The Transition of Romanian Agriculture: From Traditional Agriculture to a Digital, Sustainable Agriculture

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Abstract

With the accession to the European Union, Romania benefited from the legislative framework of the common agricultural policy, a policy that influenced the sale and processing of agricultural products, major decisions on the direction of agriculture in our country and on the costs of agricultural production. The image of Romania's contemporary agriculture differs a lot from the agriculture of European countries, this being structured differently from the rest of Europe. Romania is characterized by a lack of medium and small family farms because leaving the communist system has left its mark on their growth and development. Negotiations on agriculture (in Romania) began in November 2002 and were concluded in June 2004. In these negotiations, Romania benefited from an agreement similar to that of the states that joined the EU in 2004, namely better financing of agriculture, a stability of agri-food prices as well as real support measures for farmers (European non-reimbursable funds). The article aims to present in the introduction the advantages of Romania's accession to the EU, the evolution of Romanian agriculture in this context and the presentation of state-of-the-art projects that make possible a transition from traditional to digital agriculture in which artificial intelligence makes its presence felt.

Keywords: sustainable agriculture, digitalization, maximizing production, transition, emerging technologies in agriculture.

1. INTRODUCTION

In the period 2002-2004, the European Union carried out a series of direct negotiations so as to carry out a series of measures to support Romanian agriculture. During these negotiations were discussed the measures of direct support (the amount of funds allocated to Romania), production quotas, new measures for the development of Romanian agriculture, as well as a series of measures and agricultural production systems necessary to adhere to EU food safety standards. (sanitary, veterinary, phytosanitary norms) (Giurcă, 2005). Romania's accession to the EU has allowed the establishment of a pattern of financing Romanian agriculture, namely the transition from an unstable agricultural policy and forms of financing (depending on electoral cycles) to the implementation of real, sustainable measures to facilitate Romania's integration into the European Union. to the support given to agriculture as well as to a financing of small farmers and young farmers through different programs (Alexandri and Luca, 2008). Romania's accession to the EU has brought a plus for Romanian agriculture by providing direct payments, the state funding being much higher after accession (Hubbard et al., 2014).

The financing of Romanian agriculture through the second pillar represented a support for the development of Romanian agriculture. The adjustment of agricultural practices and the implementation of norms and objectives for greening agricultural soils and crops as well as the trend towards non-invasive agricultural technologies, the need to implement automated systems and programs (based on artificial intelligence) have led to the development of new best practice guides. of new financing programs for Romanian farmers (Giurcă, 2005). At the same time, another advantage of Romania's accession to the EU, in the agricultural field, was represented by the increase of entrepreneurship in rural areas. This aspect had the role of developing the activity of subsistence agriculture to a transition agriculture in order to achieve a diversification of non-agricultural activities into agricultural activities, profitable for farmers. Supporting entrepreneurship in underdeveloped areas has led to the emergence of small agricultural production centers, centers that give the agri-food network the necessary food for humans and animals. Another identified aspect was the emergence of new reforms...
needed in the agricultural field. These reforms have the role of managing the partner institutions in the processes of allocating and using the funds that will be allocated for Romania, implementing the common agricultural policies (CAP) and supporting the agricultural sector in case of potential shocks.

In the accession and post-accession process, numerous networks, clusters and incubators for data collection, interpretation and transformation of information obtained into knowledge have been developed in order to obtain innovative products or technologies in the agricultural field. These generators of information and knowledge have been basic pillars in the process of increasing the competitiveness of the agricultural sector, increasing and maximizing agricultural holdings, with a strong emphasis on supporting agricultural farms facing management problems, management, low level of processes, sale-purchase and supporting the renewal of generations of agricultural farmers (European Commission, 2016).

With Romania's entry into the European Union, a campaign was launched to organize and promote food chains and risk management programs in agriculture, especially on the integration of farmers in quality systems, IT and the creation of platforms that have the role of uniting farmers, providing them with information and advice on farm development, maximizing agricultural production and profit, but above all moving towards sustainable agriculture. The transition from traditional to sustainable agriculture will be gradual, with the farmer aware that in this process of transition and development farmers must conserve and strengthen agricultural ecosystems by restoring and conserving biodiversity, improving fertilization, irrigation and soil management. as well as by promoting the efficient use of agricultural resources by reducing pollution in agriculture and the use of non-invasive technologies for soil, culture, environment, man and animals.

2. MATERIAL AND METHOD

Before Romania's accession to the European Union, the contribution of agriculture to the formation of GDP was approx. 14% in 2004. The share of agriculture in the country's gross domestic GDP decreased to 8.8% (in 2006). The decrease of the contribution of the agricultural field to the GDP presented a decrease even after Romania's accession to the EU, in 2008 the index being of 7.5%. The relative share of GDP compared to the EU average remained a source of instability of GDP values, because this instability was attributed to climatic factors, the level of technology of farms and the socio-economic situation of Romania. The tendency to reduce this share is an important result from the perspective of decreasing the contribution of agricultural supply to GDP fluctuations, against the background of increasingly unstable climatic conditions and low farm capitalization. The reduction of the contribution of Romanian agriculture to the formation of GDP was due to some important fluctuations of agricultural production (table 1). The year 2008 represented the year in which the Romanian agriculture registered a major growth, compared to 2007. The positive dynamics of the gross value added (GVA) was due to the low productions from 2007, this year being one of the most unfavorable years from the point of view. climate change, throughout the transition to a market economy.

Table 1. Dynamics of agricultural production in Romania (pre-accession period)

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<tr>
<td>Agricultural production * in Romania (millions of lei current)</td>
<td>22835,2</td>
<td>31030,1</td>
<td>24277,9</td>
<td>26898,2</td>
<td>23454,8</td>
<td>32566,4</td>
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<tr>
<td>Dynamics of agricultural production * (%) (year 2000 = 100%)</td>
<td>125,7</td>
<td>149,2</td>
<td>123,3</td>
<td>127,4</td>
<td>106,4</td>
<td>129,2</td>
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<tr>
<td>(year 2002 = 100%)</td>
<td>105,2</td>
<td>124,9</td>
<td>103,2</td>
<td>106,6</td>
<td>89,0</td>
<td>108,1</td>
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The pre-accession period was a bad period for Romanian agriculture, obtaining financing projects from the state was a difficult test for farmers. At the same time, the farmers in the pre-accession period went on bank credit lines, which, compared to the pedo-climatic conditions of the pre-accession years, represented an obstacle for the farmers. Romania's post-EU accession period was a "relaxation" for farmers because the new amendments, orders and laws were in their favor. The fact that farmers were able to access non-reimbursable European funds for the purchase of new agricultural equipment and machinery and the expansion of their farms was an important step in increasing Romania's domestic GDP and increasing and maximizing agricultural production and farmers' profits. Romania's accession to the European space means for farmers and access to new technologies for agriculture, non-invasive technologies for the environment, soil, crops, productivity and profitability.

Thus, farmers had access to new technologies such as online platforms for disseminating information on technologies applied to crops, access to knowledge generation, some technologies such as drones, weather
stations, satellite stations and a number of equipment needed for the application. Fertilizers, plant protection products or even for soil disinfection. As materials, the research part used a weather station, ground sensors, state-of-the-art drone (equipped with artificial intelligence to make orthophotoplans - georeferenced maps and NDVI maps), detection sensors (recording of soil moisture, density, temperature, permeability, electroconductivity, etc.), data recording, processing, storage and dissemination system.

3. RESULTS AND DISCUSSIONS

After accession, farmers were able to access new agricultural information, based on which farmers implemented new technologies on their farms in order to reduce agricultural costs, maximize crop yields and develop sustainable agriculture. Sustainable based on these new non-invasive technologies. After accession, most farmers tried to implement non-existent technologies in Romania. Their implementation led to the emergence of Agriculture 4.0 which combined traditional agriculture with the digital environment, the Internet of Things and artificial intelligence. Thus, farmers have implemented in their own farms a series of technologies such as sensors, drones, robots, an interconnection of these equipments through the Internet. The role of these technologies was to produce adaptability, to adapt themselves to environmental conditions, without human intervention. A first example was the implementation of small drones (Figure 1) in agricultural crops in the Netherlands. The role of drones was to search for, identify and eliminate insects harmful to crops, without using invasive or chemical solutions. Based on interconnected software and sensors, the software identifies the pest, its degree of attack in the respective culture and the non-invasive ways to combat them (Figure 2).

Globally, the use of drones in agriculture is constantly increasing, because compared to other methods of aerial monitoring, drones generate more and more accurate data on the state of crops. Also, the economic nature of the use of drones is not to be neglected, for the monitoring of holdings with a size of less than 50 hectares, the drones being cheaper than surveillance by airplanes or satellite images. Data obtained through drones are used in various ways to improve the performance of a farm. The increasingly frequent use of drones in precision agriculture aims to obtain high and quality production, optimizing economic profits, integrated environmental protection.

By using drones in agriculture, farmers can benefit from maps containing information on vegetation signs. Through these maps, farmers would be able to spray fertilizer where the soil is poorer, could only irrigate drier areas and treat only plants that need to be protected from pests. In this way considerable potential savings can
be achieved, the plants would be healthy and higher yields of the monitored crops are obtained. Here is a model of the situation that everyone benefits from: a way to practice agriculture using technology. Figure 3 shows the schematic diagram of the use of drones in agriculture.

The year 2020 brought with it an unfortunate period for Romanian agriculture, a period marked by two major events: extreme drought and coronavirus pandemic. The extreme drought that occurred in 2020 was the worst in the last 50 years, as mentioned by farmers, which had a negative impact on crop productivity and, implicitly, on farmers’ profits. The coronavirus pandemic has had a negative effect on the production and distribution chain of agricultural products. Thus, the restrictions imposed by the authorities had a negative effect on farmers’ ability to sell their products. Although in some European countries these technologies have been used since 2003-2004, in Romania the use of drone technology has been placed much less than it should be.

An example of a project that combined traditional agriculture with modern agriculture (Agriculture 4.0) was the project carried out within the Research-Development Station for Agriculture Brăila, a project entitled AGRODATA. This was based on the desire of researchers from SCDA Brăila to help farmers in their production processes of agricultural crops and to guide them in good agricultural practices. Based on these guidelines farmers were able to access a number of innovative technologies, necessary to increase, develop and maximize the productivity of agricultural crops but especially, their conversion from a traditional agriculture to a digital agriculture.

The role of this project implemented in Romanian agriculture was to arouse the interest of farmers for digitalization, for the use of new non-invasive technologies, friendly to the environment, technologies that have the role of substituting classical fertilization technologies, application of chemical fertilizers and plant protection products. With the help of the drone used in this project, a series of flights were carried out with the aim of making orthophotoplanes that identified certain aspects such as the content of phosphorus (figure 3), mobile potassium (figure 4), the total content of salts (figure 5).

Figure 3. Phosphorus content in the soil

Figure 5. Potassium content of the soil
In order to make a series of determinations on agricultural crops, a series of UAV drone flights were carried out on the maize crop in the experimental fields of SCDA Brâila, a drone that has the role of making orthophotoplans. Based on the results obtained by the drone, depending on the specificity of each crop, specialists made a series of observations on crops, observations such as plant emergence, density, observation of crop abnormalities (disease attack, pests), estimating and monitoring the content of minerals in soil, estimating the degree of pest attack, monitoring and their diseases in agricultural crops and estimating crop productivity, based on the above (Figure 6).

Following the drone flights, a series of data were identified and, following their analyzes and interpretations, the researchers from SCDA Brâila made determinations for each scanned culture. Following the interpretation of the data, at the level of certain lots (P1, P2 and P6 - the red plots identified with the red color in the orthophotoplan) different problems were identified such as: small amount of nitrogen (in the soil structure), a "ragged" appearance of corn, as well as the appearance of the burning phenomenon on the leaves of corn plants (Setosphaerie turcica) and the appearance of embers (Shacelotheca reiliana) (Figure 7).
After collecting and interpreting the data, an online database was created - the Blue Monitor system, a system with the role of storing pedo-climatic data received from: the weather station, ground sensors, UAV drone flight data. The purpose of this system is to disseminate knowledge on the (early) detection of diseases and pests, the preparation of reports on the typology of pests and diseases, the recommendations of specialists for crop treatment, prevention and diagnosis of agricultural crops. The AGRODATA online platform can provide (by interconnecting these technologies) a series of reports on the evolution of pedo-climatic indices, the degree of attack of diseases and pests, weather forecasts as well as optimal methods and technologies for applying fertilization and protection products. of plants, non-invasive products for the environment, humans and animals.

CONCLUSIONS
After Romania's accession to the European Union, agriculture went through a transition from a classic, traditional agriculture to a sustainable, sustainable agriculture friendly to the environment, human and animal health. Promoting resource efficiency and supporting the transition to a low-carbon economy, resistant to socio-political changes and transitions, by increasing the efficiency of water consumption in agriculture (irrigation), the use of solar energy in agriculture, facilitating the supply and use of renewable sources (wind) and the reduction of nitrogen and methane oxides in agriculture were among the first points of discussion and negotiation at European level.

These new technologies have the role of facilitating the work of farmers, of protecting the environment and of increasing the productivity of agricultural crops by implementing these technologies at farm level. Post-accession technologies have had the effect of protecting the environment by conserving and regenerating the resources of agricultural agroecosystems. The implementation of the AGRODATA project in agriculture in the north of Bărăgan is an important step in the post-accession period, a period in which some farmers have developed both production technologies, processing technologies and cost reduction per hectare.

The development of these online platforms and the adherence of farmers to them represented a much faster circulation of information as well as a dissemination of results obtained in agricultural crops, recommendations on treatments, recommended doses per crop, based on this information forming a basis that provides farmers information on the optimal pedo-climatic conditions (for each crop), plant health, degree of attack of diseases and pests, as well as recommendations of specialists from SCDA Brăila, recommendations on maximizing production, profit and reducing costs in agriculture.
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