

# Satellite and 5G technologies in the experimentation of sustainable urban agricultural practices in Matera, Capital of European culture of 2019

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## Abstract

Agriculture, like industry, has seen its very personal "revolutions", the first linked to the crossing of plant species, the second to the mechanization and use of genetics in crops.

The FAO (Food and Agriculture Organization of the United Nation) in the past has highlighted how the constant increase of the world population determines the need to find efficient solutions for the increase of world food resources.

Increase production in symbiosis with the virtuous environmental protection policies - linked synthetically to the protection of the natural heritage by reducing fertilizers, pesticides, fuel, as well as protecting forest resources from further tillage - without forgetting the dangerous phenomenon of depopulation of rural areas and management criticalities resulting from sudden climate change, could be very difficult.

Succinctly it is possible to identify three fundamental themes to which the innovations in the world of agriculture can be traced:

Information collection and management: through sensors capable of estimating the variables of agronomic interest such as environmental factors, soil chemical composition, soil water resource content, vegetation vigor maps ...

Informazioni Study of information: to address agronomic choices in a strategic way through the analysis of acquired information (a digital system is able to process a large amount of geo-data to define a functional model of agro-ecosystem management);

Automation of operations: it represents the final step, it is good to highlight how in practice the timing of the operations is a factor determined for the purposes of the success of the business activities. Automated systems (for example, operations such as irrigation, fertilization, greenhouse climate control ...) represent a pillar in new farms.

The various researches today are aimed at creating instruments capable of actively participating in the management of the company, however the risk of distorting the role of the farmer - a figure historically based on specific characteristics and a "special relationship with the land" - is high.

In this regard, the territories of Basilicata represent a great example of how incisive the figure and the activity of the farmer on the territory can be.

These strips of land are historically characterized by a great incidence of agriculture, aimed in particular at the production of cereals.

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While maintaining the main agricultural destination, these territories for some decades now, they are experiencing - above all due to the lack of competitiveness of small local companies - much larger and more consolidated realities - the sad phenomenon of abandonment and degradation.

This phenomenon is therefore determined by the strong land fragmentation and the absence of a solid supply chain.

The experimentation in question, aims to develop innovative tools for safeguarding and enhancing the agricultural landscape of Basilicata.

## 1. INTRODUCTION

The strong spatial and temporal variability that characterizes any agro-ecosystem has determined the need to identify new tools and strategies aimed at achieving an efficient and effective management of agricultural land.

Precision farming (AdP), or precision farming, represents an agronomic management method that uses the most modern technologies in order to carry out agronomic interventions according to the real cultivation needs and the physical, chemical and biological characteristics of the soil.

This advanced form of agriculture pursues, in full harmony with the concept of sustainable development, a double objective: to increase business productivity and safeguard environmental resources.

This is ensured by the possibility of administering the productive inputs according to a variable rate system, guaranteeing numerous benefits attributable both to the economic sphere and, obviously, to the environmental sphere.

The possibility of efficiently dosing the various crop factors weighting in a point-like manner the quantities to be distributed in the field guarantees, in addition to a considerable reduction in expenses, both the increase in production and an exponential reduction in environmental impacts.

From the economic point of view, being able to rationalize the use of the different crop factors ensures the efficiency of agronomic interventions, while guaranteeing both the increase in production and a sharp reduction in expenses.

From the environmental point of view, the possibility of dosing inputs efficiently, weighting the doses to be distributed in the field, guarantees an exponential reduction of impacts on the territory.

Today, in fact, it is estimated that in an ordinary fertilizing operation in liquid form with sprayer and sprayer, product losses due to drift, ground leaks and evaporation losses can add up to values of 50-60%, with a deposit on the target of the remaining part share!

The Lucan territory has always been characterized for its vocation to agriculture, in fact the historical, cultural and social heritage inherited from the rural civilization is immense.

These surfaces are still destined for the agricultural sector which, however, is not very competitive compared to a much more consolidated reality, which has led, for some decades now, to a sad phenomenon of abandonment and consequent degradation.

The experiment in question aims to develop innovative systems for the management of agro-ecosystems, in particular a Kverneland Fertilizer Spreader fertilizer spreader connected to a Fendt

724 tractor, capable of distributing the various inputs according to a precisely variable dosage was tested.

The system refers to prescription maps, or geo-referenced maps, capable of stably associating geographical coordinates with spatial information that - in this particular case - highlight the dosage of fertilizer to be distributed in the different areas of the field in order to obtain a system extremely efficient.

These maps derive from the weighted intersection of a series of data deriving from various analyzes (eg crop vigor, production history, soil analysis, climate analysis ...).

This experimentation - also in light of the promising future prospects for smart agriculture determined by the implementation of fifth-generation mobile systems (5G) in Italy and in particular in the Matera area - represents an initiative of great importance aimed both at increasing the competitiveness of the Lucanian farms that protect and safeguard the environment and the typical landscape of this beautiful area of southern Italy.

## 2. MATERIALS AND METHODS

Nowadays there are countless agricultural machines that can work at variable rates, capable of distributing the various inputs according to a precisely variable dosage, referring to the real needs of the crops.

The possibility of identifying, defining and managing variability makes it possible to realize the real potential of the plots, representing one of the objectives to be pursued in a rational logic of economic and environmental sustainability of agricultural production.

In crop planning it is therefore essential to know precisely the location, timing and intervention techniques in order to make interventions more efficient and effective, improving yields and reducing impacts.

In cereal cultivation, these aspects appear to be fundamental in relation to the correct completion of a delicate operation such as nitrogen fertilization, which today still represents a strongly impacting operation from an economic and environmental point of view.

Prescription maps identify areas that are homogeneous within the surfaces to be cultivated (in terms of characteristics and potential productivity), subsequently defining the optimal dosage of fertilizers.

The experimentation in question will take place in Montelongo, in the Municipality of Melfi (PZ), in a land registry area identified in Sheet 19 Particles 370, 389, 553, 554, 555, 556, 557, 558, 563, 564, 565, 566, 634, 834, 835 for a total SAU of 18.35 ha., Falling within the Lopinto Agricultural Company of Melfi.

This area is adjacent to another area on which assisted and automatic driving techniques have been tested since 2014, valid for research projects Mis.125, PSR 2007-2013, and today a partner company in the GO AGROTECH project. Mis. 16.1. RDP 2014-2020.

The area is flat and well connected (being in front of the Bradanica); it is representative of the cereal companies in the northern area of Basilicata, an area that is also experiencing strong industrial expansion due to the presence of the FIAT plant and SATA induced, and therefore as such particularly sensitive from an environmental point of view.

In particular, it should be noted that the Gibraltar variety of pre-basic durum wheat - q.li 2,10 / Ha - was sown this year.

The methodology was based on the analysis of:

- ✓ production maps of several vintages in order to identify stable and unstable homogeneous areas;
- ✓ ERT (Electrical Resistivity Tomography) maps, useful for the study of the soil and aimed at continuously determining the variation of the electrical resistivity of the soil;
- ✓ georeferenced samples;
- ✓ Dell' study of meteorological trends;
- ✓ These measures are related to the variation of important agronomic parameters such as texture, skeleton, salinity, but also water retention capacity, porosity and organic substance.

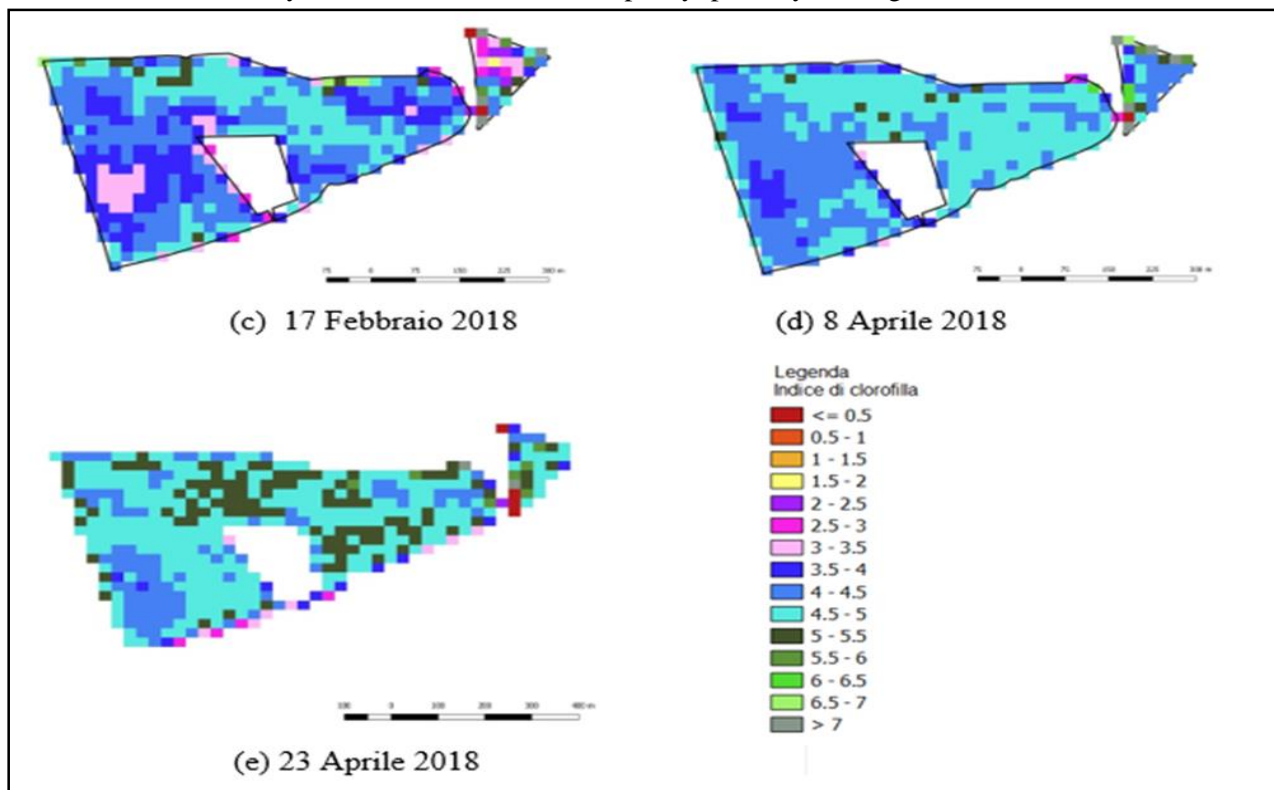


Figura 1: Chlorophyll content maps of vegetation processed from Sentinel-2 satellite images at a spatial resolution of 20 meters

The experimentation foresees the evaluation of the regularity of distribution in the field through the determination of the distribution diagram and of the distributed quantity, in order to verify the real correspondence of the fertilizer spreader to the received inputs and therefore to the efficiency in the distribution

The quality of the distribution was evaluated by examining the following parameters:

- ✓ flow rate of the fertilizer leaving the hopper;
- ✓ uniformity in both longitudinal and transverse distribution of the fertilizer spreader;
- ✓ separation of the granules during distribution.

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3. RESULTS AND DISCUSSION

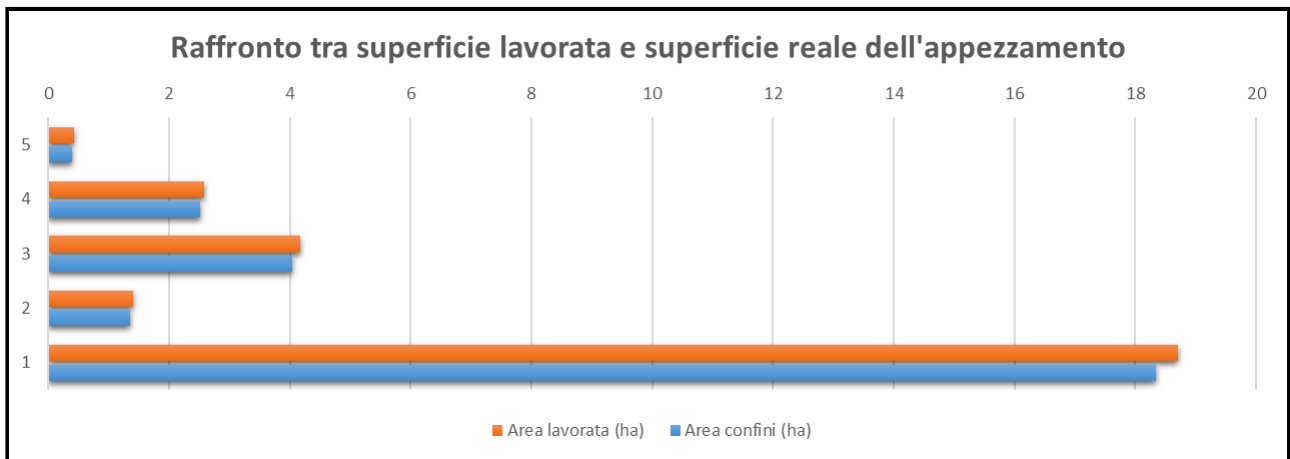
The sowing took place on November 16, 2018 through a hard-to-the-seed drill Laseminasodo brand, Demetra 6000 model.

No pre-sowing fertilizations were carried out, in the summer period digestates were distributed deriving from an alternative energy production plant.

A single fertilizer was applied with a slow-release fertilizer in February 2019, as shown in the following tables and charts, which show the efficiency of the automatic guided system with RTK support.

Riepilogo lavoro lunedì 11/02/2019					
Azienda: Masseria Lopinto					
Macchina da lavoro: Kverneland Fertilizer Spreader					
Veicolo: Fendt 724					
CAMPO	MONTELONGO GRANDE 2018	MONTELONGO PICCOLO 2017	MANNO 1-2	MANNO 3	MANNO 4
Area confini (ha)	18,34	1,35	4,04	2,52	0,4
Area lavorata (ha)	18,7	1,4	4,17	2,58	0,42
Distanza percorsa (km)	11,1	0,9	3	1,4	0,3
Dose min.	397,36	395,34	196,49	198,77	199,6
Dose med.	397,36	399,2	199,6	199,6	199,75
Dose max.	401,39	400	200	200	200

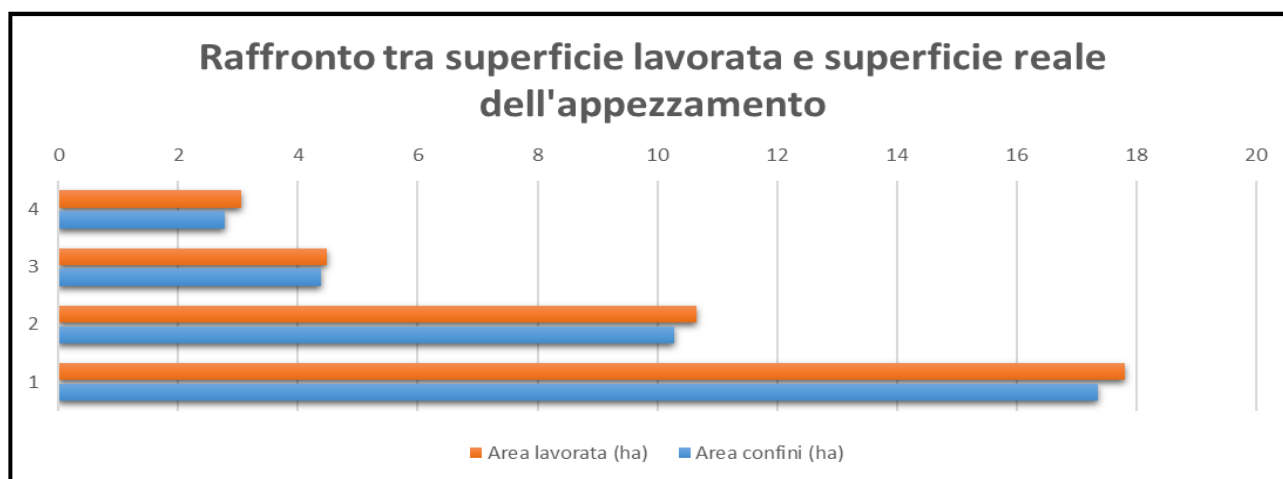
Table1: work summary Monday 11.02.2019



Graphic1: comparison between worked and real surface

Riepilogo lavoro giovedì 21/02/2019				
Azienda: Masseria Lopinto				
Macchina da lavoro: Kverneland Fertilizer Spreader				
Veicolo: Fendt 724				
CAMPO	B. LAGARELLI 2018	B. SORELLE 2017	B. SOTTOCURVA 2017	B. DON FILIPPO 2018
Area confini (ha)	17,35	10,28	4,38	2,78
Area lavorata (ha)	17,8	10,65	4,49	3,05
Distanza percorsa (km)	10,1	6	3	1,4
Dose min.	359,86	379,86	329,14	429,14
Dose med.	382,16	383,14	427,56	423,04
Dose max.	400,66	390	430	430

Table2: work summary Thursday 21.02.2019



Graphic2: comparison between worked and real surface

A hedging operation was carried out in the period of March, while a fungicide treatment is foreseen in the period of early earing (end of April - beginning of May).

The company also already has the RTK (Real Time Kinematic) system which makes possible a centimetric precision satellite guide with differential corrections.

The RTK differential corrections do not come from the classic basis that every company must buy to be able to operate with the mentioned precisions, but from a network of permanent stations (in particular the Geotop GPS / GNSS), created for topographic applications and operating on a national scale and therefore also in Basilicata.

The first experimental data show fuel savings made possible by the efficiency of the tractor's progress and savings in the consumption of fertilizer determined by fair and rational distribution in the field.

#### 4. CONCLUSIONS

In the light of the first results, and with reference to what has been mentioned, it can be pointed out how precision farming represents a valid tool to make agricultural systems more efficient and sustainable, rationalizing fuel consumption, fertilizers, crop protection products and optimizing production. The Lucanian cereal-growing area could draw innumerable advantages from the

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experiments currently underway, especially from the automatic guidance system with prescription maps and the implementation of fifth-generation mobile systems. The possibility of making our small-medium companies competitive, while protecting the typical landscape of southern Italy, make these initiatives extremely valid and functional to emerging needs.