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Transaction Costs in Agri-Environment-Climate Measures: A Review of the Literature

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Abstract: Agri-environment-climate measures (AECMs) represent a transaction of ecological capital between the government as the buyer of the agri-environmental goods and services produced in the farmland and the farmer as the seller. As such, they involve transaction costs (TC) that serve to safeguard the transaction from opportunistic behavior, problems related measurement, and other risks that can occur in the contractual relationship. These costs are an important factor in the design and implementation of any policy. However, analyzing TC is not easy. Several definitions have been proposed, and different strategies have been used to measure these costs. Despite a growing interest in this topic, research addressing the analysis of TC in AECMs has been rather scarce and lacking a systematic approach to make the different studies comparable and their results generalizable. This review article aims to provide a detailed overview of the current state of research related to the analysis of TC in AECMs by exploring the differences in methodological approaches, objectives, and scope among the most relevant studies available and by summarizing their most significant findings. It was observed that there are differences across the studies linked to their objectives in terms of the geographical context in which they are implemented, the actors involved in the program, and the objectives aimed toward in their analysis. However, the sharpest difference observed across these studies is linked to their methodological approach, which in most cases is focused on quantitative analysis. Most of these studies observed a significant variation in the magnitude and determinants of TC across different AECMs, which often depended on the characteristics of the schemes and the institutional environment in which they were implemented, as well as factors linked to specific characteristics of the farmer and/or their farming business.

Keywords: agri-environment-climate measures; transaction costs; environmental policy; planning policy



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1. Introduction

Transaction costs (TCs) as an economic concept have been studied for almost a century now. They were first conceptually introduced in 1937 by Nobel Laureate Ronald Coase in his famous paper “The nature of the firm”, where he described “the cost of using the price mechanism”. Coase argued that the execution of transactions through market mechanisms involved costs, a perspective that contrasted a lot with the position of conventional economics at that moment. After Coase proposed this idea, prominent economists further developed the concept of TCs [1–6] and set the base for the Transaction Costs Theory (TCT) which has become the backbone of New Institutional Economics. Transaction costs exist as a result of people’s bounded rationality and the uncertainties inherent to transactions. However, defining transaction costs is not easy; in fact, many definitions have been proposed, and there is considerable ambiguity and inconsistency around this concept [7]. One commonly used definition of transaction costs, consistent with Coase’s early analysis, asserts that all the costs involved in a transaction, except those of production, can be considered TCs. Some examples include the cost of searching for information, the

cost of negotiating and reaching an agreement, the cost of ensuring that parties comply with the terms of a contract, etc. Considering these costs is particularly crucial when developing public policies, as high levels of transaction costs can hinder their efficiency, effectiveness, and equity [8,9].

A good example of public policies or policy tools where TCs are especially relevant is agri-environmental schemes (AES) also known as agri-environment-climate measures (AECM). Currently, this type of policy is widely used as an instrument for the integration of environmental targets into the Common agricultural policy (CAP) in Europe and for meeting society's demand-related environmental products provided by agriculture [10]. "AECMs are essentially a transaction of ecological capital between the farmer as the seller, and the government as the buyer of the Agri-Environmental goods and services" [11]. Although AECMs cannot be considered a "pure" market, they function as a "quasi-market" in which the governmental entities play the role of representing society, which is assumed to be interested in the conservation and improvement of the environment and therefore in the environmental goods that farmers can provide. In exchange, farmers are offered the option of getting payments for their voluntary commitment to perform certain managing practices that are beneficial for the environment, which go beyond mandatory standards. At the same time, through this transaction, society's demand for conservation is addressed, and farmers are mainly compensated for additional costs, and, in some cases, for the TCs resulting from their subscription to the contract. Therefore, if we consider the definition of TCs described earlier, when it comes to AECMs the costs incurred during the process, such as the costs of negotiation, monitoring, and enforcement of the contract, are considered TCs. However, the costs incurred by the farmer in producing the agri-environmental goods or services, such as the cost of seeds, fertilizer, or labor, are not considered transaction costs. Taking into account TCs when designing these types of policies should be a priority, especially when targeting wicked environmental and natural resource issues [12], because if TCs are too high, farmers may feel less willing to enroll and participate in these programs [13], which in turn can lead to lower policy efficiency and poor environmental outcomes. Additionally, considering that TCs are not always evenly distributed among the different actors involved in the transaction, these costs could exert a big influence on the equity of the economic system [14].

As mentioned earlier, there is a lot of ambiguity around the concept of TCs which often hinders their analysis and comprehension. Therefore, in an effort to understand better the dynamics of this type of costs, some researchers have reviewed the literature or summarized the most relevant studies related to TCs in different fields, such as in planning systems [14], the sharing economy [15], blockchain and supply chain relations [16], life insurance [17], etc. However, despite a growing interest in this topic, research addressing the analysis of TCs in AECMs has been rather scarce and lacking a systematic approach to make the different studies comparable and their results generalizable. A review of the literature encompassing specifically the studies that have analyzed TCs in AECMs has not yet been carried out. Most studies that have examined TCs in the context of AECMs often have varying approaches, objectives, and methodologies [18]. For instance, some studies focus on the transaction costs incurred by farmers, while others examine the transaction costs incurred by the government or administrative entities. Additionally, some studies employ quantitative methods to estimate TCs, while others use qualitative approaches to identify and describe them.

Accordingly, this review article aims to provide a detailed overview of the current state of research related to the analysis of TCs in AECMs by exploring the differences in methodological approaches, objectives, and scope among the most relevant studies available and by summarizing their most significant findings. Overall, we intend that this review can help to synthesize existing knowledge, identify areas of consensus and disagreement, and hopefully provide guidance for policymakers and practitioners seeking to design and implement effective agri-environment-climate policies and to uncover new avenues for research based on the knowledge gaps identified throughout the various

studies that have been carried out. To achieve this purpose, the paper first introduces a brief overview of the Transaction Costs Theory. Then, the methodological process for the search and selection of relevant publications is explained. Next, results are presented and discussed, and finally, this paper provides some conclusions highlighting knowledge gaps and areas for future research.

2. Transaction Costs Theory: A Brief Review

Transaction Costs Theory (TCT), also known as transaction costs economics (TCE), has been developed based on the seminal work of two Nobel laureates: Ronald Coase [19] and Oliver Williamson [3,4]. It has become one of the key concepts and most influential contributions to New Institutional Economics (NIE). Although this theory was originally applied in the “make-versus-buy” decision in vertical integration strategies, it has been implemented ever since as a tool to analyze a wide range of organizational phenomena, such as supply chain relationships, horizontal diversification, and public–private partnerships (PPPs), among others [20]. However, this broad level of application and influence can also pose a barrier to its development, as the more fragmented the TCT literature becomes, the more challenging it is to incorporate and articulate new advances in the overall theory, especially because definitions of key concepts keep evolving in different ways across different fields. For example, several definitions have been proposed to describe the concept itself of transaction costs, from “the costs of effecting exchange” [21], “the costs of coordinating resources through market arrangements” [22], “the costs of running the economic system” [23], and “costs that arise not from the production of goods, but from their transfer from one agent to another” [24] to “all the costs that do not exist in a Robinson Crusoe economy, where property rights, transactions or any kind of economic organization are non-existent” [6].

If defining transaction costs is already challenging, measuring them is an even more complicated task. According to Zhengchao et al. [25], measuring TCs implies dealing with three main obstacles or difficulties; the first obstacle is the lack of standard terminology to define these costs, which hinders the clear identification of what transactions should be considered and what expenses should be regarded as transaction costs; the second obstacle argues that they are unobservable in non-market value due to the evolving behavior in transactions, which leads to a continuous change in transaction costs and increases the complexity of calculating them numerically; and the third obstacle refers to the fact that opportunity costs cannot be used to replace transaction costs, as they only represent a portion of the costs inherent to a transaction. To deal with measurement difficulties like these, different TC typologies have been proposed, and some of them have been applied in the context of agri-environmental policies [26]. To analyze TCs, one of the most common classifications [11,27,28] includes three main categories of costs: (1) search costs, which arise ex ante to the execution of the transaction and include activities like getting information about trading opportunities, finding suitable partners, comparing opportunity costs, etc., (2) negotiation costs, which arise ex ante or during the execution of the transaction and include activities like specifying the agreements of exchange, filling out forms, contracting, etc., and (3) monitoring and enforcement costs, which arise ex post to the execution of the transaction in order to safeguard its outcome, and include activities like submission of reports, control visits, payment processing, etc. Another commonly used categorization of TCs is based on the distribution of such costs among participants [29,30]. From this perspective, a differentiation is made between two types of costs: Public TCs, when the costs are borne by the government or the administration in charge of the design, establishment, and management of the transaction, and Private TCs when the costs are borne by the people accepting the transaction proposed (e.g., the farmers, in the case of AECMs). TCs can also be categorized based on the number of times a cost takes place. This way, they can be classified as one-off costs and recurrent costs [18]. One-off costs occur mainly ex ante the execution of the transaction and can be considered sunk costs once the contract is up and running, for example, the costs of searching, designing, and negotiating. On the other hand,

recurrent costs mainly occur *ex post* the transaction, for example, the cost of monitoring and enforcement. Lastly, TCs can also be classified into fixed costs, which enable economies of scale (e.g., information search and gathering), and variable costs, which depend on individual and intrinsic characteristics of the participants (e.g., soil samples, farm mapping, etc.) [11,31]. Some examples of activities where people incur such costs can be the collection of information about the transaction, as well as the process of negotiating, contracting, and making payments. According to Whitten and Coggan [32], TCs may include monetary costs (e.g., administrative staff, legal advice, traveling costs to meetings, etc.), opportunity costs (e.g., the potential income that could have been generated by performing other activities or carrying out other deals), and non-monetary costs (e.g., the time required to manage business affairs which could have been used in other activities).

However, despite the inconsistencies derived from this great variety of definitions and interpretations, transaction costs economists consensually agree that these costs must be differentiated from costs of production, which have been the main focus of neoclassical economics [33]. The fundamental prediction of TCT is that the actors of an organization try to maximize the gains from trade and interdependence by “assigning transactions (which differ in their attributes) to governance structures (the adaptive capacities and associated costs of which differ) in a discriminating way” [34]. So, there are two important elements here: transactions and governance structures. One of the fundamental concepts proposed in TCT is that the transaction is the basic unit of economic activity or analysis. Ramstad [35] differentiates between the concept of transaction proposed by Commons [36] and the one proposed by Williamson [34]. Commons proposed that a transaction is the transfer of property rights, whereas Williamson proposed that it is the transfer of goods, services, or information through a technologically separable interface. On the other hand, the three main governance structures are hierarchies, markets, and hybrids. TCT is used to predict which one would be chosen when organizing economic activities or transactions [37]. It explains that the right decision would be internalizing the transaction within a hierarchy when the TCs are too high and using the market mechanisms when TCs are low. However, that is not always the case, and TCT makes use of behavioral assumptions, such as bounded rationality and opportunism, to argue that the way in which governance structures are chosen is based on three key transaction attributes affecting the level of transaction costs: asset specificity (i.e., the degree to which an investment made for a transaction can also be used for other transactions), uncertainty (i.e., a transaction involving limited or non-symmetric information), and frequency (i.e., the number of transactions made in a specific timeframe). The higher the level of these attributes is, the higher the level of TCs [38].

In the context of agri-environment-climate measures, transaction costs arise from the process of implementing and managing contracts between farmers and government agencies for the provision of environmental goods and services. These transaction costs may include the costs of negotiating and drafting contracts, as well as the costs of monitoring and verifying compliance with contract terms. For example, farmers may need to invest in new technologies or adopt new management practices to meet the environmental requirements specified in the contracts, which can be costly. Similarly, government agencies may need to invest in monitoring and verification systems to ensure that farmers are meeting their contractual obligations, which can also be expensive. It is essential to point out that in AECMs, the goods that are subject to a transaction (ecological, environmental goods) are considered public goods. As such, they are characterized as being non-excludable and non-rival, which means that everybody should have access to them and their use by one person should not endanger or decrease the potential use by other people. The public nature of these goods makes it difficult to articulate property rights in a complete and effective way, which leads to market failure, and therefore the intervention of a regulatory system is required [39]. TCs in AECMs can be seen as “scheme organizational costs” [40] and represent “resource losses due to imperfect information” [27] which have to be assumed by both farmers and the administration. “Imperfect information and its implicit uncertainty can lead to opportunistic behavior or measurement problems, which are hazards that affect

the contractual relationship” [5]. More in depth, some informational deficiencies arise from the high heterogeneity in farm business characteristics when it comes to the provision of environmental goods in rural areas: this can affect the outcome of the transaction in terms of quality and price [41]. “Additionally, intrinsic difficulties in observing and measuring the actions of farmers may end up enabling the right conditions for moral hazards to take place” [12]. “Therefore, the actors involved in the transaction undertake additional activities or actions to manage these shortfalls, and by doing so, TC are generated” [42].

3. Methodology

3.1. Eligibility Criteria and Databases

Since Scopus and Web of Science are among the most extensive and most used abstract and citation databases of peer-reviewed literature; they were chosen by the authors to search and select studies related to agri-environmental schemes and/or agri-environment-climate measures addressing specifically transaction costs in their arguments. More specifically, only studies focused explicitly on analyzing and/or measuring transaction costs in this specific topic were considered. By using two databases, the authors aimed to ensure the inclusion of all relevant studies and reduce the risk of errors derived from searching and indexing failures. The timespan considered for the search was 1999–2023, and only the literature in English was included. Review articles were excluded in order to encompass primary data only.

3.2. Search Strategy

The definition of the keywords and the subsequent construction of the search strings (Table 1) that were executed in the databases were carried out as follows: the search strings were divided in two different sections combined with the AND function; the first one is related to transaction costs, and the second one is related to agri-environmental schemes. The first section involved the main keyword “TRANSACTION COST*” on its own and in combination with the words ANALYSIS, MEASURE*, and ASSESSMENT*; the search results of these combinations were merged using the OR function. The “*” indicates that any ending variations (such as the plural of the word) would be included. Quotation marks were also used to guarantee that the search engines would not take the words separately but as a whole phrase. Similarly, in the second section of the search string the main keyword AGRI-ENVIRONMENT* was used in combination with the words MEASURE*, SCHEME*, POLICY*, and PROGRAM*, and it was decided to include also the keyword “PAYMENT FOR ECOSYSTEM SERVICES*” in order to capture other potentially relevant studies, as they are highly related terms. The field codes TITLE-ABS-KEY in Scopus and TI, TS and AB in Web of Science were used. Additionally, the paper retrieval was expanded manually by performing a cross-reference analysis which allowed the authors to find other nine relevant quoted papers that were not included in the databases or that somehow were incompatible with the search strings (for more details see Table A1 in the Appendix A).

Table 1. Articles analyzed and their main characteristics.

ID	Study Authors	Title	Measure/Scheme/Program Analyzed	Quant. X	Qualit. O	Public X	Private O
1	McCann and Easter, 1999 [1]	Transaction costs of policies to reduce agricultural phosphorous pollution in the Minnesota river	4 policies designed to reduce agricultural sources of phosphorous pollution	X		X	
2	Falconer and Whitby, 2000 [2]	Untangling red tape: scheme administration and the invisible costs of European agri-environmental policy	Countryside stewardship schemes	X		X	
3	McCann and Easter, 2000 [3]	Estimates of Public Sector Transaction Costs in NRCS Programs	60 conservation systems linked to policies to reduce non-point-source pollution	X		X	
4	Falconer et al., 2001 [4]	An Investigation of Policy Administrative Costs Using Panel Data for the English Environmentally Sensitive Areas	Management agreements for Environmentally Sensitive Areas	X		X	
5	Falconer and Saunders, 2002 [5]	Transaction costs for SSSIs and policy design	Wildlife Enhancement Scheme for sites of special scientific interest	X		X	O
6	Rørstad et al., 2007 [6]	Why do transaction costs of agricultural policies vary?	12 different agricultural policy measures	X		X	O
7	Ollikainen et al., 2008 [7]	Policy-related transaction costs of agricultural policies in Finland	Agricultural and agri-environmental policy instruments	X		X	
8	Mettepenningen and Van Huylenbroeck, 2009 [8]	Factors influencing private transaction costs related to agri-environmental schemes in europe	AES across different European countries	X			O
9	Mettepenningen et al., 2009 [9]	Measuring private transaction costs of European agri-environmental schemes	AES across different European countries	X			O
10	McCann, 2009 [10]	Transaction Costs of Environmental Policies and Returns to Scale: The Case of Comprehensive Nutrient Management Plans	Comprehensive nutrient management plans approved by the Natural Resource Conservation Service	X			O
11	Ridier et al., 2011 [11]	Private transaction costs and environmental cross compliance in a crop region of Southwestern France	Different cross-compliance policy tools	X			O
12	Mettepenningen et al., 2011 [12]	Public transaction costs of agri-environmental schemes and their determinants—Analysing stakeholders' involvement and perceptions	AES accross different European countries	X	O	X	

Table 1. Cont.

ID	Study Authors	Title	Measure/Scheme/Program Analyzed	Quant. X	Qualit. O	Public X	Private O
13	Peterson et al., 2014 [13]	Transaction Costs in Payment for Environmental Service Contracts	PES contracts in a hypothetical water quality trading market	X			O
14	Weber, 2014 [14]	Does transaction costs expense create transaction gains for farmers participating in an agri-environmental scheme?	Site-specific grassland extensification scheme	X			O
15	Weber, 2014 [15]	How are public transaction costs in regional agri-environmental scheme delivery influenced by EU regulations?	AES in general		O	X	
16	Coggan et al., 2014 [16]	Private transaction costs of participation in water quality improvement programs for Australia's Great Barrier Reef: Extent, causes and policy implications	Australian Government's Reef Rescue scheme	X			O
17	Weber, 2015 [17]	Implementing EU co-financed agri-environmental schemes: Effects on administrative transaction costs in a regional grassland extensification scheme	Grassland extensification scheme	X		X	
18	McCann and Claassen, 2016 [18]	Farmer Transaction Costs of Participating in Federal Conservation Programs: Magnitudes and Determinants	Different programs aimed at tackling water quality problems associated with non-point-source pollution from agricultural production	X			O
19	Phan et al., 2017 [19]	A comparative study of transaction costs of payments for forest ecosystem services in Vietnam	Payments for forest ecosystem services (PFES)		O	X	
20	Mack et al., 2019 [20]	Determinants of the perceived administrative transaction costs caused by the uptake of an agri-environmental program	Voluntary grassland-based meat and milk program	X			O
21	Kang et al., 2023 [21]	Investing in nature-based solutions: Cost profiles of collective-action watershed investment programs	Payments for watershed services (PWS)	X		X	

3.3. Data Collection Process

The data collection process was carried out between September 2022 and January 2023. The total number of records from Scopus (97) and Web of Science (78) were retrieved for the screening phase. The screening phase was performed in three different steps. First, all records were exported into MS Excel to organize them for the subsequent bibliometric analysis. Considering a significant overlap of the search results in the observed databases, in the second step we removed duplicate records; a total of 21 articles were excluded. In the third step, the authors reviewed the title and abstract of all 154 remaining articles and removed those that were not relevant, either because they clearly belonged to other disciplines and subject matters or because they did not fit with the scope of this review; a total of 116 articles were excluded on this step. The remaining 38 records were subject to a subsequent eligibility process by going through the entire text to identify the articles that would finally be included in the review. To be included, an article had to meet two main criteria: (i) it had to address specifically the topic of agri-environmental-climate measures, schemes policies, or programs; (ii) it had to include a quantitative or/and qualitative analysis of private or/and public transaction costs. This process yielded a final selection of 21 articles (Figure 1).

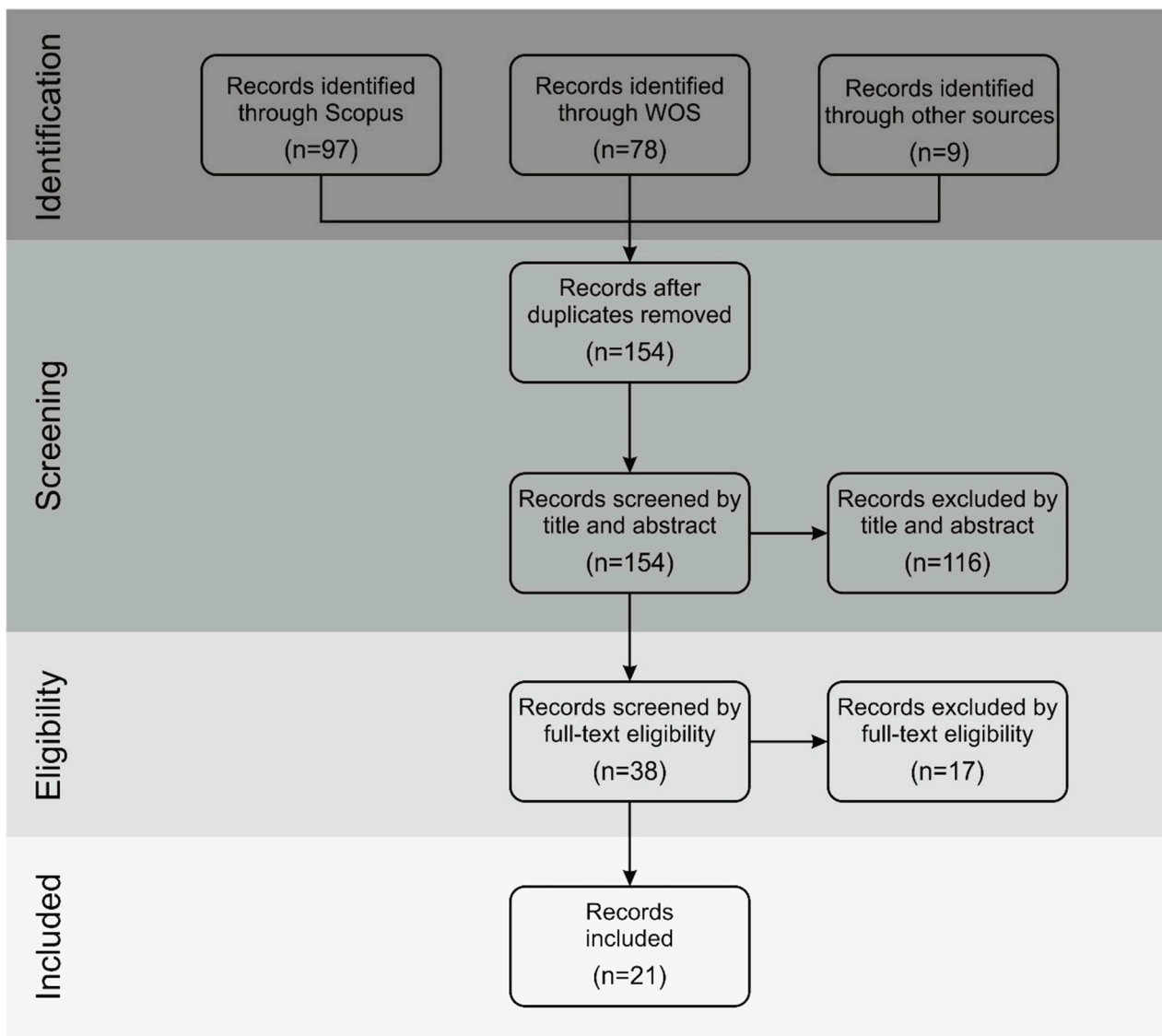


Figure 1. PRISMA-inspired flow diagram.

4. Overview of Key Differences and Findings across Studies

This section presents the results of our literature review, which aimed to obtain a detailed overview of the current state of research related to the analysis of transaction costs (TCs) in agri-environment-climate measures (AECMs). This was achieved by exploring the differences among the studies available to date and by identifying the most significant contributions that have been made. Results from this review are presented in an organized manner through different sections where studies are described and compared based on their primary research objectives, scope, methodologies, findings, etc.

4.1. Main Investigated Agri-Environment-Climate Measures

Some studies focused on very specific types of agri-environmental programs, schemes, or measures (Table 1). For example, Mack et al., [43], Weber [44], and Weber [45] focused their analysis on schemes linked to grasslands, such as voluntary grassland-based meat and milk programs or site-specific grassland extensification schemes. Kang et al. [46], McCann and Claassen [13], Peterson et al., [47], McCann [48], and McCann and Easter [49] focused their analysis on schemes and programs related to water, such as water quality problems associated with non-point-source pollution from agricultural production, watershed ecosystem services, or payment for ecosystem services in a hypothetical water quality trading market. Phan et al. [18] focused on two schemes related to payments for forest ecosystem services. By contrast, other studies approached AES and agri-environment and climate programs in a broad and general way (e.g., Weber [50], Mettepenningen et al. [51], Mettepenningen et al. [11], Mettepenningen and Van Huylenbroeck [52], and Ollikainen et al. [53]), or encompassed a set of different measures or programs in their analysis (e.g., Ridier et al. [54], Rørstad [38], McCann and Easter [55], and Falconer and Whitby [40]).

4.2. Main Differences in Scope and Objectives

As previously mentioned, this review focused solely on studies that analyzed transaction costs in agri-environment-climate measures. However, the approach to addressing transaction costs differed significantly among the included studies. Some interesting differences were observed in terms of their geographical scope and research objectives. Let us examine these variations in greater detail.

- Geographical scope

Most studies focused on a specific country or region and analyzed the transaction costs of agri-environmental schemes, measures, or programs pertaining to that particular geographical context. For example, McCann and Claassen [13] and Peterson et al. [47] conducted their studies in the United States; the study by Mack et al. [45] was conducted in Switzerland; the study by Coggan et al. [8] took place in Australia; and the studies by Weber [45,50] were carried out in Germany. Nonetheless, a few studies were more ambitious and focused on a cross-country type of approach by analyzing the results obtained in several countries. For example, Kang et al. [46] obtained their data from eighteen different programs in countries from Latin America, Asia, and Africa; Falconer and Whitby [40] analyzed thirty-seven case-study schemes in eight European member states; and the studies conducted by Mettepenningen et al. [11,51] and Mettepenningen and Van Huylenbroeck [52] were carried out in nine and ten different European countries, respectively. While these studies tend to provide a more holistic understanding of the dynamics of transaction costs in agri-environment and climate policies, they also acknowledged the challenges and limitations posed by this type of cross-country analysis in terms of how comparable results really can be; for example, Falconer and Whitby [40] expressed that “The main challenge to comparative transaction costs analysis for different schemes across the EU lies in drawing together disparate information, i.e., data relating to different schemes, with different objectives, implemented at different times, under different economic (and social) conditions, and within different legal and political frameworks”.

- Research objectives

Another interesting difference among these studies has to do with the objective of their research, which fluctuated between two main approaches: those studies that only focused on estimating transaction costs and those that further tried to identify their underlying determinants. Only a few studies focused on the first approach. For example, McCann and Easter [49] “measured the magnitude of TC associated with policies to reduce agricultural non-point source pollution”; Falconer and Saunders [56] developed a “methodology to quantify agreement-level transaction costs of individually negotiated and standard management agreements under the Wildlife Enhancement Scheme (WES) for sites of special scientific interest”; Mettepenningen et al. [11] measured the transaction costs of farmers participating in AES in several European countries; and more recently, Kang et al. [46] estimated the size and range of administrative and transaction costs in eighteen watershed management programs from different countries. On the other hand, most of the studies included in this review went for the second approach and not only tried to measure transaction costs but also analyzed the factors that can influence them. For example, in Norway, Rørstad [38] compared the degree of TCs for twelve different agricultural policy measures and then analyzed the causes of such differences considering three different dimensions: asset specificity, frequency, and point of policy application; Mettepenningen and Van Huylenbroeck [52] attempted to measure private TCs and investigated the factors influencing them in ten case studies across Europe; Weber [50] investigated “the effects of EU regulations on occurrence and composition of regional public TC” in a case study in Germany; Coggan et al. [8] assessed the “extent and causes of private transaction costs incurred by sugarcane growers participating in the Australian Government’s Reef Rescue scheme”; and Mack et al. [43] estimated private administrative transaction costs based on farmers’ perceived administrative workload, and then they analyzed how the administrative tasks and farm and farmer characteristics influenced such perceptions.

4.3. Main Differences in Methodological Approach

- Type of methodology

One of the most relevant differences among these studies is the type of methodology implemented. Out of the twenty-one studies included in this review, only three addressed TCs in AECMs through qualitative methods, one of which utilized a mixed-method approach (Table 1). In other words, only two studies implemented a purely qualitative methodology to analyze TCs in AECMs. Weber [50] conducted an exploratory approach and derived empirical evidence from a document analysis of EU regulations and a content analysis of semi-structured interviews among different public administrative units; Phan et al. [18] analyzed the difference in public TCs between two different programs by using a combination of in-depth interviews with local scheme coordinators, site visits, and secondary data analysis. In their study, Mettepenningen et al. [51] used both quantitative and qualitative methods to analyze public TCs. They conducted a statistical analysis using a proxy for public TCs in combination with an analysis of the perceptions of stakeholders on the factors influencing the public TCs. An interesting observation is that none of these qualitative studies covered private TCs; instead, they focused only on the costs borne by the administration. The rest of the studies included in this review implemented quantitative-type methodologies in their analysis, such as multivariate analysis [54], descriptive statistics, *t*-tests, analysis of variance, regression analysis [13,38,44,52,55], and even microsimulations in a hypothetical scheme by using mixed logit models [47].

- Actors involved

Another relevant difference among the studies is the type of actors they focused on. Basically, two main approaches can be identified: (a) analysis of transaction costs borne by the administration or the government, which are referred to as public transaction

costs, and (b) analysis of transaction costs borne by farmers or land managers, which are referred to as private transaction costs. Only the studies from Falconer and Saunders [56] and Rørstad [38] encompassed both types of actors in their analysis. Although the difference in the number of studies focusing on each approach is not very sharp, the first one seems to be somewhat more common in the literature, especially when research on this topic started to emerge (Table 1). For example, McCann and Easter [51] conducted some interviews among governmental agencies to analyze the transaction costs of policies to reduce water pollution caused by agricultural phosphorus; Falconer et al. [57] focused on the transaction costs related to the public sector in the implementation of agri-environmental schemes based on management agreements; Ollikainen et al. [53] assessed policy-related transaction costs related to the main agricultural and agri-environmental policy instruments in Finland by conducting interviews in two ministries: the ministry of agriculture and forestry and the ministry of the environment; Weber [50] investigated the effects of EU regulations on the occurrence and composition of regional public transaction costs; and more recently, Kang et al. [46] collected data on administrative and transaction costs of municipal-scale collective action watershed investment programs. On the other hand, most studies going for the second approach came a bit later as researchers started to point out the need for studies investigating private transaction costs in agri-environment and climate policies. For example, the studies by Mettepenningen et al. [11] and Mettepenningen and Van Huylenbroeck [52] focused on the analysis of private transaction costs in European AES; they expressed that “research on private TCs caused by an uptake of AESs is still quite limited” and aimed at tackling this knowledge gap by providing empirical evidence through the analysis of data gathered during the execution of a European project called ITAES; Ridier et al. [54] investigated the transaction costs arising at farm level associated with environmental cross-compliance programs; the study by Peterson et al. [47] analyzes private transaction costs in payment for environmental service contracts and their link with “well-known information asymmetries between the landholders and the government agency offering contracts”; and more recently, Mack et al. [43] focused their analysis in private administrative transaction costs and how they are subjectively perceived by farmers participating in a recently introduced agri-environmental program.

4.4. Main Reported Empirical Results and Findings

- Key insights linked to public transaction costs

Falconer and Whitby [40] concluded that agri-environmental schemes tend to be more costly from an administrative point of view than other policies mainly because they require a significant amount of interaction with farmers at all stages, and at times negotiating with individual participants can be a complex and time-consuming task. This goes in line with the study from Falconer and Saunders [56] who found that 70% of the total negotiation costs is born by the public sector across all agreement types. On the other hand, Weber [50] observed that monitoring costs tend to be the predominant TCs in AES implementation. The same author reaffirmed this statement later in a subsequent study [44] by showing that most public TCs linked to the scheme analyzed are related to monitoring requirements aiming to mitigate the possible moral hazard of farmers and the implementing administrations themselves to avoid misuse of European Union (EU) funds. She also observed that part of the EU-related monitoring effort is fixed and thus increases the per-contract costs in counties with fewer participants. In spite of the difference in relevance of TC types, they all acknowledged that TCs account for a large part of the payments made under the agreements, and therefore they should not be overlooked when assessing policies such as AES. McCann and Easter [55] found that TCs made up 38% of the total costs of the national program of technical assistance for agriculture. Additionally, they found that TCs were higher for systems based on management practices than for those based on structural practices since the latter requires less amount of technical assistance before the practice is successfully implemented. Rørstad et al. [39] found that policies providing

direct price support have the lowest TCs, while more direct payments for environmental amenities have the highest. Likewise, Ollikainen et al. [53] found that policy-related transaction costs (PRTC) in agri-environmental programs increase with targeted and differentiated agri-environmental measures such as the conservation of special biotopes or the establishment of riparian buffer zones. Additionally, a statistical regression model conducted by Mettepenningen et al. [51] predicted lower transaction costs in AES if their main target is only to reduce the negative environmental impacts of agriculture, considering that it is much more difficult to design schemes to stimulate the positive externalities of farming. The study by Phan et al. [18] focused specifically on the TCs associated with two coordination activities linked to an agri-environmental program (i.e., the re-distribution of payments to ES providers and the monitoring and compliance checking of the contracted parties) and determined that such TCs represent a 4.5 and 3.0% of the total program payments, respectively. Finally, the study by Kang et al. [46] found that administrative and transaction costs on average account for over one-third of total costs linked to the agri-environmental programs analyzed. However, they also observed that average annual costs varied more than 50-fold among programs during the first ten years and concluded that such programs need to budget for high administrative and transaction costs throughout their full life cycle.

Across the studies, a number of factors affecting public TCs were identified. McCann and Easter [49] found that factors such as the number of agents affected, resistance to the policy, the time frame involved, uncertainty, the technology required to implement the best management practices, and the existing institutional arrangements can have an impact in the level of public TCs. Falconer et al. [57] found that “the extent of participation appears to be important in explaining administrative cost variability across areas and their results suggested the existence of size economics regarding the number of agreements made in environmentally sensitive areas”. Additionally, they observed that scheme experience could exert downward pressure on administrative costs. Rørstad et al. [38] found that TCs increase as asset specificity increases and/or frequency decreases: at the same time they are lower for policies that are applied to commodities than other points of application. Mettepenningen et al. [51] found that “the complexity of the schemes, the number of AES that need to be designed and the required precision of measures are perceived to be the factors with the greatest influence on public TC”. Additionally, they observed that the involvement of farmers’ organizations in AES design could influence both public TCs and the uptake of the schemes by farmers (thanks to the increased trust in the AES). However, they also pointed out that trust may enable transactions which are not possible without it, and therefore, at least for the design of AES, critical trust factors result in more time spent, not less. The study by Weber [50] revealed that EU regulations are an important influencing factor on public TC occurrence in AES implementation and that TC-reducing factors such as economies of scale or scope seem difficult to achieve at the regional level. Additionally, Weber [44] observed that the role of information provision and direct interaction between the public agency and farmers can reduce the level of deviations in AES implementation. Lastly, Phan et al. [18] found that the differences of TCs between the two schemes they compared could be explained based on these three factors: (i) underlying institutional design characteristics, in particular the forest land ownership which is partly historically determined, (ii) participants number and (iii) frequency of payment.

- Key insights linked to private transaction costs

Coggan et al. [8] found that average total TCs varied slightly according to the type of improved farming activities adopted. Rørstad et al. [38] and Mettepenningen et al. [11] also observed that TCs can be very different between types of AES and farmers, which makes generalization quite difficult. For example, Weber [45] found that on average, farmers spent 9 h on informational and 6 h on negotiation tasks. Implementation tasks for the whole contract period required 67.41 h on average and thus the greatest part of time (and costs), probably due to the related reporting duties. By contrast, McCann and Claassen [13] found that farmers participating in the scheme spent 28.5 h, on average, on

signing the contract, documenting compliance, and developing applications, and half of them spent 14 h or less on all of the combination of these activities. Coggan et al. [8] found that the ratio of average private TCs to average payment received is about 38%, which is consistent with the results from Rørstad et al. [38]. Mettepenningen et al. [11] found that private TC account for 14% of the total AES-related costs and 25% of the compensation payment. In absolute terms, their results showed that the private TCs amount to EUR 40/ha per year, and negotiation costs are the most important category. They also noticed that part of the TCs associated with AES are fixed cost and that this could explain why farmers with larger farms more easily enroll for AES. Coggan et al. [8] also “concluded that transaction costs are predominantly fixed costs. This may indicate that the larger farms have a greater capacity to absorb the transaction costs and therefore they may be less of a participation deterrent for large farms compared to small ones”. This goes in line with McCann (2009) who found that small-scale farmers face higher transaction costs associated with learning about programs, interacting with administrative staff or technical service providers, gathering the information needed to complete applications or develop comprehensive knowledge, completing paperwork, and keeping records. This is especially difficult if programs change frequently or if forms and requirements differ from one program to another. Likewise, Ridier et al. [54] observed that farmers who incur lower transaction costs are generally involved in an agricultural or non-professional network and are engaged in voluntary contract programs. On the other hand, farmers who incur higher transaction costs usually do not participate much in professional networks and are not involved or are involved little in contract programs.

In the case of private TCs, different influencing factors were also identified across studies. Mettepenningen and Van Huylenbroeck [52] found that factors such as the institutional environment, the type of AES, and farmers’ trust level can influence private TC. Additionally, whether or not specific investments had to be made for the AES was also an important influencing factor in their study, which confirms Williamson’s theory and their hypothesis that TCs rise with the increasing specificity of the investment. Furthermore, they observed that private TCs decrease when farmers have access to technical or financial advice, have a higher educational level, and enjoyed an agricultural education or professional training. These results go in line with those from Ridier et al. [54] who found that “the individual characteristics of the farm, of the farmer, as well as of the organizational and/or institutional networks in which the farmer is involved, have an impact on the nature and importance of transaction costs”. They observed that farmers who are involved in agricultural or non-professional organizations have greater access to information, which enables them to reduce the TCs linked to information search. Similarly, Coggan et al. [8] found that the characteristics of landholder that had a significant relationship with the level of transaction costs are related to higher education, having previous experience applying the scheme, and being socially connected beyond being a member of the farmer association linked to the scheme. Mettepenningen et al. [11] concluded that the simplification of schemes and contracts, application procedures, and monitoring mechanisms is by far the most important element in decreasing the TCs and thus increasing uptake of AES by farmers. Likewise, Peterson et al. [47] found that less-stringent contracts not only reduce transaction costs but also substantially reduce information rents. Their results also suggest that farmers are found to be very averse to enrollment time but would be less averse to frequent inspection or moderate penalties. Moreover, the study by McCann and Claassen [13] noted that outreach efforts aimed at educating farmers about the actual application process for conservation programs can be helpful in encouraging broader interest in program participation by reducing information costs. The study by Weber [45] revealed that the main factors impacting TC are related to uncertainty and asset specificity and that, overall, farm-related factors were prominent. She also found that frequency-related factors show a minor impact. Lastly, Mack et al. [43] found that “the design and complexity of the agri-environmental program influences the perceived administrative workload”. They observed how outsourcing monitoring modules reduces administrative workload,

yet farmers rated the administrative workload of the program significantly higher than their peers.

5. Conclusions and Final Remarks

This review article aimed to provide a detailed overview of the current state of research related to the analysis of TCs in AECMs by exploring the differences in methodological approaches, objectives, and scope among the most relevant studies available and by summarizing their most significant findings. Results from this literature review showed that there are differences linked to the objective of the studies in terms of the geographical context in which they are implemented, the actors involved in the program, and the objectives aimed to in their analysis. Some studies focused on a single type of program in a specific location, and others opted for a cross-country type of approach and/or encompassed several programs in their analysis. However, the sharpest difference observed across these studies is linked to their methodological approach, which in most cases is focused on quantitative analysis, with only three studies focused on qualitative analysis. This is particularly relevant because it sheds light on the current state of research in this field. By identifying this trend, a potential gap in the literature has been highlighted, signaling the opportunity to address this topic through the development of more qualitative approaches. This could ultimately lead to a better understanding of the complexities and nuances involved in TCs in AECMs, which in turn could inform the design and implementation of more effective policies in this area.

Additionally, most of these studies observed a significant variation in the magnitude and determinants of TCs across different AECMs, which often depended on the characteristics of the schemes and the institutional environment in which they were implemented, as well as factors linked to specific characteristics of the farmer and/or their farming business. Additionally, several studies acknowledged the limitations in measuring TCs especially due to the difficulties faced when comparing “like with like” in terms of public and private transaction costs across different policy schemes, both at the national level (total costs) and for farmers. While differences in the magnitudes of private TCs associated with AECMs seemed to vary across studies, most authors agreed in the fact that they represent a barrier to program participation. They also stressed that all policy evaluations should consider TCs, given their size, and recognized how their omission can lead to the design and implementation of suboptimal schemes. The conclusions drawn by several authors are manifold: some of them [13] concluded that “efforts to simplify forms and procedures may be a cost-effective way to increase participation, particularly among farmers who have not traditionally participated in government-sponsored conservation programs, while also reducing the transaction costs borne by government agencies”. Other authors [43] recommended that the public administration needs to focus on improving its information policy (i.e., agricultural regulations) and that agricultural policy should encourage the outsourcing of program-specific monitoring modules. Some other authors [52] concluded that further research would be needed to better distinguish between farm-related factors and AECM-related factors (for example, clarity in prescriptions, whole-farm or single-parcel approach). By contrast, other authors touched upon the concept of positive TCs, often referred to in the economic literature as a deadweight loss, and stated that they are not necessarily an indication of the scheme’s inefficiency but considered the occurrence of those TCs necessary to achieving the environmental and social objectives of the agri-environmental programs and hence proposed that TCs should be viewed as a functional cost [18]. The level of trust from all actors directly involved in AECMs was also observed to be a relevant factor influencing transaction costs, especially because it can potentially reduce monitoring costs. In some cases, the studies pointed out that it is relatively easy to transfer funds to farmers, but it is quite more complicated to ensure that the right farming management practices are followed in return [40]. This lack of trust could be partly related to the

scarce knowledge on this topic that some authors observed especially among farmers Mettepenningen et al. [51].

These observations uncover new avenues for research on this specific topic, especially oriented to analyze TCs in AECMs not only from a quantitative way but also exploring stakeholders' perceptions in a more qualitative way. However, new studies should aim to develop frameworks that allow a higher level of comparability and replicability in their methods so that results can be more generalizable and therefore more useful for policy makers and other stakeholders involved in the design of new and more efficient AECMs. Additionally, it would be interesting to analyze the effect of different combinations of factors that have been found to influence TCs in AECMs, as most studies have mainly focused on assessing them separately. Nonetheless, considering the low number of articles included in this review, it is evident that it is not an easy topic to address. In fact, the main challenge for future empirical analysis has to do with the complexity inherent to the great diversity and heterogeneity of these public policies which often have different objectives, are implemented in very different context, and involve different types of actors.

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Abbreviations

AES	Agri-environmental schemes
AECMs	Agri-environment-climate measures
CAP	Common agricultural policy
EU	European union
NIE	New Institutional Economics
PPPs	Public-private partnerships
PRTCs	Policy-related transaction costs
TCs	Transaction costs
TCT	Transaction costs theory
TCE	Transaction costs economics
WES	Wildlife Enhancement Scheme
WOS	Web of science

Appendix A

Table A1. Search strings used in Scopus and Web of Science.

Scopus	
97	<p>TITLE-ABS-KEY (((("transaction cost*" OR ("transaction cost*" AND analysis) OR ("transaction cost*" AND measure*) OR ("transaction cost*" AND assessment*)) AND ((agri-environment* AND measure*) OR ("payment for ecosystem services*" OR (agri-environment* AND scheme*) OR (agri-environment* AND policy*) OR (agri-environment* AND program*)))</p> <p>Timespan = 1999–2023; Search language = Auto</p>
Web of Science	
78	<p>TI = (((("transaction cost*" OR ("transaction cost*" AND analysis) OR ("transaction cost*" AND measure*) OR ("transaction cost*" AND assessment*)) AND ((agri-environment* AND measure*) OR (agri-environment* AND scheme*) OR ("payment for ecosystem services*" OR (agri-environment* AND policy*) OR (agri-environment* AND program*))) OR TS = (((("transaction cost*" OR ("transaction cost*" AND analysis) OR ("transaction cost*" AND measure*) OR ("transaction cost*" AND assessment*)) AND ((agri-environment* AND measure*) OR (agri-environment* AND scheme*) OR ("payment for ecosystem services*" OR (agri-environment* AND policy*) OR (agri-environment* AND program*))) OR AB = (((("transaction cost*" OR ("transaction cost*" AND analysis) OR ("transaction cost*" AND measure*) OR ("transaction cost*" AND assessment*)) AND ((agri-environment* AND measure*) OR ("payment for ecosystem services*" OR (agri-environment* AND scheme*) OR (agri-environment* AND policy*) OR (agri-environment* AND program*)))</p> <p>Databases = WOS, KJD, MEDLINE, RSCI, SCIELO Timespan = 1999–2023; Search language = Auto</p> <p>TI = title; TS = topic; AB = abstract</p>

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