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REGIONE TOSCANA

EVALUATION OF THE RURAL DEVELOPMENT PROGRAMME 2014-2020

Comparison of the PLV of the farms participating in Measure 11 - organic productions and submeasure 10.1.1 - commitment of sowing on sod - with respect to conventional productions through the estimation of the yields obtained with the help of a specific modelling system based on the use of satellite images
Second Thematic Evaluation Report C2.1 - Technical Synthesis

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LIST OF ACRONYMS

MA: Managing Authority

ARTEA: Tuscan Regional Agency for Agricultural Grants

AT: Technical assistance

CAWI: Computer Assisted Web Interviewing

EC: European Commission

ET: Evapotranspiration

FA: Focus Area

EAFRD: European Agricultural Fund for Rural Development

FG: Focus groups

GHG: Greenhouse Gases

ISMEA: Institute of services for the agricultural food market

Kc: Cultural coefficient

CAP: common agricultural policy

PEC Certified Electronic Mail

PLV: Gross saleable production

RDP: Rural Development Programme

RoW: Measure Manager

RT: Tuscany Region

SEBAL: Soil Energy Balance Algorithm for Land

EU: European Union

VI: Independent Evaluator

Introduction

The aim of the thematic study is to estimate the differences in the profitability of some herbaceous crops grown organically and with conservative farming techniques (sowing on the sod) and the same crops grown with conventional methods.

The analysis provides to Toscana Region with some useful elements for the definition of the premiums in the next programming period, taking into account also that the premium granted to the beneficiaries will have to remunerate the environmental benefits that environmentally friendly production systems determine.

In particular, Thematic Evaluation C2.1 refers to the first two phases of the evaluation process:

- Structuring, which takes the form of the organisation and planning of activities, with particular attention to the definition of the evaluation question and the methods of responding to it, also due to the recognition of information sources starting from what emerged from the discussion with the RT.
- Observation, during which information and data from primary and secondary sources are gathered.

The realization of the in-depth study followed the following steps:

- **Analysis of the data provided by ARTEA** concerning the beneficiary farms as of 31/12/2018 of measure 11 and submeasure 10.1.1 - commitment Sowing on hard land in order to identify the study area and the crops involved in the in-depth study.
- **Retrieval of meteorological and pedological data** necessary for model operation.
- **Realization of two specific case studies** related to the estimation of the yield differential detected by comparing the yields of beneficiaries of Measure 11 of organic farming, 10.1.1 Conservation of soil and organic matter (commitment to sowing on the sod) with the yields of farms conducted with conventional methods. The yield differential will be estimated through the application of the SEBAL model (Soil Energy Balance Algorithm for Land) in the study area and for the selected crops. The estimation of yield, for organic farms, for farms using the sowing on sod and for conventional ones, has been realized through the use of Tethys system, a computer application developed by the proponent, which allows the quantification of evapotranspiration, biomass produced and yield of agricultural crops. The system arrives at the definition of the yield through the processing of satellite images, weather data and soil data, using Sebal and AquaCrop models. The data relating to soil characteristics were taken from the soil map drawn up by the LAMMA consortium, while the weather data come from the regional agro-meteorological network.
- **Estimation of the price differential** between organic and conventional productions through the elaboration of the information related to agricultural prices in the production phase that ISMEA periodically detects.
- **Survey of a sample of farms** involved in the study in order to verify the correspondence of the data collected on yields and those related to the price differential. The questionnaire also investigated specific aspects related to the technical and commercial management of the beneficiary farms (organic and sowing farms) and of the counterfactual farms (conventional farms).
- **Interviews with privileged witnesses** aimed at sharing and validating the results of the case studies and at deepening the theme related to the monetization of the external environmental effects deriving from the implementation of agro-climatic-environmental measures related to the reduction of GHG emissions and the carbon sink of soils.
- **Realization of focus groups** aimed at sharing and discussing the results of the evaluation analysis carried out.

1. Analysis of in-depth topics

Once the overall object of the evaluation was identified, it was then broken down into individual in-depth themes and the consequent definition of the evaluation questions. The evaluation analysis focused on a number of specific investigation themes, listed and identified below.

1. Estimation of the yield **differential** found by comparing the yields of beneficiaries of Measure 11 of organic farming, 10.1.1 Conservation of soil and organic matter (commitment to sowing on hard land) with the yields of farms conducted with conventional methods. The yield differential will be estimated through the application of the SEBAL model (Soil Energy Balance Algorithm for Land) in the study area and for the selected crops.
2. Estimation of the **price differential** between organic and conventional production through the processing of information on agricultural prices in the production phase that ISMEA periodically detects.
3. In-depth analysis of a sample of farms of specific aspects related to the cultivation techniques used (fertilization, treatments, processing, etc.), sales channels, the reference market, sales prices, marketing of organic products (e.g. the ability of farmers to sell the product with the organic label), technical difficulties encountered and possible recourse to technical assistance services.
4. In-depth study, through interviews with privileged witnesses, of the topic related to the **monetization of external environmental effects** resulting from the implementation of agro-climatic-environmental measures, with particular regard to the reduction of GHG emissions and the carbon sink of soils.

2. Report on yield analysis activities

The first phase of the analysis concerned the identification of 22 plots of land cultivated with organic methods or with the technique of sowing on hard soil and the respective 22 counterfactual plots cultivated with conventional techniques. The choice of the "pairs" of plots was made by selecting plots affected by the same crop and as close as possible so as to have similar pedological and climatic characteristics. The data relative to soil characteristics were taken from the soil map drawn up by the LAMMA consortium, while the weather data were taken from the regional agrometeorological network.

The analysis carried out through a pairwise comparison between similar plots of land managed organically or with the sowing technique and plots of land managed with the conventional method involved a total of 454 hectares, of which 170 hectares were organic, 53 hectares where the sowing technique was applied and 231 hectares managed with the conventional technique.

After the pairwise comparison between the yields of the sampled factual and counterfactual farms and after the validation of the estimated values through interviews, it was possible to proceed with an overall territorial analysis that concerned all the farms benefiting from the commitments linked to organic farming and sowing on sod included in the study area.

The territorial analysis has therefore foreseen the application of the Tethys system on a total of 2,887 hectares, 626 of which are farmed organically and 2,261 hectares conventionally.

3. Report of primary data collection activities

Direct survey of farms

The interviews at the companies covered 15 producers and were carried out in October 2021. In order to facilitate the meeting, the RT sent a PEC to the selected companies to explain the reasons for the interview and to solicit an effective collaboration. The collection of data on the cultivation technique used concerned, for some farms, more than one crop. The list of the interviewed farms, the crop cultivated and the cultivation technique adopted is given below.

Interviews with privileged witnesses

Five interviews were conducted with privileged witnesses through the google meet videoconferencing platform. The interviews involved experts in the organic sector belonging to the main professional organizations, the Italian Foundation for Research in Organic and Biodynamic Agriculture (FIRAB) and experts in conservation agriculture techniques. The interviews were aimed to share and validate the results of the case studies and to deepen the theme related to the monetization of external environmental effects resulting from the implementation of agro-climatic-environmental measures related to the reduction of GHG emissions and the carbon sink of soils.

Focus group

Two focus groups were organized in order to share and discuss the results of the evaluation analyses carried out. The first focus group involved the technicians of FEDERBIO (Italian Federation of Organic and Biodynamic Agriculture) while the second one involved the regional referents.

4. Report of secondary data collection activities

In order to estimate the price differential between organic and conventional production, statistical information on agricultural prices at the production stage, collected periodically by ISMEA as part of the observatory of agricultural and agri-food markets, was processed.

The price database can be consulted at www.ismeamercati.it and provides information on prices at origin, broken down by main marketplace and product variety.

Referring to the table of the companies subjected to direct investigation (par. 7), it is possible to identify the reference crops and the corresponding prices of the products that are most pertinent to the geographical area of analysis (the Province of Siena). To this end, the prices practiced in the Tuscan marketplaces and, more generally, in the markets of Central Italy are taken into consideration; some beneficiaries interviewed indicated the marketplace of Bologna as a price reference, and therefore this market was included in the analysis.

The results of *screening* the availability of price data useful for comparing conventional and organic methods show that, for the conventional method, up-to-date data are available for all the crops surveyed, with a certain articulation also in terms of varieties and plots. For organic crops, on the other hand, the availability of data is much more limited, making a comparison between the two production methods impossible in some cases.

The analysis of yields carried out with satellite images will then be completed with a comparison of prices of conventional and organic production of fava beans, durum wheat and common wheat, with some territorial focus and by variety.

5. Limitations of the methodological approach

The methodology used, which is based on the interpretation of satellite data, provides a very precise "snapshot" of the state of the crops, allowing a fairly accurate estimate of agricultural yields. The methodology, as better described in the next paragraph, has several methodological and practical advantages, making it possible to extend the analysis to significant portions of the territory and therefore to a large number of beneficiaries. The approach used, which foresees a detailed and vertical analysis on a specific territory (Val d'Orcia), can be easily replicated and extended to other regional realities characterized by different agronomic and pedoclimatic conditions.

The application of the model, however, requires a large database, both graphical and alphanumeric, necessary for the correct identification of plots, crops and cultivation techniques applied. In order to be able to apply innovative methodologies of evaluative analysis, such as those based on the use of satellite images, it is necessary that the monitoring systems of the RDP provide a detail of information that must go beyond the data set necessary for the proper conduct of the administrative process and ordinary monitoring activities.

6. Strengths and weaknesses and criticalities found

Strong points

The Observation phase was characterised by the joint selection, between the evaluator and the MA structures dedicated to this activity, of the subjects to be interviewed and the direct surveys to be carried out, dosing the available human and temporal resources, in order to carry out, within the available time limits, the activities of collection and recognition of information and data useful for the elaboration of the Thematic Evaluation Report.

The estimation method based on the use of satellite images makes it possible to extend the analysis to relevant portions of the territory and therefore to a large number of beneficiaries, allowing estimates to be made on representative samples of farmers. Such representativeness is difficult to achieve with traditional methods of analysis (questionnaires) in view of the high number of farms participating in agro-climatic-environmental measures.

As far as the direct surveys on farms are concerned, the possibility of carrying out face-to-face interviews with farmers not only made it possible to find the purely quantitative data necessary to verify and validate the results that emerged from the analysis of satellite images, but also to widen the field with respect to the object of investigation and to detect the different positions, attitudes and experiences of the actors involved, obtaining a more complete and exhaustive picture.

The comparison of prices between conventional and organic production relies on the availability of price archives and databases that cover the entire national territory and are collected continuously over time. The ISMEA archives therefore allow a complete spatial and temporal analysis of prices, thus completing and enriching the analysis of quantities carried out with the aid of the TETHYS system.

Weaknesses

In the initial phase of data retrieval from ARTEA related to the beneficiary farms of measure 11 and sub-measure 10.1.1 - commitment of sowing on land necessary for the identification of the study area, the definition and obtainment of these data had a rather long and complicated process, especially for the identification of the plots of land of the farms that have joined the operation "Conservation of soil and organic substance" and in particular the identification of plots where the sowing on land was carried out.

The use of satellite images suffers from a technological limitation linked to the fact that the optical satellite signal is rejected and/or altered by clouds and similar atmospheric phenomena, so that in the event of cloud cover over the plots of land under investigation at the time of the satellite's passage, observation is unfortunately unserviceable. This technological limitation related to the use of satellites with optical sensors has been effectively countered through the joint use of several satellites, belonging to different constellations (ESA Sentinel constellation and NASA Landsat), during the course of the agricultural season and thanks to the use of advanced agronomic modeling that allows you to estimate the values of different parameters during periods of unavailability of useful satellite images.

In the direct on-farm surveys some difficulties were found to identify the yields of the specific plot under analysis: the farmer is able to provide the average yield of the farm but often he is not able to provide the yield of the specific plot. Moreover, as far as grasslands are concerned, in some cases the crops have been grazed and/or have been damaged by wildlife, making it difficult for the farmer to quantify the yields punctually, and as far as the cultivation of field beans is concerned, in several cases the crops are used for green manure and therefore it was not possible to determine the production.

The analysis of prices also had to face some difficulties and criticalities: the marketplaces surveyed and recorded in ISMEA's price archive do not always adequately cover all the crops surveyed, especially with regard to data on organic production, and therefore it was sometimes necessary to refer to markets not immediately close to the farms interviewed.

7. Conclusions and recommendations

In line with Terms of References, the main recommendations are given below in the form of a "Logbook".

It should be noted that the analytical description of the results of the evaluations carried out will be the subject of the Analysis and Judgment phases and, therefore, will be reported in full in the second part of the thematic report in question, i.e. C2.2.

Theme	Conclusion	Recommendations	Action
Structuring phase - Defining the evaluation design	The preparation of the thematic report was an occasion of intense and fruitful collaboration between the IE and Regione Toscana. This made it possible to bring out Regione Toscana's cognitive needs in the best possible way, allowing the IE to calibrate methods and evaluation activities accordingly.	No specific recommendation	
Observation Phase - Definition of subjects to be involved in interviews with privileged witnesses and focus groups	Thanks to the precise definition of the evaluation research (object - criteria - indicators - questions), the working methods have also made it possible to identify the subjects to be involved in the interviews with privileged witnesses and in the focus groups.	No specific recommendation	
Observation phase - Identification of the study area and the plots/crops to be analyzed	The extraction of the data necessary for the identification of the study area and the correct application of the yield estimation model has required a long and complex dialogue with the ARTEA structures in order to define and extract the data with the necessary level of detail. These difficulties derive	In order to facilitate the activities of evaluation analysis and make them more responsive to the cognitive needs of the MA, it would be necessary to take into account the information needs necessary to conduct the	

	<p>from the fact that the monitoring systems of the RDPs are mainly structured to respond to the needs linked to the administrative procedure inherent in the applications for support and payment.</p>	<p>evaluation activity adequately.</p>	
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