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How Can Collective Action Support the Agroecological Transition in Geographical Indication Vineyards? Insights from the Loire Valley Wine Area

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Abstract: Few studies have examined the agroecological transition in viticulture, which involves transformation processes, especially at the territorial scale where collective action plays a key role in the dissemination of transition strategies. Collective action in the agroecological transition must be studied in order to encourage and accelerate changes in practices. In this study, collective action is analyzed to understand how governance structures influence the development of collective agroecological transition strategies. Elinor Ostrom's Institutional Analysis and Development and Social–Ecological Systems analysis frameworks were applied to the Anjou-Saumur wine area in the Loire Valley, where nearly 80% of wine production is under protected designations of origin. Data were collected through seven semi-structured interviews, which were analyzed qualitatively in order to identify the main actors and collective strategies in the agroecological transition. The study showed that the polycentric structure of governance in the protected designations of the origin system enables institutional actors to collectively coordinate their actions. Moreover, collective action is structured in three focal action situations that overlap at the institutional level due to two key actors in the agroecological transition, but also due to tacit rules of the organizational structure for some actors. Action situations dynamically interact with each other across time and geographical scales, helping the agroecological transition process forward by combining top-down and bottom-up strategies. This study provides a novel way of applying the IAD/SES framework as well as a new look at collective action for the agroecological transition at the institutional scale in French viticultural systems under protected designations of origin. This paves the way for interdisciplinary research for the agroecological transition, and might help to select the best strategies to encourage changes of viticultural practices.

Keywords: agroecology; geographical indications; viticulture; product specification; IAD/SES; polycentric governance



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1. Introduction

It has become increasingly necessary to change the current agricultural systems by developing sustainable practices. To this end, agroecology has often been put forward as an alternative agricultural model to reduce the environmental impact of agriculture [1–3]. Specifically, research has shown that agroecological practices can help enhance the ecological functions of agroecosystems and thus reduce the need for chemical inputs [4,5], which has become an important issue in viticulture [6,7].

However, transforming our practices and social organizations into locally adapted agroecological systems implies transition and transformation processes [8–10]. Transition pathways and strategies are diverse according to the transition actors' underlying perceptions of agroecology [11]. Some strategies are apparent, such as certification for

organic agriculture [12], whereas others are less noticeable [13] and vary from reducing inputs to redesigning agroecosystems. As a result, the alternatives to the conventional farming system are numerous, ranging from more substitutive to more transformative agroecological models [14,15]. Therefore, the agroecological transition (AET) requires an understanding of both ecological and socio-economic causes and constraints, particularly in the case of the wine sector.

Wine-growing management increasingly considers agroecological issues [6,16], such as biodiversity preservation and development, pesticide reduction, soil quality conservation, and the adaptation of vineyards to climate change [17]. Furthermore, agroecology and the AET mainly seem to be studied at the plot and farm scales and much less so at the territory and landscape scales; although, the literature suggests that the latter are crucial for efficient transitions [18,19]. Action at the landscape level allows AET strategies to be scaled up to a territorial scale, e.g., by enhancing biodiversity to reduce insect pests [5]. However, a biodiversity-based vision of the AET [20] should be developed to better understand the tradeoffs made by winegrowers when adopting agroecological practices.

Collective action is necessary to coordinate the many different stakeholders involved in the AET (farmers, government agencies, local authorities, technical and research institutions, etc.) and enable changes in farming practices [21]. The territorial scale is often favored for the study of collective action, especially in the field of resource management [22]. Problems posed by collective action, including the size of the group of actors involved and their heterogeneity [23], can be overcome with territorial polycentric governance structures, i.e., multiple centers of semiautonomous decision-making, and rules promoting the creation and sharing of knowledge [24,25]. In order to study the agroecological transition, it is important to understand what the different possible collective strategies are for the agroecological transition, as well as the factors influencing their development such as governance structures.

This study aimed to analyze how collective action might influence the elaboration of AET strategies and discuss their effectiveness in encouraging agroecological changes in winegrowers' practices. To do so, we used the Institutional Analysis and Development (IAD) and Social–Ecological Systems (SES) frameworks of E. Ostrom [26–28] to characterize collective action and analyze the transition in action. We took a qualitative approach with a case study in the Loire Valley vineyard and a focus on the Anjou-Saumur wine area in France, where actors are already very involved in the AET.

In the Loire Valley, close to 90% of wine production is under a geographical indication (GI): either a protected designation of origin (PDO) or protected geographical indication (PGI) (INAO in 2020). Geographical indications are interesting tools in the context of the AET for two reasons. First, they exemplify embedded and localized agricultural systems [29] and thus may be used to scale the AET to a territorial level [30,31]. Second, collective action is inherent to geographical indication systems as much for their implementation as for their longevity [32–34]. In France specifically, geographical indication product specifications are the product of a producer-driven institutionalized system [34,35], in which collective producer groups (“Organismes de Défense et de Gestion”, ODGs) are responsible for drafting and defending the product specifications [33,36]. Thanks to the collective action fostered by these institutionalized geographical indication systems, these collective organizations could produce AET strategies at different geographical levels.

The IAD framework has already been applied to geographical indication systems [32,34,37], although not in the context of the AET. Studies of the AET that have used the SES approach often combined it with a multi-level perspective and the socio-technical analysis framework [8,20,38]. The few studies that have considered the AET of geographical indication systems have used the socio-technical approach only [29]. We chose to apply the combined IAD/SES framework [39] to geographical indication systems to study how collective action influences the establishment of AET strategies, by focusing on focal action situations, i.e., networks of interconnected action situations. The novelty of this work is based both on the use made of the IAD/SES framework of E. Ostrom,

usually applied by analyzing rules, whereas we analyze the focal action situations, and on the new perspective brought by this analytical framework on collective action in the agroecological transition.

The article is organized as follows. First, after presenting the context and the studied area, we explain the polycentric nature of PDO systems in the Loire Valley (Section 2.1). Second, we discuss the interest of applying the IAD/SES framework to agricultural systems and, more specifically, geographical indication systems as well as the methodology used (Sections 2.2 and 2.3). Third, focusing on the Anjou-Saumur wine area, we highlight focal action situations, which are the social spaces where individuals or groups of individuals interact and produce outcomes. These outcomes have enabled the production of AET strategies at the scale of the studied area. We finally discuss the effectiveness of these AET strategies in relation to a transformative vision of agroecology (Section 3).

2. Materials and Methods

2.1. Study Context

2.1.1. Agroecological Transition of Geographical Indications in France

Since the 1980s, the agroecological transition (AET) has been gradually highlighted in agricultural policy agendas in Europe and France (Table 1), encouraging many forms of territorial and collective strategies [40–42]. Even though not all policies have been efficient [43], there has been a clear acceleration in the production of policies aimed, if not directly at the AET, at least at improving the sustainability of food systems (Table 1).

Table 1. The main agricultural policies contributing to the agroecological transition (AET) in France and Europe.

Policies (EU and France)	AET Application Measures	Year	Brief Summary
“Loi d’Orientation Agricole” (law n°80-502)	French Organic Agriculture	1980	First official law regulating organic agriculture in France.
European regulation (CEE 2092/91)	Organic Agriculture	1991	European regulation officializing the principles of organic agriculture in the EU.
Common Agricultural Policy—reform	Agro-environmental measures (MAE)	1992	Direct payments to farmers, first introduction of voluntary agri-environmental measures.
Common Agricultural Policy—reform	Conditionality	2003	Payments to farmers are submitted with respect to certain food safety, environmental, animal health, and welfare standards.
“Grenelle Environnement” (law n°2009-967)	High Environmental Value (HVE)	2008	Open debate on environmental issues and sustainable development that gave way to regulations on agriculture and other subjects. Concerning agriculture, the Grenelle gave way to the “environmental certification of farms” and the implementation of the HVE label after 2012.
Ecophyto plan	DEPHY farm network	2008	Result of the “Grenelle Environnement”. Its original aim was to reduce the use of phytosanitary products by 50% from 2008 to 2018. The “DEPHY farm” network was set up in 2010 in order to accompany voluntary farmers in their approach to reducing phytosanitary products.
“Loi d’Avenir pour l’Agriculture et la Forêt” (law n°2014-1170)	Creation of economic and environmental interest groups (GIEE)	2014	The first law to explicitly talk of agroecology in farming systems in France. In particular, the GIEEs aimed to motivate farmers to collectively carry out a long-term project to sustainably modify or consolidate their agricultural systems and practices.

Table 1. Cont.

Policies (EU and France)	AET Application Measures	Year	Brief Summary
Ecophyto II, Ecophyto II+	Groupes 30,000	2016	An update of the Ecophyto pushed back to 2025 the objectives of a 50% reduction in phytosanitary products and created the “Groups 30,000” whose objective was to collectively implement systems and techniques already tested and proven by the DEPHY network. New update for the Ecophyto plan to accompany the definitive ban of glyphosate was made in 2018.
“Etats Généraux de l’Alimentation” EGA (Egalim law n° 2018-938)	Plans filière, INAO’s options for ODGs	2018	The EGAs were public debates associating all stakeholders of food production. It concerned the creation and distribution of value in food production and the access to sustainable and healthy food for all. It gave way to the Egalim law in 2018.
European Green Deal	Farm-to-Fork	2020	European deal to reach an objective of no net emissions of GHG by 2050. Concerning agriculture, this gave way to the Farm-to-Fork strategy for a sustainable food supply chain.
Common Agricultural Policy—reform	Eco-schemes	2022	Strengthening conditionality and new eco-schemes supporting voluntary actions going further than basic regulations.

After the promulgation of the Egalim law in 2018, the National Institute of Origin and Quality (INAO), the public agency in charge of supervising Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI) systems in France, produced three options to help local geographical indications (GIs) management bodies (“Organismes de Défense et de Gestion”, ODGs) and their member farmers move toward the AET: (i) include specific agroecological measures directly in the product specifications (such as “improving the efficiency of the spraying equipment”), (ii) encourage farms to pursue environmental certifications as part of a collective approach at the ODG level, and (iii) include in the specifications an obligation to obtain an environmental or organic farming certification. These options were officially presented by the INAO to ODGs in 2020.

The wine sector, which is the most important for French geographical indications, was the first engaged sector and the INAO published a guide to agroecology in viticulture in 2017 [44]. This guide, written jointly by the INAO and the French Vine and Wine Institute (IFV) compiled a large number of agroecological measures [45]. Based on this guide, the INAO’s national committee for designations of origin relating to wines selected measures that were presented to wine ODGs to be directly implemented within product specifications. In February 2022, the selection included 12 standard measures, the two most recent giving the possibility to completely prohibit the use of herbicides and insecticides [46]. The system benefits from a simplified procedure that allows the specifications to be modified more quickly than usual.

2.1.2. Geographical and Ecological Description of the Loire Valley Wine Area

The Loire Valley wine area is one of the 10 French wine areas [47] and is located in the northwest of France (Figure 1). It straddles 15 departments and four administrative regions (Pays de la Loire, Nouvelle Aquitaine, Centre Val de Loire, and Auvergne Rhone Alpes) and covers approximately 57,000 ha, which represents around 8% of the French wine-growing area [48]. The region contains 57 geographical indications, including 52 PDOs and 5 PGIs, which makes it the third-largest wine region in France in terms of geographical indication wines, accounting for approximately 11% of the national PDO wine production [48].

The area is divided into five main areas from west to east (Figure 1): the Nantais, Anjou-Saumur, Touraine, Centre-Loire, and Puy de Dôme areas. In addition, there are two smaller wine production areas: the Fiefs Vendéens and Haut-Poitou areas.

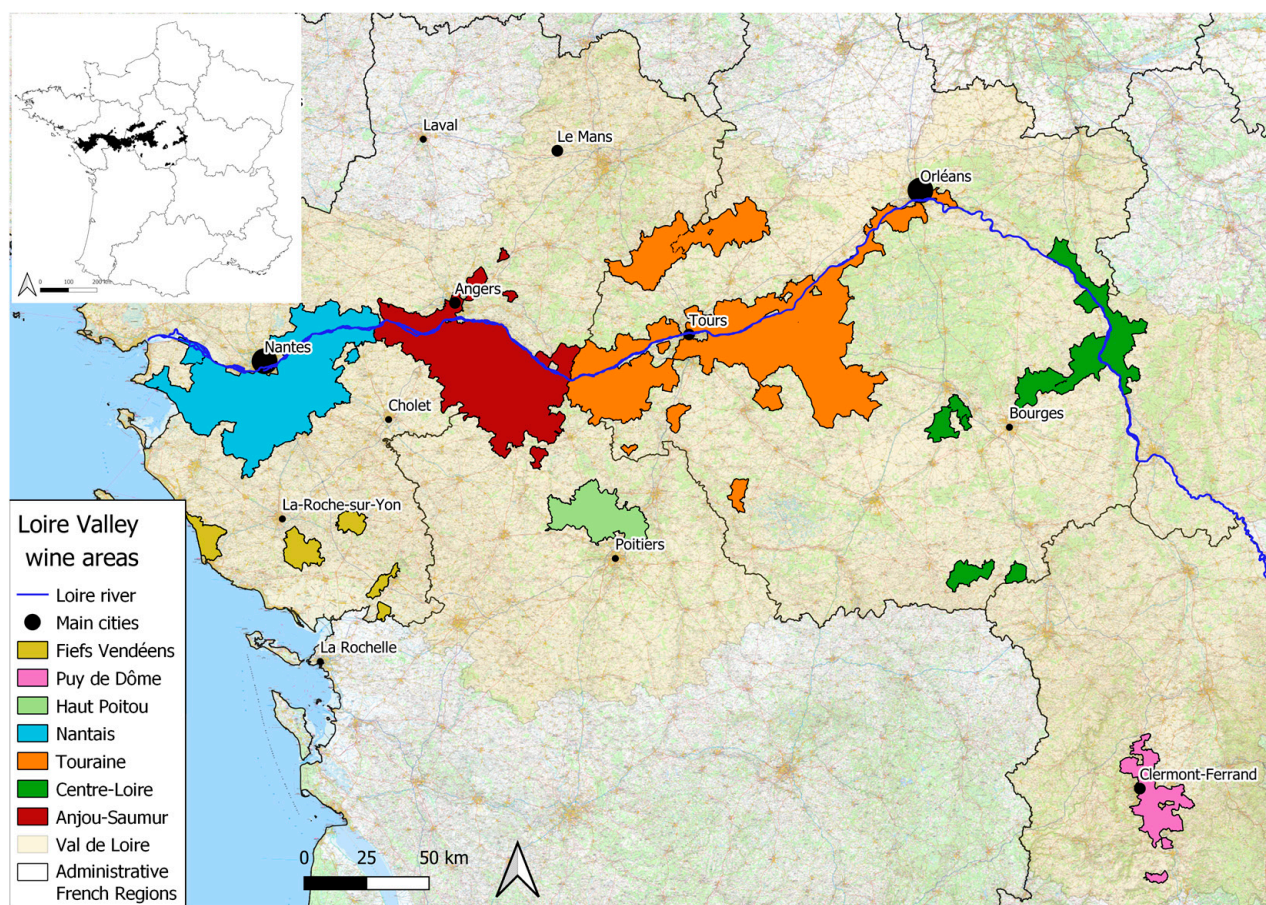


Figure 1. Map of the Loire valley wine areas.

The wines produced in the Loire Valley are diverse, including all colors as well as dry, sweet, and sparkling wines. We chose to focus only on PDOs, as over 80% of the wine production in the Loire Valley is under a PDO [48]. A particularity of the Loire Valley is that many PDO areas overlap, allowing winegrowers to produce more than one PDO wine at the farm and plot scales.

Product specifications are designed to ensure product quality and origin based on controllable elements, which means that they do not necessarily address all the challenges of agroecology in viticulture. There are four main agroecological issues in viticulture (Table 2): the adaptation of vineyards to climate change, the reduction of pesticides, and the preservation of biodiversity and soil quality [17].

Winegrowers have always adapted their practices and genetic plant materials (such as the choice of variety) to the local context and variations in climate and soil combinations. Today, they need to face new challenges and adapt their practices to address agroecological issues, which is especially difficult in viticulture because some practices are fixed at the establishment of the vineyard. Furthermore, grapes are a perennial crop and are sensitive to certain wood and cryptogamic diseases as well as to inter- and intra-annual climate variations. As a perennial crop, vines are important to consider for the preservation of biodiversity at the landscape scale [49]. A biodiversity-based vision of agriculture [20] appears especially important for viticulture both to enable the adaptation of practices and plant material to climatic variations and to contribute to the conservation of cultivated and noncultivated biodiversity, which, in turn, will help maintain the terroir to which the vines are linked.

Table 2. Regulation of viticultural practices in a product specification with regard to the main agroecological issues in viticulture and the possible agroecological practices that can be implemented. An example of “Anjou” wine specification (JORF, October 2022). Agroecological issues [17] are: preservation and development of biodiversity (PDB), reduction of phytosanitary products (RPB), preservation of soil quality (PSQ), and adaptation of vineyards to climate change (ACC).

Decision-Making	Regulation of Practices in the Product Specification of the “Anjou” PDO	Examples of Non-regulated Practices	Examples of Agroecological Practices That Can Be Implemented in Viticulture	Agroecological Issues
Establishment of the vineyard: raw materials (varieties, rootstocks, and clones)	Authorized variety according to wine color	Selection of rootstock and clone	Adapting raw materials to soil/sub-soil and local climate constraints to control the vine development. Use of new varieties for climate adaptation. Management of competition between vines and with the grass cover, agroforestry (inside and around plots).	PDB, RPB, ACC
Establishment of the vineyard: training system	Plant density, row spacing, pruning type, height of the canopy	Row direction, planting of trees (e.g., fruit trees) in the vine row	Delayed pruning to enable vines to resist frostbite, crushing vine shoots to reduce organic matter loss. Reduce sensitivity to pests with prophylactic practices, prioritize biocontrol practices, preventing sunburn.	RPB, PSQ, ACC
Managing of the vineyard: yield management	Pruning with a specific number of buds per branch, maximal yield, irrigation is prohibited	Pruning time		PSQ, ACC
Managing of the vineyard: vine health	A “good overall cultural state” of the vine is required	Canopy management: hedging, leaf removal, cluster thinning, phytosanitary treatments		PDB, RPB, ACC
Managing of the vineyard: soil health and biodiversity	Compulsory vegetation cover (spontaneous or sown) on the inter-row OR tillage to manage spontaneous vegetation OR use of approved bio-control products; cover crop around the plot where machines are running	Cover species, mulching, fertilization, neighboring land use	Leave spontaneous vegetation for at least half of the inter-rows.	PDB, RPB, PSQ, ACC

2.1.3. The Nested Collective Organization System of Viticultural Geographical Indications in the Loire Valley

The Loire Valley wine area presents an integrated organization of institutional actors linked to geographical indications. Winegrowers who produce under PDOs or PGIs declare their harvests to the corresponding ODG, (“Organisme de Défense et de Gestion”, defense and management organization), which is an organizational system particular to France [36,37]. In the Loire Valley wine area, the ODGs of PDOs are themselves organized in several wine federations that also act as unions.

There are two official interprofessional bodies in the Loire Valley wine area: the BIVC in Centre-Loire, and Interloire for the Nantais, Anjou-Saumur, and Touraine areas (Figure 1). These interprofessional bodies enable interactions between approximately 3000 winegrowers, cooperatives, and merchants for economic governance, research and development, and the safeguarding and promotion of Loire Valley wines. Interloire represents most of the Loire Valley’s winegrowers, and we chose to concentrate on this area. We specifically focused on the Anjou-Saumur area as it contains the most PDOs and has the most wine estates (Figure 2).

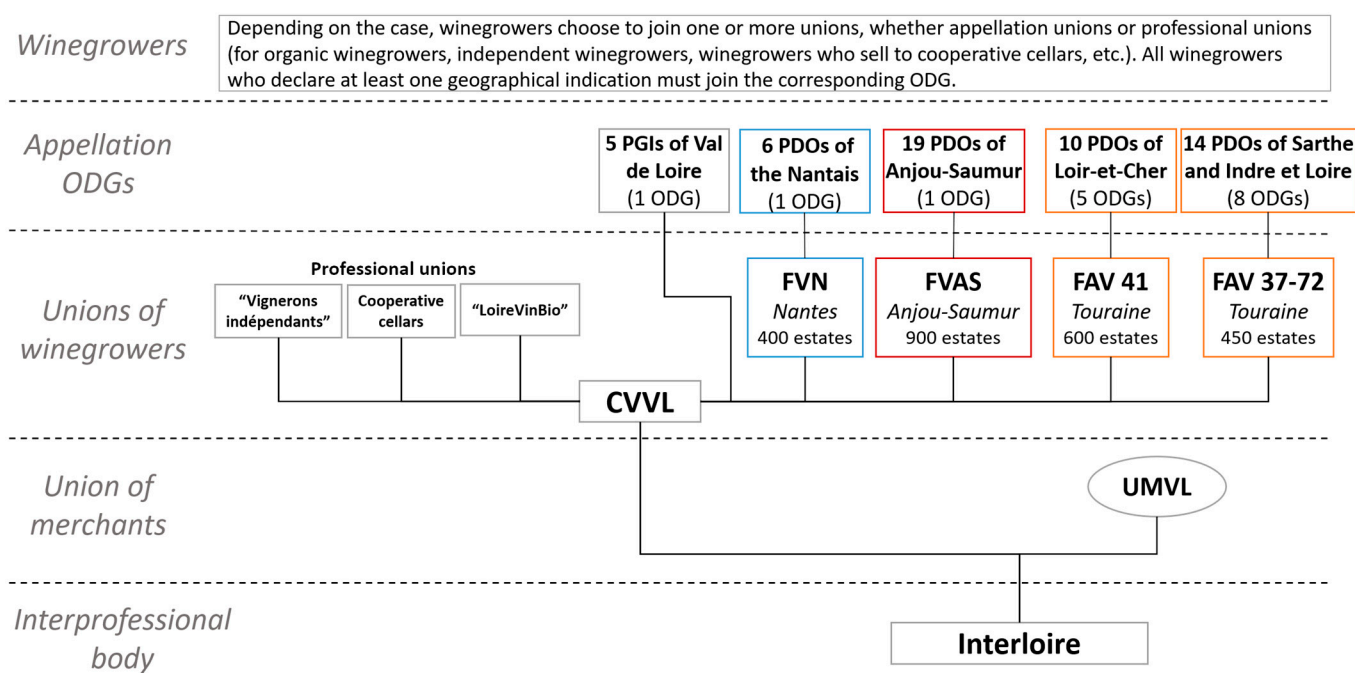


Figure 2. Organization of the professional ecosystem tied to the geographical indications of the wine areas from Nantais to Tours. CVVL: Confederation of wine unions of the Loire Valley; UMVL: Union of Houses and Brands of Val de Loire; FVN: wine federation of Nantais; FVAS: wine federation of Anjou-Saumur; FAV 41: wine federation of Touraine, Loir-et-Cher district; FAV 37–72: wine federation of Touraine, Indre-et-Loire, and Sarthe districts. ODGs: “Organisme de Défense et de Gestion”, defense and management organization.

Four of the wine federations of the Loire Valley wine area have chosen to regroup themselves under one body, the Confederation of Wine Unions of the Loire Valley (CVVL), which brings together the wine federations of Nantais, Anjou-Saumur (FVAS), and Touraine. In 2016, it also joined the ODG of the Loire Valley PGIs as well as three professional unions: the union of Independent Winegrowers, the union of cooperative cellars, and LoireVinBio (organic winegrowers’ union) (Figure 2). Since then, the CVVL ensures that opinions are harmonized so it may represent them at the interprofessional level, thus enabling the representatives of the winegrowers to work jointly with the professionals of the wine trade. The interprofessional body Interloire is composed of two entities: the CVVL and the Union of Houses and Brands of Val de Loire (UMVL), which is a trade union. Table 3 presents the governance structure of Interloire, the CVVL, and the FVAS.

The governance of the PDO system in the Loire Valley has a coordinated polycentric structure [50]. Decisions are made at all geographic and institutional levels of the system with overall coordination of action when addressing transversal problems through official discussion arenas. This is particularly the case in the context of the AET, as actors of the PDO system in the Loire Valley interact among themselves but also with many other agricultural and environmental institutions, state representatives, and local authorities, who each have a different role in relation to the winegrowers producing PDO wines.

Interactions between these different actors can help foster different AET strategies, which may encourage changes in wine-growing practices.

Table 3. Functioning of governance for the three main geographical indication actors of the case study in Anjou-Saumur: Interloire (the interprofessional body), CVVL (the Confederation of Wine Unions of the Loire Valley), and FVAS (wine federation of Anjou-Saumur).

Actor	Governance Bodies	Elected Representatives
Interloire	Bureau	6 members (3 winegrowers, 3 wine merchants) including an elected president for three years by the General Assembly (alternation between a winegrower and a wine merchant)
	General Assembly	30 winegrowers, 30 wine merchants
	Advisory Board	All presidents of ODGs, wine federations, the CVVL and the trade union (UMVL)
	Strategic Orientation Council	nine winegrowers, nine wine merchants
CVVL	Bureau	8 winegrowers (one per institutional member chosen from the administration council)
	Administration Council	16 winegrowers (two per institutional member, half of them sit at the strategic orientation council of Interloire)
	General Assembly	30 winegrowers (ratio according to the size of the institution they represent, these are the same winegrowers who sit at the Interloire General Assembly)
FVAS	Bureau	10 winegrowers
	PDO Sections	23 sections with an elected president(s) and several representatives for each
	General Assembly	Representatives with a ratio proportional to the surface area of the PDO sections
	Board of Directors	33 winegrowers (all the section presidents and all members of the bureau)

2.2. Analytical Framework

We used the combined IAD/SES framework from E. Ostrom to study the effects of agroecological transition (AET) strategies as outcomes of the interactions between actors in the context of PDOs [26,27,34,39]. Key aspects of this framework include the analyses of governance, actors, resource systems, and resource units.

The IAD/SES framework was developed to analyze how actors of a social-ecological system interact within a given set of rules (or governance system) to manage a common-pool resource. It may also be applied to other types of problems of collective action [27,28]. The focus of the framework is the focal action situation, or action arena, where actors in the system interact according to rules-in-use to produce outcomes for the collective management of the SES. In agroecosystem management, especially in the case of geographical indications, the managed resource corresponds to all the elements of an agricultural landscape (hedges, forests, agricultural plots, soil, water, etc.). Outcomes have a retroactive effect on elements of the SES and can lead to further action situations. Moreover, focal action situations can overlap and may form a “network of adjacent action situations” where the outcomes of one action situation generate the rules for another [51].

Building on the recent literature on the IAD/SES framework [52], we propose an application of the framework to the governance system (“who can do what to whom, and on whose authority”, [53]) of PDO wine systems in the Interloire area of the Loire Valley to study the effects of collective action for the AET. Despite carrying a fairly anthropocentric vision of the ecological system [54], the IAD/SES framework can be applied to studies of agroecosystem management, as it allows to equally consider the social and ecological sub-systems [55].

We analyze the AET through the prism of the IAD/SES framework as an issue of collective action around which the various actors (funders, research institutes, trade unions, winegrowers, technical institutes, local authorities, etc.) organize themselves (or not) to manage the agricultural land as a common-pool resource. The IAD framework has already been applied to geographical indication systems to study the establishment of specifications as well as the processes of changing them [32,34,37]. Nevertheless, few studies have studied

the link between the AET and the governance systems tied to geographical indications [29], and we argue that the IAD/SES framework can help fill this gap. Our approach focused on studying focal action situations, unlike studies that focused on the different levels of rules [32,37], which allows us to highlight the capacity of a complex polycentric system to implement AET strategies while fitting into a more global regulatory context [24,25,56].

2.3. Data Collection and Analyses

2.3.1. Data Collection

To analyze the dynamics of collective action and its role in the AET within the PDOs of the Loire Valley, we collected empirical data through seven qualitative, semi-structured interviews with key institutional actors in the wine area: we interviewed two INAO employees (the territorial delegate of the Pays de la Loire region and a national inspector who was also a member of the national INAO environmental commission), the head of the viticultural department at the regional Chamber of Agriculture of Pays de la Loire, the director of the technical institute IFV, the director of the FVAS, the director of the CVVL, and the manager of the “Sector relations” department of Interloire.

The interview questions concerned (i) the professional career of the interviewee and basic information about the role of the institutional structure in which they worked, (ii) the AET in the wine sector and in the Loire Valley wine area particularly, (iii) the PDO wine specifications and their role in the AET, and (iv) the structure and rules of interactions between institutional actors of the area. We built the interview guide with the objectives of identifying all the stakeholders involved in the AET, highlighting the interactions between the actors, and characterizing the AET strategies according to the IAD/SES framework. Interviews were recorded and fully transcribed.

Further data were collected from public documentation on the official websites of all the identified actors in the studied system as well as from documentation provided by the interviewees themselves. We also collected public data from the French Ministry of Agriculture. Finally, we collected informal information by participating in two professional meetings organized by key actors, such as Interloire, to discuss technical research results.

2.3.2. Data Analyses

We analyzed the data according to the IAD/SES framework [28,39,57]. Our analytical approach produced an analysis of the “rules-in-use” of the studied system in the AET context as well as the identification and analysis of the key focal action situation through the construction of networks of actors involved in the AET.

We first conducted a qualitative analysis of the semi-structured interviews, supplemented with technical documents when necessary. This way, we identified the actors with a role in the AET, the interactions between these actors and the rules-in-use regulating them that fell within the scope of the AET, and their key chronological steps. Next, we identified the different collective AET strategies as outcomes of the interactions between the actors with a potential retroactive impact not only on the actors and their interactions, but also on the practices of winegrowers at different geographic scales. Finally, we delineated the different focal action situations to analyze collective action. We produced a conceptual map to represent the actors, interactions, outcomes, and focal action situations.

3. Results and Discussion

Our results are threefold. First, we show that although the producer groups (“Organismes de Défense et de Gestion”, ODGs) have some lever of action for the agroecological transition (AET) of PDO winegrowers, they are part of a broader institutional system of interacting actors who have produced several collective transition strategies in which the ODG was not always the most central actor. Second, we highlight the nested nature of this system, in which focal action situations overlap due to certain actors who participate in several institutional bodies and are therefore central in decision-making for the AET.

Finally, we identify several retroactive and dynamic effects on the structure of the focal action situations network and highlight their role in transforming agricultural systems.

3.1. *The Collective Dynamics of the Agroecological Transition in the Anjou-Saumur Wine Area*

The collective action of the AET in the Anjou-Saumur area can be broken down into three different focal action situations. First, the ODG (FVAS), a group of winegrowers in charge of defending PDOs, takes advantage of its special role to encourage changes in practices. Second, the interprofessional body uses its “Plan Filière” to facilitate access to financial resources for research and development actions in relation to the AET and integrate transition monitoring indicators. Finally, technical support services, including those dedicated to organic farming, directly support winegrowers in changing their viticultural practices. Figure 3 presents these main focal action situations where the AET strategies were debated among the key actors of the AET in the Loire Valley. The following sections present a more detailed analysis.

3.1.1. *The Key Role of the Producer Group in Leveraging the Agroecological Transition of PDO Winegrowers*

In response to the strategy adopted for geographical indications at the national level in 2014 and the three options submitted by the INAO in 2020, the ODGs of the Loire Valley wine area were involved in this dynamic fairly early on. The ban on weeding plot borders (standard measure n°2 in the national INAO’s options) was adopted in the PDO specifications of the entire Interloire wine area before 2010. The Anjou-Saumur wine federation (FVAS) was a pioneer in this commitment as the first to go further: in 2015, discussions between PDO sections of the FVAS led to the implementation of a new standard measure, which banned chemical weeding between vine rows (standard measure n°3). This measure was officially implemented in the 16 PDO specifications of the Anjou-Saumur area in 2019 and is represented in focal action situation A in Figure 3.

Although introducing this standard measure to all product specifications of the Anjou-Saumur wine area was a significant step for PDO winegrowers, the FVAS may not have had the most leverage to further engage winegrowers in the AET. Despite the INAO’s commitment at the national and regional levels, changing product specifications is too long a process to fit into the current European Union regulations [37]. Even without considering the administrative process, ODGs must ensure that most of their winegrowers (classically over 90%) can implement the measure before executing it officially, so as to not suddenly deprive some growers of the possibility of producing PDO wines. The geographical indication specifications are rules that winegrowers write themselves and are respected and controlled. According to our interviews, introducing any other agroecological obligation or environmental certification (e.g., High Environmental Value [HVE], Organic Farming, “Terra Vitis” . . .) in addition to the PDO appeared to be too demanding and risked delaying the adoption of more agroecological practices by winegrowers.

Although the FVAS encouraged winegrowers to change their practices, this did not directly trigger the other actions that took place. This can be partly explained by the general questioning around the role of product specifications in the AET and its relation to the product’s quality and typicity, making agroecological concerns secondary in the writing of product specifications [58,59]. It can also be explained by the fact that the ODG belongs to a huge network of actors that allows the production of complementary transition strategies. In particular, after the Egalim law was enacted in 2018, there was a clear organization of actors in the PDO wine system to produce common transition strategies. Our analysis suggests that other dynamics surrounding the AET were fostered by different groups of actors, as represented in Figure 3 (focal action situations B and C), and we detail these dynamics in the next sections.

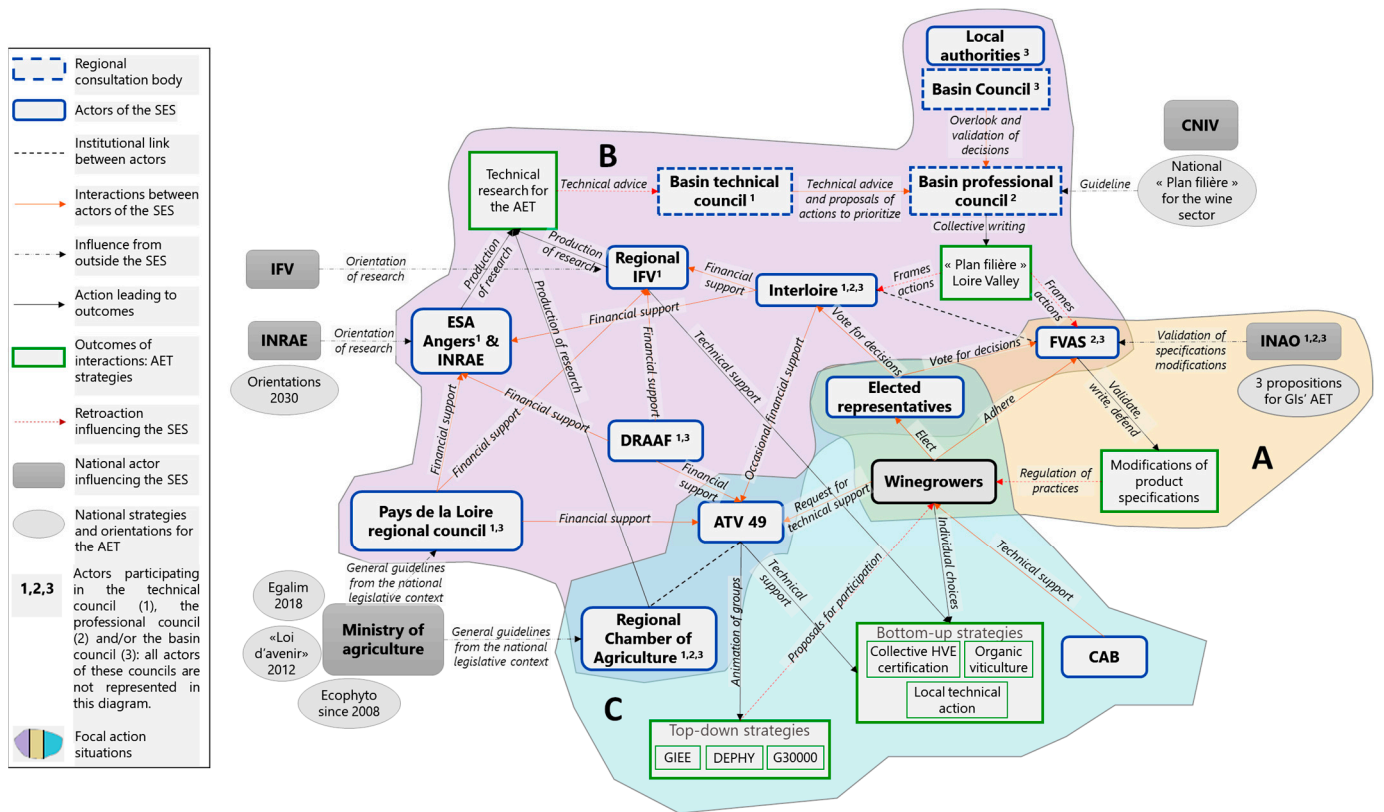


Figure 3. Conceptual mapping of the interactions between actors of the PDO wine system in the Anjou-Saumur and Interloire areas (Loire valley). Only actors directly taking part in the elaboration of an AET strategy were represented, thus for clarity some institutional actors were not represented if they did not play a central role in interactions in the AET context. Letters A, B and C designate the three different focal action situations. INAO: National Institute of Origin and Quality; CNIV: National committee of interprofessional bodies; ESA: Ecole Supérieure des Agriculture (Institute of higher education and research); INRAE: National Research Institute for Agriculture, Food, and Environment; IFV: French Vine and Wine Institute; DRAAF: Regional Directorate for food, agriculture, and forestry; ATV: Technical Viticultural Association, part of the Chamber of Agriculture; CAB: association of organic and biodynamic farmers.

3.1.2. The Driving Force of the Interprofessional Body in the Agroecological Transition at the Regional Scale

Though the Egalim law of 2018 explicitly mentioned changing geographical indication specifications to mandate environmental certification, it ultimately triggered a collective organization of actors in the Interloire wine area through the national Sector Plans (“Plan Filière”). The national Sector Plans at the level of each agricultural sector were intended to serve as examples for regional variations. In the wine sector, the national plan was structured around four engagements [44]: social, environmental, health, and value creation and sharing. Each regional wine area (e.g., Loire Valley, Bordeaux, Bourgogne) was required to write its own version of the plan.

Actors of the area produced an efficient organization to produce a strategic development plan called the “Plan Filière Val de Loire 2030”, which was published in 2019. They intended it to be a coordinating document, defining both the ambitions for the Loire Valley wine production until 2030 and the indicators to be used to monitor the progress toward these ambitions. The plan is organized into four themes, including the creation of value and protection of the environment, human health, and social issues, thus implicitly considering all dimensions of sustainable viticultural systems. Although the plan is not explicitly an AET strategy, it can be considered as such because it now serves as a reference and guide

by Interloire and the Regional Council of Pays de la Loire for financing technical research and viticultural projects.

Verbatim 1. *“That’s what guides us in terms of agroecological transition—it’s essentially the Plan Filière.”*

At the scale of the interprofessional body Interloire, we observed three official discussion arenas that allow interactions between all actors of the wine sector, ranging from technical institutions to research institutions, local authorities, regional state representatives, and national institutions. One of these discussion arenas is the Basin Council, which is mandatory for every wine area in France to enable discussions between the state authorities and the professional representative bodies of the wine area on major political orientations and policies in the wine sector. Another discussion arena is the Technical Basin Council, where the technical commission of Interloire interacts with the other technical organizations of the territory: the French Vine and Wine Institute (IFV), the local chambers of agriculture, and the ESA Angers (a private institute of higher education and research in agriculture). The direction and presidency of the technical council are common to the regional IFV and the technical commission of Interloire.

Following the Egalim law and the demand for a regional “Plan Filière”, professional institutions of the wine area created a third discussion arena called the Professional Basin Council, chaired by the president of Interloire and composed of the members of Interloire as well as the regional INAO and chambers of agriculture. The Professional Basin Council makes decisions based on proposals from Interloire’s Strategic Orientation Council. With the technical support of the Technical Basin Council and the validation of the Basin Council, the Professional Basin Council was responsible for writing the regional version of the “Plan Filière”. These interactions and the writing of the “Plan Filière” are represented in focal action situation B in Figure 3.

According to our interviews, the Egalim law, the creation of the Professional Basin Council, and the writing of the “Plan Filière” were the impetus for the coordination of actors in the wine sector.

Verbatim 2. *“What was very interesting with the sector plan was that it finally formalized things. [. . .] Today the idea—and this is what is interesting in this regional construction, in my opinion—is the fact of bringing people together to pursue a common objective within a framework that is much broader than one’s PDO.”*

This dynamic, fostered by the interprofessional body, made it possible to move from a “niche” system [60] at the level of each ODG, or even at the level of the PDO areas, to an encompassing regional dynamic. As such, the sector plan does not directly imply a change in practices; however, for the first time in the area, all the actors of the PDO wine sector can refer to a unique document that was collectively written and validated and acts as a coordinator and monitor of change at the regional level. It is the self-organization of actors for the collective writing of the sector plan that is part of a transformative agroecological transition: forming a multi-actor network is one of the domains for the transformation of systems [15].

3.1.3. A Dynamic of Collective Learning Fostered by Local Technical Advisory Services

At a smaller scale, collective action for the AET takes many different forms, which are all monitored and accounted for by the “Plan Filière”. One such form is the direct interaction between winegrowers and technical organizations, such as the regional chambers of agriculture, which help them with specific demands. These demands may concern specific and local technical actions (e.g., adaptation of soil management practices to organic practices) or assistance in obtaining environmental certifications (organic, HVE, etc.). In Maine-et-Loire, the “Association Technique Viticole” 49 (ATV49, a technical viticultural association that is part of the Pays de la Loire regional Chamber of Agriculture) provides local support to winegrowers who wish to obtain environmental certifications (whether

organic or other) and has created training groups to support them in this regard. Since 2019, the ATV49 is officially authorized to accompany winegrowers towards a collective HVE certification. The ATV49's accompaniment concerns all winegrowers, but organic winegrowers can choose to work with another technical advisory service, the regional CAB Pays de la Loire ("Coordination Agrobilologique", association of organic farmers) and its local declination GABB Anjou ("Groupement des Agriculteurs Bio et Biodynamiques"), dedicated only to organic and biodynamic farming.

In 2021, 26% of estates and 23% of surfaces in the Loire Valley were certified (or about to be certified) in Organic Agriculture and 31% of estates and 53% of surfaces were HVE certified (see Table 1) [61]. These demands of winegrowers resulted from the interaction between technical advisory services and winegrowers. Additional collective strategies were put in place by these same technical bodies and came from national regulations, such as the Ecophyto plan (see Table 1). These different interactions between winegrowers and technical advisory services and the outcomes of the interactions are represented in the focal action situation C in Figure 3.

Overall, our analysis shows that many actors interact within the scope of the AET of PDOs in the Interloire wine area. The results suggest that these interactions form a network of actors organized in three different focal action situations (A, B, and C; Figure 3), and each focal action situation has one or several outcomes, which are the different AET strategies and pathways in the context of the Loire Valley wine area. We analyze these focal action situations more precisely in the next section.

3.2. The Dynamics of Polycentric Governance of the Agroecological Transition Strategies in the Loire Valley

A key result of our analysis is the overlap of the three focal action situations, as shown in Figure 3. At the institutional level, some institutional actors are part of several discussion arenas. At the individual level, certain tacit rules in the different organizations allow some winegrowers to sit on several bodies (see Table 3). These overlaps facilitate consensus building among actors with their own visions and perceptions of the AET.

3.2.1. Focal Action Situations Overlap Due to Institutional Actors at the Interfaces

Some actors at the institutional level are involved in the overlapping of focal action situations. This improves the chances of reaching a consensus by strengthening the links between actors in the network and contributes to the polycentricity of the governance system, enabling the multiplication of decision making and, therefore, transition strategies. Two actors, in particular, are at the interface of focal action situations.

The first is the wine federation (FVAS), although we have shown that it is not the main driver in the AET because it is mainly involved in product specification modifications. Still, as the ODG and wine federation, the FVAS interacts directly with the INAO at the regional and national levels as well as with the other actors in the wine sector at the local and regional levels while maintaining close contact with the winegrowers through the PDO sections and working groups. This makes the FVAS one of the system's key actors and illustrates that the focal action situations are complementary instead of in competition. Furthermore, this involvement shows that the different collective strategies are cumulative and coordinated, which is the very objective of the "Plan Filière".

The second actor at the interface of focal action situations is the Chamber of Agriculture, which acts on several geographical scales: at the territorial level, the ATV49 interacts directly with the winegrowers, whereas the regional wine service sits on the various basin councils to bring technical advice to these bodies. This involvement of the Chamber of Agriculture is advantageous as it is a generalist organization with broad views of agriculture. Therefore, it participates in discussions and decisions in the wine sector as well as other agricultural sectors, which means that it manages transverse issues, such as the AET, on a broad scale. Furthermore, its sources of funding are diverse, which gives the organization a position of strength. However, in a system where cooperation seems to take

precedence over competition, this translates into a centrality of the Chamber of Agriculture as a research and technical actor close to winegrowers, enabling porosity between the different focal action situations but also between the viticultural sector and other agricultural sectors.

These two actors play different roles in the nested system of institutional actors and are both critical for the AET of PDO winegrowers. They help structure the network of actors, which is crucial for the AET as networks enable local collective action and help coordinate local contexts to other scales of action [15]. Furthermore, these two institutional actors are those who accompany winegrowers on a daily basis, and, therefore, in addition to being a link between the different focal action situations, are also a link between the winegrowers and the other institutional actors of the territory.

3.2.2. Focal Action Situations Overlap Due to Tacit Rules Structuring the Network of Actors

Among the institutional actors, certain tacit rules of organization result in certain individuals participating in several arenas of discussion. This is the case for the elected representatives of FVAS sitting in the general assembly of the regional union confederation (CVVL) as well as at Interloire's general assembly and the Professional Basin Council (see Table 3). It also applies to members of the CVVL's administration council, half of whom represent winegrowers at the interprofessional body's Strategic Orientation Council.

Verbatim 3. *“It's little arrangements between friends...it works. We try to make it the same list as best we can, because, that way, people who have been acculturated to the subject at the level of the General Assembly of the CVVL can carry the message to the General Assembly of Interloire.”*

According to our interviews, these combinations of roles are voluntary and have the advantage of simplifying the system, which allows actors to reduce the negative effects of heterogeneous opinions. It can be argued that heterogeneity in a group of actors multiplies the risk of diverging opinions and can harm collective action [23], making it difficult to reach a consensus. By ensuring that the same people who have discussed and reached a consensus about an issue in one institutional body can discuss the same issue with other people in another arena, these key actors reduce the risk of dissension and limit transaction costs, and may even foster networking between actors [22,34,51], which takes advantage of the positive effects of actors' heterogeneity [33].

However, the advantages of simplifying interactions and reducing the effects of heterogeneity can be further examined by considering the actual representativeness of winegrowers in the AET at the institutional level. All AET strategies aim to bring about and implement a change in viticultural practices that directly concerns winegrowers, but the winegrowers are ultimately only involved in institutional collective action through their elected representatives. Because these elected officials are only elected at the FVAS level but then sit in several bodies, this raises the question of the representative and democratic nature of this complex system of decision making [62]. This also questions the role of nonelected winegrowers, who were never directly involved in defining regional strategies such as the “Plan Filière” and, therefore, the interactions between elected and nonelected winegrowers. This also questions the role of winegrowers' knowledge in the development of institutional collective strategies, if it does not come from diversified sources. The role of knowledge and learning are crucial for the AET [15,63], and, in particular, for its implementation at the winegrower level. This, therefore, questions the effectiveness of collective institutional strategies in changing viticultural practices and calls for research at the farm level [64].

3.3. Agroecological Transition Strategies Are Dynamic in Time and Geographic Scales

3.3.1. Agroecological Transition Strategies Influence One Another over Time

In addition to overlapping, the focal action situations also have a temporal dynamic due to the continuous nature of the AET. Specifically, the AET strategies resulting from the interactions between actors have retroactive effects on the actors, rules, or interactions.

This is particularly the case for the effects of the “Plan Filière” on focal action situations B and C (Figure 3). The “Plan Filière” is not a transformative agroecological strategy as it does not involve direct action but instead follows and encourages action on a more regional scale. However, because it resulted from a large-scale consensus that brought together various actors with heterogeneous viewpoints, it is now acclaimed and often used as a reference. The rules established by this “Plan Filière” (both those it directly established and those resulting from monitoring its indicators of change) influence the interactions between actors, particularly financial interactions. For example, the Technical Basin Council now prioritizes the technical actions to be financed by Interloire and the Regional Council of Pays de la Loire according to the orientations of the “Plan Filière”. This may ultimately encourage more transformative strategies, such as research for the AET and technical actions at a more local scale.

We, therefore, observe a Network of Adjacent Action Situations, as theorized by McGinnis (2011) [51], which emphasizes the temporal dynamic of the AET. Just as we have seen an acceleration of public policies concerning the AET over the past 10 years, the AET has accelerated at the regional level in the PDO wine system of the Interloire area. A PDO wine is produced by combining regulated practices in the product specifications with other practices that are increasingly linked to agroecological practices (e.g., leave spontaneous vegetation to grow at least on half of the inter-rows, Table 2). If the Anjou-Saumur area participated in reducing chemical inputs before the Egalim law and modification of the specifications, it was with the drafting of the “Plan Filière” that we were able to see its rippling effect on the coordination of actors in the sector and on collective action.

3.3.2. Bottom-Up and Top-Down Strategies Are Complementary for an Efficient Agroecological Transition

Two types of regulation tools interact at the territory scale [22]: (i) those that come from the state, viewed as “top-down” approaches and “governance by government” [65], and (ii) those that come from the actors of the SES themselves, which are “bottom-up” approaches or “governance by self-organization” [53]. This question of top-down versus bottom-up often arises in studies of the AET and, in particular, in studies of the obstacles preventing the large-scale dissemination of agroecological solutions [9]. At a territorial scale, we can see the interaction between the national orientations of certain actors with respect to the AET (INAO, INRAE, Chambers of Agriculture) and local issues specific to the agricultural environment and landscape. At this scale, we also observe the interaction between national agricultural policies and local actions of technical advisory institutes carrying out the demands of producers with their own issues and motivations for change. Moreover, we can see that bottom-up and top-down collective strategies are combined in several focal action situations in the Anjou-Saumur wine area to produce more transformative agroecological strategies. Although the focal action situations of the same system overlap and interact over time, this system is not independent of neighboring systems or the national and international contexts in which it lies. Thus, the dynamics of geographic scales also play a role in the transformativity of AET strategies because it is precisely the combination of the two types of governance (top-down and bottom-up) that can be a solution for scaling up the AET [66]. Geographical indication systems, as a form of bottom-up regulation and a producer-driven approach, must therefore be considered as a vector for implementing a national AET policy [29]. Otherwise, the AET risks being conducted only in a top-down manner, which might slow or even prevent the adoption of agroecological practices by winegrowers [15]. The transition pathways are multiple [67], and do not have the same implications in terms of changing practices. However, the existence of multiple pathways contributes to the dynamicity of the AET over time. In our case, the different AET strategies are complementary, allowing a territorial trajectory anchored in a larger-scale dynamic.

4. Conclusions

By applying the IAD/SES framework at a territorial level to the Anjou-Saumur wine area, our study showed that the polycentric structure of governance of the PDO system enabled institutional actors in the Loire Valley PDO wine sector to collectively coordinate their actions and encourage changes in wine-growing practices. Interactions between actors ranged from financial support to technical support and took place at all geographical scales, from the local to the national level. Collective action for the AET in the PDO wine system of Anjou-Saumur and the Loire Valley is structured around a network of actors organized in three focal action situations. This led to the production of different AET strategies, including the modification of product specifications, technical research for the AET, the production of the “Plan Filière”, and various local technical actions resulting from both the initiative of winegrowers and national public policies. The analysis of these three focal action situations showed the dynamic effects of the AET over time and across geographic scales. This study provides a novel way of applying the IAD/SES framework by focusing on the action situations and how they interact at the territorial level, allowing a description of the ongoing process of transition in the PDO viticultural system. Furthermore, this provides a new look at collective action for the AET at the institutional level by showing that coordinated transition pathways can contribute to the AET even though they do not always have a direct impact on viticultural practices, if they are the result of a nested institutional network of actors. However, given the place of winegrowers in our analysis, future research on collective action should consider individual choices, which also play a role in the AET. It seems especially necessary to explore the AET at the level of winegrowers to understand which social organizations help them most effectively and to question the role that the ODG and other institutional actors play for them.

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