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Review

Innovative Contract Solutions for the Provision of Agri-Environmental Climatic Public Goods: A Literature Review

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Abstract: Lack of public funding and environmental deterioration are promoting the search for innovative mechanisms enabling to boost farmers' provision of agri-environmental climate public goods. This work aims to contribute to the current debate by highlighting the role of innovative contractual solutions through a systematic review of more than 60 articles. The review analyses the potential of result-based and collective contracts as innovative solutions compared to action-based instruments, which are those currently most used. The design of innovative contracts and other mechanisms, e.g., auction and screening contracts, can reduce the policy failures due to asymmetric information. The paper emphasises the trade-off between an accurate design of agri-environmental schemes and the related administrative burden, highlighting the need for a better understanding of the role of mechanisms design into the policy cycle. Some new instruments were not analysed in the review, due to the scarcity of literature, and there is the need of more case studies providing information on the effectiveness of instruments when implemented in different contexts. We fill the gap in empirical evidence through a SWOT analysis that evaluates the effectiveness and acceptability of innovative instruments for policy purposes.

Keywords: agri-environmental schemes; result-based; action-based; collective contract; asymmetric information; common agricultural policy; effectiveness; policy failures; mechanism design

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1. Introduction

Human pressure on the environment is rapidly increasing and causing an urgent need to improve environmental activities. Public goods from agriculture and forestry are very important since they usually insist on a significant share of territories and activities such as pasture management, ditch maintenance, forest cleaning, etc. contribute to environmental quality, e.g., by preventing landscape degradation, soil erosion, hydrogeologic risk, etc. New international strategies such as the New Green Deal against climate change will be increasingly important since they can coordinate different realities and countries to enhance the global effects of policy measures. Sustainable development is about engaging stakeholders (including landowners) in learning adaptive management and negotiating how to move forward in a complex world where they do not have all the information they need [1]. Since the MacSharry Reform in 1992, the Common Agricultural Policy (CAP) has dedicated growing attention to environmental issues. The provision of environmental benefits through agriculture, such as agri-environmental-climate public goods (AECPGs), has evolved over time and now represents one of the main justifications to the public support given to farmers [2–4]. However, this provision is not aligned with the societal demand yet.

Public goods provision could be classified in different ways, among which one of the most utilised is the "point or non-point" source, based on the spatial origin of the activities providing AECPGs.

One of the main failures of the current policy regime stems from the policy makers' inability to cope with the heterogeneity of private costs of producing environmental benefits within and among farms [5]. Incomplete information can lead to inefficiency as a consequence of either an over-compensation of some farmers with consequent waste of funding or under-compensation of practices that can provide higher environmental benefits [6]. Some policy failures result from the different level of information between the principal (regulator) and the agents (farmers). Asymmetric information is very common in environmental regulation and can reduce the provision of public goods through agriculture [7] insofar as it greatly reduces the accuracy in designing the set of payments and other policy parameters such as measures and commitments [3]. Besides this, information asymmetries can cause both adverse selection and moral hazards due to hidden information before the contract implementation or hidden actions after the contracts are implemented [8].

The above critiques and problems make it necessary to find innovative solutions. Indeed, since the CAP is financed thanks to the European taxation programme [2], European citizens are the ones to pay for public goods and can accept this destination of public funding only in the case that they consider it as effective and efficient.

The academic debate is very active in finding new solutions to improve the information uptake by farmers (auctions, self-revelation mechanisms, etc.) and to design new contracts. The literature underlines that agri-environmental schemes (AESs) can reach a good level of effectiveness only in areas where a set of ecological prerequisites are already in place [9]. Besides this, recently the trust in the European activities has been mined by different elements and anti-euro movements around member states. This missed consensus could be very harmful to reach common AECPGs goals. Brexit, for example, could be harmful to the farmers. The UK Government announced its intention to formulate a novel agricultural policy following the principle that public funding should be restricted to public goods with a starting list of AECPGs provided by agriculture and forestry [10]. Recognising the potential for AESs participation to enhance population's wellbeing may demonstrate an added value of AESs and strengthen the argument for AESs funding after the UK exit from the European Union [11].

During the recent years, people's awareness regarding the impact of agricultural activities on the ecosystem has enormously increased, focussing more on negative than on positive effects, making the debate about the expenditure on the agricultural sector very active. Europeans have also learned that AESs are an expensive way to promote conservation. As a policy tool, they are complex and can be utilised only in Europe where biodiversity, for example, is strongly linked to farmers' activities [12]. Climate change will also alter the provision of environmental services from the farmers and directly impact the social actors. The debate about the correct definition of ecosystem and environmental services in payments for ecosystems or environmental services (PES) is very active and analysed in the literature [13]. The regulator can exploit the institutional structures established under PES as good entry points to conduct further training and capacity-building efforts for adaptation [14]. Trust in institutions and achieving environmental objectives (New Green Deal, etc.) cannot be separated from a better ability to implement common goals.

There is a growing awareness that European agriculture has not only the functions of providing food and income for the whole community. Indeed, it can also perform environmental functions, by contrasting climate change and securing biodiversity. For these reasons, the agricultural sector will continue to benefit from the classic subsidies even within a spending horizon that sees a strong contraction of public budgets and the transfer of part of the rural and direct payments' national budgets to environmental activities [2]. In the last decade, the words "green" as well as "market" had a prominent role in the CAP policy, due to the need to counteract market and environmental problems caused by the phase of guaranteed prices. In this new programming period "efficiency" becomes the

main keyword, especially in the face of the current crisis due to the COVID-19 pandemic, which will further contract the EU spending ability [2,15]. To improve effectiveness, it is also important to understand how to reduce farmers' exit from AESs when the agreement period expires. Role of farmers and farm-specific characteristics, farmer's learning process over time, neighbourhood effect and changes in policy design made by regional authorities are examples of variables influencing exit decision [16].

An environmental policy is generally aimed at negotiated approaches. In fact, away from the simple cause-and-effect scenarios, it is difficult to identify ideal outcomes and main beneficiaries [1]. There is a fertile debate about the future CAP reform due to the introduction of a new green architecture. Proposed innovations include implementing new instruments between cross-compliance and AESs, i.e., the so-called eco schemes, as well as new contractual arrangements for AESs [2].

The contract solutions that are more analysed in literature are action-based, result-based and collective action contracts. While the action-based contracts currently represent in the UE framework the most utilised solution for the provision of AECPGs, the following two categories represent alternative contracts considered as the most suitable solutions to solve issues and improve the benefits both for farmers and administration, in terms of remuneration, AECPGs provision, public spending, and its effectiveness and efficiency. In the action-based approach, farmers get funds based on actions that they have implemented, and payments are usually related to an estimation of sustained costs. In the result-based approach, farmers get funds based on the environmental results that their actions have caused, and payments are usually based on the estimation of benefits. Collective implementation refers to a type of contract that promotes the involvement of stakeholders in the definition of strategies that must be pursued by a multiplicity of actors, rather than from a single farmer. In the past years, the collective contract has often been utilised in the CAP second pillar measures.

There are further types of contracts, e.g., the value chain solution and the land tenure contract, but these instruments are beyond the scope of this review. Indeed, these two last types of contracts may become very useful in the future, but at present they have not yet been very much studied and available literature is too poor. The value chain contract solution refers to a type of funding related to the input and output of stakeholders involved in the supply of AECPGs. This type of contract is usually utilised in product supply chains to create an optimal distribution of the value among participants. In common law systems, land tenure is the legal regime in which land is owned by an individual, who is said to "hold" the land. A land tenure contract determines who can use land, for how long and under what conditions, and in our case, how the land should be managed to improve the agri-environmental situation. Land tenure solutions are poorly analysed in the literature. The security of tenure and the formalisation of landlord commitments to tenants have positive influence on the farmer's decisions on soil investments and diminish the risk factors related to the lease agreements leading to a significant increase in efficiency [17]. In the land tenure solution, the regulator has to decide if it is more cost-effective to buy an area where to put in practice environmental protection together with an environmental association (buy option) or to give a payment to farmers for their environmental actions (compensation-option) [18]. In some areas, property-right incentives are tested, and rights and responsibilities are shared between the land manager and some other agency. These contracts are seen as cost effective and un-intrusive [1].

The literature on the action-based approach highlights the lack of effectiveness of this type of contract, identifies asymmetric information [19–22] as one of the main causes of its failure, and proposes innovative information uptake mechanisms, such as auction and self-selected contracts, to reduce it [23–28]. The result-based approach is one of the most promising substitutes of action-based approach because of its direct connection between environmental results and price paid for them [29,30]. Collective implementation is important to widen the diffusion of AESs and also because it can partially overcome the problem of high transaction costs characterising the previous instruments [20,31–33]. The paper

aims to answer the following research questions: "How can innovative contract solutions improve the effectiveness of the AECPGs provision under asymmetric information and avoid policy failures?"; "How can innovative information uptake mechanisms improve the effectiveness of the current payment methods?" Therefore, this study aims to provide an analysis of strengths, weaknesses, opportunities, and threats of innovative contracts in comparison with the current action-based approach and to highlight the relations between new institutional arrangements and asymmetric information, thus contributing to reduce policy failures in the design of measures promoting AECPGs provision. Indeed, while the literature on the environmental impact of CAP is quite rich, a comprehensive review focussing on the role of information asymmetry in the design of innovative contracts and their related environmental performance—to the best of the authors' knowledge—is still missing. However, an overall and comparative analysis on the main instruments and their features would be very useful both for researchers and policy makers. This work could provide policymakers with a reliable and helpful basis to formulate decisions and improve the current situation [34].

The paper is structured as follows. Section 1 describes the situation of environmental policies in Europe and the reasons to look for and to implement innovative solutions to improve the provision of AECPGs. Section 2 describes the methodology adopted. Section 3 presents the main results, consisting in an analysis of external factors that influence policy implementation, farm adoption and contract performances and in some insights on how innovative contracts may help to solve problems of information asymmetries. Section 4 discusses results and presents a SWOT analysis of the main contract solutions, providing decision makers with a summary of their characteristics. Finally, the last section presents conclusions.

2. Materials and Methods

Literature reviews have become quite common in scientific journals because they are able to provide an overview of the actual knowledge regarding a research topic [35]. They can be helpful to update and improve the research activities mostly in highly debated topics; in fact, a literature review is the first step of a broader research process [36]. A systematic review involves organised, replicable and transparent procedures and can remove the research bias by making values and assumptions explicit [34]. This paper, by following the systematic literature review rules, aims to present a comprehensive framework of current problems and proposed solutions related to agri-environmental policies. In the first part of the study, we performed a narrative literature review to select and gather all the relevant papers. The bibliographic analysis has been constructed starting from the most relevant scientific articles indexed in scientific databases [37]. We conducted a first exploratory research to better frame our argument and to find the best keywords for the databases research [35]. We utilised the excel software to organise the exported papers and for the bibliometric analysis. The paper selection and the coding activities were conducted by the authors with a contents-based assessment [38]. In the research and selection we followed the PRISMA Guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [39–41]. We provide an overview of the research procedure with the PRISMA Flow Chart (Figure 1).

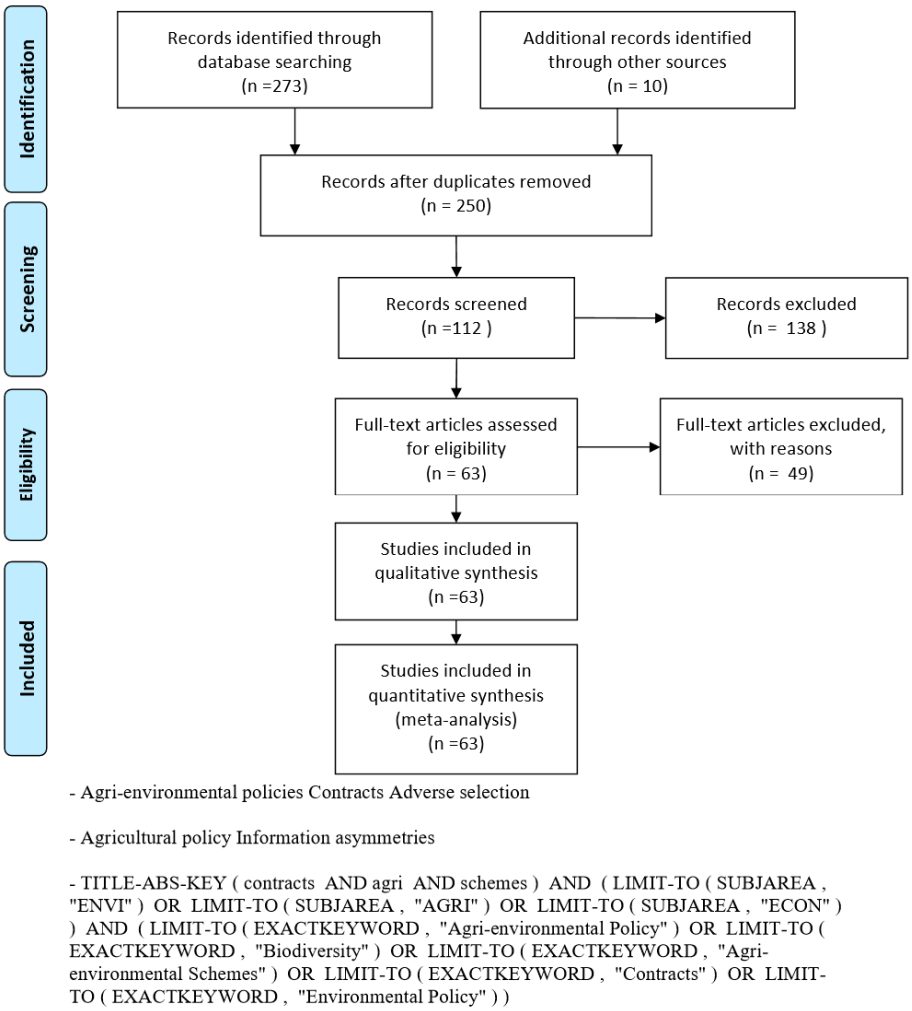

Figure 1. Prisma Flow Diagram.

We carried out the literature review in September 2020 on the Web of ScienceTM (WOS) and Scopus databases. The search was limited to original research papers in English and published in peer-reviewed journals, published from 1995 to 2021. We have not considered preprint databases to include in our analysis only high quality reviewed studies [40]. We conducted a stepwise approach starting from general researches, e.g., without using field restrictions, to a more detailed one, including fields restriction and strict keywords strings. Following a common methodology, we divided the research process into three phases [42,43]. In the first, we assessed the inclusion and exclusion criteria for the database research. In the second phase, we decided the best string of words to utilise in the research and we exported all the resulting papers postponing the selection to the third phase. In the last one, we repeatedly assessed all the papers' full text to include only relevant papers (PRISMA phases).

The first selection was conducted using the keywords "Agri-environmental policies", "Contracts" and "Adverse selection" for the title, abstract and keywords with a global approach without field restriction. This first general round of research made easy to find the best string of keywords and to avoid the exclusion of relevant articles [43]. In the second selection, we utilised a strict string of keywords involving words such as "Contract", "Agri" and "Schemes". This procedure allowed us to better frame the context of the debate about contracts and its impact on the environment.

We expanded the paper retrieval by manually adding other quoted papers when they fitted within the scope of the literature review. Thus, the cross-reference analysis allowed

us to avoid the exclusion of important articles for the topic only due to the incompatibility with the research strings. Ten papers were added based on the reference analysis of already included papers or of the authors' prior knowledge [43]. After the first searching activities, we found almost three hundred articles.

In the screening phase, by analysing title and keywords, we limited the results and selected the most interesting and suitable articles for the topic (case studies, analysed problems, innovative contract solutions, information uptake, etc.). When it was difficult to understand the topic from the title of the article we postponed the decision if including, or not, the paper to the next level of analysis [43]. After completing this phase, we exported data related to 112 articles (Figure 1).

In the eligibility phase we selected 63 papers based on relevance of abstract and full text for the research question [41]. This literature review is based more on a descriptive analysis of the selected papers than on a statistical one [42]. The analysis of the selected papers, as in other studies, has been done by all the authors together and all the disagreements have been solved between the authors with group discussions [40]. After completing the selection activities, we started with the descriptive analysis of the papers content.

The process of providing AECPGs is quite long and complex. Figure 2 shows how policy, farms and social and ecological environment can influence the different phases of the implementation process of contract solution through policy measure.

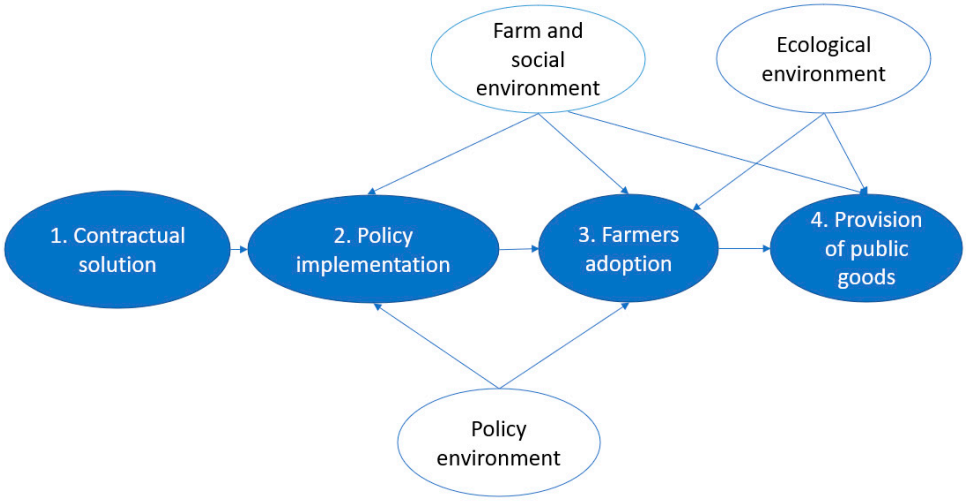

Figure 2. External and internal influences on the process of AEPGS provision by contract solutions.

Figure 2 focusses on the key phases of the policy cycle that can affect the provision of public goods. Phase 1 starts from the logic definition of a contract; in this phase, issues can arise with the definition of contract terms and conditions and with the dimension of the interested area. The contract duration, for example, represents a crucial definition point. From an ecological perspective, longer contracts are advantageous as they ensure that an area stays a suitable habitat for a longer time. Reversely, shorter contracts allow land owners to earlier reconsider their decision to participate in the scheme and switch back to the conventional (without AES practices) [44]. Factors such as the future availability of the land need to be considered in the contract duration and often a portfolio of different contract types allows the regulator to make the best choice for different cases and maximise environmental outcomes [45]. Phase 2 deals with how to transform the contract solutions in something practical, the selected instruments are utilized to create and implement the new policy process. Generally, farmers who already participated in AESs programmes are more prone to continue in further programming periods and request less compensation [46]. The policy environment is a relevant external factor which affects the definition of property rights and therefore the choice between sanctioning or incentivising the farmers' actions [47] or the farmers' acceptability of proposed solutions [48].

In phase 3, the new instrument is advertised, and farmers can start to agree and subscribe the contract. However, some problems related to the participation and the selection processes may arise. Institutions should pay special attention to the following questions: "Is the policy intended to be self-sustained or supplemented by general tax money? Do the landowners themselves select the conservation sites or the selection is made by the relevant authority?" Generally, landowners prefer external payments and can be prone to the self-sustained ones only if they are part of a voluntary environment scheme very common for the forest areas [49]. At the end of the policy implementation processes, the provision of public goods and the environmental protection can start. In the monitoring and outcome phases, the decision maker should put effort to control the farmers' adoption and compliance to commitments. Phase 4 is the result of interplay between efforts and ability of decision makers in controlling the ecological condition at farm and territorial scale [50].

Following the approach in Figure 2, selected articles concerning innovative contractual solutions were classified according to the three phases of the agri-environmental policy cycle: implementation of AESs, adoption mechanisms at farm level and outcome monitoring in terms of AECPGs provision. The results of this classification are presented in Table 1. Meanwhile, Table 2 shows the classification of contract solutions according to the type of external environment.

Table 1. Classification of retrieved papers based on policy cycle phases.

Contract Solutions	Implementation	Adoption Mechanisms	Monitoring and Outcome	Total Number
Action based	20	25	17	62
Result based	17	22	20	59
Collective actions	11	15	13	39
Total	48	62	50	

Table 2. Classification of retrieved papers based on type of external factors influencing AECPGs provision.

Contract Solutions	Policy Environment	Farm and Social Environment	Ecological Environment	Total Number
Action based	29	27	17	73
Result based	23	23	16	62
Collective actions	11	15	7	33
Total	63	65	40	

While results have been organised by presenting the literature review findings according to external factor typology, in the discussion section positive and negative aspects of the analysed contract solutions have been organised in the form of a SWOT analysis, which has been considered a robust approach to summarise findings [51]. Indeed, the SWOT analysis allows to clearly present all the information gathered in the literature review also with a visual approach that is helpful to better frame the different instruments. With the SWOT chart we laid out the weaknesses and strengths, threats, and opportunities of each kind of contract solution. This analysis allowed us to highlight the main positive and negative features of each contract solution considering the context in which it is implemented and to individuate the most suitable instruments.

3. Results

The following section introduces the main findings related to the type of external environments influencing AECPGs provision (Sections 3.1–3.3), and then describes the state of the art of innovative solutions and how they can contribute to overcome the problems related to information asymmetry (Section 3.4).

3.1. Policy Environment

Several factors affect the policy environment, which in turn influences several activities, from policy choice of the most appropriate contract type to the design and implementation of the selected contract. Asymmetric information is the key limiting factor to the effectiveness of environmental policies and make them expensive to run [24]. There are two types of asymmetries, i.e., hidden information and hidden actions, that depend on the relation between the principal and the agents and influence the results of contracts implementation. The hidden information problem occurs before the contract is implemented (ex-ante) and depends on the fact that farmers have private information about the participation costs that they do not reveal to the regulator. It follows the inability of the regulator to set up a proper level of payment (i.e. miscalculation) that leads in most cases to the problem of adverse selection causing an overcompensation for environmentally ineffective farmers and an under-compensation for the effective ones. Thus, the adverse selection is associated to the difficulties for the regulator to quantify the individual participation cost—which, in the action-oriented scheme, is usually measured in terms of foregone farming profit—and consequently select the most effective and efficient farmer [8]. Against this background, a low-cost farmer can benefit by participating as a high-cost one, receiving a high payment that includes an information rent (measured by the difference between the payment and participation cost) [52]. This overcompensation does not lead to higher environmental benefits, but according to the literature it reduces the cost-effectiveness of the entire programme [53]. Theoretically, the perfect AESs payment should remunerate the farmers only for the cost incurred to comply with the AECPGs provision contracts since the difference between payments and compliance costs, when positive, generates an economic surplus (over-compensation) for farmers but a deadweight loss for the programmes (i.e. social cost) [54], making policies inefficient. At the European level, this would result in giving high funding to countries that claimed low costs and low funding to countries with high costs; consequently, high-cost countries will not take part in the programmes because they would be under-compensated for their provision of AECPGs. On the other hand, the inclusion of overcompensated countries can mine both the effectiveness and efficiency of AESs, by causing costs with no environmental quality gains. The marginal cost of an environmental programme is one of the most important parameters in the optimal AESs design, since it represents a measure of the efficiency of the UE spending [55].

As we previously introduced, information asymmetry problems arise because individual farm types are not easily observed by the regulator [52]. The lack of information on the main local needs and environmental vulnerabilities can result in the absence or inadequacy of spatial targeting. Spatial information must be really accurate and forms an important part of the (regional) performance measurements; moreover, it determines the amount of payments [56]. This approach can represent a problem in strong egalitarian nations such as Norway, where differentiated payments based on different levels of benefits could be difficult to implement [57].

3.2. Farm and Social Environment

Inefficiency and ineffectiveness of AESs and related policy issues are in a nutshell a matter of farmers' behaviour and knowledge. In fact, strong and persistent positive associations between farmers' self-perceived ability (i.e., perceived behavioural control) and their intention to implement nature conservation practices have been found [58]. Farmers can be classified into four categories based on the acceptance of the EU environmental policies.

The first group includes farmers who put in practice voluntary environmental activities without any type of remuneration (voluntary custodians' activities). There are different opinions in the literature discussing the role of the schemes related to this type of mindset farmers. Studies of different disciplines such as social psychology and identity theory have been utilised to study how project participation affects farmers' motivations regarding the subsidised and unsubsidised nature conservation practices and the conservationist values [58]. For some researchers, the remuneration of good environmental practices can

discourage pro-environmental behaviours by farmers, since farmers not involved in the scheme may stop their voluntary activities in the absence of a good remuneration for them. Furthermore, some farmers can cause damage to the environment to receive remuneration for the consequent restoring actions, while the farmer who simply cares for his/her land would not receive any funding [59]. These opportunistic and hazardous behaviours can further discourage good pro-environmental farmers. The second type represents the farmers who are positively involved in the schemes and who trust the EU system and the related environmental practices. Generally, they care about climate and environmental issues, and they are effectively involved in the EU CAP measures. The third type includes the farmers who do not understand the importance of good agricultural practices (GAP) or who do not consider adequate the EU remuneration for those actions, and consequently, they do not participate in the agri-environmental schemes. The identification of farmers who show negative preferences for specific attributes would allow better targeting of design features among different groups of farmers and a partial reduction of the farmers reluctance to join AESs [60]. The last and more complex type refers to farmers who can understand the positive effect of practices and their remuneration. Still, they do not participate because of a lack of trust in the EU administration. This missed participation is the result of their idea about climate change, agricultural pollution, and the fairness of the EU policies. Several farmers asserted that a problem could be represented by biodiversity conservation projects run by "green-wavers" (i.e., dogmatic environmentalists with no real insight into the realities of rural communities) instead of persons who understand farmers' problems [58]. Intermediate situations between these categories are often present in most real-life settings. Some examples can be those of farmers not involved in AESs due to the amount of bureaucracy required and of farmers involved but characterised by moral hazard, cheating and other opportunistic behaviours.

Espinosa-Goded et al. (2013) underline that variables reflecting transactions costs, such as trust in institutions, trust in the AESs implementation, previous AESs experience, have strong effects on participation and adoption therefore acting as a participation barrier [48]. Some farmers participate only to cheat when the expected pay-off of cheating is greater than the (known) pay-off of the alternatives, i.e., compliance or non-participation [61]. These types of behaviour could be avoided if it is possible to implement an adequate and low-cost level of monitoring that can guarantee a good level of compliance and correct environmental actions [8]. However, AESs require complex administrative structures to acquire information and monitor the environmental effects of the AESs [62]. Monitoring activities should be tailored to measures, and sanctions must be proportionated to the risk of failure. In fact, when a mechanism of control and sanction is not well designed, the provision of environmental goods tends to be lower. While in cross-compliance measures the compliance is directly proportionate to monitoring intensity, this is not the case in AESs, because participation is voluntary and a stricter enforcement would result in a decreased level of participation [47].

Policy implementation problems, as one of the first phases, can play a crucial role in all the policy attributes, influencing efficiency, effectiveness, participation, and policy failures. In the past, the choice of wrong monitoring and control parameters (targeting, cost justification, efforts, etc.) or too high burden costs caused a lack of participation. Several papers have analysed and modelled the quantitative impacts of EU-reimbursement-related tasks on required time allocation for agricultural county administrations [56]. Higher educational levels and less bureaucracy from the government can reduce the transaction costs of contracting and make it easy to deal with AESs. The literature has highlighted the role of farms' size in affecting participation, especially in the area-related schemes, due to the level of transaction and compliance costs [63]. Small family farms have high difficulties to enter in some schemes due to high costs or lack of commitment to the scheme's rules. Participation costs can be a policy barrier insofar as they are too high with respect to the remuneration. Collective implementation contracts may be one of the major solutions thanks to the sharing of costs among participants [59].

3.3. Ecological Environment

The second type of asymmetry occurs when a contract has already started and refers to hidden actions (moral hazard), i.e. when a landowner adopts an inappropriate behaviour because he/she has an incentive to avoid fulfilling his/her contractual responsibilities [24], for example, participation in AESs with the high provision of public goods or where set-aside is related to high productivity land while ensuring a low provision of public goods or setting aside land with low productivity. In this way, he/she gets an overcompensation for his/her poor supply of environmental goods. Generally, moral hazard arises because monitoring cannot detect all those who fail to comply with contractual obligations; however, an adequate level of monitoring can solve the issue, but this causes an increase in the cost of the process [8]. In several cases, when cost abatement results in a low level of control, moral hazard problems arise, and the effectiveness collapses, being that farmers can cheat on both quality and quantity of the declared actions. The first-best solution would be represented by a perfect information level between principal and regulator [52]. This solution is rather theoretical i.e. impossible in practice or too costly for a real implementation. Therefore, agri-environmental policies can achieve only a second-best solution because the regulator cannot collect all the needed information. The optimal monitoring effort may be different for risk-averse farmers or risk-neutral farmers. The use of stochastic efficiency models when designing AESs may allow policy makers to find incentive-compatible constraints; this is usually possible only when the general class of risk aversion of farmers is known and the quota for both the risk categories is comparable [64]. The ability of compliance and monitoring to effectively resolve the moral hazard problem is measured by the convergence between the second-best solution and the first-best solutions. It has been shown that the convergence is determined by: (a) the degree of risk aversion displayed by farmers and, (b) the cost structure of the monitoring process [8]. Besides this, a poor targeting or lack of incentive aiming at a proper agglomeration level can reduce the contract ability to reach the minimum ecological threshold required to trigger an adequate provision of environmental benefits [65].

3.4. Innovative Solutions

The literature provides several solutions to avoid policy failures and propose discriminatory payment systems or new selection mechanisms. Figure 3 shows how innovative contract solutions and innovative information uptake mechanisms can partially solve the asymmetry problems in the critical points of the policy loop.

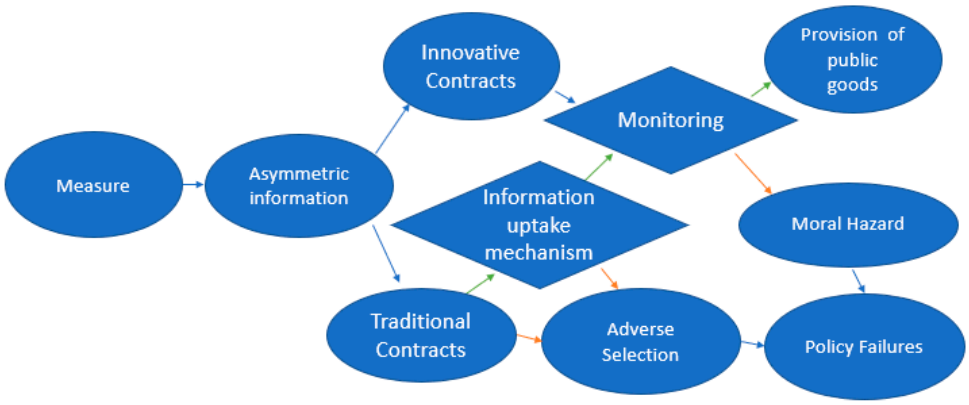

Figure 3. Innovative solutions in the public goods provision process.

The asymmetric information can affect the policy loop in several steps as well as changing preferences between traditional contracts (action-based) and innovative ones (result-based and collective). Policies maintaining a traditional approach in the presence of information asymmetries can be ineffective if adverse selection occurs, while they can improve their results if innovative information uptake mechanisms are utilised. When

information uptake is too costly, innovative contracts may face this problem by a good level of monitoring. Figure 3 shows the pivotal role of monitoring in contrasting moral hazard and promoting the effectiveness of the AESs. However, this per se is not a solution since the level of monitoring can influence farmers' strategic behaviour only: (a) when decision-makers can develop effective indicators/proxies of the environmental impacts; (b) when decision-makers value public goods on the basis of society's willingness to pay for them; and (c) when the monitoring activity is not too costly. Plenty of literature is looking to adapt innovative environmental indicators using new available data (i.e., remote sensing) or new digital tools (i.e., artificial intelligence). Therefore, if the level of monitoring is not adequate to prevent the moral hazard from the farmers, a policy could fail both in the case of traditional and innovative contracts. The application of new information uptake methods to action-based contracts can raise the regulator information level, thus detecting cheating farmers, improving the efficiency of payments, and avoiding adverse selection issues. Problems of moral hazard can be related to wrong monitoring levels after contract implementation. Innovative contracts remuneration is not based on measuring the costs associated with AESs actions, and information asymmetries cannot rise if farmers are paid following their environmental results.

Several actions can play a crucial role against information asymmetries problems, improving the effectiveness and efficiency of the AESs. Some studies tried to model the two types of information asymmetry by analysing the effects of monitoring level, the area involved and the level of penalties [22,52,66,67].

The self-revelation mechanism, for example, refers to a series of actions in which farmers autonomously reveal their hidden information. With this system, the transaction costs can be avoided by designing contracts in which different types of farmers self-select appropriate contracts from a "menu". Using this method, the regulator can easily detect the amount of costs borne by each farmer for complying with that measure [52]. These instruments can include screening contracts or standard contracts. In the first type, the responsible authority offers different contracts intended for different types of farmers and then each actor can choose the right type for him/herself [46]. In this process the regulator can improve the uptake of information, learning from farmers' decisions. In the second one there is only a type of contract, and the actors can decide whether to subscribe or not the AESs. In the case of screening contracts, it is more difficult to find the right types of instruments for the selection process. However, they can be more efficient to improve the information uptake and, consequently, the efficiency of the related payments. Usually, differentiated instruments perform better; indeed, greater complexity of the menu of contracts may be justified in areas with more heterogeneous agricultural systems. On the other hand, fixed payments remain the best solution in relatively homogeneous areas, where the increase of the transaction costs could not be compensated by the increase of the effectiveness of the differentiated scheme [6].

The auction mechanism represents the second instrument against asymmetric information. With auctions, AESs contracts are awarded through a competitive bidding mechanism, in which farmers are expected to have higher incentives to reveal their true compliance costs [68]. This instrument can make the provision of environmental services cheaper; however, it cannot improve the effectiveness of environmental actions [69]. Between the several types of auction, the target-constrained type is the most studied, while the budget-constrained has to be improved both in theory and practice [23]. Auction mechanisms are used as a research tool to induce landowners to reveal their private information, which can then be used "against them"; this has ethical implications that have not been explored yet [24]. In fact, price discrimination is often considered unfair by policy-makers and farmers, making auctions hardly applied in Europe [46]. How well such targeted auctions preserve an auction's rent-reducing powers is an empirical issue that needs to be tested through laboratory and computational experiments.

The decision to differentiate payments rather than to use a uniform posted-price system typically determines greater transaction costs. This negative aspect could be common

in low-income countries, where auctions often involve semi-literate and poor farmers [24]. In this case, transaction costs are strongly justified because they can significantly improve several aspects of an AES (remuneration, efficiency, effectiveness). The regulator, should try to use different instruments, e.g., auctions, screening contracts, etc., to maximise the services obtained from its limited budget. Another possibility to increase effectiveness under such circumstances is to use "compliance rewards", i.e., payments made to farmers who, when inspected, are found to follow the terms of a scheme. For example, if the costs of monitoring and enforcement per farmer are high regarding the received payment, reducing monitoring effort to fund compliance rewards improve effectiveness [53]. Investing in mechanisms to reduce informational rents is more important than, for example, investing in methods to measure ecosystem services themselves [24]. With a reduction of informational rents, we can significantly increase the effectiveness of the ecosystem services provision, which has been poor and inefficient in recent periods. In fact, whereas we could find no examples of screening conservation contracts, several well-known auctions for conservation contracts do exist [24]. The situation remains probably unchanged with a focussed interest on auction utilisation. However, the self-selection mechanisms could have strong positive effects in the future of AECPGs' schemes. The scientific debate tried to move from inputs-based payments to outputs-based because this would encourage landowners to innovate and supply services at a lower cost [24]. Today there is a challenge between inputs and outputs payments because the second type can increase the impact of AESs, which the Court of Auditors has proved to be currently ineffective and optimise the CAP expenditure.

4. Discussion

In this section, we propose a comparative analysis of the main features of action-based, result-based and collective action contracts [70]. To each contract type is dedicated a subsection where also based on the above analysis about causes of policy failure and how they can be faced and overcome, we present a SWOT analysis of action-based contracts (Figure 4), result-based contracts (Figure 5) and collective contracts (Figure 6).

Main Strengths	**Main Weaknesses**
• High farmers' acceptability and participation due to low risk	• Low effectiveness and efficiency of the payments due to information asymmetries and hidden actions
Main Opportunities	**Main Threats**
• Optimal in situations where it is difficult to find proper indicators • Compliance with WTO rules	• Moral hazard problems due to an inadequate level of monitoring

Figure 4. Action-Based Approach SWOT analysis.

4.1. Action-Based Approach

In the past, the action-based approach has dominated the regulation of AECPGs' provision; however, its performances have been poor in the effective provision of ecosystems' goods such as biodiversity protection and climate change fighting (Figure 4).

Main Strengths	Main Weaknesses
• High effectiveness and efficiency of payments also in case of information asymmetries	• Difficulties in finding proper result indicators
Main Opportunities	**Main Threats**
• Social capital building due to an improved farmers' knowledge • Low monitoring costs for lower problems of moral hazard, adverse selection, etc.	• Low participation of risk adverse farmers, concerned with external factors • Problems of compliance with WTO rules • Results influenced by external factors, such as weather and market instability

Figure 5. Result-Based Approach SWOT analysis.

Main Strengths	Main Weaknesses
• Reduced transaction costs thanks to economy of scale • Improved ecological effectiveness • Increased participation rates • Chance of sharing risks, knowledge, aspirations, decision responsibility, etc. • Lower monitoring costs due to mutual collective monitoring • Lower asymmetric information problems caused by moral hazard due to the willingness to preserve reputation	• Additional costs to co-ordinate group actions
Main Opportunities	**Main Threats**
• Collective raising of knowledge • Peer pressure reputation • Higher external participation due to lower costs • Creation and sharing of social capital • Better provision of emergency actions in difficult periods through collective actions	• Difficulty in individuating the optimal group size • Construction of groups of like-minded people • Difficulty in finding a proper leader

Figure 6. Collective Implementation SWOT analysis.

The action-based approach presents less risk than the result-based approach for both the regulator, who knows beforehand the remuneration price and farmers who have a secured remuneration [21]. In fact, action-based payments are not influenced by market prices and other external factors, such as weather. However, several problems can undermine Action-based AESs' efficiency and effectiveness, e.g., difficulties in the information uptake about the cost incurred by farmers, information asymmetries and moral hazard problems [71]. Although different farmers may bear very different costs based on farm sizes and mechanisation, every farmer will receive the same amount of money for the same action. The lack of payment differentiation can lead to an inefficient use of public resources [71]. On the other hand, in the case of result-based AESs, it could be very difficult to find the right indicators for particular types of custodians' activities, and in these cases, the input-based approach would be a good solution [29]. Furthermore, the WTO agreements put a lot of pressure on the EU institutions to keep the world trade

markets free and protect the globalised world. As a consequence, environmental payments can be accepted only as green-box measures without trade distorting effects [69]. The action-based system complies with all the WTO rules [72] because it is not interpreted as a prohibitionist limitation between countries. The action-based instruments as a tool for environmental protection present important issues and few advantages and have shown poor cost-effectiveness and efficiency. Indeed, a study of the Wales areas declares that current AESs (action-based) are more effective at delivering income support to ensure community and cultural cohesion than at delivering ecosystem services [73].

For several AESs, the action-based approach was extremely successful because acceptance and adoption were two of the most utilised indicators of the effectiveness of the schemes. When monitoring level and environmental background are inadequate, it would be complex to control results and it is easier to monitor farmers' respect of an AES that requires them to perform actions regardless of the results. However, while from the participation point of view, these schemes have been optimal, they were not able to ensure the provision of any important outcomes in terms of environmental protection, climate change fighting, etc. [29]. Some researchers suggested that action-oriented schemes should promote long-term attitudinal and cultural change, but there is no evidence that these mechanisms can cause these improvements [29]. Although about twenty years ago Latacz-Lohmann et al. underlined that we lacked any feasible alternative to the action-based system of payments [72], today the situation has improved, and we can rely on several innovative alternatives, e.g., the ones described in the following sub-sections.

4.2. Result-Based Approach

The output-based approach dominates the scientific literature as one of the most suitable solutions to improve the provision of AECPGs and strongly optimise the EU public spending (Figure 5). In this mechanism, the ecosystem services are treated as real market goods, hypothesising that there is a market price for every AECPGs provided [74].

Since the first studies, result-based instruments showed strong effectiveness in terms of environment protection and efficiency of the payment for beneficial actions [71]. Obviously, it is easier and more effective to remunerate with a proper quantity of money when measuring achieved results rather than when paying for actions regardless of the real improvement they can produce. A true measure of results can guarantee a better targeting of the final goods remuneration, which are treated as market goods with their own prices [29]. In contrast with the action-based strength, for which it is simple to find the right action to pay, in the result-based approach, it could be very difficult to find the right indicators and to quantify a proper payment [29]. The effectiveness of these schemes is strongly influenced by choice of indicators. With optimal indicators, the regulator will be able to save money and respect the differences existing among farms, with bad indicators, the efficiency falls. To be good, an indicator needs to have the following features: to be measurable and identifiable, to not conflict with agricultural goals, to be consistent with ecological goals, and to reflect the effort of participating farmers [29]. Policies should face the challenge of quantifying indicators starting from situations where results are easily measurable, rather than changing the entire system to result-oriented from the beginning [75].

The result-based contract is directly linked to the desired environmental objectives and allows farmers to choose on their own the most efficient way of management to reach these objectives [74]. Monitoring tools have an educational value by making apparent the causational links between land management practice and environmental quality [1]. Often, farmers self-monitor results to improve their chances of reaching targets. As a result, farmers can create new knowledge and invest in keeping the cost of provision as low as possible, raising the profit from the payment. Indeed, one of the result-based opportunities is creating farmers' new knowledge and social capital building. This can enhance farm efficiency and the effectiveness of environmental actions. Output-based payments encourage land managers to use gathered information to innovate and cost-effectively produce ES outputs [19,76]. Some experiments confirm that payments by results

can produce decentralised incentives for land managers that use their private knowledge and skills to produce biodiversity services; consequently, farmers participate in biodiversity schemes sure of their provision of the targeted quantity of goods [29,75]. Matzdorf et al. 2008 maintain that there are three positive effects in the result-based approach: (a) when removing managerial restrictions, farmers are stimulated to innovate in environmental provision; (b) regulations are considered likely to increase the adoption of any scheme, and; (c) when farmers are paid according to outcomes, there is an incentive to use the land that will produce the best environmental results [77]. Farmers must have knowledge regarding the species and the landscape because they have to self-monitor their results, and an under-target provision of goods would result in a totally missed remuneration for actions that have already been done. Furthermore, from an external point of view, these mechanisms need lower monitoring costs by the regulator for the control and make it easy to achieve low level of moral hazard and asymmetries [29]. Indeed, a price-based contract that pays based on the value of the ES output is attractive in terms of its administrative requirements as it only requires output monitoring [19].

Unfortunately, payments based on output are strongly influenced by external factors such as market prices and weather conditions [21]. The influence of external factors can nullify all the farmers' efforts, and mine the remuneration payment just before the measurement of the outcomes. Payments on results can be influenced also by internal factors related to the area, such as agronomic variables, e.g., single species or multiple species grazings differ in their results on grass and biodiversity, and by social variables, for example common versus private property and individual versus collective [78]. These critical points introduce another issue related to the participation of risk-averse farmers, who will be less willing to participate in an AES affected by factors that can modify the level of remuneration and are outside farmers' control [21]. Several surveys tested farmers' willingness to participate in AESs under different remuneration types [76,79]. Based on the survey of Matzdorf et al. (2010), previous experiences are a very relevant factor, insofar as a high share of farmers (almost 80%) are willing to continue the participation in result-based AESs, at least with the same area involved [74].

WTO represents an important issue for the result-based approach evolution. In fact, WTO accuses this new instrument to be trade distorting and correcting. This limits the possibility of a government to create high level of result-oriented measures [29]. While a less strict interpretation of WTO agreements could be a solution, this must be discussed at global level by WTO leaders and the states involved.

The difference in indicators validity between different areas of the same territory represents another issue since it is difficult to explain to farmers why certain plant species are irrelevant for remuneration on their sites, while they are eligible for payments only a few kilometres away [77].

However, there are several practical examples of result-based AESs that confirm all the positive effects of the outcome-based approach in comparison with the action-based approach [74].

4.3. Collective Implementation

The collective implementation represents a totally different approach (Figure 6). A group of farmers and stakeholders with common ideas is involved to maintain and improve the environmental situation of an area. This type of scheme enables regulators to interact with a group of people rather than to a multiplicity of single farmers. This cooperative organisation results in a higher effectiveness due to an easier administration process.

The scientific literature regarding the application of the collective implementation to agricultural no-point source pollution is still poor; however, there are several studies related to biodiversity improvement employing collective, rather than individual, subsidies and penalties [32]. Indeed, the collective implementation is generally more effective in the biodiversity provision, and this is important when considering the court of auditor's criticisms about recent results [2]. Collective contracts represent one of the most suitable

solutions for the future improvement of the agri-environmental schemes' effectiveness and efficiency.

The transactions' costs abatement is one of the major effects in respect to other solutions. In fact, the bureaucracy, participation and administration costs fall down because they are shared among the farmers involved in the group [59]. Often, farm size can limit participation in the EU AESs because costs are a barrier to the entrance when the scale is too small. Farmers who did not participate in the AESs due to the high level of costs can participate with the collective implementation. With better participation, it is possible to guarantee more protected areas. A collective bonus should be paid to increase the willingness of the farmers to work as a group rather than as single farms, based on the better environmental effects. This monetary bonus is paid in addition to the agri-environmental scheme funding if a certain adoption threshold is reached. This premium increases farmers' expectations about others' participation [80]. Financial incentives alone are not always sufficient to secure collaborative agreements. Alternative approaches are needed to build social capital and create the partnerships necessary to deliver ecosystem services at this scale [81]. Collective regulatory incentives play a key role to solve the lack of local sharing of the results and the reluctance to participate in the collective schemes created by individualised protection activities [32].

The cooperative implementation can overcome some issues, also in areas characterised by the presence of small farm realities, improving the participation rates. Hodge et al. (2000) sustain the need of collective implementation in large-area policies because the scale of restoration and the environmental benefits ratio can truly improve [82]. Obviously, a good communication level and the inclusion of management institutions in the collective group are really important to spread the participation to the neighbour farmers [82]. Collective implementation is usually important in all cases where proper management of surrounding areas is necessary to achieve targets for a protected area. In several realities, there are groups of farmers gathered in cooperatives that participate together in the AESs. Environmental Cooperatives do not explicitly aim at exerting group pressure on their members to participate in more AESs; they merely play a facilitating role [83]. Regional cooperatives have an added value in enhancing farmers' intention and willingness to participate in AESs [83].

Collective AESs can also help risk-averse farmers to overcome their doubts. In fact, with this instrument, the risks, the costs, the decision responsibilities, and the objectives can be shared among all the participants. At the same time, the sharing of knowledge among farmers will be very important and can improve the overall level of agricultural practices in an area [59]. Thanks to the creation of new collective knowledge, all the realities of an area can take advantage from this rural network also if they are not strictly agricultural ones (tourism, shops, etc.). Information asymmetries problems can be partially solved thanks to the mutual monitoring between the participants in the group. The moral hazard problem can be solved because the farmers involved want to preserve their reputation in the group and this overcomes all the cheating activities (self-monitoring preserving the reputation) [59]. However, the costs to manage and coordinate group actions at a collective level could rise, but the pressure is also shared between the participants [59]. The collective rise of knowledge could also be spread to realities outside the consortium, creating a social capital important to improve the whole rural area. The increase of social capital lowers the cost of monitoring behaviours and induces compliance with the community rules [84]. The collective process could also stimulate collective thinking amongst local farmers about the potential for defining and marketing local brands of farm products [20]. An improved organisation and a high number of custodians of the territories would make it simple to provide effective emergency actions in difficult periods such as drought, landslide or flooding events (collective actions) [59].

Negative external-influenced aspects can be related to the construction of like-minded people groups. In fact, in the past, being closely connected with AESs contracts was considered as antithetical to good farming; this acted as a barrier to collective participation.

A general solution would not function for all the areas because every environment is the result of a complex historical process of evolution [1,31]. Obviously, if there are people with common interests and objectives, it would be easier to achieve common goals. In some cases, it could be difficult to find the right size of a group [59]. In general, we can think that the more farmers are involved in an AES, and the higher is the provision of AECPGs. This is not right because there are several optimisations and moral hazard problems due to negative human relationships among the participants. These problems can mine the collective trust and the mutual monitoring. A great challenge is the identification of a leader who can motivate and enhance ideas, running the collectivity in the best way and guaranteeing the best provision of AECPGs [59]. Another threat to the correct adoption of large-area collective instruments could be a scale mismatch between the policy level and the collective fields level. Collective actions among resource managers is a key element to overcome socio-economic scale mismatches and it is an important institutional requirement for the implementation of the financial compensation arrangement [33].

There is an interest to link the collective implementation to the result-based instrument to strongly improve the efficiency of payment quantification. Further research is required to study the influence of the payment-by-results approach on farmers' motivation and how this changes in collective AESs [83]. The co-management (cooperation between conservation groups, private owners, state and local agencies) of the resources would solve several issues in the AESs where wider coordination of decisions is needed (water management, biodiversity action plans, common land management, achievement of biodiversity conservation threshold, etc.) and can facilitate the creation of a context for the potential development of collective agri-environment contracts [20].

The above description of the features of the three main contract solution highlight how it is not possible to find an approach that is suitable to every situation and can be implemented in any case. For example, due to WTO issues, result-based approaches could be applied in the case of natural landscape or biodiversity protection, but not in cases where there is an impact on markets. Sometimes, good results can be reached only by combining more than a contract typology. In this framework, it is paramount that decision-makers have a rich toolbox from which it is possible to select one of more instruments, considering both the specificity of the AECPGs to be provided and the specificity of the context where it is provided. From this point of view, further research on additional contract solutions (e.g., value chain and land tenure) may contribute to enrich the endowment of possible instruments, although we have not analysed them due to the scarcity of literature.

5. Conclusions

EU funding did not usually reach a good level of effectiveness as regards environmental protection when using action-based approaches. Indeed, while action-oriented approaches continue to dominate the AESs, their ineffectiveness has been clearly demonstrated in the literature. Consequently, literature regarding contract implementation is mainly concerned on how to find the best remuneration type between action-based and other types of payments to achieve a good level of environmental protection. However, innovative methods to improve the uptake of information can be applied to the present action-based mechanisms (self-revelation, auction, screening contracts) and can be very helpful in reflecting the differences among the farmers in the payments.

In this framework, results-based and collective contracts represent the most concrete solutions that could be implemented in the new regulation for improving the provision of public goods. A right level of monitoring is very difficult to be individuated, but it can match the information levels and encourage farmers and regulators to maintain fair behaviours.

While innovative solutions seem to be able to improve current situation, it is not possible to find a contract solution that is suitable for all public goods produced by agriculture and all the contexts in which they are produced.

Result-based schemes might be more efficient to optimise biodiversity and landscape improvements and to better target farmers payments and information. However, the literature highlights the difficulties to find the best indicators. Indeed, identifying the right indicators for complex biodiversity and landscape conservation AESs in case of result-based instruments represents a challenge for both present and future researchers. In result-based schemes, a complete understanding of farmers' goals becomes very important. When applying result-based instruments, farmers may autonomously choose the best innovative actions to reach the goals at the lowest cost; nevertheless, the total risk of missing the AESs targets and payments is sustained by them. Consequently, if farmers do not understand completely the objectives and the actions to be carried out to reach them, they cannot achieve the stated results, and the scheme would fail. Thus, a strongly result-based method leaves all the responsibilities to the farmers, and the regulator does not care about individuating and promoting the more effective actions. In the case of collective implementation, the regulator helps farmers to take the best actions to make it easier to achieve the results and, therefore, payment and risk are partially shared between regulator and farmers. This makes collective approaches more suitable for risk-averse and scarcely innovative farmers.

With collective-implementation AESs, the participants can share transaction costs, risks, and knowledge. This sharing can strongly facilitate small farms to be involved in the protection schemes. Based on the results of our review, a movement towards result-based or collective approaches focussing on environmental policies is needed on the European level. These new targeted strategies can contrast environmental problems, such as climate change, with better mitigation and adaptation actions.

Recently, some authors have started to analyse new mixed approaches that can involve the action-based approach together with the result-based and can represent one of the most important innovative solutions for the future. In fact, they can allow to have the strengths of the action-based and result-based methods while avoiding the main related weaknesses. A mixed approach involving a result-based approach together with a collective implementation of the AESs is still scarcely studied in the literature, but it would be greatly helpful for the future. All these solutions are important in the policy debate because they can optimise the EU public spending. Reaching enhanced environment protection by using low funding would enhance the policy consensus in the European institutions. Besides this, an improved provision of AECPGs obtained by a lower percentage of public spending can create a virtuous circle that can spread both farmers' willingness to participate in AESs and people's environmental awareness.

In the future, policies should increasingly represent and resolve the heterogeneities of the areas to better exploit payments. In this case, according to the present analysis, policy makers might gather more information to improve and test the effectiveness of their instruments, farmers might have more tailored instruments that can increase their willingness to participate in the AESs thanks to a secure and right remuneration of their activities, and EU citizens might enjoy the positive effects of the AECPGs and increase their trust in the EU and awareness of the public spending. The EU can easily motivate its spending and can maintain the environment in good condition with a raised effectiveness never reached before. Based on our results, this can be possible only if a mix of effective instruments will be available insofar as they allow summing different positive characteristics, e.g., the easy quantification of the result-based approaches with the collective spreading of the AESs. These instruments should be designed at the European level, but they must be adaptable to the single realities. Policy implementation problems, like the one related to the identification of optimal indicators for result-based approaches, size for collective actions, and monitoring, must be solved before such promising instruments could be successfully implemented in practice. With this systematic literature review, the authors wanted to provide a state of the art of knowledge about the main environmental contracts, information uptake mechanisms and information asymmetries in the policy process. Other scientists or interested persons can exploit this summary of the current scientific findings

to start their research in a quicker and easier way. Indeed, further research is needed to better clarify the different effects and applicability of innovative instruments during the policy implementation process and to improve the action-based approach that currently remains the most utilised in the EU AESs, despite its ineffectiveness.

Besides this, there are several contracts that have not yet been adequately studied, such as land tenure contracts and value chain solutions for environmental protection, and that can become important instruments. Surely, other solutions can be discovered and/or adapted to the AECPGs measures through further research. Better policies and increased awareness about environmental problems can be crucial to improve the climate scenario and to reach the results already fixed by the new European strategies more easily (Green Deal and CAP 2021–2027).

The main limitations of this study are principally related to the research activities and to the paper analysis. In our research, we excluded all the "grey" literature, book chapters and non-scientific articles.. In fact, as already stressed in the introduction section, our research was only related to articles published in indexed peer-reviewed scientific journals. As exceptions, we cited several documents and reports from the European Commission because they are constantly updated, and they have been useful in clarifying certain topics. We did not exclude case studies outside Europe in our review, albeit the results can be more tailored to Europe because a good percentage of the included papers analysed European CAP case studies. The results can be upscaled to a global level by generalising the characteristics (strengths and weaknesses) of the contracts. However, they should be applied and adapted respecting, when implementing contracts, the heterogeneities of the different realities. Another limitation is related to the results of the review process in terms of a summary of findings of previous research. The authors selected and analysed literature based on the analysis of papers' content, and this process was more subjective than the creation of the database by PRISMA approach. Due to availability and readability limits, it was not possible to consider all the papers without an automatic processing. Consequently, all the papers deemed not important for the topic based on the analysis of title, abstract and full text were excluded by the authors. Although this increased the subjectivity of the systematic review, it allowed the authors to present a more complex and articulated analysis than with the processing of coded information would have been allowed.

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References

1. Valentine, I.; Hurley, E.; Reid, J.; Allen, W. Principles and processes for effecting change in environmental management in New Zealand. *J. Environ. Manage* **2007**, *82*, 311–318. [CrossRef]
2. European Commission. The post-2020 common agricultural policy: Environmental benefits what the future CAP will bring to the table. *Agric. Rural Dev.* **2019**, *19*. Available online: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiUhM-Jr5_xAhWK26QKHWFmC3EQFnoECAYQAA&url=https%3A%2F%2Fec.europa.eu%2Finfo%2Fsites%2Fdefault%2Ffiles%2Ffood-farming-fisheries%2Fkey_policies%2Fdocuments%2Fcap-post-2020-environ-benefits-simplification_en.pdf&usg=AOvVaw3GfXdDbF1uw-tEyOiylMH9 (accessed on 20 June 2021).
3. European Commission. *How the Future CAP will Contribute to the EU Green Deal*; European Commission: Brussels, Belgium, 2020; p. 2.
4. EEA. *Agriculture and the Green Economy*; European Environment Agency: Brussels, Belgium, 2012; pp. 1–10.
5. Armsworth, P.R.; Acs, S.; Dallimer, M.; Gaston, K.J.; Hanley, N.; Wilson, P. The cost of policy simplification in conservation incentive programs. *Ecol. Lett.* **2012**, *15*, 406–414. [CrossRef] [PubMed]
6. Bartolini, F.; Gallerani, V.; Raggi, M.; Viaggi, D. Implementing the water framework directive: Contract design and the cost of measures to reduce nitrogen pollution from agriculture. *Environ. Manage.* **2007**, *40*, 567–577. [CrossRef] [PubMed]
7. Bartolini, F.; Vergamini, D.; Longhitano, D.; Povellato, A. Do differential payments for agri-environment schemes affect the environmental benefits? A case study in the North-Eastern Italy. *Land Use Policy* **2020**, *107*, 104862. [CrossRef]
8. Ozanne, A. Moral hazard, risk aversion and compliance monitoring in agri-environmental policy. *Eur. Rev. Agric. Econ.* **2001**, *28*, 329–348. [CrossRef]
9. Kleijn, D.; Berendse, F.; Smit, R.; Gilissen, N.; Smit, J.; Brak, B.; Groeneveld, R. Ecological effectiveness of agri-environment schemes in different agricultural landscapes in The Netherlands. *Conserv. Biol.* **2004**, *18*, 775–786. [CrossRef]
10. Bateman, I.J.; Balmford, B. Public funding for public goods: A post-Brexit perspective on principles for agricultural policy. *Land Use Policy* **2018**, *79*, 293–300. [CrossRef]
11. Saxby, H.; Gkartzios, M.; Scott, K. 'Farming on the Edge': Wellbeing and Participation in Agri-Environmental Schemes. *Sociol. Rural* **2018**, *58*, 392–411. [CrossRef]
12. Batáry, P.; Dicks, L.V.; Kleijn, D.; Sutherland, W.J. The role of agri-environment schemes in conservation and environmental management. *Conserv. Biol.* **2015**, *29*, 1006–1016. [CrossRef]
13. Derissen, S.; Latacz-Lohmann, U. What are PES? A review of definitions and an extension. *Ecosyst. Serv.* **2013**, *6*, 12–15. [CrossRef]
14. Van de Sand, I.; Mwangi, J.K.; Namirembe, S. Can payments for ecosystem services contribute to adaptation to climate change? Insights from a watershed in Kenya. *Ecol. Soc.* **2014**, *19*, 47. [CrossRef]
15. Matthews, A. *Coronavirus Uncertainty as CAP Decisions are Postponed*. 2020, pp. 1–5. Available online: http://capreform.eu/coronavirus-uncertainty-as-cap-decisions-are-postponed/ (accessed on 20 June 2021).
16. Defrancesco, E.; Gatto, P.; Mozzato, D. To leave or not to leave? Understanding determinants of farmers' choices to remain in or abandon agri-environmental schemes. *Land Use Policy* **2018**, *76*, 460–470. [CrossRef]
17. Akram, N.; Akram, M.W.; Wang, H.; Mehmood, A. Does land tenure systems affect sustainable agricultural development? *Sustainability* **2019**, *11*, 3925. [CrossRef]
18. Schöttker, O.; Wätzold, F. Buy or lease land? Cost-effective conservation of an oligotrophic lake in a Natura 2000 area. *Biodivers. Conserv.* **2018**, *27*, 1327–1345. [CrossRef]
19. White, B.; Hanley, N. Should We Pay for Ecosystem Service Outputs, Inputs or Both? *Environ. Resour. Econ.* **2016**, *63*, 765–787. [CrossRef]
20. Hodge, I. The governance of rural land in a liberalised world. *J. Agric. Econ.* **2007**, *58*, 409–432. [CrossRef]
21. Derissen, S.; Quaas, M.F. Combining performance-based and action-based payments to provide environmental goods under uncertainty. *Ecol. Econ.* **2013**, *85*, 77–84. [CrossRef]
22. Ozanne, A.; White, B. Hidden action, risk aversion and variable fines in agri-environmental schemes. *Aust. J. Agric. Resour. Econ.* **2008**, *52*, 203–212. [CrossRef]
23. Schilizzi, S.; Latacz-Lohmann, U. Conservation tenders: Linking theory and experiments for policy assessment. *Aust. J. Agric. Resour. Econ.* **2013**, *57*, 15–37. [CrossRef]
24. Ferraro, P.J. Asymmetric information and contract design for payments for environmental services. *Ecol. Econ.* **2008**, *65*, 810–821. [CrossRef]
25. Latacz-Lohmann, U.; van der Hamsvoort, C. Auctioning Conservation Contracts: A Theoretical Analysis and an Application. *Am. J. Agric. Econ.* **1997**, *79*, 407. [CrossRef]
26. Connor, J.D.; Ward, J.R.; Bryan, B. Exploring the cost effectiveness of land conservation auctions and payment policies. *Aust. J. Agric. Resour. Econ.* **2008**, *52*, 303–319. [CrossRef]
27. Glebe, T.W. Scoring two-dimensional bids: How cost-effective are agri-environmental auctions? *Eur. Rev. Agric. Econ.* **2008**, *35*, 143–165. [CrossRef]
28. Vergamini, D.; Viaggi, D.; Raggi, M. Evaluating the Potential Contribution of Multi-Attribute Auctions to Achieve Agri-Environmental Targets and Efficient Payment Design. *Ecol. Econ.* **2020**, *176*, 106756. [CrossRef]
29. Burton, R.J.F.; Schwarz, G. Result-oriented agri-environmental schemes in Europe and their potential for promoting behavioural change. *Land Use Policy* **2013**, *30*, 628–641. [CrossRef]

30. Russi, D.; Margue, H.; Oppermann, R.; Keenleyside, C. Result-based agri-environment measures: Market-based instruments, incentives or rewards? The case of Baden-Württemberg. *Land Use Policy* **2016**, *54*, 69–77. [CrossRef]
31. Riley, M.; Sangster, H.; Smith, H.; Chiverrell, R.; Boyle, J. Will farmers work together for conservation? The potential limits of farmers' cooperation in agri-environment measures. *Land Use Policy* **2018**, *70*, 635–646. [CrossRef]
32. Yoder, L. Compelling collective action: Does a shared pollution cap incentivize farmer cooperation to restore water quality? *Int. J. Commons* **2019**, *13*, 378–399. [CrossRef]
33. Carmona-Torres, C.; Parra-López, C.; Groot, J.C.J.; Rossing, W.A.H. Collective action for multi-scale environmental management: Achieving landscape policy objectives through cooperation of local resource managers. *Landsc. Urban Plan.* **2011**, *103*, 24–33. [CrossRef]
34. Tranfield, D.; Denyer, D.; Smart, P. Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *Br. J. Manag.* **2003**, *14*, 207–222. [CrossRef]
35. Farias, L.M.S.; Santos, L.C.; Gohr, C.F.; de Oliveira, L.C.; Amorim, M.H.d. Criteria and practices for lean and green performance assessment: Systematic review and conceptual framework. *J. Clean. Prod.* **2019**, *218*, 746–762. [CrossRef]
36. Thomé, K.M.; Cappellesso, G.; Ramos, E.L.A.; Duarte, S.C.d. Food Supply Chains and Short Food Supply Chains: Coexistence conceptual framework. *J. Clean. Prod.* **2021**, *278*, 123207. [CrossRef]
37. Bugge, M.M.; Hansen, T.; Klitkou, A. What is the bioeconomy? A review of the literature. *Sustainability* **2016**, *8*, 691. [CrossRef]
38. Kanger, L.; Sovacool, B.K.; Noorkõiv, M. Six policy intervention points for sustainability transitions: A conceptual framework and a systematic literature review. *Res. Policy* **2020**, *49*, 104072. [CrossRef]
39. Maesano, G.; di Vita, G.; Chinnici, G.; Pappalardo, G.; D'amico, M. The role of credence attributes in consumer choices of sustainable fish products: A review. *Sustainability* **2020**, *12*, 10008. [CrossRef]
40. González-Rubio, J.; Navarro-López, C.; López-Nájera, E.; López-Nájera, A.; Jiménez-Díaz, L.; Navarro-López, J.D.; Nájera, A. A systematic review and meta-analysis of hospitalised current smokers and COVID-19. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7394. [CrossRef]
41. Maesano, G.; Vita, D.; Amico, D.; Chinnici, G.; Pappalardo, G.; D'Amico, M. What's in organic wine consumer mind? A review on purchasing drivers of organic wines. *Wine Econ. Policy* **2021**, 1–35, just accepted. [CrossRef]
42. Golbabaei, F.; Yigitcanlar, T.; Paz, A.; Bunker, J. Individual predictors of autonomous vehicle public acceptance and intention to use: A systematic review of the literature. *J. Open Innov. Technol. Mark. Complex.* **2020**, *6*, 106. [CrossRef]
43. Leonidou, E.; Christofi, M.; Vrontis, D.; Thrassou, A. An integrative framework of stakeholder engagement for innovation management and entrepreneurship development. *J. Bus. Res.* **2020**, *119*, 245–258. [CrossRef]
44. Drechsler, M.; Johst, K.; Wätzold, F. The cost-effective length of contracts for payments to compensate land owners for biodiversity conservation measures. *Biol. Conserv.* **2017**, *207*, 72–79. [CrossRef]
45. Lennox, G.D.; Armsworth, P.R. Suitability of short or long conservation contracts under ecological and socio-economic uncertainty. *Ecol. Modell.* **2011**, *222*, 2856–2866. [CrossRef]
46. Latacz-Lohmann, U.; Breustedt, G. Using choice experiments to improve the design of agri-environmental schemes. *Eur. Rev. Agric. Econ.* **2019**, *46*, 495–528. [CrossRef]
47. Bartolini, F.; Gallerani, V.; Raggi, M.; Viaggi, D. Modelling the Linkages between Cross-Compliance and Agri-Environmental Schemes Under Asymmetric Information. *J. Agric. Econ.* **2012**, *63*, 310–330. [CrossRef]
48. Espinosa-Goded, M.; Barreiro-Hurlé, J.; Dupraz, P. Identifying additional barriers in the adoption of agri-environmental schemes: The role of fixed costs. *Land Use Policy* **2013**, *31*, 526–535. [CrossRef]
49. Zabel, A.; Bostedt, G.; Ekvall, H. Policies for forest landscape management–A conceptual approach with an empirical application for Swedish conditions. *For. Policy Econ.* **2018**, *86*, 13–21. [CrossRef]
50. Bartolini, F.; Vergamini, D. Understanding the spatial agglomeration of participation in agri-environmental schemes: The case of the Tuscany Region. *Sustainability* **2019**, *11*, 2753. [CrossRef]
51. Helms, M.M.; Nixon, J. Exploring SWOT analysis–where are we now: A review of academic research from the last decade. *J. Strategy Manag.* **2010**, *3*, 215–251. [CrossRef]
52. Moxey, A.; White, B.; Ozanne, A. Efficient Contract Design for Agri-Environment Policy. *J. Agric. Econ.* **2008**, *50*, 187–202. [CrossRef]
53. Yano, Y.; Blandford, D. Use of compliance rewards in agri-environmental schemes. *J. Agric. Econ.* **2009**, *60*, 530–545. [CrossRef]
54. Vergamini, D.; Viaggi, D.; Raggi, M. Integrating spatial econometric information and optimisation models to improve agri-Environmental payment design: A resource allocation model for emilia-Romagna (Italy). *Agric. Econ. Rev.* **2017**, *18*, 40–59.
55. Gómez-Limón, J.A.; Gutiérrez-Martín, C.; Villanueva, A.J. Optimal Design of Agri-environmental Schemes under Asymmetric Information for Improving Farmland Biodiversity. *J. Agric. Econ.* **2019**, *70*, 153–177. [CrossRef]
56. Weber, A. Implementing EU co-financed agri-environmental schemes: Effects on administrative transaction costs in a regional grassland extensification scheme. *Land Use Policy* **2015**, *42*, 183–193. [CrossRef]
57. Cho, W.; Blandford, D. Bilateral Information Asymmetry in the Design of an Agri-Environmental Policy: An Application to Peatland Retirement in Norway. *J. Agric. Econ.* **2019**, *70*, 663–685. Available online: https://onlinelibrary.wiley.com/doi/abs/10.1111/1477-9552.12313 (accessed on 20 June 2021). [CrossRef]

58. Josefsson, J.; Lokhorst, A.M.; Pärt, T.; Berg, Å.; Eggers, S. Effects of a coordinated farmland bird conservation project on farmers' intentions to implement nature conservation practices–Evidence from the Swedish Volunteer & Farmer Alliance. *J. Environ. Manage.* **2017**, *187*, 8–15. [PubMed]
59. Franks, J.R. The collective provision of environmental goods: A discussion of contractual issues. *J. Environ. Plan. Manag.* **2011**, *54*, 637–660. [CrossRef]
60. Espinosa-Goded, M.; Barreiro-Hurlé, J.; Ruto, E. What do farmers want from agri-environmental scheme design? A choice experiment approach. *J. Agric. Econ.* **2010**, *61*, 259–273. [CrossRef]
61. Hart, R.; Latacz-Lohmann, U. Combating moral hazard in agri-environmental schemes: A multiple-agent approach. *Eur. Rev. Agric. Econ.* **2005**, *32*, 75–91. [CrossRef]
62. Canton, J.; de Cara, S.; Jayet, P.A. Agri-environmental schemes: Adverse selection, information structure and delegation. *Ecol. Econ.* **2009**, *68*, 2114–2121. [CrossRef]
63. Ducos, G.; Dupraz, P.; Bonnieux, F. Agri-environment contract adoption under fixed and variable compliance costs. *J. Environ. Plan. Manag.* **2009**, *52*, 669–687. [CrossRef]
64. Peterson, J.M.; Boisvert, R.N. *Agricultural & Applied Economics Association Incentive-Compatible Pollution Control Policies under Asymmetric Information on Both Risk Preferences and Technology*; Oxford University Press on behalf of the Agricultural & Applied Economics Assocation: Oxford, UK, 2018; Volume 86.
65. Finn, J.A.; Bartolini, F.; Bourke, D.; Kurz, I.; Viaggi, D. Ex post environmental evaluation of agri-environment schemes using experts' judgements and multicriteria analysis. *J. Environ. Plan. Manag.* **2009**, *52*, 717–737. [CrossRef]
66. Ozanne, A.; White, B. Equivalence of input quotas and input charges under asymmetric information in agri-environmental schemes. *J. Agric. Econ.* **2007**, *58*, 260–268. [CrossRef]
67. Quillérou, E.; Fraser, R. Adverse selection in the environmental stewardship scheme: Does the higher level stewardship scheme design reduce adverse selection? *J. Agric. Econ.* **2010**, *61*, 369–380. [CrossRef]
68. Viaggi, D.; Raggi, M.; Gallerani, V. Evaluating the potential contribution of contract auctions to Agri-Environmental Policy efficiency: A simulation model for Emilia-Romagna (Italy). *Agric. Econ. Rev.* **2010**, *11*, 18–28.
69. Uthes, S.; Matzdorf, B. Studies on agri-environmental measures: A survey of the literature. *Environ. Manage.* **2013**, *51*, 251–266. [CrossRef]
70. Humphrey, A. *SWOT Analysis for Management Consulting*; SRI International: Menlo Park, CA, USA, 2005.
71. Moxey, A.; White, B. Result-oriented agri-environmental schemes in Europe: A comment. *Land Use Policy* **2014**, *39*, 397–399. [CrossRef]
72. Latacz-lohmann, U.; Hodge, I. European agri-environmental policy for the 21st century. *Aust. J. Agric. Resour. Econ.* **2003**, *47*, 123–139. [CrossRef]
73. Arnott, D.; Chadwick, D.; Harris, I.; Koj, A.; Jones, D.L. What can management option uptake tell us about ecosystem services delivery through agri-environment schemes? *Land Use Policy* **2019**, *81*, 194–208. [CrossRef]
74. Matzdorf, B.; Lorenz, J. How cost-effective are result-oriented agri-environmental measures?-An empirical analysis in Germany. *Land Use Policy* **2010**, *27*, 535–544. [CrossRef]
75. Gibbons, J.M.; Nicholson, E.; Milner-Gulland, E.J.; Jones, J.P.G. Should payments for biodiversity conservation be based on action or results? *J. Appl. Ecol.* **2011**, *48*, 1218–1226. [CrossRef]
76. Niskanen, O.; Tienhaara, A.; Haltia, E.; Pouta, E. Farmers' heterogeneous preferences towards results-based environmental policies. *Land Use Policy* **2021**, *102*, 105227. [CrossRef]
77. Matzdorf, B.; Kaiser, T.; Rohner, M.S. Developing biodiversity indicator to design efficient agri-environmental schemes for extensively used grassland. *Ecol. Indic.* **2008**, *8*, 256–269. [CrossRef]
78. Zabel, A. Biodiversity-based payments on Swiss alpine pastures. *Land Use Policy* **2019**, *81*, 153–159. [CrossRef]
79. Wezel, A.; Vincent, A.; Nitsch, H.; Schmid, O.; Dubbert, M.; Tasser, E.; Fleury, P.; Stöckli, S.; Stolze, M.; Bogner, D. Farmers' perceptions, preferences, and propositions for result-oriented measures in mountain farming. *Land Use Policy* **2018**, *70*, 117–127. [CrossRef]
80. Dessart, F.J.; Barreiro-Hurlé, J.; van Bavel, R. Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *Eur. Rev. Agric. Econ.* **2019**, *46*, 417–471. [CrossRef]
81. Reed, M.S.; Moxey, A.; Prager, K.; Hanley, N.; Skates, J.; Bonn, A.; Evans, C.D.; Glenk, K.; Thomson, K. Improving the link between payments and the provision of ecosystem services in agri-environment schemes. *Ecosyst. Serv.* **2014**, *9*, 44–53. [CrossRef]
82. Hodge, I.; McNally, S. Wetland restoration, collective action and the role of water management institutions. *Ecol. Econ.* **2000**, *35*, 107–118. [CrossRef]
83. Van Dijk, W.F.A.; Lokhorst, A.M.; Berendse, F.; de Snoo, G.R. Collective agri-environment schemes: How can regional environmental cooperatives enhance farmers' intentions for agri-environment schemes? *Land Use Policy* **2015**, *42*, 759–766. [CrossRef]
84. Dletz, T.; Ostrom, E.; Stern, P.C. The struggle to govern the commons. *Int. Environ. Gov.* **2017**, *302*, 53–58.