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Servizio di Valutazione Indipendente del Programma di Sviluppo Rurale 2014-2022 della Regione Campania a valere sul Fondo Europeo Agricolo per lo Sviluppo Rurale (FEASR)

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Monothematic report 2023: "the contribution of the Campania RDP to combating climate change - a cross-reading"

Non-technical synthesis

Roma, December 2023

Unione Europea
Fondo europeo agricolo per lo sviluppo rurale: *l'Europa investe nelle zone rurali*

REGIONE CAMPANIA

PSR14·20 Campania

LATTANZIO KIBS

MONITORING & EVALUATION

Introduction

The purpose of the single-issue report is to estimate the overall greenhouse gas emission reductionsachieved by the RDP by considering both direct reductions (nitrous oxide c-sink from soils, CO2 fromRenewable Energy Sources (RES, energy efficiency) and indirect emission reductions calculated through the Carbon Footprint (CFP) tool using a Life Cycle Assessment (LCA) approach. The analysisincluded:

- Estimation of emissions from agri-environmental measures (M10.1 and M11) considering direct emissions, represented by the reduction of nitrogen loads (mineral fertilization) and C-sink in agricultural soils, and indirect emissions based on the Life Cycle Analysis (LCA) methodusing the counterfactual technique with the comparison of the two cultivation techniques (integrated and organic) with the conventional one.
- The CO2MPARE model, a software developed by ENEA that enables the estimation of the impact on CO2 emissions by identifying for different types of 'intervention to be implementedthe resulting climate-altering emissions, was used to estimate the emissions of RES energy production measures.
- Conducting two direct surveys involving beneficiaries of agri-environmental measures and structural measures of the Campania RDP aimed at investigating the effects of climate change on farm management, farm income statements, strategies that farms are adopting or will adopt to adapt to climate change, and how the tools made available by the RDP can contribute to this adaptation.
- The realization a case study related to Measure 4.2.1 - Processing, marketing and development of agricultural products in agro-industrial enterprises aimed at defining the advantages of a processing enterprise financed by the RDP on the containment of energy costs. In particular, the project from Agrioil Spa aimed at the realization of a new generationoil mill was analyzed; through the realization of a visit to Agrioil's facilities, it was possible toverify the effects of the intervention on the quality of production and the reduction of the environmental impact of milling activities.
- The results of the thematic study were then discussed and shared through the application ofa participatory technique with an audience of stakeholders.

Climate change in Campania

Within this general framework, the PNACC identifies the main risks from climate change on theagricultural and forestry sectors.
In summary, climate change may result in the following hazards for the agricultural and forestrysector:

- reduced water quality and quantity and increased irrigation demands with increased risks offailure to meet water needs;
- decrease of organic matter and soil fertility, with increased risks of soil degradation andtriggering desertification processes;
- alteration of development cycles (phenology) of crops;
- increased parasitic pressure;
- reduction in animal welfare;
- increased risks of forest fires;
- increasing extreme weather events and the damage they cause;
- More technical complexity in crop and livestock management.

Based on the Report on Risk Management in Agriculture of 2020 and considering the 2018 data, present in the Risk Management System (SGR) within SIAN (National Agricultural Information System) the policies facilitated through Measure 17 of the PSRN covered 5.68 Billion € in 2018 at the national level, Campania slightly exceeds 55 Million € and represents only 1% of the National insured value. Therefore, it can be said that farmers in the Campania region make little use of the subsidized policy tool both in absolute terms (€50 million only 1% of the national total) and as a percentage of the value of production (1.8% of the PPB).

Data at the regional level (figure below) show how the damages recognized by the Ministry attributed to natural disasters calculated as the sum of the period 2003-2018 places Campania in the intermediate class between 1401-2000 €/ha of UAA. Regarding catastrophic calamities (drought, late frost and floods) Campania in the historical series 2010-2018 appears to be in the very high class together with Emilia Romagna, Puglia and Sicily.

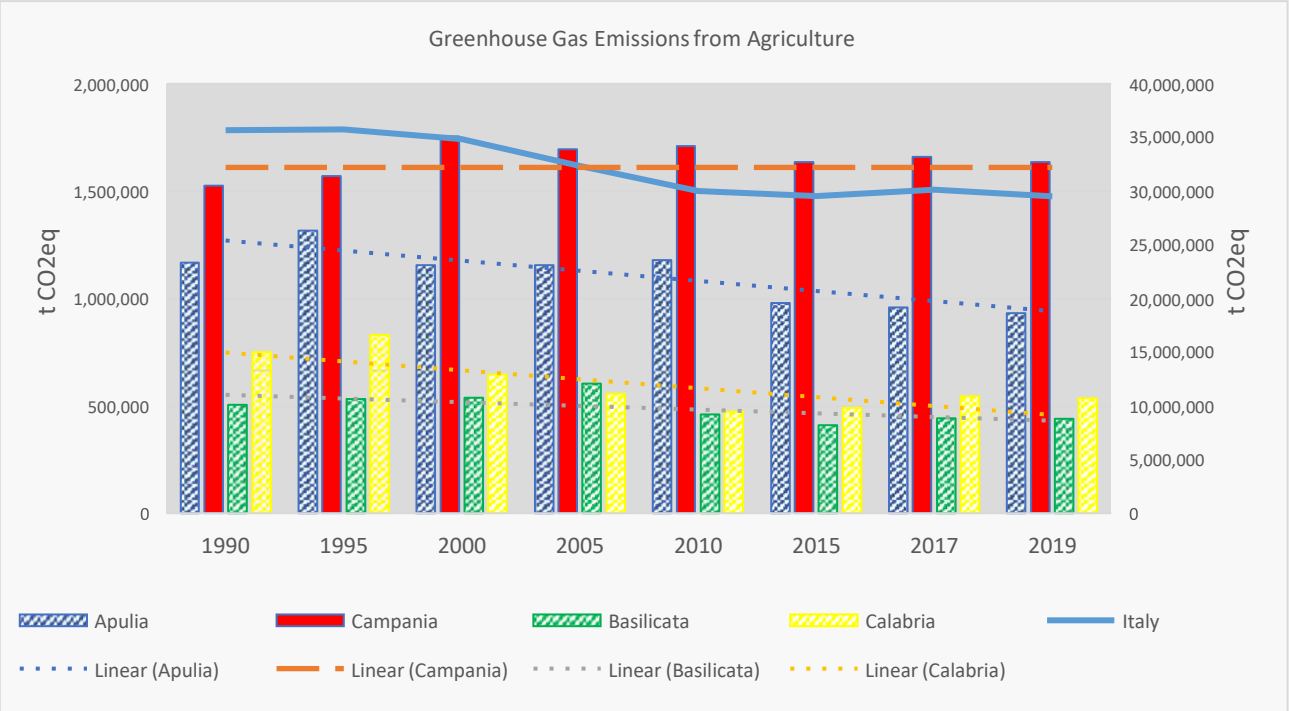
GHG emissions from the agriculture sector in Campania.

For the agriculture sector, the main emission categories are represented:

- From enteric fermentation (CH4 emissions),
- from manure management at all stages, from the time of excretion in the shelter to distributionin the field (CH4 and N2O emission),
- from agricultural soils attributable mainly to the use of nitrogen fertilizers (N2O emission),
- from the combustion of agricultural residues (emission of CH4 and N2O).

The trend of greenhouse gas emissions from the agriculture sector since 1990 at the national level has been declining. Emissions from the agricultural sector accounted for in the NIR in the Campaniaregion account for 5.5% of emissions nationwide and 39.6%% of emissions in the south in 2019. The indicator trend in the region appears to be increasing by 7 percent over the 1990/2019 period, and it is the only southern region and one of the few Italian regions to increase the value of emissionsfrom the agricultural sector. This increase is most likely due to the increase in livestock numbers (buffaloes) that occurred during the period.

Figure 1 - Background Indicator Greenhouse Gas Emissions from Agriculture IC45



The energy (electric and thermal) from RES of agricultural and/or forestry origin produced in the region turns out to be 619 ktoe in 2020, an amount corresponding to about 53% of the total energy derived from RES; the remaining 47% share is provided by photovoltaics and hydroelectric for the electric component and by heat pumps for the thermal one. In Campania in 2016 there was a consumption of 137 ktoe of oil equivalent in agriculture and forestry with a fairly stable trend over theperiod 2009-2016 in contrast to a national figure that decreases by 7 percent

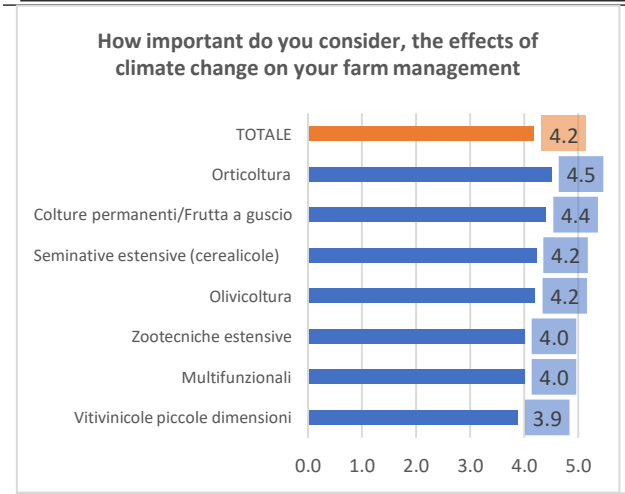
Sample surveys of Campania RDP beneficiaries aimed at verifying the impacts of climate change on agricultural activities

Two direct surveys were conducted involving two samples of beneficiaries: the first involved beneficiaries of structural measures 4.1.1 - Support for investments in agricultural holdings and the second involved beneficiaries of area-based measures 10.1.1 - Integrated Production, 11.1.1 - Conversion of farms to organic farming systems, and 11.2.1 - Maintenance of organic farming practices and methods. They investigated the effects of climate change on farm management, on farm income statements, the strategies that farms are adopting or will adopt to adapt to climate change, and how the tools made available by the RDP can contribute to such adaptation

The Results were analyzed overall and according to different farm clusters, i.e., typological aggregates of farms that, on the basis of intrinsic characteristics, make recognizable the "attitudes"of the farms. This framework, defined with the contribution of a panel of experts

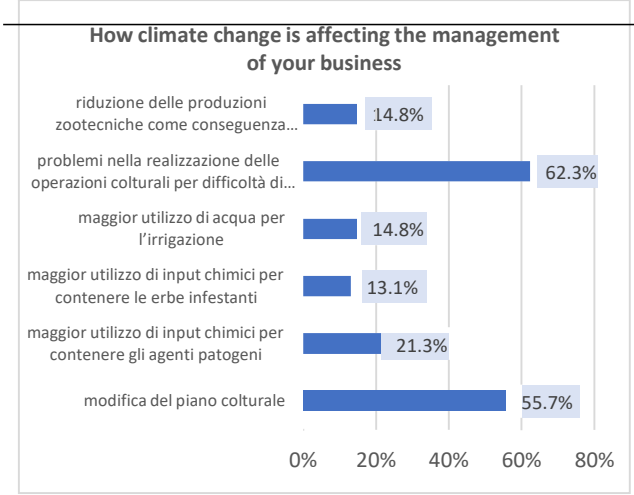
allows an alternativereading of the context of intervention, the agricultural system, the subject of the policy, through ananalysis of the characteristics and dynamics of groups of companies

The following is a summary of the data collected.

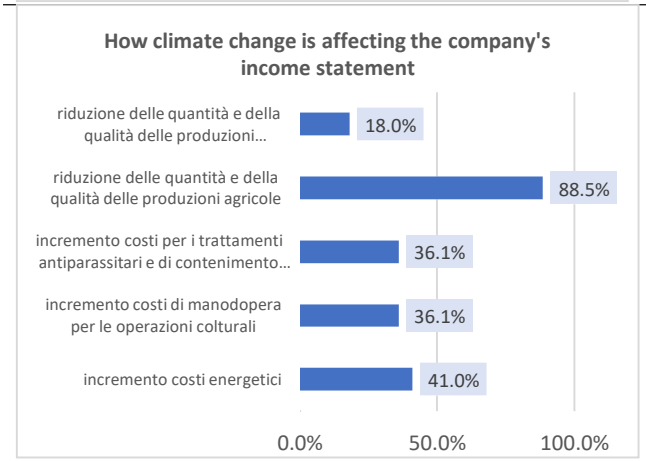


Importance is very high for all areas withan average rating of 4.2

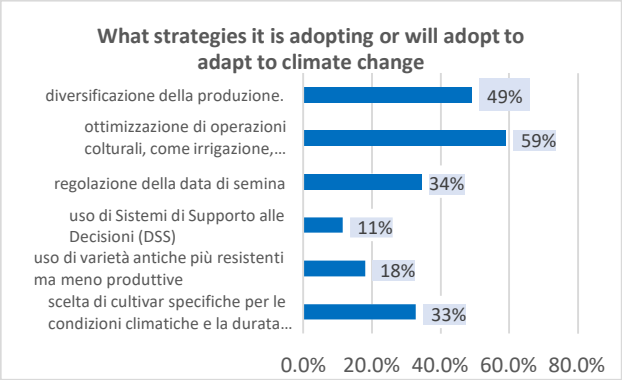
Horticulture permanent crops/nuts appear to be the sectors most affected by climate change



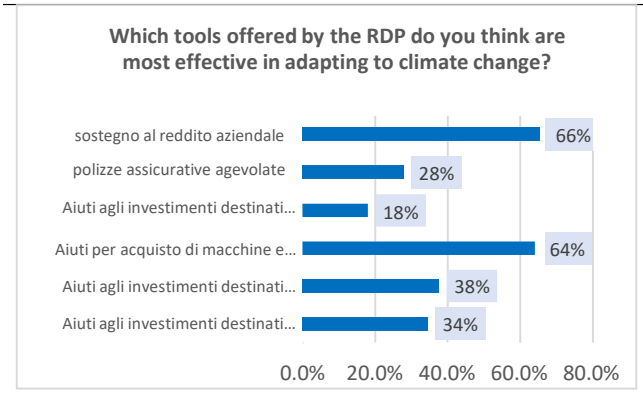
Most respondents report problems in carrying out cropping operations due to difficulties in accessing land, and the needto change the cropping plan



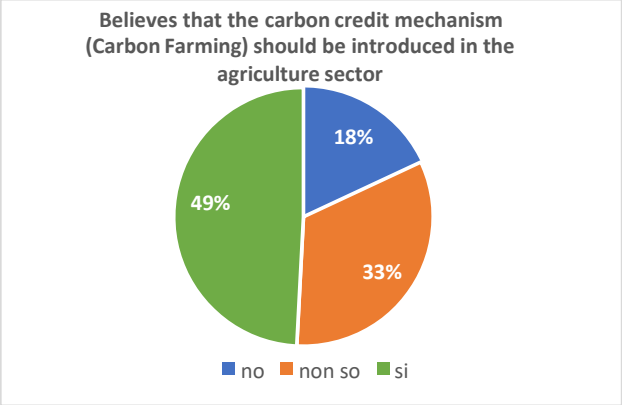
- Reduced quality' and quantity of productions (on all groups)
- Increased energy costs (esp. extensive animal husbandry and horticulture)
- Increased labor costs and costs of pesticide treatments etc. (in part. Viticulture)



- Adoption of techniques for input rationalization (fertilization, water use, etc.).
- Diversification of production, reorienting to less demanding and more resistant crops
- Planting date management (advance or postponement according to weather)
- The choice of specific cultivars for contexts characterized by adverse climatic conditions



- Income support measures (mainly first pillar and compensatory allowance, but also agri-environmental measures)
- Purchase of machinery and equipment for input management optimization
- Energy production from renewable sources



Nearly half of respondents see introduction of Carbon Farming as an opportunity to incentivize sustainable agricultural practices that contribute to greenhouse gas emission reduction and carbon sequestration

The reduction of GHG emissions determined by agri-environmental measures using a life cycle assessment (LCA) approach

Regarding the estimation of **direct emission reduction** these are represented by the reduction of nitrogen loads (mineral fertilization) and C-sink in agricultural soils.

The RDP Campania interventions considered potentially conducive to GHG reduction are those thatreduce the use of mineral fertilizers and thus the emission of nitrous oxide (operations 10.1.1, and measure 11), and those in operations 10.1.1, 10.1.2, and measure 11 that result in increased absorption in agricultural soils (Cropland) of C-sink.

Overall, the area under commitment (SOI) contributing to GHG reduction is 181,506 hectares 28% of the region's agricultural area. 52 percent of the SOI is associated with the operation related to integrated agriculture, 32 percent with organic farming and the remaining 16 percent for operation 10.1.2.

Overall, the actions of the Campania RDP contribute to the reduction of nitrous oxide emissions, compared to conventional agriculture, by 27.8 tons of N20, representing an emission reduction of 8,279 tCO_{2eq} -year. In particular, integrated farming contributes 69% (5,677 tCO_{2eq}) while the remaining 31% is achieved through organic farming (2,602 tCO_{2eq});

With regard to carbon removals in agricultural soils determined by the RDP, values in CO_{2eq} are obtained that are much higher than those achieved by mineral fertilizer reduction and are 265,784 tCO_{2eq}. Adding up the contribution of the two sectors (mineral fertilizer and CO_2 absorption), the total GHG emission reduction is thus 274,063 Mg year.

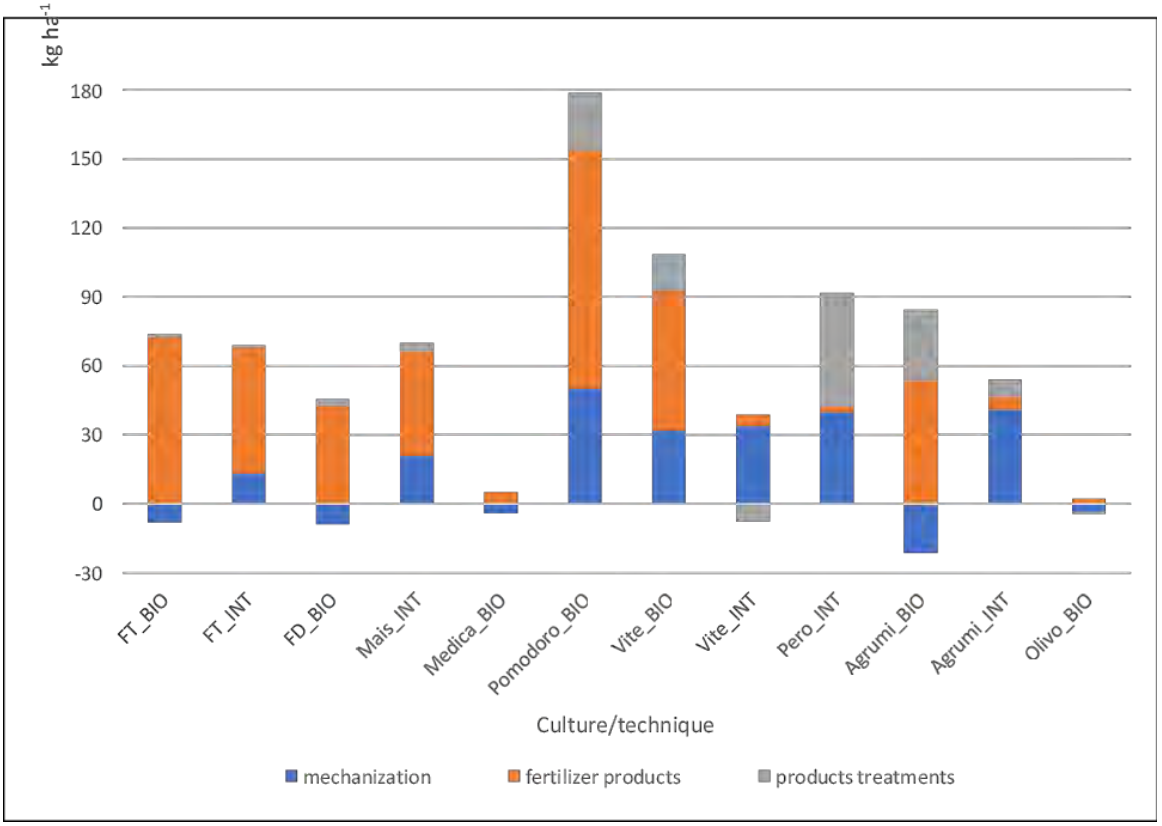
Regarding the reduction of indirect emissions, Measures 10.1.1 - Integrated Production and 11 - Adoption and Maintenance of Organic Production Practices and Methods were considered.

Mechanization in absolute and percentage terms is the largest source of emissions for all crops andcultivation techniques analyzed, followed by fertilizers and pesticides the latter being particularly high, as might be expected, for tree crops (pear, grapevine and citrus).

Interestingly, in almost all comparisons, the virtuous schemes have lower total emissions per unit area than their conventional counterparts except in the case of alfalfa and olive where the results are equivalent.

Analyzing the different components (mechanization, fertilizers and pesticides) the highest values ofreductions of organic and integrated compared to the conventional technique are observed in fertilizers, demonstrating the high energy content of these products; among these the values of organic wheat tomato and vine stand out (118, 72 and 61 kg/ha EC). The reductions achieved by mechanization are at an intermediate level; with the highest reduction values again for organic tomato and integrated pear and vine (50, 41 and 40 kg/ha of EC) finally, the lowest decreases are in plant protection products with integrated pear and organic citrus having the highest reduction values (49.5 and 31 kg/ha of EC). To be noted some negative data where that is, the subsidized cultivation technique emits more than the conventional, in mechanization the citrus, the two wheatand alfalfa all organic demonstrating the greater use in the use of machines (weeding, tillage, etc.)of this cultivation technique, also the integrated vine turns out to emit more than the conventional for plant protection products, this could be due to a greater use of less polluting and less harmful products for health but also less effective.

Figure 2 - Differences in greenhouse gas emissions, between organic and conventional farms and between integrated and conventional



The verification of the effects induced by the integrated and organic farming actions on the entire regional territory makes it possible to estimate that in total the two measures result in a regional reduction of 11 million kg of EC, of which 6.7 thanks to organic and 4.3 million kg of EC of the integrated. Analyzing the figure per unit area, overall there is a reduction of 73 kg/ha of EC of which116 from organic and 46 kg/ha from integrated. Transforming the value of Carbon Equivalent into tCO_2eq through the stoichiometric coefficient gives an overall value of emission reduction of 40,330tCO_2eq.

Reduction of GHG emissions determined by RES energy production measures using an LCA approach

The implementation picture as of Dec. 31, 2022, of operations directly related to the energy themeoutlines a situation still characterized by a low degree of progress: while for operation 16.6.1 thereare no projects initiated nor obviously welded, operation 7.2.2, which subsidizes public installations for the production of energy from renewable sources, records 13 applications initiated[1], of which 3are welded by 2022, for a total admitted investment of more than 1.4 million euros.

Thus, it is operations 4.1.1, 4.1.2 and 4.2.1, aimed at improving the competitiveness of beneficiary farms and agro-industrial enterprises, that account for the bulk of interventions

[1] Initiated are those applications that have received at least one payment under any title (advance, SAL, Balance)

with energy purposes within the Campania RDP, both in terms of project numbers and investment activated[2].

This is 650 projects welded and 1,024 projects started, for a total investment of nearly 11.5 million euros, (21.6 million considering started projects) with a clear prevalence of operation 4.1.1 in termsof project numbers (nearly two-thirds of total welded "energy projects").

When reasoned in terms of energy investments activated, the situation appears more balanced, withoperation 4.2.1 accounting for nearly a quarter of the expenditure welded for renewable energy production. Two large photovoltaic plants built by processors benefiting from Operation 4.2.1 alone activate a total energy expenditure of nearly 1.5 million euros.

Going into the merits of the subsidized energy sources, there is a large prevalence of investment in the installation of photovoltaic panels: 90 percent of the completed interventions are for the construction of solar energy systems, mainly for the production of electricity (almost three quarters of the installed photovoltaic panels).

On the other hand, interventions on biomass plants assume a secondary weight within the concludedproject pool, both in terms of numerosity (10 percent) and, above all, of activated investment (only 4percent of the total).

The CO2MPARE model is the application developed by ENEA that, consistent with a Life Cycle Assessment (LCA) approach, allows estimating the impact on CO2 emissions. Thanks to this specific model, it is possible, starting from the allocation of funds, to define in quantitative terms theinterventions to be implemented and, consequently, the resulting climate-altering emissions. The application of the CO2MPARE model made it possible to estimate the total cumulative impact of emissions from RDP interventions dedicated to the production of energy from RES. Emissions include both emissions from the construction and operation phases, summed over the expected lifetime.

Considering the completed projects, it is estimated that plants totaling 6.4 kWp of installed capacityhave been realized, of which about 90% concern photovoltaic plants for the production mainly of electricity, 9% biomass thermal plants, while the installed capacity referring to wind power plants is negligible.

The greatest contribution to the reduction of GHG emissions is made by the construction of photovoltaic plants for the production mainly of electricity, thanks mainly to the greater success that this type of intervention has found by absorbing most of the financial resources: with about 11 million euros of expenditure there is a saving of 52.7 kt CO2 (which becomes 97.38 kt CO2 if we consider the projects started). Biomass plants also contribute an important share of 15.24 kt CO2 to GHG reduction, which becomes 68.91 kt CO2 when considering initiated projects. The contribution of wind power plants is absolutely negligible.

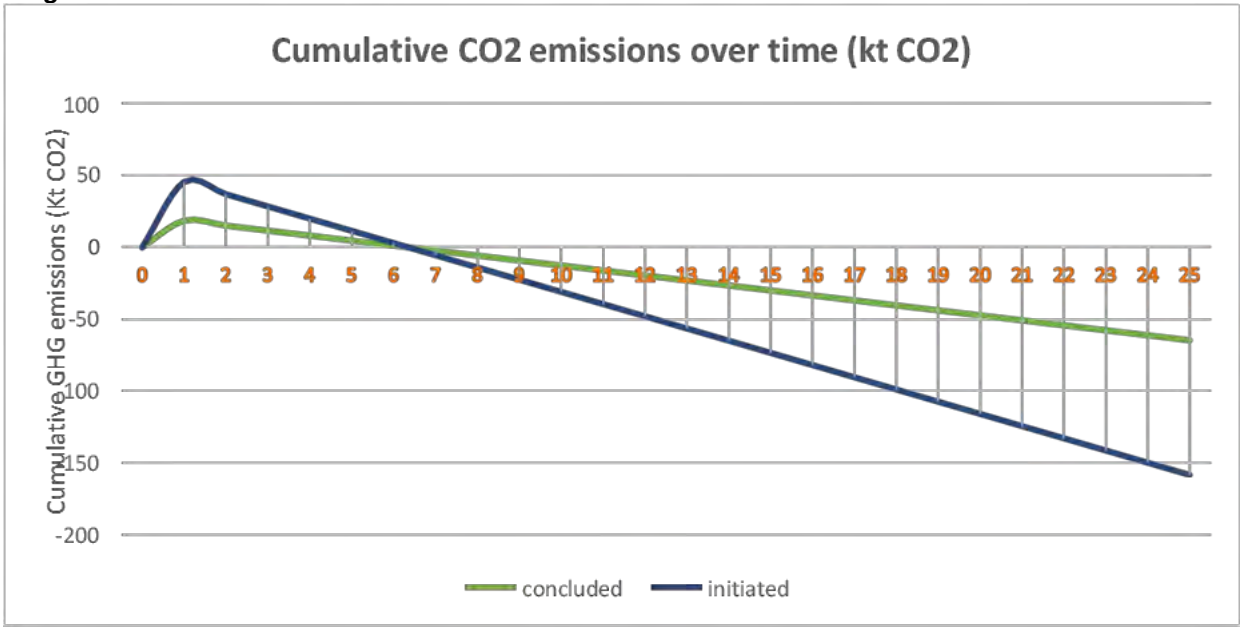
Considering the reduction in emissions per € invested, the most efficient investments are for biomass power plants with a reduction of 37.15 kg CO2 per € invested due to the fact that biomass power plants can operate on a continuous cycle while photovoltaic panels and

[2] Investments for energy production from renewable sources are identified, in the regional monitoring system(Financial-Physical Monitoring Table), from the type of intervention ("facilities for energy production from renewable sources") and sub-intervention (which shows the energy source involved).

wind power plants are tied to solar irradiation and wind.

The next graph shows the emission profile for the entire life of the plants. The model simplifies reality by assuming that all investments occur in the first year and that the construction phase of all projects lasts one year. This implies that the first year in the graph illustrates the total projected construction phase emissions; emissions begin to decrease after the construction year, indicating that the operational period leads to a reduction in emissions. Emissions decrease continuously, and in about 6 years the emission reductions due to the implemented interventions offset the initial construction phase emissions. This allows the operational time required for the program to achieve carbon neutrality to be identified.

Figure 3 Cumulative CO2 emissions over the lifetime of the interventions



Source: CO2MPARE Model- ENEA

The overall effects of the RDP Measures on the reduction of GHG emissions.

The effects of RDP measures on the reduction of GHG emissions include.

- Reduction of direct emissions from agriculture
  - Carbon absorption (C-sink)
  - Nitrous oxide from mineral fertilizer

- Reduction of indirect emissions from agriculture
  - Mechanization,
  - fertilizer products,
  - products treatments

- Energy production from RES

The effects of the different lines of action involved in the emission reduction target can be schematized as follows:

Figure 4 Overall contribution of the RDP to climate change mitigation.

Reduction of greenhouse gas emissions (MgCO2eq-a-1)			
Agricultural Sector			Energy sector
direct emissions		indirect emissions	
Reducing emissions fromagriculture	*Carbon absorption (C-sink)*	*Mechanization, fertilizerproducts, treatment products*	*Energy production fromRES*
Nitrous oxide frommineral fertilizer	*C-sink in agricultural soils*		
8.279	265.784	40.331	8.532
322.926			

The evaluative elaborations carried out make it possible to estimate:

- a reduction in annual nitrogen input, compared to conventional agriculture, of 27.7 tons of N20, equivalent to an emission reduction of 6,415 $MgCO_{2eq}$ /year; in particular, integrated agriculture contributes more than 69% while the remaining 31% is achieved through organicfarming;
- Carbon removals in agricultural soils much higher than those achieved by mineral fertilizer reduction and amounting to 265,784 $MgCO_{2eq}$ /year;
- A reduction in indirect emissions estimated through the Carbon Footprint (CFP) tool of 40,331$MgCO_{2eq}$ /year.

Lastly, considering the interventions for energy production from renewable sources, analyzed through the CO2MPARE model, which, consistent with a Life Cycle Assessment (LCA) approach, allowed us to estimate a reduction in greenhouse gas emissions avoided through energy production from renewable sources promoted by the RDP of 8,532 $MgCO_{2eq}$ /year.

The overall contribution of the RDP to the reduction of climate-altering gas emissions, calculated bythe sum of the different components considered, is thus 322,926$MgCO_{2eq}$ /year, with a clear predominance of the agricultural carbon sink over the other effects.

Adding up the total contribution generated by the RDP (reduction of mineral fertilizers, increased CO2 absorption in soils, reduction of indirect emissions, production of energy from renewable sources), the total reduction in GHG emissions is therefore 322,926 Mg year. Comparing this value with the total value of GHG emissions in the Campania region of 18,659,569 tons of CO2 equivalent in 2019, we find that this reduction affects 1.7 percent.

Commission Implementing Decision (EU) 2023/1319 of June 28, 2023 revised the annual non-ETS emission allocations from 30 to 40 percent at the European level and raised them for Italy from 33 percent to 43.7 percent compared to 2005. Considering the Campania region's 2005 emissions of 22,880,081 tons of CO2 equivalent, the RDP contributes 3.2% to the targets.

The case study for estimating the emission reduction of a processing industry through a CFP (Measure 4.2.1)

The case study involved an agro-industrial enterprise beneficiary of Measure 4.2.1 that through the PSR contribution has realized a new generation olive mill aimed at control the production chain even better, producing a higher quality oil superior by improving both the valorization of the product and the impact environmental impact of milling operations. The new milling plant, guarantees processing without the addition of water and the simultaneous production of a by-product that is different from the usual pomace: we in fact, two by-products are obtained:

- Pulp (pate);
- Olive Kernel residue.

Pate consists of moist pulp without traces of hazelnut and is suitable for various purposes such as agronomic use as a soil conditioner, livestock feed or as biomass for biogas production. Agrioil contributes the pate to a biogas production plant. The pate is used in part to feed of a boiler serving the plant and partly sold. The reuse of both by-products closes the company's production cycle.

On basis of comparative LCA, a method for comparing different scenarios to highlight improvements or deteriorations in performance environmental performance by considering the different stages of a product's life cycle, the following were compared: the grading system with protereactor vs. the gramulation system with independent tanks and the extraction system centrifugal equipped with DMF technology vs. a three-stage system. Overall for processing 12,000 quintals of olives results in savings of more than 5 tons of CO2 equivalent, 62,400 MJ of fossil resources and 3,240 m3 of water, which compared to a processing traditional 3-stage processing represent savings of 33% for the GHG production, 25% regarding fossil resources and 19% regarding regarding water consumption. To increasingly incentivize the shift to environmentally friendly technologies one could increase the share of the score allocated to priority criteria that reward technologies that can save inputs and reduce emissions.

Conclusions and recommendations

to climate change are optimization of crop operations, such as irrigation and fertilization, and diversification of production. Among the tools offered by the RDP to adapt to climate change, those considered most effective are Farm income support to deal with uncertainty and economic shocks and aid for the purchase of machinery and equipment to optimize inputs. Less evident was interest in investment aid for renewable energy production and energy reduction and subsidized insurance policies as well as investment aid for irrigation system efficiency. Finally, nearly half of the respondents see the introduction of carbon farming as an opportunity to incentivize sustainable agricultural practices that contribute to the reduction of greenhouse gas emissions and carbon sequestration.

The evaluative elaborations carried out allowed us to estimate:

- a reduction in annual nitrogen input, compared to conventional agriculture, of 27.7 tons of N20, equivalent to an emission reduction of 6,415 MgCO2eq/year; in particular, integrated agriculture contributes more than 69% while the remaining 31% is achieved through organicfarming;
- carbon removals in agricultural soils much higher than those achieved by mineral fertilizer reduction and amounting to 265,784 MgCO2eq/year.
- A reduction in indirect emissions from agri-environmental measures estimated through the Carbon Footprint (CFP) tool of 40,331 MgCO2eq/year.
- A reduction in emissions from RES plants analyzed through the CO2MPARE model of 8,532MgCO2eq/yr.

The overall contribution of the RDP to the reduction of climate-changing gas emissions, calculated by the sum of the different components considered, is therefore 322,926MgCO2eq/year, comparing this value with the total value of greenhouse gas emissions of the Campania region equal to 18,659,569 tons of CO2 equivalent in 2019, it is found that this reduction affects 1.7%. Considering the non-ETS emission reduction target of 43.7 percent compared to 2005, the RDP contributes 3.2 percent.

The case study involved an agro-industrial enterprise that was a beneficiary of Measure 4.2.1, which through the RDP contribution built a new generation olive mill. Based on comparative LCA, a method for comparing different scenarios to highlight improvements or deteriorations in environmental performance considering the different stages of a product's life cycle, the following were compared: the grading system with protereactor vs. the grading system with independent tanks and the centrifugal extraction system equipped with DMF technology vs. a three-stage system. Overall, processing 12,000 quintals of olives results in savings of more than 5 tons of CO2 equivalent, 62,400 MJ of fossil resources and 3,240 m3 of water, which compared to traditional 3-stage processing represent savings of 33% in GHG production, 25% in fossil resources and 19% in water consumption. To increasingly incentivize the shift to environmentally friendly technologies, the share of the score allocated to priority criteria that reward technologies that save inputs and reduce emissions could be increased.