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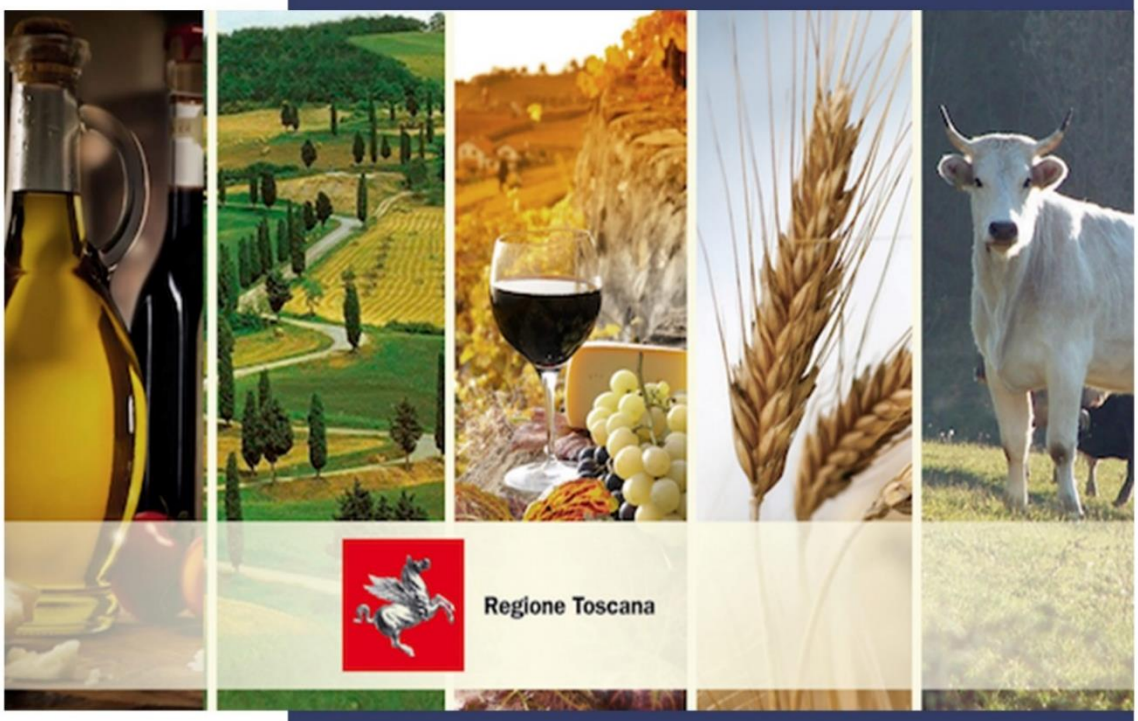

Rome,
December 2021

REGIONE TOSCANA

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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 sod seeding - with respect to conventional productions through the estimation of the yields obtained with a specific model based on satellite images

Thematic Evaluation Report C2.2: Analysis and Judgement
Dissemination Synthesis

LATTANZIO KIBS

MONITORING & EVALUATION

Table of Contents

LIST OF ACRONYMS 3
1. Background 4
2. The study area 5
3. Comparison of yields 6
4. Price comparison 7
5. Comparison of production value 9
6. Direct investigations 10
8. The answer to the evaluation questions 14
9. Conclusions and recommendations 15

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LIST OF ACRONYMS

MA: Managing Authority

ARTEA: Tuscan Regional Agency for Agricultural GrantsAT:

TA Technical assistance

CAWI: Computer Assisted Web Interviewing

EC: European Commission

ET: Evapotranspiration

FA: Focus Area

EAFRD: European Agricultural Fund for Rural DevelopmentFG:

Focus groups

GHG: Greenhouse Gases

ISMEA: Institute of services for the agricultural food marketKc:

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

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1. Foreword

This thematic study explores the differences that exist between the production of some herbaceous crops:

- ✓ with **organic** methods,
- ✓ with **no tillage** methods,
- ✓ with **conventional** methods,

in terms of:

- **yields** (weight of production),
- **prices**,
- **value of production**.

The analysis provides the Region with some useful elements for the **definition of premiums in the next programming period**, which may also take into account the environmental advantages of environmentally friendly production systems.

In particular, Report C 2.2 refers to the last two phases of the evaluation process:

- **Analysis**: processing and analysis of data collected directly through the TETHYS system (processing of satellite images), through interviews at the farms concerned and with privileged witnesses, through focus groups; systematization of secondary data that emerged from the desk analysis;
- **Judgement**: formulation of detailed answers to the evaluation questions.

Work phases

1. **Analysis of ARTEA data** (beneficiary farms as of 31/12/2019 of measure 11 and submeasure 10.1.1 - commitment Sowing on sod) to identify the study area and crops;
2. **Retrieval of meteorological and pedological data** needed for the model;
3. **Realization of two case studies** for the comparison of the yields of beneficiaries of Measure 11 (organic farming) and Measure 10.1.1 (commitment to sowing on hard land) with the yields of farms conducted with conventional methods. The yield differential is estimated through the application of the SEBAL agronomic model in the study area and for the selected crops through the use of the **TETHYS** system, a computer application that arrives at the definition of the yield through the processing of satellite images, weather data and soil data, with the use of Sebal and AquaCrop models;
4. **Analysis of price differences** between organic and conventional production through the processing of ISMEA data on agricultural prices at the production stage;
5. **Survey of a sample of companies** involved to validate the estimates made and to investigate other specific aspects (technical and commercial management of the companies);
6. **Interviews with privileged witnesses** 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 greenhouse gas emissions and the carbon sink of soils;
7. **Realization of focus groups** aimed at sharing and discussing the results of the evaluation analysis carried out in the previous phases.

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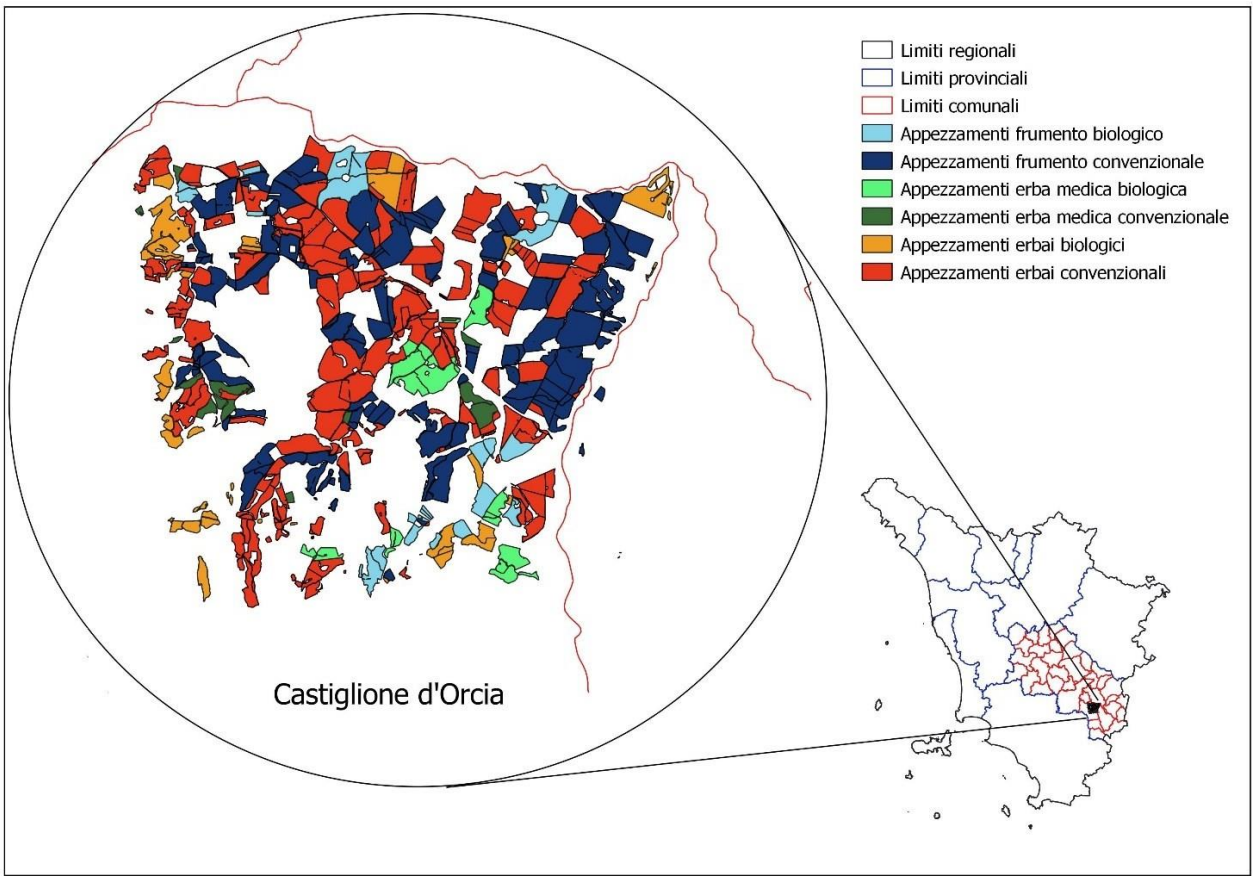
2. The study area

For the identification of the study area, an area characterized by the consistent presence of plots conducted with the technique of organic farming and with conservative farming techniques (sowingon the hardwood) was selected.

The analysis of the monitoring data provided by ARTEA led to the identification of **Val d'Orcia** as the study area.

The **crops** under investigation are:

- ✓ durum wheat,
- ✓ common wheat,
- ✓ alfalfa,
- ✓ oats,
- ✓ grasslands,
- ✓ broad bean,
- ✓ clover.



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3. Yield comparison

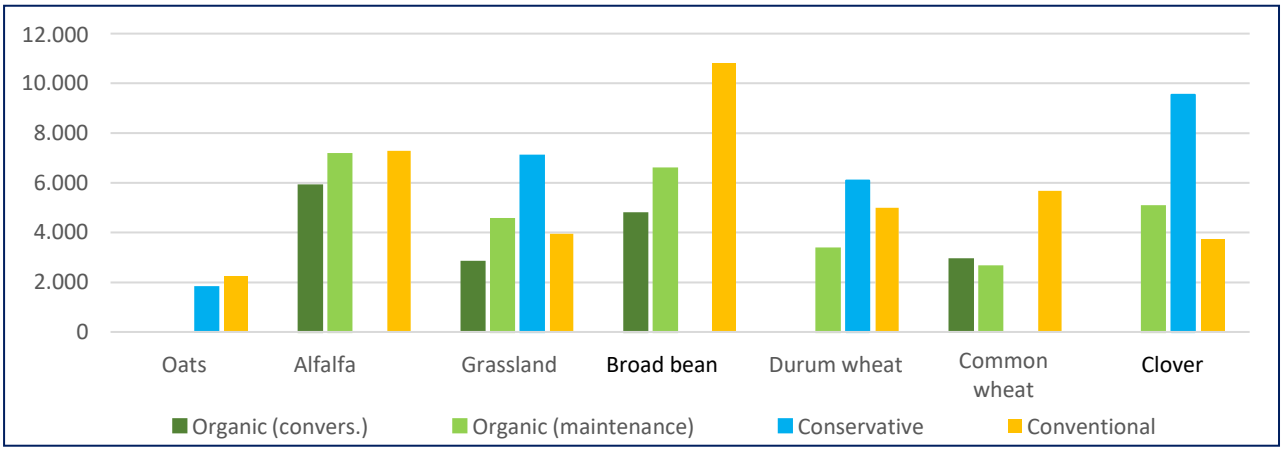
The analysis of the yields of the different crops according to the different production methods considered was carried out, in the first instance, through a "**pairwise comparison**" between:

- ✓ 22 plots conducted with organic or conservative production methods;
- ✓ 22 plots similar in characteristics conducted by conventional method;

The area analysed in the pairwise comparison totalled **454 ha**, of which:

- ➢ 170 hectares of organic farming (133 maintenance and 37 introduction),
- ➢ 53 hectares of conservation agriculture
- ➢ 231 hectares are farmed conventionally.

The following graph shows the **production** data (Kg of product in dry matter) of the different crops, comparing for each the values of the different production methods.



- ➢ **In-conversion organics** can never reach the yields of conventional, even for fodder crops,
- ➢ **Organic in maintenance** obtains yields for fodder crops that are higher than or in line with conventional, while for wheat and broad beans the yield is lower than conventional;
- ➢ **Conservation agriculture** is always superior to conventional, except for oats.

The **yield differentials** (percentage ratio between organic and conservation yields compared to conventional yields) calculated from these data are summarized in the table below.

Culture	Organic yield (conversion)/ conventional	Organic (maintenance)/conventional yield	Conservative/conventional yield
Oats			-19%
Alfalfa	-19%	-2%	
Grassland	-29%	15%	79%
Broad bean	-56%	-39%	
Durum wheat		-33%	22%
Common wheat	-49%	-54%	
Clover		35%	156%

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- **the yield of organic in conversion** is always lower than conventional (values ranging from -19% for alfalfa to -56% for broad beans; intermediate values for grassland and soft wheat);
- the **organic yield in maintenance** is lower than conventional for the two wheat crops and for broad beans (-39%) and higher than conventional for grass and clover (+15% and +35% respectively);
- **Conservation agriculture** always has higher yields than conventional, with the exception of oats (-19%).

An **overall territorial analysis** was then carried out covering all the plots present in the study area (Municipality of Val d'Orcia), aggregating all the organic crops (introduction and maintenance), all the wheat (hard and soft) and the grasslands together with clover.

The results of the analysis, involving 626 hectares of organic and 2261 hectares of conventional crops, are shown in the table:

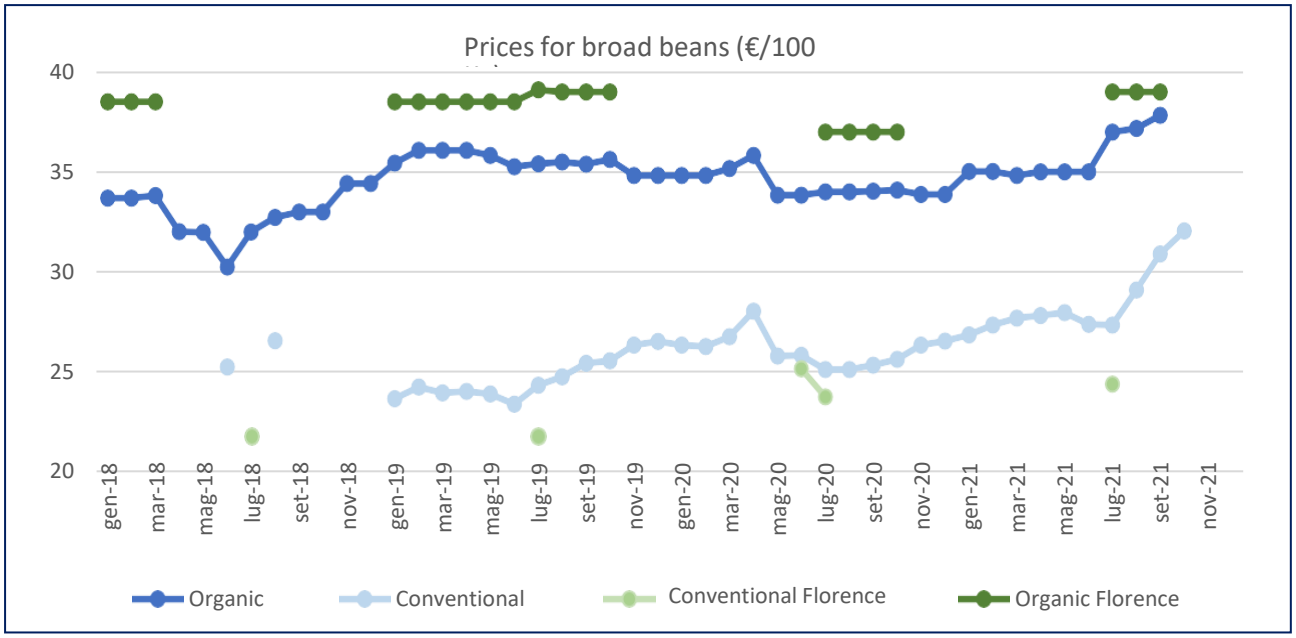
Culture	Organic multi	Conventional multi	Difference %
Alfalfa	4.663	5.846	- 20,2%
Grassland	4.552	4.904	- 7,2%
Wheat	3.972	5.868	- 32,3%

- **organic is always lower than conventional**, especially alfalfa (-20%) and especially wheat (-32%);
- the **territorial analysis substantially confirms the results obtained in the pairwise comparison**.

4. Price comparison

For the analysis of price trends and for the estimation of the differential between organic and conventional production the statistical information collected periodically by **ISMEA** as part of the **observatory of agricultural and agri-food markets** and divided by main marketplace and product variety was processed. The main results of the analysis are presented below.

4.1 Analysis of the price of broad beans on national and local markets



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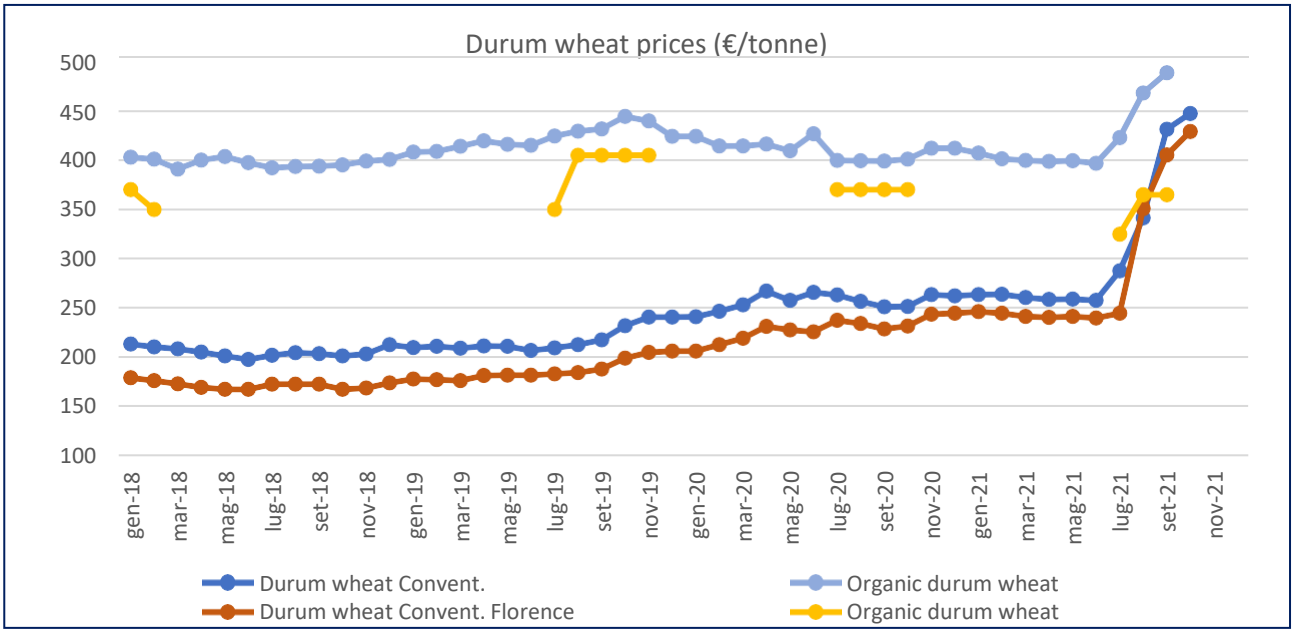
- **Organic production** of broad beans **regularly has a higher price than conventional production**, in the order of 5/12 euros per 100 kg of product;
- **However,** this **price differential tends to reduce** quite noticeably over time, from around 50% in January 2019 to 22% in September 2021.

4.2 Analysis of durum wheat prices on national and local markets



- The **price differential in favour of organic production** in January 2018 is 189 euros per tonne (89% of the conventional price) and **increases until August 2019** (216 euros per tonne, 102% of the conventional price);
- **In the most recent year and a half, on the** other hand, **this differential has been progressively narrowing** (126 euro/tonne in August 2021, 37% of the conventional price), until undergoing a very strong contraction in September 2021 (only 57 euro/tonne in favour of organic, 13% more than conventional).

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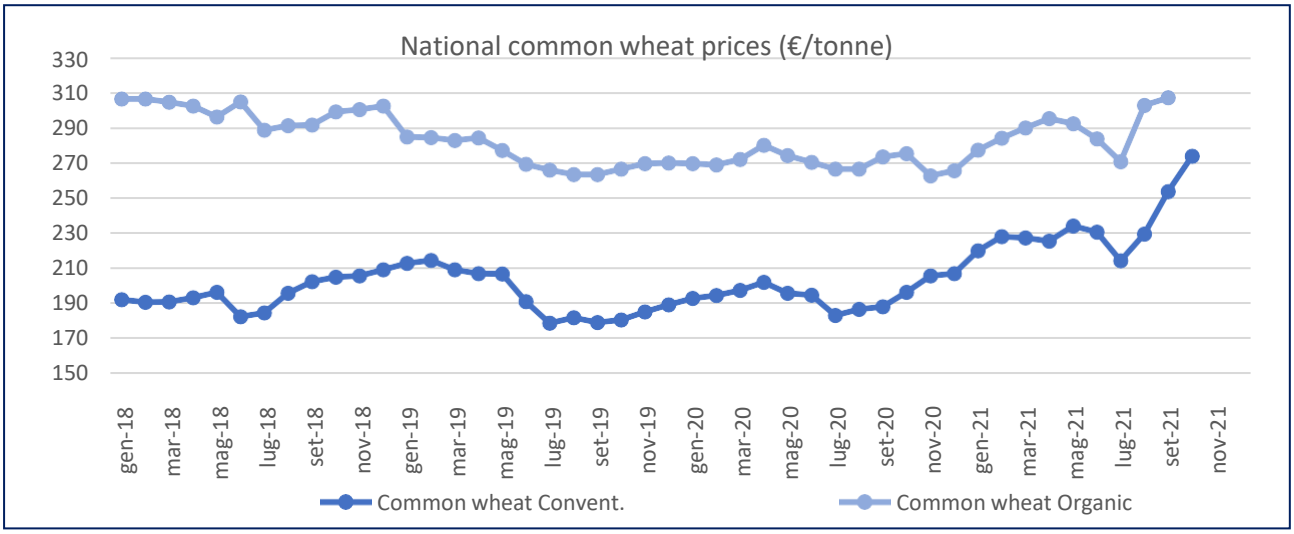
4.3 Price analysis of common wheat on national markets



- Prices of organic common wheat are generally stagnant, but the **differential with conventional production is still high, although progressively decreasing**;
- the price differential in favour of organic production recorded at national level at the beginning of the analysis period was around 120 euros per tonne (about 60% of the conventional price), but **already during 2018 it had fallen to 93 euros per tonne** (45% compared to the conventional price);
- Substantial stability until October 2020 (79 euro per tonne in favour of organic production) was followed by a **period of further decline**, with the price differential **settling at the end of 2021 just above 50 euro/tonne** (21% of the conventional price).

5. Comparison of production value

The analysis of the value of production (Gross Saleable Production) puts into system the estimates of the yields made with the application TETHYS and the analyses related to the price trends deduced from the ISMEA database, focusing the evaluation attention on the crops for which we have the information of price and quantity for the different cultivation techniques considered.

The analysis is first carried out with reference to the **prices recorded in the year 2019**, the reference year against which the yields were estimated:

Crops	Organic prod. (mant.)	No tillage prod.	Conv. Product.	Organic price	Convent. price	Organic GSP	No tillage GSP	Convent. GSP	Organic/ convent. GSP	No tillage/ conventi on. GSP
	(Kg s.s. /ha)			€/t		€/ha			%	
Oats		1.802	2.216		152,3		274,4	337,4		**-18,7%**
Grassl.	4.549	7.091	3.955		133,2		944,5	526,8		**79,3%**
Broad bean	6.582		10.808	387,1	217,5	1.019		940,3	**8,4%**	
Durum	3.365	6.089	4.999	394,0	187,0	1.326	1.139	934,8	**41,8%**	**21,8%**

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Crops	Organic prod. (mant.)	No tillage prod.	Conv. Product.	Organic price	Convent. price	Organic GSP	No tillage GSP	Convent. GSP	Organic/ convent. GSP	No tillage/ conventi on. GSP
wheat										
Comm. wheat	2.638		5.677	265,4	211,6	700,2		1.201	**41,7%**	

- for organic **broad bean** production, the price differential compared to conventional production makes it possible to offset the lower yields associated with this production method and thus guarantee a **slightly higher production (8.4%) in value** compared to conventional production;
- A similar phenomenon is observed for **durum wheat,** for which, however, the high price difference between the two production methods results in a **PLV that is over 40% higher** for organic production**;**
- for **soft wheat,** the decidedly lower yields of organic production (less than half of the conventional) are not compensated by the price differential, leading to a **reduction in PLV of 41.7%;**
- for **sowing on hard land**, except for oats, **the PLV was higher** than that recorded for conventional crops.

In order to investigate the most recent dynamics, which show the progressive narrowing of the price gap between organic and conventional productions, the **analysis is extended using the prices of 2021**; the results of this analysis are shown in the table:

Crops	Organic prod. (mant.)	No tillage prod.	Conv. Product.	Organic price	Convent. price	Organic GSP	No tillage GSP	Convent. GSP	Organic/ convent. GSP	No tillage/ conventi on. GSP
	(Kg s.s. /ha)			€/t		€/ha			%	
Oats		1.802	2.216		165,2		297,8	366,2		**-18,7%**
Grassl.	4.549	7.091	3.955		123,1		872,9	486,9		**79,3%**
Broad bean	6.582		10.808	390,0	243,8	1.027		1.054	**-2,6%**	
Durum wheat	3.365	6.089	4.999	325,0	242,5	1.094	1.476	1.212	**-9,8%**	**21,8%**
Comm. wheat	2.638		5.677	280,0	243,8	738,6		1.384	**-46,6%**	

6. Direct investigations

The **company visits** and **"face to face" interviews** involved 15 companies located in the municipalities of Castiglione d'Orcia, San Casciano Dei Bagni, Pienza and San Quirico D'Orcia, for a total of 24 different plots.

Below are the main results of the surveys:

- ✓ the **yields declared by producers do** not differ much from those estimated, with differences generally not exceeding 10-15%;

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- ✓ half of the companies surveyed use **technical assistance services**;
- ✓ the use of **measure 2.1 "consultancy services"** concerns only 25% of the companies, due to consultations that are too generic for very specific and specialised knowledge needs;
- ✓ the main technical difficulties for farms in applying the organic technique mainly concern the **satisfaction of the nutritional needs of the plants**;
- ✓ Similarly, for conservation agriculture, the greatest difficulty lies in the purchase of **machinery for sowing on hard land, which is often very expensive**;
- ✓ in the face of a certain variability in prices, the **differential in favour of organic wheat has narrowed over the years**, also due to the growing interest of large industrial pasta producers in the origin of the raw material (pasta produced with Italian wheat) rather than the cultivation method used (pasta produced with organic wheat).

Moreover, it was also made:

- ✓ **5 interviews with privileged witnesses**, involving 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.
- ✓ **2 focus groups**, which involved the technicians of the Italian Federation of Organic and Biodynamic Agriculture (FEDERBIO) and the regional officials and managers responsible for themeasures being studied.

With regard to **yields**, the experts confirmed the estimates made by processing satellite images, albeit with some specificities:

- ➢ Organic production is **lower when the farm is in the conversion phase**;
- ➢ The yield limitation of organic production is linked to the possibility of distributing nitric and ammoniacal **nitrogen**;
- ➢ **limited yield differentials on forage crops** (grassland, clover) between organic and conventional farms: even conventional farms use very modest inputs on these crops;
- ➢ the production of the farms practising **sowing on hard land** is very similar to the conventional farms due to the climatic trend of the season under investigation (lack of water in the post-sowing and caryopsis swelling phases).

For the **scarce diffusion of conservative agriculture commitments** on the Tuscan territory, the experts identified the following main reasons:

- ➢ lack of attention to **cost** reduction due to fewer crop operations;
- ➢ Farmers' mentality **not open to the introduction of innovations**;
- ➢ **high purchase cost of the machinery** needed for sowing on hard land;
- ➢ **Reduced supply by contractors of** work with machines suitable for conservation agriculture;
- ➢ difficulties in controlling **weeds**, especially following the ban on the use of glyphosate introduced by the Region of Tuscany
- ➢ production obtained by conservative farming techniques does not fetch better **prices** than production obtained by conventional methods.

With respect to the issue of **price differentials** between products obtained with organic farming techniques compared to conventional production, the experts point out that:

- ➢ over the years there has been a **progressive reduction in the price range for** durum wheat from 40-45% a few years ago to the current 20%.
- ➢ Conventional wheat **prices** are **highly variable** from year to year and linked to the commodity

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market. This fluctuation also affects organic wheat prices.

- The Italian food industry, especially following the scandal linked to glyphosate residues found in wheat from abroad, is focusing on the **origin of the raw material** (pasta made with Italian wheat) rather than on the product made with organic raw materials;
- the growth in the supply of organic products has not been matched by an equivalent growth in consumer demand for these products, leading to a **reduction in prices**.

With regard to the novelty introduced by the draft regulation for the new programming period, that **the premium granted to beneficiaries may reward the environmental benefits** resulting from the environmentally friendly production system, it emerged from the discussion that:

- the current **organic premium**, in view of the reduction in the price differential between conventional and organic production, **is no longer sufficient** to provide an incentive for farms to introduce or maintain this cultivation technique;
- the proposal to recognize **a "flat" positive externality per hectare** equal for all seems **unfair in** view of the fact that different cultivation systems present different technical difficulties and different emission reduction values;
- The **monetary quantification of the** positive **environmental externalities** generated by the application of organic farming and conservation agriculture techniques is difficult;
- Through the use of **accounting systems for CO2 equivalent emissions,** including those based on the use of satellite imagery, the agricultural sector could gain access to the carbon credit market, a market from which the agricultural sector is currently excluded due to problems with accounting for emissions;
- provide for a **higher premium** for those who do "advanced" organic farming, linked above all to the length of rotations and the species used in the rotation, factors that greatly increase the environmental effect.

7. Monetisation of external environmental effects

Evaluating the externalities of the agricultural sector is an extremely complex task; in this context, the focus has been on the **effects linked to the reduction of greenhouse gas (GHG) emissions and the carbon sink of soils**.

Positive environmental externalities could in fact be **monetised** through the creation of incentive mechanisms and/or a carbon credit market linked to the increasingly stringent GHG reduction targets defined through the Paris agreements and the last COP 26 in Glasgow.

The **2030 targets**, forwarded by the European Union as part of the Paris Agreement, are:

- for the EU-ETS sector: 40% overall reduction compared to 2005 emissions;
- for the non-EU-ETS sector: 30% reduction compared to 2005 emissions;
- The **LULUCF** (**Land Use, Land Use Change and Forestry**) **sector**, which includes CO2 emissions and absorption in the management of forests, agricultural land and pastures, and land use change, provides for the "no debt" rule, i.e. the commitment to a **zero carbon balance**.

The **Effort Sharing Regulation** (842/2018/EC) refers only to emissions from non-EU-ETS sectors and divides the European -30% among the Member States, with differentiated objectives. For Italy, the Regulation envisages an emissions reduction target of -33% compared to 2005.

Currently, emissions are estimated according to the methodologies approved by the UNFCCC and IPCC and are counted by all member states by compiling the **national inventory**.

Agricultural sector emissions consider the following sectors:

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- emissions of nitrous oxide from the soil, mainly due to the use of nitrogen fertilisers;
- methane emissions due to enteric fermentation;
- nitrous oxide and methane emissions from livestock manure management;
- non-CO2 emissions related to combustion processes of agricultural residues.

In addition to these sectors of agricultural interest, there are also those contained in the LULUCF sector, which as a whole considers all aspects related to the different land uses and possible management systems of agro-forestry land.

This "**watertight compartment"** method of GHG accounting, one relating to the "agriculture" sector and the other to the LULUCF sector, does not allow, for example, the attribution of GHG saved due to the carbon sink in the "agriculture" sector.

Emissions from the agricultural sector accounted for in the national inventory for the Tuscany region represent 1.7% of emissions at the national level in 2017. The indicator is down 37% from 2005 to 2017, compared to a national average value of -6%.

In 2017, therefore, the Tuscany region had already achieved the emission reduction target of -33% compared to 2005, as required by the Effort Sharing Regulation (842/2018/EC), referring only to emissions from non-EU-ETS sectors.

The **environmental effects related to the reduction of greenhouse gases** produced by the application of the organic cultivation method and by sowing on the land are schematically ascribable:

- to the increase of the **organic substance in the soil** (C-sink) (organic farming and no tillage);
- the **reduction of the use of mineral fertilizers** and therefore the emission of nitrous oxide (organic farming).

The most evident effects on the reduction of greenhouse gas emissions are determined by the **absorption of carbon in the soils,** equal to 1.8 Mg/ha of CO_{2eq} for the commitment related to sowing on land and 3.51 Mg/ha of $CO_{2\ eq}$for the application of the organic technique, see the table below:

Commitment	Emissions reduction			Carbon sink in soils	Total emission reductions + removals
	Reduction of mineral nitrogen inputs	Reduction N_2O	Reduction in CO 2eq	Reduction in CO 2eq	CO 2eq
	Mg/ha				
No tillage				1,80	1,80
Organic farming	0,01	0,0001	0,03	3,51	3,54

Currently, there are two schemes for the agricultural sector that provide incentives to reduce emissions:

- the **White Certificates** market, in which farms can participate as voluntary entities;
- the **carbon credit** system, based on a voluntary market.

However, the use of such schemes to incentivise farmers to apply environmentally sound management techniques is **still unattractive** to them, due to:

- modest price levels recognised for tonnes of CO2 in the voluntary market system;
- difficulty of access for farms;
- possibility of introducing into the white certificate system only energy savings and not soil sinks.

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One of the possible alternatives is the creation of a **system of incentives linked to the achievement of the** emission reduction **targets of** the agricultural sector (-30% to 2030), also useful to stimulate a country system Italy that records in the period 2017/2005 a reduction of only 6. It would be, in essence, to establish a **compensation mechanism at the national level**, through which the State could use the credits generated by the agricultural sector to achieve the objectives to 2030. This is provided that the offsetting possibilities between the LULUCF sector and the no-ETS sector become more substantial, and that an accounting model consistent with the one ISPRA is developing for estimating changes in organic carbon content in agricultural soils and pastures is created.

Considering what has emerged from the estimate of the reduction of CO2 emissions achieved through the application of ISPRA coefficients and the price of CO2 on the European ETS market. (currently equal to 55-56 euros per tonne, but according to recent estimates it could exceed 100 euros per tonne in 2030), **a value of CO2 between 50 and 60 euros per tonne** can be considered **reasonable and incentive for farms**.

These values would therefore **make it convenient for companies to adopt virtuous agricultural practices** as, considering the range of estimated CO2 savings, incentives would be obtained that vary from about 100 €/ha for sowing on hard to 200 €/ha for organic farming.

8. The answer to the evaluation questions

What is the difference in PLV between farms participating in Measure 11 and farms practicing conventional agriculture?

Judgement criterion	Summary answer evaluation question per criterion
Yield difference between farms using organic farming techniques and conventional farms	The yield differential between organic and conventional production shows **yield values for organic** products that are **always lower than conventional ones,** but with marginal differences for grassland, more evident for alfalfa and even more relevant for wheat.
Price difference between products marketed under the organic label and conventional products	The **price differential** between organic and conventional production remains **high on the whole**, but shows a **decreasing trend** especially for durum wheat
PLV difference between farms using organic farming techniques and conventional farms	With the exception of soft wheat, the PLV obtained by organic farms is always higher than that of conventional farms thanks to a price gap observed in 2019 that more than compensates for the lower yield. The narrowing of this price gap **in 2021** determines **forall organic productions analysed a lower profitability than the conventional one.**

What is the difference in PLV between farms participating in operation 10.1.1 compared to farms practicing conventional agriculture?

Judgement criterion	Summary answer evaluation question per criterion
Yield difference between farms using conservation agriculture techniques	The **yields of the farms that practice sowing on grass** are **always higher than those recorded for conventional farms**, with the exception of oats.
Difference in PLV between grassland farms and conventional farms	Considering that PLV is exclusively influenced by yield, **profitability is always higher** than for conventional farms, except for oats.

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How can quantifying GHG reduction through the application of organic farming techniques and no-tillage promote and support payment schemes based on environmental outcomes?

Judgement criterion	Summary answer evaluation question per criterion
Monetary quantification of the environmental benefit	The current carbon credit markets applicable to the agricultural sector (white certificates and voluntary market) are **unattractive**. One possible scenario proposed involves the creation of a **nationwide offsetting mechanism**, through which the state could use credits generated by the agricultural sector to meet the 2030 targets

9. Conclusions and recommendations

THEME	CONCLUSION	RECOMMENDATION
Profitability of organicfarms	The decreasing trend of the price differential between organic and conventional production, together with lower yields, leads to a reduction in production value for organic farms, which could discourage farms from participating in Measure 11.	Identify a **payment scheme based on the results**, as provided for in Article 70, paragraph 5, EU Regulation 2115/2021, to recognize a positive environmental externality linked to the reduction of GHG emissions. The value of the ton of CO2 that determines an incentive varies from 100 €/ha for sowing on hard soil to 200 €/ha for organicfarming.
GHG emission reduction targets in the agricultural sector	The 2030 GHG emission reduction target for Italy compared to 2005 is 10.79 Mln tCO2. As of 2017, emissions have been reduced by only 1.93 Mln, so by 2030 a further 8.86 Mln tCO2 must be saved.	Create an **offsetting mechanism at the national level**, through which the state coulduse credits generated by the agricultural sector in the next programming period also inorder to meet the GHG reduction targets at 2030
Profitability of holdings practicing minimum tillage	The yields of the farms that practice sowing on grass are always higher than those recorded for conventionalfarms with the exception of oats.	**Encourage the spread of commitments tosow on hard ground** which, while substantially maintaining farm profitability, guarantees high environmental benefits linked to the reduction of GHG emissions andthe increase in soil fertility.

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THEME	CONCLUSION	RECOMMENDATION
Scarce diffusion on the regional territory ofthe commitments of sowing on hard land	The scarce adherence to theintervention of the sowing on hard land is attributable to the modest importance that farmers attribute to the reduction of production costs and to the improvement of soil fertility. The high cost of purchasing the machinery necessary for sowing on unbroken soil is also highlighted, together with the reduced offer from contractors of work carried out with machines suitable for conservation agriculture.	Carry out **specific information actions** to raise farmers' awareness of the economicand environmental benefits of applying conservation agriculture techniques

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