PRECISION AGRICULTURE AND CONSERVATION OF COASTAL LANDSCAPES

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Abstract – The application of Precision Agriculture strategies represents an opportunity for farmers to obtain economic benefits given by the optimization of inputs and the reduction of the pressure exerted by agricultural systems on the environment, especially in coastal areas. In this context, the present experimentation was inserted, which aimed to evaluate a sprayer for the distribution of pesticide products on cereal crops in the coastal area of Metapontino, an irrigation area with a surface of 280 979 ha. In this area, as demonstrated by the experimentation conducted, the challenge of producing food and at the same time protecting nature and safeguarding biodiversity, it is possible to face it through the introduction of global positioning systems (GPS), a technology capable of integrating the information on soil type, climate, cultivar, crop and farm management, topography and economy.

Methodology

The application of Precision Agriculture strategies represents an opportunity for farmers to obtain economic benefits given by the optimization of inputs and the reduction of the pressure exerted by agricultural systems on the environment, especially in coastal areas.

The management of cultivation practices through the application of variable dosage of production inputs can guarantee numerous benefits, which can be divided into substantially two types of advantages:

- Economic advantages, due to the rationalization in the use of the different cultivation factors;
- Environmental benefits, related to the reduction of the negative impact of agricultural practices on natural resources.

In this context, the present experimentation was inserted which aimed to evaluate a spraying machine for the distribution of pesticide products on cereal crops in the coastal area of Metapontino, the agricultural production area of Matera, and once the cradle of Pythagorean knowledge.

The Bradano-Metaponto irrigation area has an area of 280 979 ha, comprising the territory of 25 municipalities in the Bradano, Basento, Cavone, Agri and Sinni basins in their lower course. 22.2 % of it is equipped for irrigation, while 9.1 % is actually irrigated.

From this point of view, the Bradano-Metaponto area is the most advanced of the Lucanian consortium areas.

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There is no doubt that the Metapontino area is the area with the greatest susceptibility to development in the region, not only in the purely agricultural context but in a wider socio-economic context. It is the only territory that since the 1950s and 1960s has recorded a significant demographic increase, expressing growth potential not yet fully expressed.

By virtue of the growing weight that some centrifugal attraction-dependence factors have had towards some neighboring regions and Puglia in particular. The Mediterranean climate, the favorable soil conditions, the flat land, the presence of large works of collection, transport and distribution of the water resource and finally the existence of an adequate infrastructure network have transformed the landscape of the area (until a few decades ago a swamp in which malaria claimed victims) in a very orderly chessboard of vegetables and fruit trees, citrus fruits, olive trees and vines. All these conditions make the metapontine area a highly suitable area for the creation of supply chain processes in the field of fruit and vegetable crops, here characterized by high levels and marked earliness. In terms of transformation and marketing, the area in question is now commonly considered as an "agro-industrial center", due to the level of production specialization achieved, the high profitability of the sector and the levels of employment that are significantly higher than to the rest of the region.

The surface of the irrigation area is 280 979 hectares of which 22 %, that is 62 424 hectares, is equipped for irrigation while 41 %, that is 25 555 hectares, is actually irrigated. The climate of the area is Mediterranean, with average temperatures ranging from a minimum of about 7-8 °C to a maximum of over 30 °C in summer. Precipitation is around 550 mm per year, mainly distributed in the autumn-winter period. The predominant crops in the area are fruit and vegetables, whose diffusion has been encouraged in past years as well as by the favorable pedo-climatic characteristics, also by the good supply of production factors. The main crops are strawberries, cabbage and salads among vegetables, stone fruits (especially peach and apricot) and citrus fruits (oranges and clementines) among the fruit trees, even if the latter are currently experiencing a phase of stasis due the high production and commercial risks associated with their cultivation. The cultivation of the vine is intended for 60 % for the production of table grapes, while the remaining part for the production of wine grapes (for self-consumption or purchased and processed mainly in Puglia). The table grapes, on the other hand, are marketed in part by local operators and in part by extra-regional operators (from Puglia). Next to the fruit and vegetables, which characterizes the coastal strip and the valley floors of the rivers that surround it, in an almost unmistakable way, the landscape is also marked in its innermost and steep slopes by the ancient presence of the olive tree, whose cultivation was already known and practiced in the area by settlers belonging to the settlements of Hellenic origin, as evidenced by the numerous finds found in more than a few companies. While presenting different systems of plants conducted in a modern and rational way, the olive growing of the Metapontino mostly follows the structural characteristics of the province of Matera (small farm sizes and production mainly destined to self-consumption). The use of the cultivation of durum wheat as an income supplement is widespread (frequent part-time phenomena), even in the more flat areas, given the limited number of days per hectare and the relative concentration of cultivation operations in a few months of the year . Most of the cereal farms, due to the small size of the company, have a predominantly family-run business and a subcontracting system limited to harvesting.

The recent launch of the MOCs (Macro Market Organizations, promoted with EU co-financing) and the Organization of Producers activated by the fruit and vegetable CMO have made it possible to become part of established circuits of large organized distribution; suffice it to say that 97 % of Lucanian agricultural exports are concentrated in the fruit and vegetable production of the Metapontino area.

With reference to this last aspect, the problems relating to the management of water resources have assumed a decisive importance for several years already. The reduction, but above all the rationalization of irrigation volumes, in order to lower production costs and limit the impact deriving from excessive water consumption, represent the main objectives that modern agriculture must set itself.

Moreover, the most recent scientific research, in the field of irrigation management in citrus fruit cultivation, is aimed at promoting eco-sustainable agriculture.

To achieve these objectives, it is essential to have the possibility of constant monitoring of the relationships between soil, plant and atmosphere.

It is therefore necessary to provide for socially fair, ecologically sustainable and economically advantageous agricultural activity, through an inclusive process of the parties. Farmers face a twofold challenge: to produce food and at the same time protect nature and safeguard biodiversity. Using natural resources prudently is essential for our food production and for our quality of life.

The changes that are taking place in Italian agriculture can be attributed not so much to a recession, due to changes in the international panorama, but rather to a crisis of technological identity. To make such a profound change possible, it is necessary to carefully review the cultivation practices and technologies adopted in the light of modern achievements in the field of knowledge and technology. Precision agriculture owes its birth and evolution precisely to the potential deriving from the widespread application of new technical solutions to the primary sector. In its essence it consists in the application of principles and technologies for the management of spatio-temporal variability, associated with all aspects of agricultural production. Without variability, the concepts of precision agriculture would have little meaning and probably would never have developed.

- The first phase of its application consists in the measurement and interpretation of variability.
- The second phase uses this information to manage variability, adapting agronomic inputs to local conditions within the field.
- The third phase, perhaps the most important, consists in validating the proposed approach, using indicators capable of measuring the effectiveness of "site-specific" practices. In the event that the results are not satisfactory, the management proposals must be suitably modified before transferring them to the farmers.

Whatever the application sector, there is now a widespread need to develop a useful tool, capable of making the agricultural system productive, profitable and environmentally friendly, through the transition from "generalized" agriculture to the entire farm area (fertilization, irrigation, weeding, variety, uniform sowing density) to a "specific site" which, while retaining an extensive character, starts from a detailed knowledge of the environment and knows how to match the use of production factors to specific local characteristics. The challenge therefore of modern agriculture is to use modern technologies both to identify the processes underlying production and to manage spatio-temporal variability, in order to maximize economic revenues, always respecting environmental constraints. (scheme of the integrated approach to precision agriculture) The introduction of global positioning systems (GPS) and yield displays, equipped with GPS and mounted on automatic harvesters, has already made it possible to quantify the variations in yield within the fields and to produce production maps, classifying the different areas according to the quantitative and qualitative properties of the product collected. This technology, together with the spread of geographic information systems on computers (GIS) and the ability to process and map attributes related to productivity, thanks to the use of advanced techniques of spatial analysis and dynamic simulation of crop systems, has facilitated the spread of precision agriculture. The georeferenced information on the crop response can therefore be inserted in a GIS and integrated with the information relating to the type of soil, the climate, the cultivar, the crop and farm management, the topography and the economy.

With the availability of acquiring high resolution satellite images, it is now possible to read the Earth's surface and what it covers in an ever more precise and detailed way. The evolution of the reflection and absorption capacity of sunlight at different wavelengths by vegetation is today related to the quantitative and functional development of the same; it is therefore possible, by calculating suitable radiometric vegetative indices, to obtain important indications about the vegetative growth rates of the crops and the possible onset of stress which, in turn, can influence the quantity and quality of the final product. The GPS system offers the possibility of being able to express the position of any point in the plot as a pair of geographical coordinates and to associate information and data relating to it. It also records the variability present within it, coding it and creating a geographical format within a reference system. The use of a satellite receiver in agriculture can find various applications, which can essentially be traced back to the detection of the boundaries of a plot and the determination of the position of a machine operating inside it, so as to be able to create a registration at a point (mapping) and / or the implementation of information (variable dosage distribution).

To this end, the tests carried out have made it possible to evaluate the performance of the distribution, quantity and quality, according to the different guides of the tractor: manual guide, assisted guide and automatic guide with satellite correction.

The results showed a sharp reduction in the failure rates in automatic driving just 0.2 %, as well as the overlaps obtained with automatic driving were 0.2 % compared to 1.5 % recorded with automatic driving.

Alongside these technical data linked to the functionality of the tractor, there is a higher advancement speed with automatic driving, which also reaches 12.6 km/h compared to 6.6 km/h that can be reached with the manual guided machine; this trend is repeated for the turning times, data which therefore express greater maneuverability of the machines driven by self-driving tractors.

Therefore, with a view to an economic and environmental sustainability of crops in coastal areas, the use of these guide systems appears indispensable for optimizing crop interventions in terms of the use of human and production resources according to crop needs, The other serves to ensure production systems that are respectful of particularly sensitive landscapes such as coastal ones.

The study is basic for the implementation of RTK systems for 5G data transmission.

GNSS systems (global satellite navigation system) are proving to be very useful in many aspects of our lives; their integration into mobile devices, then, makes asking where a place is has become a useless question. The satellites continuously transmit information to the terrestrial stations that identify the position of the satellite itself and the time at which it is transmitting the signal (derived from an internal atomic clock) while the user receiver uses its own clock to compare the data received: it can be performed several measurements with different satellites to obtain the position of the receiver according to a principle called trilateration.

Satellite observation allows to optimize the use of water for irrigation, to improve agricultural productivity, to minimize the use of pesticides. For example, the correct use of satellite observation data would improve crop estimates by 200 %, thus facilitating the forecast of food crises and consciously using water and pesticides. Ultimately, help from space makes these activities more sustainable.

If space technologies demonstrate their great ability to support the quality of life on our planet, they have practically exclusivity in supporting human exploration of the universe. Sustainable development is the challenge of these years and it is easy to imagine that it will not be a challenge that we will win simply.

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