SMART FARMING IN CORN CULTURE

Marinela **ILIE**
PhD Student, The Bucharest University of Economic Studies, Romania
Email: Marinela.ilie93@gmail.com

Abstract
There is no more mechanized agricultural process that does not benefit from computerized assistance that optimizes working parameters and obtain qualitative indices of lifting, comfort and safety in the process of increased work for the user, low fuel consumption and manpower and low negative impact on the environment. The concept of "Precision agriculture" involves adjusting inputs in the agricultural system (seeds, fertilizers, pesticides), to distribute all where it is needed just as long as it takes.
Measurement of differences working parameters through sensors and transducers, analysis of information received through computer systems or specific software and sending orders for modification of other parameters on tractors and machines has created the "Smart farming" system.
The advantages of using smart farming are immense in all aspects. The user inserts the working parameters into the computer, monitors the processes and through the actuators execute the necessary settings. Complete and accurate information on the processed surface, fuel consumption, seed, fertilizers, pesticides, or quantities harvested in agricultural harvesting machines are received in real or centralized time. Cultivating cereal like corn can be extremely profitable regardless of the surface, but for that it is essential to observe some particularities of this plant. Romania is one of the largest maize producers in the European Union; in this article is presented all cost and also cost prognosis for smart farming in corn culture.

Keywords: *agriculture, precision agriculture, smart farming, corn culture*
DOI: 10.24818/CAFEE/2019/8/21

Introduction

Smart farming is a concept of resource management on a farm, which uses modern technologies, whose main purpose is to increase the quantity and quality of agricultural production. Today, farmers are hearing more and more about precision equipment, geo-positioning systems, sensors, actuators, drones, robots and other issues that until recently were impossible to associate with this field of activity.
The tendency in the agro market is that farmers around the world make decisions based on scientific data. The role of precision agriculture is to apply the right product, in the right quantity, to the right place. If, until now, in traditional agriculture, most of the farmers made subjective decisions on the farm, precision agriculture provides data that encourages objective decisions, which maximize business results.
Romania, is one of the largest maize producers in the European Union, so the farmers which really want to increase their production and to make more profit reducing costs, are using smart farming. This paper presents the way in which intelligent and precision agriculture is made at a farm from Romanian corn culture. With the help of intelligent applications, everything is monitored, the evidence of the costs is efficient and real, otherwise the

estimation of the production is easily achieved so the farmer can predict the profit. Such a scenario is presented in this paper.

1. Literature review

In the context of increasing global population and the negative consequences of climate change, the need for food is increasing. And farmers around the world make decisions every year about the different tools and technologies they will use to produce the best crops possible, as shown in the document.
Thus, precision agriculture involves a process of collecting and analyzing data, in stages, from offline to online. All data collected presents real information that can highlight distinct needs for administration and complex analysis, the focus now moving from the entire plot to sections of interest. With a wealth of data available, a farmer always knows how to sow differentially on his plot, what treatments to apply, how and where to maintain humidity, how to vary them and others.
A study conducted by The Climate Corporation in 2017, on a sample of 150 Romanian farmers operating over 96,000 ha from the most performing agricultural areas of the country, revealed essential information of daily practices in medium and large farms. Moreover, the study provided an overview of current agricultural methods and the future of agriculture in the new digital age. According to the research, 75% of the respondents, for the Romanian farmers, the mobile phone is a constant tool every day.

Tabel 1. Corn Production 2007-2018

Year	Surface thousands /hectares	Average Production Kg/ha	Total Production thousands / tons
2007	2524,7	1526	3853,9
2008	2441,5	3215	7849,1
2009	2338,8	3409	7973,3
2010	2098,4	4309	9042,0
2011	2589,7	4525	11717,6
2012	2730,2	2180	5953,4
2013	2518,3	4488	11305,1
2014	2512,8	4770	11988,6
2015	2605,2	3462	9021,4
2016	2581,0	4159	10746,4
2017	2402,1	5959	14326,1
2018	2371,0	7740	18.353,0

Source: 2007 - 2018. National Institute of Statistics (INS)Data – Statistical Yearbook of Romania

Thus, at the beginning of 2018, there were, according to information taken from the Climate Field view, 18 farmers who used the application for corn cultivation. We can say that this percent is very important in Corn production of Romania from 2018, as we see on Table 1.
According to the data taken from the National Institute of Statistics, The area cultivated with corn in 2018, represents 45.8% of the area cultivated with grain for grains, and the area cultivated with wheat 40.8%. The cereal production increased mainly due to the 28.1% increase in maize production. As we can see, the cultivated area of corn is smaller than the surface cultivated in 2011-2018, and in the last 11 years, the biggest production was in 2018, 18.353 tons.

2. Smart Farming in Corn Culture- Methods, Costs, Prognosis

Maize has a production capacity of about 50% higher than the other cereals, but also a wide spreading area, because it is little influenced by climate change. Moreover, maize has a high resistance to drought, heavy rains, but also to diseases and pests, and the agrotechnical and harvesting works can be fully mechanized.
Apart from these arguments, maize is cultivated all over the world and due to the very varied possibilities of exploiting the production. It is used also in human nutrition and as animal feed. Also, biofuels and cellulose can be obtained from corn, and some parts - corn silk, for example - are used for medicinal purposes as well.
How we do it in smart farming? So far, production per hectare has been increased by applying higher doses of inputs per hectare, mainly fertilizers and pesticides. In perspective, due to Digital Farming, the first stage (soil perception and evaluation) of the decision-making process in the elaboration of agricultural technologies that the farmer will apply in the field will gain a great importance, precisely because of the information received regarding the characteristics. to each sole. Depending on this information, the farmer can make the best decisions to increase the efficiency and sustainability of the farm in the medium and long term.
For example, based on the complete agrochemical mapping maps, copied to a memory stick and read by a powerful machine, we can indicate how and where to apply the inputs. In the image below (Figure 1) there is a capture from the Geoscan application. This is used by the farm for satellite crop monitoring, here can be tracked on each hectare. The Geoscan program provides us with high-level and accurate images from the surface of each part and gives us indications regarding the evolution of vegetation indices.

The Frizonagra farm from Romania, use this satellite aplication in crop monitoring. From my activity in the farm i saw that Geoscan is helping detect:

- High and low productivity areas in each plot;
- Different evolution of varieties from a certain culture;
- Insufficient or excessive fertilization;
- Agro-technical operations of poor quality;
- Overgrowth of weeds;
- Diseases of plants or damage caused by insects;
- Water stress - lack of water or flooded areas;
- Damage caused by wild animals;
- Estimation of damage caused by hail.

Figure 1. Satellite image from the Geoscan application
Source: Image captured as a result of the activity carried out at the Frizonagra SRL Farm

And that is not all, one important part in corn culture is fertilization which is done with a large amount of nutrients. It is necessary to fertilize with nitrogen, phosphorus and potassium, depending on the soil and irrigation conditions.
The application of foliar fertilizers consists of 1-2 administrations, the first in the phase of 4-6 leaves, and the second at an interval of about 2 weeks from the first administration. Solution volumes between 300-500 m^3 / ha are used, with a concentration of 1.0-1.5%. Foliar fertilization must be accompanied by chemical weed control and does not replace basic fertilization with nitrogen, phosphorus and potassium. In smart farming we do this with a machine name Rogator, Trimble Application, sensors and 2 Monitors(Figure 2,3,4). With the maps from Geoscan, saved in the application from the machine, the Rogator use only the required amount of fertilizer for each soil area. The same is true of herbicides. This reduces the amount of substance used, therefore the costs that are also carefully monitored.

Figure 2 (a and b). Fertilization with Rogator at Corn Culture
Source: Images captured as a result of the activity carried out at the Frizonagra SRL Farm

Figure 3. Monitoring of fertilization in maize
Source: Image captured as a result of the activity carried out at the Frizonagra SRL Farm

The sowing is done with the help of the sowing machine Figure 4. During this time, the operator but also the farmer, both connected to the application, can track the quantity of seeds sown per square meter and from here can start a first estimate of the production. Depending on the properties of the land, with the help of the map saved in the application mounted on the machine, the quantity of grains is applied according to the properties of the land. Also in the farm, the manager, in the decision-making process, uses the statistical reports transmitted by the sensors of the weather stations in the application installed in a computer (Fig.5).

Figure 4. Precision seeding at the corn crop
Source: Images captured as a result of the activity carried out at the Frizonagra SRL Farm

As a result of the activity I carried out at the farm, I noticed that in addition to the current weather conditions, the farmer also has access to the following information:

- Forecast of temperature and precipitation values for the next 7 days;
- Sprinkler forecast for suitable time intervals for applying plant protection products;
- Sowing forecast for the appropriate time intervals for sowing large crops;
- Prognosis of the risk of diseases and pests in crop.

This information can be provided for each soil regardless of its distance from the weather station, within the specified range of the significance of the data.

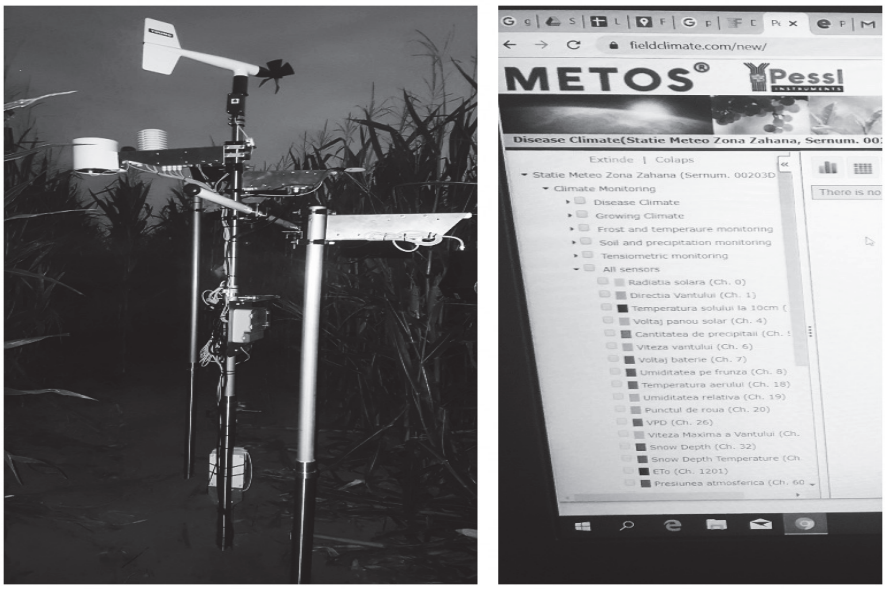

Figure 5. Weather Stations and Intelligent Monitoring of Corn

Source: Image captured as a result of the activity carried out at the Frizonagra SRL Farm

For irrigation in corn cultivation is used a Pilot irrigation systems which are automated and through a control panel you can set the operating parameters of the equipment, as well as the dosage amount with soluble fertilizers and irrigation water. Harvesting is done with the help of the combine that also has sensors installed to monitor the production, time and fuel consumption. Also, the intelligent application returns real-time information about the harvested soil, as we see in Figure 6.

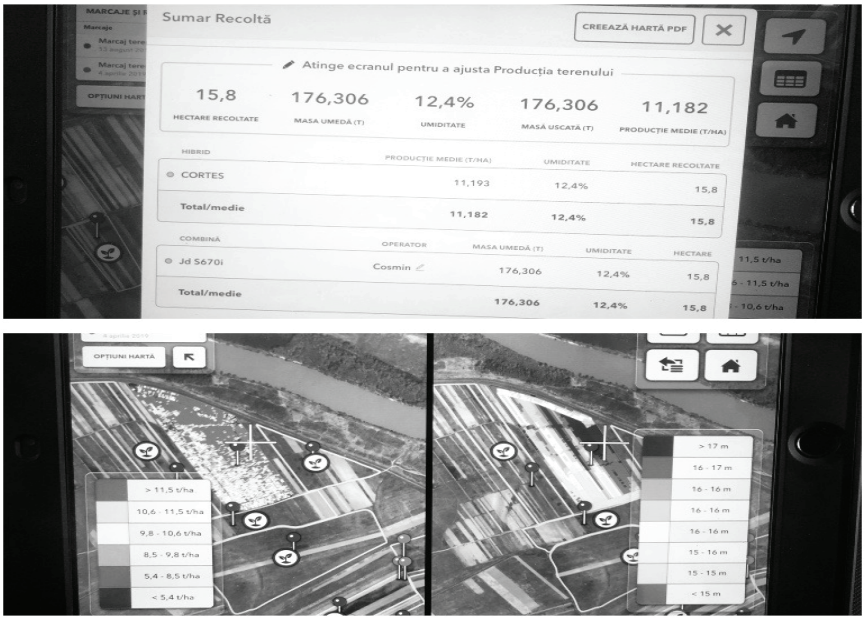

Figure 6. Corn Harvesting

Source: Images captured as a result of the activity carried out at the Frizonagra SRL Farm in 2019

As we see in the Figure 6, we can see the real production from our personal computer or smartphone. Even more, we can predict and make prognosis for profit. With all the economic information which I took from the farm, based on the application used and on personal observation of the activity in the farm, I realized 3 prognoses for 1700 ha (Table 2).

Table 2. S.C. FRIZONAGRA S.R.L – CORN 2018 – 2019 (PROGNOSIS)

INCOME	1700 Ha						
	Revenues		**LOW**		**MEDIUM**		**HIGH**
Price (18/19 Prognosis)			€125,00		€130,00		€135,00
Yield (t/ha)			7,7		9,00		10,5
Subsidies			€230,00		€250,00		€260,00
GROSS INCOME			***€1.192,50***		***€1.420,00***		***€1.677,50***
DIRECT COSTS							
	Cost/unit	Rate/ha LOW	EUR/ha	Rate/ha MEDIUM	EUR/ha	Rate/ha HIGH	EUR/ha

TOTAL DIRECT COSTS (SEEDS+ FERTILIZERS+ PESTICIDES+ Using Smart Applications)			€470,00		€450,00		€430,00
Operations							
Fuel & Oil & LPG Gas			€50,00		€40,00		€35,00
Repairs & Maintenance			€70,00		€60,00		€50,00
Electricity+ internet			€15,00		€12,00		€11,00
Freight							
Grain (t)			€80,00		€65,00		€50,00
Contract Work							
Services Third parties			€80,00		€70,00		€60,00
Insurance			€18,00		€15,00		€14,00
Rent			€160,00		€145,00		€135,00
TOTAL DIRECT COSTS			**€943,00**		**€857,00**		**€785,00**
INDIRECT COSTS							
	Cost/unit						
Salaries			€100,00		€95,00		€90,00
Depreciation of machinery			€95,00		€90,00		€80,00
Management Charge			€50,00		€40,00		€35,00
Operating Interest			€100,00		€95,00		€90,00
TOTAL INDIRECT COSTS			**€345,00**		**€320,00**		**€295,00**
TOTAL COSTS			***€1.288,00***		***€1.177,00***		***€1.080,00***
NET MARGIN/hectare			-€95,50		€243,00		€597,50
Break Even Price (to cover all the costs)			€167,27		€130,78		€102,86
Break Even Yield (to cover all the costs)			10,30		9,05		8,00

Source: Own processing of economic data obtained from the farm

Conclusions

Smart Farming in a corn crop includes one or more of the following functions:

- Determination of sectors with soil differences in a soil with satellites;
- Applying a suitable seed quantity according to the characteristics of each soil sector, at the precise distance and the appropriate depth, whic is determined with a software application.
- Applying a quantity of fertilizer that is really necessary, depending on the availability of nutrients in each sector, the characteristics of the soil, the culture and the density of planting it.
- Reducing the water losses needed for the culture in the state of development, based on climate information, soil moisture and the hydration status of the plants.
- Distribution of the quantity of plant protection products according to the intensity of the pest, weeds or disease in each sector (where it does not exist, it does not apply).
- Measuring the yields of the different sectors of the soil, thus finding out which produces more and which less, the machines automatically manage the quantity of seeds, the quantity of fertilizers, the quantity of plant protection products and the quantity of water.
- Integration of all this information for the best cost reduction and record.
- Use of technology for each work performed in culture through applications installed on phones, tablets, computers.
- Increase the Profit.

References

1. European Commission (2016) "*The Internet of Things. Digital Agenda for Europe"*, European Commission" [Online] [Accessed: 01 September 2019], Available: https://ec.europa.eu/digital-agenda/en/internet-things
2. Popescu, G. (2014). PROPOSALS REGARDING THE FOCAL POINTS OF A FUTURE STRATEGY FOR THE DEVELOPMENT OF RURAL SPACE AND OF AGRICULTURE IN ROMANIA. *Competitiveness of Agro-Food and Environmental Economy*, 26.
3. Audit Report Frizon Group, [Online], [Accessed: 19 July 2019], Available: http://frizongroup.ro/wp-content/uploads/2018/05/Frizonmaica-Raport-de-audit.pdf, and http://frizongroup.ro/ro/
4. Whitepaper - FrizonGroup, [Online], [Accessed: 20 September 2019], Available: http://frizongroup.ro/wp-content/uploads/2018/05/Frizon-whitepaper.pdf