Trakia Journal of Sciences, Vol. 19, Suppl. 1, pp 162-167, 2021

Available online at:
http://www.uni-sz.bg

ISSN 1313-3551 (online) **doi:10.15547/tjs.2021.s.01.024**

ECONOMIC ASPECTS AND CHALLENGES IN PRECISION AGRICULTURE

N. Penev*, M. Petrov

Trakia University, Faculty of Economics, Stara Zagora, Bulgaria

ABSTRACT

Precise agriculture is an intersection in which meet high technologies, knowledge of the earth, soil, climate and good practices in agricultural activity. Economic aspects with precise agriculture are related to the introduction of those practices that can help improving the optimization of costs and achievement of higher quality products and better crop collection rates. In order to introduce the practices and techniques of precise agriculture specific investments are required in: information assurance, agro -technical procedures, monitoring services, and the use of GPS devices for mapping the field and planning the production process according to the specific needs of the farm. There are a wide variety of techniques that could be introduced in the production process, but only in certain cases these practices could be viable and could lead to real pay-back in a reasonable period of time and of course, could lead agricultural production to optimization levels , reducing costs of exploitation and improving financial statements of the farm.

Key words: agriculture, economics, new technologies

INTRODUCTION

Precision farming is a set of techniques and principles in the implementation of agricultural activity, which allow to obtain information about the needs of the farm and to implement actions in specific "points", as needed. In particular, precision farming focuses on the ability of farmers and stockbreeders to obtain real-time information on the condition of their farms; be able to better plan their activities; to be able to apply only those resources that are needed at the moment of the farm. In recent years, this direction in agriculture has become increasingly relevant due to the need to increase the efficiency of agricultural holdings, while maintaining the sustainability of natural resources. A report to the EP's Committee on Agriculture and Rural Development entitled "Promoting innovation and economic development in the future management of European farms" highlighted the growing demand for agricultural products and the importance of technological innovation in order to achieve higher productivity without damaging natural resources.

MATERIAL AND METHODS

The objectives of the study are to review the existing opportunities and methods for applying precision agriculture on the Bulgarian market. To assess the challenges for successful application of the methods in question and achievement of successful economic optimizations and improvement of the general economic condition of agricultural holdings.

The research methods focus on systematization and analysis of current data on the application of techniques, for a set of specialized information on climate, soil, condition of agricultural crops available on the Bulgarian market by private and public organizations that offer services in this field. The necessary investments in technologies and automation for the successful application of precision agriculture in Bulgarian agriculture are compared. And the problems and challenges

Correspondence to: *Nikolay Penev, Trakia University, Faculty of Economics, Stara Zagora, Bulgaria*

facing the Bulgarian farmers in the successful application of technologies and innovations related to precision agriculture are traced.

METHODS AND TECHNIQUES FOR APPLYING THE PRINCIPLES OF PRECISION AGRICULTURE

One of the basic principles of precision agriculture is to provide "knowledge" about the land and crops. The aim is intelligent management by knowing the specifics of the location, the needs of the culture and the current state of the farm. A basic principle that must be observed when applying methods and techniques for precision agriculture is to start from the intelligent management of the farm. The microclimatic features of the region or locality where the crops are grown are observed and those crops that can grow best in the respective region are initially selected. The aim is to achieve optimal biological capacity of the crop / breed, which will lead to maximized to the marginal revenue per unit of arable land in the crop sector and per head of livestock in the livestock sector. It is important to take into account the cost of managing the farm.

Precision agriculture is structured on several principles that underlie the management of the farm:

i. Obtaining information on the state of natural resources: climatic and microclimatic features, the state of the soil cover of the areas, the state of the vegetation index of plant crops, monitoring the conditions for keeping animals in agricultural buildings (temperature, humidity, lighting)
ii. Systematization of the collected data in statistical tables and their aggregation in mathematical models.
iii. Presentation of the state of the farm, as clearly as possible through the use of maps and graphs indicating the state of the farm.
iv. Technologies for application of fertilizers and plant protection products with the possibility of "variable rate" according to the collected information.
v. Real-time monitoring of the farm, using mobile meteorological stations - control of temperature, humidity, and precipitation in specific points of agricultural land. Periodically take a "medium sample" to monitor the condition of the soil.
vi. Opportunity to implement timely and adequate measures using optimal resources and preserving the vitality of natural resources for as long as possible.

Emphasis is placed on the balance in which the farmer has the opportunity to develop their crops according to the natural conditions, the selection and the biological capabilities of the crop. Therefore, observing the principles of intelligent management, the farmer will grow and develop precisely those crops that have biological potential and are resistant to pathogens and adverse climatic conditions.

From the point of view of farm management, it relies on the possibility to provide information and to take timely and concrete actions as far as possible with a "point range" - ie. the actions are applied with volume and intensity exactly "where are needed". This allows to greatly optimize the cost part of the farm by reducing the consumption of fertilizers, food protection materials, and in animal husbandry the process of feeding animals can be optimized.

According to the methodology developed by Assoc. Prof. Gergana Slavova-Stefanova (2) It is worth mentioning that there is a theoretical and practical difference between the concepts of precision agriculture and digital agriculture.

Precision agriculture is related to the actual practices and principles of management of the farm that can lead to the improvement of the yield and reduction of the costs of farming. However digital farming uses the aid of technologies in order to achieve information collection, planning and control functions.

Digital farming techniques include technological innovations in many aspects, especially the use of tools and software that allow the collection and aggregation of farm information. It is used to obtain and control the indicators needed to implement actions related to "precision farming". Navigation systems are widely used to map areas and to distribute arable land into "blocks". Other monitoring and control systems involve drones flying over agricultural areas and, if possible, the

use of satellite images. The most interesting and useful for farmers is the opportunity to use mobile and cloud services and applications to obtain "intuitive information" about the state of the farm in real time.

The integration of a set of multifaceted and large-scale data into a mobile application that can fit "in the pocket" of the farmer is achieved. These technologies provide access to a variety of information that can be updated in a timely manner and is integrated into applications using software and visualization methods developed by technologies using visualization principles in sync with Geographic Information Systems. (GIS ahead).

As stated so far, farm management focuses on information-based actions that are systematized, processed and "translated" into an understandable language for both the farmer and the agricultural machinery that provides the opportunity to implement actions related to " variable rate "of application of fertilizers and plant protection materials. It is very important to note, in this way, can be loaded into the navigation system of agricultural machinery and accordingly apply the necessary settings to refine the consumption of fuel, fertilizers, plant protection materials.

It is important to note that the methods and principles used in precision agriculture in Bulgaria are not an innovation of recent years and are not generated and accompanied by advances in digital technology. The principles of intelligent and precise agriculture have been in use since the period of planned farming in Bulgaria. It was then that the participants in the development of agriculture had as a high value to integrate the achievements of science and technology in the development of material production.

They achieved it without the use of digital technology. There was a systematic and consistent activity of collecting and systematizing data on climate and land. The information obtained was applied in the management of the farms. In the activity of the agricultural holdings during the planned period of development of the Bulgarian economy, specialist's agronomists and zoo engineers and zoo technicians have obligatorily participated. The activities that are being collected in the current years, through external information services and processes are automated through the methods of "digital agriculture", years ago were part of the activities of agronomists and other agricultural professionals.

The difference is in the way of collecting information and the application of reclamation or agro-technical activities. What remains unchanged in the way of understanding agriculture and the search for synergy between knowledge and material production. Another indicator of "smart management" of agricultural areas is the historical distribution of subsectors in agriculture. It has always been tailored to the specifics of the region (natural conditions, climatic features) and of course to the type of culture they planned to grow. It has always been selected to be in line with the microclimatic characteristics of the region and the needs of the culture or species of animals that have been raised in the region. The clearest example of this is the regional distribution of traditional crops and the long-term realized selection of breeds which are very well adapted to the climate characteristics of the region.

Economic optimizations and challenges in introducing the methods of precision agriculture.

With a successful implementation of the techniques of precision agriculture, optimizations in agriculture are achieved in two aspects. On the one hand, an improvement in the revenue side is achieved by achieving higher levels of the biological potential of the cultivated crops. On the other hand, tangible savings are achieved in the expenditure part of the farm due to the reduction of the use of fuels, fertilizers and plant protection materials.

In the crop sector, these "small changes" in the cost per acre of arable land can lead to large differences in total costs and thus have a positive effect on the finances of the farm.

The main challenges in the crop sector are to achieve the necessary scale of activity so that the changes in the way of growing crops and the costs that are invested in the production process have a business purpose. It is also very important for the

farmer to have modern agricultural machinery in order to be able to integrate the collected information about the farm into the navigation system of the machines.

On the one hand, the scale is needed to be able to make investments in the field of precision agriculture, and on the other hand, the benefits and savings to lead to real optimization of income and expenses in the economy.

It is especially important that revenues are also optimized in order to preserve the vital indicators of the soil and plantations. If the production of agricultural products is too intensive, the farmer enters a large "turnover" of the cultivated crops and can damage soil, water, or destroy the biodiversity in the immediate ecological area. This is contrary to the principles of sustainability and intelligent agricultural management. In the event of degeneration of the ecological conditions, many times higher losses are suffered and the development of the biological potential of the crops becomes impossible. An example of this is excessive fertilization of the plantations, which leads to negative consequences for the cultivated crops: reduction of the quality of the production and creates a need for subsequent reclamation of the soil cover of the plantations.

● In the livestock sector, precision farming techniques help to improve the living conditions of farm animals, improve hygiene, reduce disease and optimize animal nutrition. Several different scientific disciplines work together in order to obtain benefits in the living conditions of cow farms, pig farms, and small farm animals. P. Daskalov (2015) (3). Many innovations are held even in the sphere of automation and computer control of electronic systems.

Principal aim of the joint effort of interdisciplinary studies is the development of the biological potential of the breeds. This result is vital and this process does not develop with effort in only one direction: nutrition, living conditions, medical care or only selection. It is interesting to note that in animal husbandry, nutritional imbalances (and not enough and excessive) lead to a reduction of biological potential and, accordingly, leads to minimization of the obtained production and tightening of the expected financial results. Balance and maintaining optimal levels of many indicators is vital for the economy. The very fact of looking for specific indicators, finding a way to obtain and be metrified them and their subsequent control is already a step towards precision agriculture in the livestock sector. Breeders also have access to laboratories and scientific instruments upstream in the supply chain because they are most often used by food resellers and food processors to monitor the quality of milk and meat produced. Cattle farms, for example, can purchase a device or use external services that measure the total number of somatic cells in milk (5), which is associated with the presence of mastitis in dairy cows. Based on the results of the tests made, breeders can understand the level of the health status of the animals they care. On the other hand, indicators measured in milk: the percentage of protein, carbohydrates and fats indicate the extent to which the desired diet has been achieved. In this way, breeders follow the principles of precision farming. They obtain information about the condition of the farm and make changes in the way of eating, exactly where it is needed with the investment of minimal additional funds and optimizing the expenditure part of their farm. However, the benefits are not limited to immediate savings, but have a long-term effect in improving the quantity and quality of yields.

The challenge for farmers is to reach the required scale of production and to have confidence that the investments or costs made (initially) will affect the activities of their farm and lead to long-term savings and improved yields and product quality. In order to enable the whole process and successfully integrate, Knowledge, technology and labor potential are required. According to K. Stankov (2020)(4) mostly large farm possess the capacity of organizing their production using highly qualified personnel and are able to optimize their working load.

TECNOLOGICAL INNOVATION AVAILABE ON THE BULGARIAN MARKET

The presented opportunities for work and achieving better results and cost optimization in agricultural holdings are in line with the available

technologies and innovations available on the Bulgarian market. The studied methods and practices are only those that can be found on the Bulgarian market.

Farmers who wish to invest in services and equipment providing conditions for precision agriculture have the opportunity to find them from existing Bulgarian companies that are importers of agricultural machinery or working for development for farm management software. There are also companies that develop their own models of drones, which have very good technical indicators and make it possible to shoot on agricultural land from a height inaccessible to most drones for general use. Other Stara Zagora companies offer services for integrated farm management and integration of many technologies, in the already mentioned sequence: obtaining information, creating a plan and introducing local actions. This is a condition for the proper integration of work processes and to move to the use of methods and techniques for precision agriculture.

Bulgarian agricultural producers have access to the following products and services offering information support of agricultural activity and application of the principles of precision agriculture.

Products provided by private companies.

- ATVs adapted for soil collection.
- Navigation systems for management of agricultural machinery
- Mobile meteo - stations.
- Tablets controlling an integrated navigation system
- Electronic control of irrigation systems
- Devices for quality control of milk and meat.
- Drones for flying around the farm.
- Laboratory instruments for quality of foods and animal health.
- Software for integrated management with GIS services.
- Software for irrigation planning and management.

Services provided by private companies.

- Soil collection
- Mapping of the land with the help of GIS software.
- Compilation of a map with a vegetation index of the farm based on satellite images.
- Drawing up a map with a vegetation index based on drone flying and photos with a spectrographic filter.
- Analysis of collected statistical data.
- Compilation of a "block sequence" that can be imported into the navigation system of agricultural machinery and to implement agro-technical activities with a "variable application rate".

Services provided by government institutions.

- National Agricultural Advisory Service.
- Center for testing and assessment of soil suitability and quality.
- National Institute of Meteorology and Hydrology. .
- Hail Control Agency - have a system of radars and the ability to monitor the condition and presence of hail clouds in real time.

State institutions working in the field of increasing the knowledge and competence of agricultural producers.

- Agricultural institutes at BAS with regional experimental farms .
- Centers for Vocational Education .
- Agricultural high schools.
- High schools for veterinary medicine
- Universities offering in their curriculum disciplines related to Agronomy, Zooengineering, Agricultural Engineering, Veterinary Medicine. Agricultural Economics.

CONCLUSION

If precision agriculture is a set of techniques and principles using high technology to have a local effect on agricultural land, then its implementation requires search and compliance with the principles and methods of intelligent farm management. It integrates the scientific discoveries made in the field of agricultural sciences, space technology, electronics and geographic systems. The results are related to knowledge of setting up and managing farms so that they are in sync with the environment, because in this way the crops grown become the most sustainable and efficient. With the help of

the proposed methods and principles for application of precision agriculture as a working practice, qualitative and quantitative optimizations in the use of resources can be carried out and the vitality of the environment, which is used for agricultural activity, can be preserved. The benefits obtained in compliance with the stated principles of work have a long-term positive impact on crops and livestock. The challenge remains to what extent farmers are willing to change their way of working and seek technical advice and make investments in this direction. Larger farms have a greater capacity to invest in additional services and employ more qualified staff than medium and small farms.

REFERENCES

1. EP report on fostering innovation and economic development in the future governance of European farms. https://www.europarl.europa.eu/doceo/document/A-8-2016-0163_BG.html
2. G. Slavova-Stefanova. Metodological insights.
3. P. Daskalov, K Arvanitis, N Sigrimis, J Pitsilis , 2015. Development of an advanced microclimate controller for naturally ventilated pig building
4. Milk analyzer Ekomilk Horizon ESSENTIAL. R&D department placed in Stara Zagora of Bultech 2000 .Ltd.https://www.bulteh.com/ekomilk-horizon-essential-somatic-cell-analyzer.html
5. K. Stankov, 2020 Labor productivity of diary cattle farming in Central and Southeast Bulgaria.
6. PRO DRONE SYS - A company with R & D department placed in Stara Zagora. http://prodroneagro.com/wp-content/uploads/2019/02/Pro-Drone-Agro-Presentation-07-02-19.pdf
5. Nik Electronics Ltd. Precision Agriculture services. https://nik.bg/preczizno-zemedelie/
6. Geographical Information System GIS http://www.technologica.com/products/deployment/gis
7. Software for integrated management system. Company placed in Bulgaria. https://meteobot.com/softuer/zemedelski-softuer/
8. Software for integrated management system retailing in Bulgaria. https://agriculture.trimble.com/reseller-locator/