoption\\_of\\_the\\_Internet\\_of\\_Things\\_IoT\\_in\\_Agriculture\\_and\\_Smart\\_Farming\\_towards\\_Urban\\_Greening\\_A\\_Review](https://www.researchgate.net/publication/332762725_Adoption_of_the_Internet_of_Things_IoT_in_Agriculture_and_Smart_Farming_towards_Urban_Greening_A_Review)

- 
- [3] Horwitz L., Connected Farming Harvests Data and Gives Agriculture a Jolt, 2020. <https://www.iotworldtoday.com/smart-cities/connected-farming-harvests-data-and-gives-agriculture-a-jolt>
- [4] Feher A., Stanciu S., Iancu T., Adamov T.C., Ciolac R.M., Design of the macroeconomic evolution of Romania's agriculture 2020–2040, Land Use Policy, Vol. 112, 2022. <https://www.sciencedirect.com/science/article/pii/S026483772100538X>
- [5] Vlăduț V., Tăbărașu A.M., Voicea I., Muscalu A., Matei Gh., A challenge for romanian agriculture, Analele Universității din Craiova, seria Agricultură – Montanologie – Cadastru, 2020.
- [6] Statista Research Department, Reasons for not using Internet of Things (IoT) devices in Romania 2022. <https://www.statista.com/statistics/1394854/romania-reasons-for-not-using-internet-of-things-iot-devices/>