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Economic Implications for Farmers in Adopting Climate Adaptation Measures in Italian Agriculture

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Abstract: The purpose of this paper is to provide an assessment of the economic convenience of adopting adaptation measures to climate change at farm level. Concerns raised about climate risks on agriculture indicate that adaptation of the agricultural sector to climate change is necessary to mitigate the negative consequences of climate change. Despite many opportunities to implement climate adaptation measures at farm level, there are several obstacles to their adoption. Farmers' decision to implement adaptation measures lies in the difficulty of accessing knowledge about adaptation practices and in the lack of resources for upfront investments required by adaptation. The need to investigate economic convenience in terms of costs and benefits of adopting adaptation measures to prevent or reduce damage from adverse climatic events by farmers arises from this consideration. More importantly, climate protection and management of climate change are European environmental policy objectives. However, adaptation to climate change remains complex, and literature on the costs and benefit of agricultural adaptation is limited. Based on these considerations, this paper provides an analysis of the economic convenience of adopting adaptation measures in Italian farms. The economic convenience to implement adaptation measures is calculated on the reduction of the impact of climate damage. Our results show the economic convenience of adaptation measures. These findings help to improve the still too limited access to information on adaptation policies at farm level as well as the benefits that adaptation produces in economic and environmental terms, on human and ecosystem health. This study supports farmers' decisions in adopting climate adaptation measures and provides information for policy makers to identify specific financial instruments for adaptation measures.

Keywords: climate change; resilience; cost and benefit assessment

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1. Introduction

Concerns about global warming are currently attracting interest among global policy makers and the issue is central to political and scientific debate. The Intergovernmental Panel on Climate Change (IPCC), which is the United Nations body for assessing science related to climate change, affirmed the urgency of a global action to restrain climate change and address its effects that are difficult to control [1]. Climate change is becoming a source of significant additional risks for agriculture and food systems, and climate risk to agriculture can have several effects [2]. The European Severe Weather Database (ESWD)—the European database on extreme weather events—demonstrated in 2021 that there were about 1500 extreme events; an increase of 65% for cloudbursts, floods, tornadoes, hailstorms, and heat waves, compared to previous years (https://eswd.eu/ accessed on 10 October 2022). At an EU level, climate change mitigation is a policy objective. A Special Report by the European Court of Auditors revealed that more than 100 billion euros (over a quarter of EU agricultural expenditure in 2014–2020) were devoted to climate change mitigation. Despite this, greenhouse gas emissions produced by agriculture have not decreased for over a decade. The report further revealed that most of the measures financed by the Common Agricultural Policy (CAP) have limited potential for mitigating climate change because it failed to incentivize the adoption of effective environment friendly practices. However, the fight against climate change continues to be one of the strategic objectives of the CAP.

The European Commission included three general objectives in its new strategy, including "to bolster environmental care and climate action and to contribute to the environmental and climate objectives of the EU" and nine strategic goals focused on social, environmental, and economic factors, including "contribute to climate change mitigation and adaptation" (Reg. 2021/2117) [3]. The CAP explicitly provides financial facilities and programs for the ex-ante subsidization of agricultural insurance contracts; similar measures have been extended to the transition period before the enforcement of the upcoming CAP [4].

The effect of climate change in Italy is revealing. In 2021 a Eurobarometer survey emphasized that climate is the fourth emergency in Italy after diseases, the economy, and world hunger [5]. This has raised major concerns among Italians, with eight out of ten Italians considering climate change a "very serious" problem (84% higher than the EU average of 78%). More than six out of ten (63%, equal to the EU average) consider national governments rather than the European Union to be responsible for initiating measures to curb climate change. The National Strategic Plan (NSP) 2023–2027 provides an opportunity to curb climate change through community funding. Public funding of adaptation measures in the agricultural sector may relax farmers' financial constraints associated with adopting climate smart agriculture practices. This may help to sustain agricultural activities.

Given that adaptation to climate change is complex and literature on the costs/benefits of agricultural adaptation is limited, this paper contributes to the topic providing an analysis on the economic convenience of adopting Climate Adaptation Measures (CAMs) by Italian farms. The economic convenience to implement CAMs is differentiated by typology of Italian farm and economic size class. This paper is organized into 5 sections: the first is the introduction; the second presents background information on the topic; the third argues data and research methodology; the fourth shows results; the fifth reports discussions, main conclusions, and future research.

2. Theoretical Background: Adaptation and Climate Change in Agriculture

Adaptation and mitigation represent global challenges for farmers. The OECD defines adaptation to climate change "[...] as an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts, in order to alleviate adverse impacts of change or take advantage of new opportunities" [6]. Under this perspective the literature on the cost-effectiveness of CAMs for farmers contributes to the debate on reducing economic and environmental risks related to climate change. Although there is no unambiguous definition of adaptation in the literature, Bosello et al. [7] provide two main approaches to define and identify adaptation. The authors classify adaption into planned adaptation and autonomous adaptation. Planned adaptation is the measures to mitigate or neutralize negative impacts of climate change implemented by public or private bodies, while autonomous adaptation refers to the resilience of natural and socio-economic systems. In each case, adaptation has a cost to be compared with benefits, such as avoided damage, or capitalized benefits as a result of adopting and implementing adaptation measures. To this end, there is the need to assess costs and benefits of adaptations in agriculture to face climate risk, and to monitor the effectiveness of adaptation strategies and actions. However, quantifying costs and benefits may be a challenge. This is because of the uncertainty associated with climate change [8] complicating cost–benefit assessment relying on climate-change related models, data, and factors [9].

Some studies have focused on the impacts of climate change and the effects of climate risks on agriculture [10–15]. In the context of the CAP, as well as at farm level, the increase in extreme weather events has led to a strong adoption of tools to control different risks in agriculture [16]. Various classification criteria have been set to categorize risk in agriculture [17] and the negative events commonly associated with climate change, such as floods, drought, plant diseases, extreme weather events, soil erosion, and water eutrophication [18]. References [19,20] conclude that the increased frequency and intensity of extreme events can influence long-term yields, directly damaging crops at crucial developmental stages, and reducing the efficiency of farm inputs. According to some studies, there are barriers to the implementation of adaptation measures in agriculture [21,22] influenced by socio-economic factors such as age, education level, household size, household income, farm size, and agricultural experience [23–27]. These studies [28] demonstrate that the selection of adaptation strategies and their integration in farm management activities clashes with structural, contextual, and individual obstacles. According to [29] the impact of such events may largely vary according to local and context-specific conditions of production systems, for example, crop type characteristics, soil composition and structure, and hydrogeological profile. Some studies point out that farmers' perceptions of adverse climate events may be influenced by the specific features of the farm and its pedoclimatic context, as well as by socio-economics aspects [30–33]. Consequently, because farmers have different experiences with extreme weather events, the perception of the need for adaptation and the selection of optimal strategies may vary. In contrast, some studies analyze the perception of the negative consequences of non-adaptation and its costs for the farm in the long-term [34,35]. According to [26] economic sustainability of the implementation measure is a critical requirement for its adoption.

From an economic perspective, a literature review showed how few studies address a cost–benefit assessment, which may also be due to the difficulty of quantifying them. Our goal is to contribute to the existing literature analyzing the economic convenience to implement CAMs in order to reduce climate risk damage. It is extremely clear and well-known that agriculture is exposed to numerous adverse climate events, not always controlled by farmers, that directly affect agricultural outcomes, such as yields, revenues, and incomes [36], thus making agriculture susceptible to climate change [37]. The agri-food sector is of fundamental importance in the achievement of environmental and climate objectives, particularly in terms of reducing greenhouse gas emissions (CO_2, CH_4, and N_2O) and combating environmental degradation. In the next decades the intensification of hard-to-predict extreme weather events will put pressure on the agricultural sector, impacting farmers' incomes and farms' survival. The EU Strategies "Farm to Fork" and "Biodiversity 2030" presented by the EU Commission could play an important role in combating climate change. During the second Farm to Fork Conference on 14 and 15 October 2021(https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy/farm-fork-conference_en accessed on 29 October 2022), the Commission reaffirmed this role, emphasizing that sustainable food production and consumption contribute to reducing the effects of climate change on production. It is important that consumers have clear information about nutritional characteristics, the health and safety of food [38], its origin and sustainability of cultivation systems, production, processing, and marketing that generate support to the local economy [39] and contribute to the reduction of waste [40]. This information could "win" over the skepticism of consumers and convince them to choose sustainable products, which have a "premium price" in good taste and quality important for health and the environment [41]. The response of agri-food companies towards processes and productions with low environmental impact is witnessed by an increasing number of certifications: 169 agricultural companies and 897 companies in the food industry comply with UNI EN ISO 14001—Environmental Management Systems (Accredia database, https://services.accredia.it/ppsearch/accredia_companymask_rmote.jsp?ID_LINK=1739&area=310, accessed on 10 November 2022). Moreover, for several years, there has been attention on a short supply chain on the part of various organizations (trade, producers, consumers) and national and regional public policies [42]; in particular, more than 20% of farms practice direct sales (ISTAT data). This spreads awareness of farmers and consumers on environmental issues related to trends in global climate change and their growing impact on agricultural productivity.

3. Materials and Methods

The purpose of this paper is to assess the economic convenience for the adoption of CAMs by farmers, based on avoided damage, differentiated for type of farming and economic size class. Our research is conducted as part of the LIFE project "ADaptation in Agriculture" (ADA) (https://www.lifeada.eu/ accessed on 21 March 2023). In particular, the ADA project aims to increase the resilience of the agricultural sector by developing knowledge and planning tools that Producer Organizations (POs) and farmers can use to adapt to climate change. More than 100 climate change adaptation measures (https://www.lifeada.eu/en/adaptation-actions/ accessed on 21 March 2023) were identified within the project and were articulated in eight thematic groups as below:

1. Soil management.
2. Soil conditioners and fertilizers.
3. Agronomic techniques.
4. Crop protection.
5. Water resources management.
6. Engineering, digitization, and training.
7. Innovative breeding techniques and animal welfare.
8. Winemaking techniques.

To this purpose, we provide an economic analysis that can support the choice of the farmers in adopting CAMs. The decision to implement CAMs for farmers is based both on an average annual cost that farmers have to face, and on effectiveness measures in terms of their ability to avoid damage from adverse climate.

Under this perspective, the economic convenience for farmers to adopt CAM is evaluated on the cost and benefit associated to measures. In the ADA project, through desk research and open interview with agricultural experts, we analyzed the costs and benefits of the climate change adaptation measures, and we identified the following data for each measure:

- Range of costs to be incurred for the implementation of the measure. We collect range investment costs, and average annual cost per hectare. These annual costs take into account the depreciation of the investment and the maintenance cost of the investments.
- Degree of effectiveness of the measure in relation to the risks (high, medium, low). Twelve climate risks have been classified and each adaptation measure responds directly to a main climate risk, but also to one or more related risks. In particular, risks taken into account are drought, wind, hail, flood events, late frost, damage by extreme maximum and minimum temperatures, intense precipitation, loss of suitability of the territory, saltwater intrusion, erosion, and phytosanitary damage.
- Further economic benefits, in addition to possible damage avoided.
- Environmental benefits.
- Possibility of public funding (e.g., CAP).

However, in order to evaluate economic convenience, our paper only considers the benefit relative to the damage avoided with the adoption of a measure. Other benefits brought about by the adoption of the measure could be integrated into the evaluation in future studies.

Estimates by Coldiretti that is the leading organization of agricultural entrepreneurs at national and European levels (www.coldiretti.it, accessed on 24 February 2023) indicate that in the decade 2009–2018 extreme events in Italy cost the agricultural sector EUR 14 billion, also considering damage to structures, infrastructure, and production. In 2022, estimated losses amounted to 10% of national agri-food production, worth more than EUR 6 billion: losses of up to 70% less for different varieties of fruit and vegetables, between 50 and 60%

less for maize, between 10 and 30% less for wheat, 20% less for mussels and clams, 45% less for maize and fodder for animal feed, and 20% less for milk.

Moreover, according to the experts that were interviewed, every year, the potential damage to Italian crops, in terms of yield and income, is between 10 and 40% of production in quantity and value. This estimate refers to each climate event such as drought, frost, hail, extreme temperatures (maximum and minimum) etc. Such damage is not homogeneous, so in some areas it affects less than 10%, while in others it may affect the entire harvest. The entire agricultural economy is quite sensitive to weather, and adverse weather events are increasingly frequent, of greater intensity, and unpredictable, so they can strike anywhere. Therefore, the possibility of a climate risk must always be considered. Considering yield loss estimated by interview, we assumed that adverse climatic events (whatever they may be) are very likely to cause damage on average, equal to, or greater than 30% of the value of the farm's production. However, this assumption can be adjusted for scenarios of probabilities of losses less or greater than 30%.

In our analysis, the avoid damage value is calculated using Italian FADN data (https://rica.crea.gov.it/ accessed on 20 July 2022) and calculated the average farm value of Gross Production by typology of farm and economic size class based on three types of farming (open field horticulture, fruit growing, wine growing) and three economic size classes (high, medium, low; class economic size is defined on basis of Standard Production (SP) High: >100.000 € SP; Medium: between 25.000 and 100.000 € of SP; Low $\leq$ 25.000 € of SP). The average value of Gross Production per farm referred to the data of the last three available years (in our case Italian FADN data referred to years: 2017–2019).

As mentioned before, we assumed that the economic damage is equal to 30% of the value of production. The benefit of each measure to prevent/reduce damage is calculated by the measured effectiveness. The following assumptions were made regarding effectiveness of the measure:

- High = capable of reducing the damage from 70 to 100%.
- Medium = capable of reducing the damage from 30 to 70%.
- Low = capable of reducing the damage from 10 to 30%.

Finally, the average farm benefit is compared to the average farm cost to be incurred for the adoption of CAMs.

Summarizing, in our analysis input data are:

- percentage of the damage (we assumed 30% on production value);
- average annual adaptation cost to implement the measure;
- degree of effectiveness of the measure (high, medium, low);

In order to provide results through the application of our analysis we assumed the following possible average annual adaptation costs per hectare:

- Low: 250 €
- Medium: 500 €
- High: 1000 €
- Very high: 2000 €.

In order to estimate average farm cost, each cost per hectare above was multiplied by the average UAA (Utilized Agricultural Area) type of farming and class of economic size. The farm average UAA came from FADN data (2017–2019).

Considering the average annual cost of implementing the measure and the related benefits we could calculate:

- cost impact on gross production value (GPV) (cost/GPV);
- incidence of the benefit on the GPV (loss avoided) $\rightarrow$ (net benefit/GPV);
- impact of the net benefit/ cost $\rightarrow$ net benefit/cost (Net benefit = Benefit – Cost);

In particular, the impact of the net benefit/cost represents the convenience degree to implement the measure. The degree of convenience (Y) is calculated as follows:

$$Y = ((B - C)/C)) \times 100,$$

where B is equal to benefit deriving from the damage avoided. B is equal to ExD/100, where E explains the measure effectiveness (which can be 85%, 50%, or 30%); D identifies the likelihood of damage that we assume is equal to 30xGPV/100.

The variable C represents the adoption cost of the CAMs that is given by cost per hectare paid by farmers to implement CAMs (Cha) multiplied for UAA: C = ChaxUAA

Finally, by substituting the explanatory variables in the initial equation we can affirm that

$$Y = ((Ex30xGPV/100)/100)/(ChaxUAA)$$

In this paper we show an assessment based on the impact of the net benefit/cost, exclusively considering the benefit from the damage avoided through the adoption of the measure based on the assumptions made.

For the assessment, we proposed the following degrees of convenience cost-effectiveness based on the incidence of net benefit over cost:

>200%	Very high
From 100% to 200%	High
From 50% to 100%	Very good
From 10% to 50%	Good
From 0.1% to 10%	Convenient
From 0 to −50%	To be convenient other benefits should be considered
<−50%	To be convenient also farm specificities should be considered.

The discussion of our findings is reported in the next section.

4. Results

We present the results of our analysis based on the above assumptions of costs and degrees of effectiveness of the measure, assuming a damage of 30% of the value of production.

This analysis can be adapted to different values of the input data and assuming damage less than or greater than 30% of the value of production. Table 1 shows the FADN data that were used to evaluate the cost-effectiveness of adopting CAMs. We considered three types of farming (open field horticulture, fruit growing, wine growing) and three economic size classes (high, medium, low).

Table 1. FADN data used for the cost-effectiveness analysis of adopting the measure (average farm values 2017–2019).

Supply Chain	Farm Size	GPV (€)	UAA (ha)	Hypothesis of Damage (30% of GPV)
Open field horticulture	Large	260.790	20.2	78.237
Open field horticulture	Medium	73.161	3.5	21.948
Open field horticulture	Small	24.964	1.5	7.489
Fruit	Large	248.332	23.7	74.500
Fruit	Medium	65.321	7	19.596
Fruit	Small	21.908	2.8	6.572
Wine	Large	240.397	29	72.119
Wine	Medium	47.128	7.7	14.138
Wine	Small	16.566	3.5	4.970

Table 2 shows the assessment of the degree of convenience of each measure, considering only the benefit from the probable damage avoided in the hypothesis of a damage equal to 30% of the value of production. We assumed the following average annual costs per hectare: 250, 500, 1000, 2000.

Table 2. Economic convenience degree of the adaptation measure (Y).

Supply Chain	Farm Size	High Effective Capable of Reducing the Damage from 70% to 100%				Medium Effective Capable of Reducing the Damage from 30% to 70%				Low Effective Capable of Reducing the Damage from 10% to 30%			
Cost/ha		**250**	**500**	**1000**	**2000**	**250**	**500**	**1000**	**2000**	**250**	**500**	**1000**	**2000**
Open field horticulture	Large	*****	*****	*****	***	*****	*****	***	#	*****	***	#	##
Open field horticulture	Medium	*****	*****	*****	****	*****	*****	*****	***	*****	****	**	##
Open field horticulture	Small	*****	*****	*****	****	*****	*****	****	**	*****	***	#	##
Fruit	Large	*****	*****	****	**	*****	*****	***	#	****	**	#	##
Fruit	Medium	*****	*****	****	**	*****	****	**	#	****	**	#	##
Fruit	Small	*****	*****	****	*	*****	****	**	#	***	#	##	##
Wine	Large	*****	*****	****	*	*****	****	**	#	***	#	##	##
Wine	Medium	*****	*****	****	#	*****	***	#	##	**	#	##	##
Wine	Small	*****	****	**	#	****	**	#	##	**	#	##	##

Legend: Convenient: *; Good: **; Very Good: ***; High: ****; Very High: *****. If the costs exceed the net benefits: To be convenient, other benefits should be considered: #; To be convenient, also farm specificities should be considered: ##.

Table 2 shows that, if the adaptation measure is highly effective, its adoption for farms is convenient for each average cost considered. Medium/small wine farms for which the cost per hectare is very high are an exception; in this type of farm, the convenience could be achieved by considering any additional benefits. If the measure has low effectiveness and implementation costs are high and/or very high, the adoption of the measure should be evaluated according to farm specificities and considering any further benefits, such as the possibility of benefiting from public funding. In case of a high average cost, the presence of additional benefits might be sufficient for horticultural and fruit farms, due to their high production values. In case of a measure with moderate effectiveness and very high costs, the farm specificities must be considered.

5. Discussion and Conclusions

Climate change directly influences productivity, affecting the profitability of farmers, especially those who have small and medium-sized farms, and their ability to survive. It also negatively affects the quality of production. Adaptation to climate change plays a role of primary importance, but the economic expense to be incurred for the implementation of the measures can discourage farmers.

The cost–benefit analysis of the cost-effectiveness of adopting measures to adapt the agricultural sector to climate change has been marginally investigated in the literature. This study aims to provide an assessment on economic convenience for the adoption of CAMs to climate change at farm level. The economic convenience is based on effectiveness of measures in counteracting climate risk, starting from an assumption that the avoided damage deriving from an adverse climatic event is equal to 30% of the farm's GPV. The importance of this research lies on the fact that economic convenience is a leverage for farmers to adopt adaptation measures [43–45].

This analysis is adaptable to any different damage estimation rate from our assumption (30%) and, applied to specific cases, can take into account any other benefits related to the measure. In fact, adaptation measures cannot only avoid/prevent damage caused by climate change, but also play a role in improving economic performance.

The FADN sample data was used to explore the cost–benefit assessment of adaptation measures. To the best of the authors' knowledge, the FADN sample data has never been used in this regard. The results reported do not take into account the actual physical, economic and financial size of the farm, but are based on average data referring to both farms and the costs to be incurred for the adoption of the measure. However, in our opinion, they provide a useful benchmark on the degree of convenience of adopting adaptation measures. The results of our research could help to promote sensibilization and spread awareness on issues related to trends in global climate change and their growing impact on agricultural activities and productivity. The importance of the study lies in its contribution to the lacking literature on the costs and benefits of adaptation measures. In particular, the quantification of the damage avoided with the implementation of individual adaptation measures is poor in economic literature. In addition, these interventions to avoiding/preventing damage can play a role in improving corporate performance. The evidence of the economic sustainability of the adaptation measures to be implemented plays a key role in convincing the farmer of the economic convenience of adopting adaptation plans.

At the same time, this can be the basis for deepening the cost/benefit ratio of CAMs implementation, taking into account the characteristics of the farm and its cultivation processes. The adoption of CAMs entail a wide range of costs depending on several factors, such as farm location and methods of implementation. Moreover, as far as investments to implement the measure are concerned, the market offers many solutions with a wide range of prices. In our opinion, precisely because of the many above-mentioned factors, the results of our study provide interesting information for the implementation of adaptation measures that are an important part of public policy. The results of our research, in fact, respond to the need to raise and spread awareness on issues related to global climate change trends and their increasing impact on agricultural activities and productivity.

In this paper we show an assessment based on the impact of the net benefit/cost, exclusively considering the benefit of the avoided damage on the basis of the assumptions made. This is because, considering the numerous variables linked to all the benefits and specific to each measure, the analysis must be adapted from time to time. Other benefits, independent of the occurrence of the adverse climatic event, should be considered:

- benefits related to the improvement of production quality and increase of yield (organoleptic properties, better size that allows a better placement on the market etc., and/or an increase in yields). The economic value of these benefits depends on the adaptation measure, as well as on the specificity of the farm, so can be suitably valued based on the measure taken into consideration;
- the possibility of benefiting from CAP payments;
- the environmental benefits, e.g., water saving, carbon storage, pesticide pollution reduction.

The above-mentioned further benefits could be taken into account in future studies.

Furthermore, the paper does not consider the real size and characteristics of the farms. However, it provides a reference judgment on the convenience of adopting the adaptation measures. Therefore, at the same time, it can be the basis for investigating in greater detail various measures in different supply chains, considering the characteristics of the farm and company cultivation processes. The limitation of this research consists in its exemplification, due to the use of average data and estimates that cannot be replaced by structural, economic, and patrimonial characteristics, and also by the productive context in which the farm is situated. However, the analysis findings provide interesting information for adaptation measures. For these considerations, methodological and empirical insights are desirable for a more precise and objective assessment. These considerations suggest that climate change measures are a major part of public policies at local, national, and global levels. In line with the EU adaptation strategy (EU COM 2021/82), our paper contributes to scientific literature to make farmers more resilient to climate change. Our challenge is to outline specific measures for the agricultural sector, to counteract impacts of climate change also at a local level. Finally, the results of our study could be applied to a wide spectrum of climate risks and a large number of adaptation measures in order to have a more integrated view on the issue. Moreover, further investigations on economic convenience to adaption might encourage policymakers and practitioners to commit to their promotion, further boosting farmers' engagement and adoption of adaptation measures.

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References

1. AR6 Climate Change 2021: The Physical Science Basis. Available online: https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/ (accessed on 10 October 2022).
2. Mahato, A. Climate change and its impact on agriculture. *Int. J. Sci. Res. Publ.* **2014**, *4*, 1–6.
3. Regulation (EU) 2021/2117 of the European Parliament and of the Council of 2 December 2021 Amending Regulations (EU) No 1308/2013 Establishing a Common Organisation of the Markets in Agricultural Products, (EU) No 1151/2012 on Quality Schemes for Agricultural Products and Foodstuffs, (EU) No 251/2014 on the Definition, Description, Presentation, Labelling and the Protection of Geographical Indications of Aromatised Wine Products and (EU) No 228/2013 Laying down Specific Measures for Agriculture in the Outermost Regions of the Union Special Reports-European Court of Auditors (2021). Common Agricultural Policy and Climate Half of EU Climate Spending but Farm Emissions Are Not Decreasing. Publication Office of European Union. Available online: https://www.eca.europa.eu/Lists/ECADocuments/SR21_16/SR_CAP-and-Climate_IT.pdf (accessed on 21 October 2022).
4. Pieralli, S.; Pérez Domínguez, I.; Elleby, C.; Chatzopoulos, T. Budgetary impacts of adding agricultural risk management programmes to the CAP. *J. Agric. Econ.* **2021**, *72*, 370–387. [CrossRef]
5. Eurobarometrer Special 513. Climate Change. March–April 2021. Available online: https://europa.eu/eurobarometer/surveys/detail/2273 (accessed on 11 November 2022).
6. OECD. Climate Change and Agriculture Impact, Adaptation and Mitigation. 2010. Available online: https://www.oecd.org/greengrowth/climate-change-and-agriculture-9789264086876-en.htm (accessed on 12 October 2022).
7. Bosello, F.; Kuik, O.; Tol, R.S.J.; Watkiss, P. *Costs of Adaptation to Climate Change: A Review of Assessment Studies with a Focus on Methodologies Used*; EEA Report, 6th Specific Agreement No 3602/B2005.EEA under the Framework Contract No. EEA/AIR/04/004; EEA: Geneva, Switzerland, 2007.
8. Hallegatte, S. Strategies to adapt to an uncertain climate change. *Glob. Environ. Chang.* **2009**, *19*, 240–247. [CrossRef]
9. Pindyck, R.S. Uncertainty in environmental economics. *Rev. Environ. Econ. Policy* **2007**, *1*, 45–65. [CrossRef]
10. Rosenzweig, C.; Parry, M.L. Potential impact of climate change on world food supply. *Nature* **1994**, *367*, 133–138. [CrossRef]
11. Parry, M.; Rosenzweig, C.; Iglesias, A.; Fischer, G.; Livermore, M. Climate change and world food security: A new assessment. *Glob. Environ. Chang.* **1999**, *9*, S51–S67. [CrossRef]
12. Parry, M.; Rosenzweig, C.; Iglesias, A.; Livermore, M.; Fischer, G. Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Glob. Environ. Chang.* **2004**, *14*, 53–67. [CrossRef]
13. Parry, M.; Rosenzweig, C.; Livermore, M. Climate change, global food supply and risk of hunger. *Philos. Trans. R. Soc. Biol. Sci.* **2005**, *360*, 2125–2138. [CrossRef]
14. Fischlin, A.; Price, J.; Leemans, R.; Gopal, B.; Turley, C.; Rounsevell, M.; Dube, P.; Tarazona, J.; Velichko, A. Ecosystems, their properties, goods, and services. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*; Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E., Eds.; Cambridge University Press: Cambridge, UK; Available online: https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter4-1.pdf (accessed on 10 December 2022).
15. Calicioglu, O.; Flammini, A.; Bracco, S.; Bellù, L.; Sims, R. The future challenges of food and agriculture: An integrated analysis of trends and solutions. *Sustainability* **2019**, *11*, 222. [CrossRef]
16. Meuwissen, M.P.; de Mey, Y.; van Asseldonk, M. Prospects for agricultural insurance in Europe. *Agric. Financ. Rev.* **2018**, *78*, 174–182. [CrossRef]
17. Marin, L. Classification of risks in agricultural insurance. Scientific Papers Series Management. *Econ. Eng. Agric. Rural. Dev.* **2019**, *19*, 173–178.
18. McBean, G.; Ajibade, I. Climate change, related hazards and human settlements. *Curr. Opin. Environ. Sustain.* **2009**, *1*, 179–186. [CrossRef]
19. Porter, J.R.; Semenov, M.A. Crop responses to climatic variation. *Philos. Trans. R. Soc.* **2005**, *1463*, 2021–2035. [CrossRef]
20. Antle, J.M.; Capalbo, S.M.; Elliott, E.T.; Paustian, K.H. Adaptation, Spatial Heterogeneity, and the Vulnerability of Agricultural Systems to Climate Change and CO_2 Fertilization: An Integrated Assessment Approach. *Clim. Chang.* **2004**, *64*, 289–315. [CrossRef]

21. Le Dang, H.; Li, E.; Bruwer, J.; Nuberg, I. Farmers' perceptions of climate variability and barriers to adaptation: Lessons learned from an exploratory study in Vietnam. *Mitig. Adapt. Strateg. Glob. Chang.* **2004**, *19*, 531–548. [CrossRef]
22. Woods, B.A.; Nielsen, H.Ø.; Pedersen, A.B.; Kristofersson, D. Farmers' perceptions of climate change and their likely responses in Danish agriculture. *Land Use Policy* **2017**, *65*, 109–120. [CrossRef]
23. Bryan, E.; Deressa, T.T.; Gbetibouo, G.A.; Ringler, C. Adaptation to climate change in Ethiopia and South Africa: Options and constraints. *Environ. Sci. Policy* **2009**, *12*, 413–426. [CrossRef]
24. Masud, M.M.; Akhtar, R.; Nasrin, S.; Adamu, I.M. Impact of socio-demographic factors on the mitigating actions for climate change: A path analysis with mediating effects of attitudinal variables. *Environ. Sci. Pollut. Res.* **2017**, *24*, 26462–26477. [CrossRef]
25. Masud, M.M.; Azam, M.N.; Mohiuddin, M.; Banna, H.; Akhtar, R.; Alam, A.S.A.F.; Begum, H. Adaptation barriers and strategies towards climate change: Challenges in the agricultural sector. *J. Clean. Prod.* **2017**, *156*, 698–706. [CrossRef]
26. Kabir, M.H.; Alam, M.M. Developing a conceptual model for identifying determinants of climate change adaptation. *J. Clim. Chang.* **2021**, *7*, 25–35. [CrossRef]
27. Chenani, E.; Yazdanpanah, M.; Baradaran, M.; Azizi-Khalkheili, T.; Najafabadi, M.M. Barriers to climate change adaptation: Qualitative evidence from southwestern Iran. *J. Arid Environ.* **2021**, *189*, 104487. [CrossRef]
28. Eakin, H.; York, A.; Aggarwal, R.; Waters, S.; Welch, J.; Rubiños, C.; Smith-Heisters, S.; Bausch, C.; Anderies, J.M. Cognitive and institutional influences on farmers' adaptive capacity: Insights into barriers and opportunities for transformative change in central Arizona. *Reg. Environ. Chang.* **2016**, *16*, 801–814. [CrossRef]
29. Tarolli, P.; Straffelini, E. Agriculture in hilly and mountainous landscapes: Threats, monitoring and sustainable management. *Geogr. Sustain.* **2020**, *1*, 70–76. [CrossRef]
30. Azadi, Y.; Yazdanpanah, M.; Mahmoudi, H. Understanding smallholder farmers' adaptation behaviors through climate change beliefs, risk perception, trust, and psychological distance: Evidence from wheat growers in Iran. *J. Environ. Manag.* **2019**, *250*, 109456. [CrossRef] [PubMed]
31. Mirzaei, A.; Azarm, H.; Yazdanpanah, M.; Najafabadi, M.M. Socio-economic, social-capital, and psychological characteristics and climate change adaptive behavior of farmers in Iran. *Clim. Res.* **2022**, *87*, 1–12. [CrossRef]
32. Tran, T.T.; Chen, H. Climate change risk perception and adaptive behavior of coffee farmers: The mediating role of climate-related attitudinal factors and moderating role of self-efficacy. *J. Environ. Stud. Sci.* **2021**, *12*, 354–368. [CrossRef]
33. Yin, S.; Yang, X.; Chen, J. Adaptive behavior of farmers' livelihoods in the context of human-environment system changes. *Habitat Int.* **2020**, *100*, 102185. [CrossRef]
34. Pickson, R.B.; He, G. Smallholder farmers' perceptions, adaptation constraints, and determinants of adaptive capacity to climate change in Chengdu. *SAGE Open* **2021**, *11*. [CrossRef]
35. Wu, H.; Mweemba, L. Environmental self-efficacy, attitude and behavior among small scale farmers in Zambia. *Environ. Dev. Sustain.* **2010**, *12*, 727–744. [CrossRef]
36. Komarek, A.M.; De Pinto, A.; Smith, V.H. A review of types of risks in agriculture: What we know and what we need to know. *Agric. Syst.* **2020**, *178*, 102738. [CrossRef]
37. Parker, L.; Bourgoin, C.; Martinez-Valle, A.; Läderach, P. Vulnerability of the agricultural sector to climate change: The development of a pan-tropical Climate Risk Vulnerability Assessment to inform sub-national decision making. *PLoS ONE* **2019**, *14*, e0213641. [CrossRef]
38. Di Fonzo, A.; Liberati, C. Consumers are unaware about European legislation on communication of the health benefits conveyed by claims. An empirical survey. *Ital. Rev. Agric. Econ.* **2020**, *75*, 51–59. [CrossRef]
39. Bimbo, F.; Russo, C.; Di Fonzo, A.; Nardone, G. Consumers' environmental responsibility and their purchase of local food: Evidence from a large-scale survey. *Br. Food J.* **2021**, *123*, 1853–1874. [CrossRef]
40. Perito, M.A.; Di Fonzo, A.; Sansone, M.; Russo, C. Consumer acceptance of food obtained from olive by-products: A survey of Italian consumers. *Br. Food J.* **2020**, *122*, 212–226. [CrossRef]
41. Giuca, S.; Meo, R.; De Leo, S.; Macrì, M.C.; Scornaienghi, M. L'Italia e la PAC Post 2020. Policy Brief 9 OS 9. Migliorare la Risposta Dell'agricoltura dell'UE alle Esigenze della Società in Materia di Alimentazione e Salute, Compresi Alimenti Sicuri, Nutrienti e Sostenibili, Sprechi Alimentari e Benessere degli Animali 2020. RRN-MIPAAF. Available online: https://www.reterurale.it/PAC_2023_27/PolicyBrief (accessed on 14 December 2022).
42. Giarè, F.; Giuca, S. (Eds.) *Farmers and Short Chain. Legal Profiles and Socio-Economic Dynamics*; INEA: Rome, Italy, 2013.
43. Narain, U.; Margulis, S.; Essam, T. Estimating costs of adaptation to climate change. *Clim. Policy* **2011**, *11*, 1001–1019. [CrossRef]
44. Mitter, H.; Larcher, M.; Schönhart, M.; Stöttinger, M.; Schmid, E. Exploring Farmers' Climate Change Perceptions and Adaptation Intentions: Empirical Evidence from Austria. *Environ. Manag.* **2019**, *63*, 804–821. [CrossRef]
45. Klein, R.J.; Midgley, G.; Preston, B.L.; Alam, M.; Berkhout, F.; Dow, K.; Shaw, M.R. Adaptation opportunities, constraints, and limits. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2015; p. 899.