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The role of Biodistricts in enhancing food security: case studies from Italy

Prof. Luna Kappler

SUPERVISOR

Prof. Elena De Nictolis

CO-SUPERVISOR

Greta Bortolotti

CANDIDATE

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Abstract

This thesis examines the role of biodistricts in enhancing food security through sustainable agricultural practices and community engagement. According to Dias et al. (2021), biodistricts are geographic regions where farmers, government officials, tourism businesses, associations, and citizens work together to manage local resources sustainably while upholding organic standards and practices. Thus, the research stems from the following research question: *"What role do biodistricts play in enhancing food security through sustainable agriculture, local governance and community-based food systems in Italy?"*

Although the urgency of sustainable food systems is becoming increasingly recognized, the challenge of preserving food security in Italy while advancing resilient community-based food systems, sustainable agriculture, and efficient local governance is the fundamental issue at the heart of this research question. Indeed, environmental deterioration, such as soil depletion, biodiversity loss, and water pollution, has posed a growing danger to food production in recent years. These factors all compromise agriculture's long-term sustainability. Furthermore, Italy's national food system is fragile due to its reliance on international food markets, which exposes it to changes in prices, interruptions in the supply chain, and outside shocks.

In order to better investigate the aforementioned issue, three Italian biodistricts—Val di Vara, Panzano in Chianti, and Cilento—have been chosen as main subject of the study. Through a comprehensive literature review, case-study analysis and related interviews, the study explores how these biodistricts contribute to food security by promoting sustainable agriculture, fostering local economies, and strengthening community ties. Hence, this research adopts a qualitative methodology combining a literature review with the empirical insights provided by semi-structured interviews conducted with key actors of the three Italian biodistricts. Findings are analyzed in relation to broader EU policy frameworks, including the Green Deal and the CAP Strategic Plans, to assess the contribution of biodistricts to sustainable food systems.

The discussion will then compare the unique approaches and outcomes of each case study, providing insights into the effectiveness of biodistricts in different regional contexts. It is expected to verify that biodistricts play a significant role in revitalizing rural territories and communities, serving as concrete examples of sustainable food systems. The thesis concludes with recommendations for policy and practice to support the development and scaling of biodistricts to achieve sustainable and secure food systems.

1. Contextualizing biodistricts: origins, relevance and purpose of the study

Extreme events brought on by climate change, economic or geopolitical instabilities, as well as disease epidemics can cause, propagate, and prolong food insecurity worldwide. Generally speaking, they accomplish this severe consequence by lowering the productivity of agriculture and fisheries, endangering subsistence, and interfering with the distribution of food and public services (FAO, 2021; Tadesse et al., 2014). Extreme natural events can also lead to political instability, human migration, and price rises for food. Access to and availability of nutritious food are decreased because of these direct and indirect effects. It can be challenging to anticipate, plan for, and prepare for the spreading and systemic effects that severe events can have on global food security due to their size, scope, and complexity (Mehrabi et al., 2022).

Whilst food security is becoming more widely acknowledged as a global issue, there are still significant gaps in the literature that address its localized, structural, and policy-driven aspects, especially in high-income nations like Italy. Historically, low-income countries have dominated discussions on food security, highlighting issues with underdevelopment in agriculture, food scarcity, and malnutrition (FAO, 2015; Clapp, 2019). Notwithstanding the relevance and urgency of these concerns, a number of factors, including market dependence, environmental degradation, economic inequality, and unsustainable food production methods, still influence food security in developed nations (IPES-Food, 2017).

The conventional focus on food production as the main factor influencing food security represents a substantial gap in literature. Several studies contend that the solution to food insecurity lies in boosting food production through industrial agriculture and technical improvements (Godfray et al., 2010; Tilman et al., 2011). Nevertheless, recent research emphasizes that accessibility, affordability, and sustainability are just as important as food availability in ensuring food security (Sen, 1981; Lang & Heasman, 2015). Although interest in alternative food networks (AFNs), such as organic farming and local food systems, has increased as a result, little is known about how they contribute to long-term food security (Kneafsey et al., 2013).

The insufficient analysis of regional strategies that combine territorial development and food security represents another significant gap. Studies on agroecology and food sovereignty support decentralized, community-driven food networks, whereas global food policies frequently favor large-scale food supply chains (Altieri & Toledo, 2011; De Schutter, 2014). However, there are still few empirical studies evaluating their efficacy in industrialized countries, especially in European environments. The biodistricts of Italy, which provide a distinctive approach to combining short food supply chains,

organic farming, and local governance, have received little attention in the discourse surrounding food security. Known as "ecoregions" or "organic regions," the bio-districts are a tangible illustration of agroecological concepts applied to food systems. According to Assiri et al. (2021), they are a type of bottom-up rural governance model that aims to develop the economic and sociocultural potential of the area where they are located by involving farmers, the general public, tourism operators, and government organizations.

The advantages of biodistricts for the environment and their function in advancing organic farming are the main subjects of current research (FAO, 2021; European Network for Rural Development, 2022). However, there are still not many thorough studies that examine their role in ensuring food security from a variety of perspectives, including social inclusion, economic viability, and policy integration. It is crucial to comprehend how biodistricts might improve local food security and resilience in light of the mounting worries about climate change, biodiversity loss, and economic instability.

Of relevance to the discussion about food security, especially in Italy, is the analysis of the Global Food Security Index (GFSI), developped by a collaboration between the Economist Impact and Corteva Agriscience. It takes into account 113 nations' food availability, price, quality, and safety as well as sustainability and adaptation. Based on 68 distinct measures, the index is a dynamic quantitative and qualitative benchmarking tool that assesses the factors influencing food security in both industrialized and developing nations. Italy is ranked 17th out of 26 European countries and 27th out of 113 countries in the index.

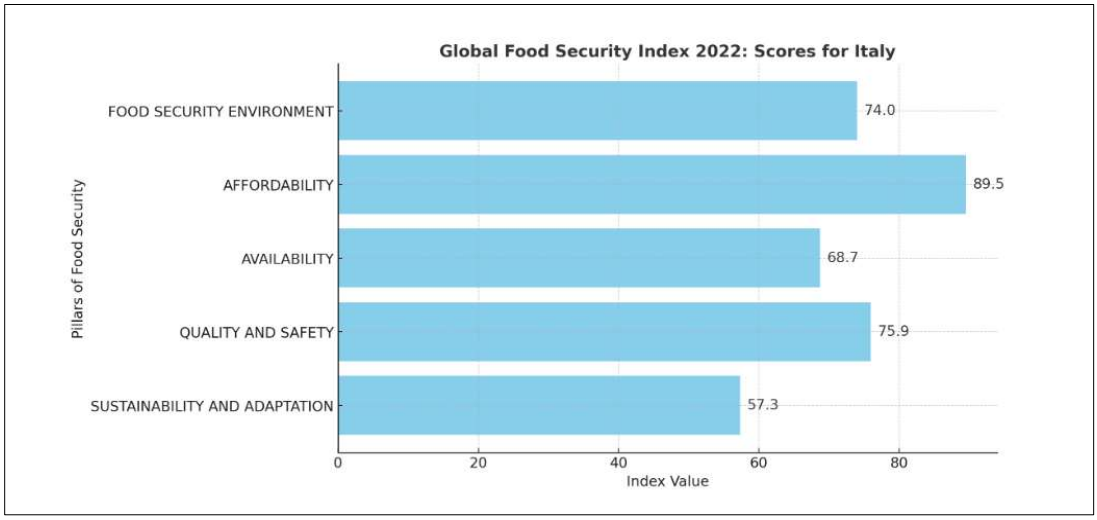

Figure 1: GFSI 2022, scores for Italy

It performs most effectively in the Affordability pillar, where it is ranked 12th in the area and 17th globally (Economist Impact, 2022). As shown in the graph above, it performs the worst in Sustainability and Adaptation, ranking 20th in the region and 40th internationally. According to data, Italy has to preserve the marine biodiversity of its lakes, rivers, and seas while safeguarding the amount and quality of its agricultural water supplies from pollution and unsustainable withdrawals. Policies to control, coordinate, and mitigate extreme events brought on by climate change are also necessary. Nonetheless, Italy maintains a strong environment for food security by offering its citizens reasonably priced, safe, and high-protein food.

To conclude, this broader vision reflects the evolution of biodistricts from local organic initiatives into integrated territorial models for sustainability. In this light, biodistricts can be further understood through the lens of two complementary theoretical frameworks that underpin sustainable food system transformation: agroecological transitions and food sovereignty. The concept of agroecological transition refers to the progressive transformation of food and farming systems based on ecological principles, moving from input substitution towards systemic redesign and re-localization (Gliessman, 2016; Wezel et al., 2009). Biodistricts contribute to this process by promoting not only organic practices, but also participatory governance and territorial coordination mechanisms that support agroecological innovation (Passaro & Randelli, 2022; Dara Guccione et al., 2024).

In parallel, the paradigm of food sovereignty, defined as the “right of communities to shape their own food systems” in ecologically, socially, and culturally appropriate ways, offers a complementary perspective (Patel, 2009): biodistricts put this principle into practice by fostering democratic decision-making, empowering small-scale producers, and restoring local control over food distribution and land management (Altieri & Toledo, 2011). As such, they provide a territorial infrastructure for re-embedding food systems within local economies and communities. Interpreting biodistricts through these frameworks helps clarify their relevance in addressing global challenges, and reinforces their alignment with EU strategic priorities, such as the Green Deal and the CAP Strategic Plans (IPES-Food, 2024).

2. Investigating the role of biodistricts in promoting sustainable development

In light of the gaps in the literature presented above, the research question *"What role do biodistricts play in enhancing food security through sustainable agriculture, local governance and community-based food systems in Italy?"* aims to critically evaluate how biodistricts contribute to Italy's increased food security. Through an analysis of their effects on food accessibility, sustainability, and governance frameworks, this study will offer a more sophisticated comprehension of how regional agroecological models might support national and international food security initiatives. Additionally, it will look at how biodistricts serve as creative models of governance that encourage cooperation between local people, farmers, and policymakers across sectors.

Additionally, this study will investigate how biodistricts serve as socioeconomic development accelerators, promoting robust local food systems that decrease dependency on international supply chains and minimize climate change vulnerabilities. In this framework, biodistricts can improve food availability and food sovereignty by supporting organic farming, bolstering short supply chains, and fostering participatory decision-making, that allows communities to take charge of their own food production and distribution.

This thesis will also evaluate how biodistricts function as creative governance models that promote cooperation across sectors among farmers, policymakers, local communities, and other stakeholders. In order to guarantee that sustainable food production and consumption habits are included into more comprehensive agricultural and economic policies, this analysis will provide insight into how well they bridge the gap between grassroots efforts and institutional frameworks. Finally, by assessing the diverse ways in which biodistricts improve food security, this study will add to the current discussion on sustainable food systems and provide policy suggestions for their broader adoption.

3. Research design and methodology

To meet the purpose of the research, a two-step methodology is adopted. The study is built through a qualitative research design that combines desk-based research and a case study analysis.

In the first part, the literature review is carried out, summarizing the current state of the art on food security, circular economy, biodistricts and their legal background. It draws from pertinent policy documents, peer-reviewed scholarly articles and institutional reports from agencies including the Food and Agriculture Organization (FAO), European Commission and the European Network for Rural Development. The aim of the literature review is to provide a conceptual framework by highlighting the definition and current governance of biodistricts and their link with circular economy to discuss how biodistricts affect food security.

As a second step of the research, semi-structured online interviews will be conducted and the three interviewees are represented by individuals directly involved in the management of the selected biodistricts, including coordinators, and practitioners who play an active role in implementing the biodistrict model. The interviews aim at gathering first-hand insights and experiential accounts that complement the document-based analysis of each case, previously conducted. This approach allows for a deeper and direct understanding of the contextual dynamics, governance structures, and lived challenges within each biodistrict, providing a richer and more nuanced perspective on their development, practices, and impacts. An interview protocol was designed to ensure both depth and comparability of responses, combining open-ended questions with thematic guidance focused on governance, circular economy practices, and food security outcomes. Questions were structured to enable data triangulation with secondary sources and were piloted prior to full deployment to enhance validity.

The third part of the research will depict a comparative analysis on three Italian biodistricts that were selected based on purposive criteria, including geographic diversity, variation in governance models (top-down, bottom-up, hybrid) and their demonstrated engagement with circular economy principles. This approach allowed for a comparative perspective on how different configurations of biodistricts contribute to sustainable food systems and territorial resilience. The selected case studies will provide a typical sample of biodistricts functioning in different geographical contexts:

- *Cilento biodistrict* (Campania): it has been the first biodistrict which was established in Italy and became well known for its robust agroecological network, along with its connection with UNESCO heritage initiatives.

- *Panzano in Chianti biodistrict* (Tuscany): this biodistrict has been chosen for the renowned wine-producing region that hosts it. For years it wisely combines organic farming techniques with high-value agri-food international tourism.
- *Val di Vara biodistrict* (Liguria): what characterizes this biodistrict is its strong commitment to promoting organic farming throughout educational initiatives: in this sense, it invests in research and innovation projects to stimulate sustainable agricultural practices, fosters a direct connection between farmers and citizens as well as the organization of events and fairs.

4. Literature review

The European Union's framework for promoting agriculture, rural development, and food security is known as the Common Agricultural Policy (CAP) and it seeks to address environmental issues, boost rural economies, and develop a resilient, competitive, and sustainable agricultural sector. A crucial component of this framework is the CAP Strategic Plans, which assist EU Member States in customizing agricultural policies to meet their unique requirements. In line with EU policies such as the European Green Deal, these proposals incorporate financing for specific market interventions, rural development initiatives, and direct payments to farmers. By decreasing reliance on synthetic fertilizers, increasing the use of renewable energy, and encouraging ecologically friendly farming methods, CAP Strategic Plans support sustainable food systems in response to global issues such as climate change and geopolitical instability while preserving food production and security. Within the framework of the CAP Strategic Plan, it will support local development initiatives that will reach approximately 56% of rural residents through the promotion of biodistricts and food districts (EU Commission, 2025).

More specifically, the current programming period of the CAP for 2023–2027 represents a significant reform aimed at making European agriculture fairer, greener, and more results-oriented. Officially adopted on December 2, 2021, and entering into force on January 1, 2023, the CAP sets out several key objectives: ensuring fair income for farmers, enhancing competitiveness, improving the farmers' position in the food supply chain, promoting climate action, preserving the environment and the biodiversity, supporting generational renewal, fostering vibrant rural areas, safeguarding food quality and health standards, and promoting knowledge and innovation (European Commission, 2023a). Each EU Member State has developed a national CAP Strategic Plan, which integrates funding for income support, rural development, and market measures, all tailored to the specific needs of each country (European Commission, 2023b). The total budget for the 2021–2027 period amounts to approximately €387 billion, distributed between the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD), supplemented by an additional €8 billion from the Next Generation EU initiative to support necessary structural changes in rural areas (European Commission, 2023b). In terms of environmental sustainability, at least 25% of direct payment budgets are allocated to eco-schemes promoting environmentally and climate-friendly farming practices, and at least 35% of rural development funds are dedicated to actions benefiting climate, biodiversity, the environment, and animal welfare (European Commission, 2023c). For the first time, the CAP also introduces a social conditionality, linking payments to compliance with EU labor and social standards to improve working conditions on farms (European Commission, 2023b).

In light of this introductory framework, the literature review is structured as follows. Firstly, it will be provided a definition of biodistricts, an examination of their salient features, and their role in advancing agroecological practices in Italy. After that, it explores the laws that control these areas and examines pertinent national and EU policies. The section concludes by examining the relationship between biodistricts and the circular economy, emphasizing the ways in which these regions promote resource efficiency, cut waste, and aid in sustainable local development.

4.1 Definition of biodisticts

According to the International Network of Eco-Regions, Bio-Districts are defined as follows: "*territories where farmers, citizens, public authorities, and other local actors realize a formal agreement aimed at the sustainable management of local resources, based on the principles and model of organic farming and the agroecological best practices, in order to boost the economic and sociocultural development of their community*." They are also synonymous with the terms Organic-District and Eco-regions. France, Italy, and Portugal were the first countries to create Bio-Districts, although Italy is the nation where these territorial formations are most prevalent (Poponi et al., 2023). Over the past ten years, the number of Bio-Districts in Italy has increased significantly. Since 2009, when the first Cilento Bio-District (Campania Region, BURC n.63 of 19 October 2009) was recognized by law, the number has increased to 26 in 2017 (Giuca et al., 2017) and 41 in 2021 (Basile et al., 2021). Bio-Districts can be crucial to put into practice a new sustainable production and consumption paradigm in Europe's environmental transition path. Indeed, organic farming is recognized as a crucial instrument for delivering ecosystem benefits to society through the European Farm to Fork strategy and the New Green Deal (European Commission, 2019). In this context, the critical target set by the EU to be reached by 2030 is ambitious: raising the percentage of organic farming to at least 25% of all agricultural land (EU Commission, 2020). In the successful completion of this target, bio-districts play a crucial role, as they represent an innovative tool to enhance specific elements of both environmental and economic sustainability. Through their foundation, local economies can thrive and flourish thanks to the improvement of biodiversity conservation, protection of the environment, and multifaceted exploitation, unifying agriculture with all local economic sectors (CREA, 2019)

This thesis contributes to these EU policy objectives by offering a field-based analysis of three Italian bio-districts, each representing a different model of territorial innovation. It provides empirical evidence of how bio-districts operationalize the principles of agroecology and circular economy, revealing the mechanisms that facilitate transitions toward localized and resilient food systems. One key insight about the relevance of biodistrict within EU policy goals is that while all the three case

studies advance organic farming, their contributions to food security and community empowerment vary according to governance structure, socio-political cohesion and integration with other sectors such as renewable energy and tourism. This study also identifies challenges that remain underexplored in policy discourse, such as the fragile institutionalization of these models. In doing so, this research both aligns with the EU Green Deal's ambitions and highlights the need for adaptive, context-sensitive governance strategies to ensure the scalability and long-term sustainability of bio-districts across Europe.

4.2 Legal background

The district model was initially implemented by the Italian government in 2001 in an effort to promote local development in the agri-food industry and boost agricultural competitiveness (Toccaceli, 2015). Rural Districts (RDs) and Quality Agri-food Districts (QADs) are the two categories of primary sector districts established by legislative order No. 228 of 2001 on the Orientation and Modernization of Agriculture, commonly referred to as the "Law on Modernization of Agriculture." Both district typologies have unique characteristics related to the rural and agricultural world, even though they are founded on the idea of local production systems (LPSs), which are described as "*homogeneous productive contexts characterized by a high concentration of mainly small and medium sized enterprises, and by a peculiar internal organization*"[1].

On the one hand, in the case of RDs, LPSs are defined as "*characterised by a homogeneous historical and territorial identity, resulting from the integration of agricultural and other local activities, as well as from the production of goods or services of particular specificity, consistent with traditions and natural and territorial vocations*".[2]

On the other hand, for what concerns QADs, they are "*characterised by a significant economic presence, and an interrelationship and productive interdependence between farms and agri-food businesses, as well as by one or more certified and protected products pursuant to current EU or national regulations, or by traditional or typical products*"[3]

Building on the definition provided above, the distinct features of RDs include multifunctional agriculture, local customs, and the connection between farms and other local activities, whereas quality manufacturing and the integration of the agri-food chain are the distinguishing features of QADs. However, according to Giacomo Becattini, the main Italian theorist of districts from an economic

[1] Article 36, paragraph 1, Law no. 317 of 1991, as modified by Law no. 140 of 1999
[2] *Ibid*., article 13, paragraph 2
[3] *Ibid*., article 13 paragraph 1

perspective, both typologies are predicated on a "sense of belonging," which is the district's qualifying factor.

Then, Italian law was amended in 2017 (Law 27 December 2017, No. 205. Article 13 of D.Lgs 228/2001) to formally create Food Districts (FDs): the district concept expands to encompass new classifications including urban agricultural zones and organic districts (Italian Government, 2001). In accordance with EU policy, these districts were created to support regional food systems, sustainability, and economic growth. Full local engagement has been limited by the process's tendency to be top-down rather than bottom-up, despite efforts to develop a participatory and integrated governance paradigm. Building on this foundation, Law 205/2017 (Italy's 2018 budget law) formally defined "distretti del cibo" (food districts) as a consolidated framework uniting these district models to promote sustainable local development and strengthen agri-food value chains (Italian Parliament, 2017). The 2017 law envisions food districts as partnerships designed to foster a new development model for the agri-food sector, revitalizing "Made in Italy" food value chains and enhancing territorial cohesion (ILS LEDA, 2023). Together, these provisions reflect an ongoing policy emphasis on integrated supply chain initiatives and place-based agricultural development in Italy (Italian Government, 2001; Italian Parliament, 2017).

To conclude the legal framework, the Typical Italian Product Districts (TIPDs), which were introduced in 2023 with the goal of improving the recognition and promotion of regional agri-food goods in both domestic and foreign markets, represent the most recent development (Strambi, 2024).

4.3 Circular economy and biodistricts

As outlined by Poponi et al. (2020), the shift from a linear economy (namely, following a "take-make-dispose" structure) to a circular economy (CE) has stimulated a more sustainable approach to sustainable development. Within this framework, economic strategies and policies aimed at improving and restructuring regional agricultural and agri-food systems have a direct impact on the creation of biodistricts. In order to improve and increase rural development, these policies seek to encourage farming methods that are more sustainable and community-based (Truant et al., 2020). Furthermore, this approach relates also to the several possible advantages of organic farming for sustainable development, namely the implementation of CE models for biodiversity, new job opportunities, youth attraction as well as food and health security (Poponi et al., 2023). Indeed, Toccaceli (2018) noted that the biodistricts model has evolved over time: they were once merely concerned with agriculture, but they have now diversified into a more complete system that encompasses a variety of food production methods, along with food processing.

Nowadays, biodistricts incorporate many phases of the food supply chain, from processing to distribution, rather than the exclusive cultivation of raw agricultural goods: this results in a more integrated and resilient food system. The intrinsic value of biodistricts is then assessed through the distinctive characteristics of the area, such as soil, climate conditions or local food traditions: these features influence the process of food production and add value to the uniqueness of the regional products. Moreover, this stronger integration within the supply chain, from farming to distribution, stimulates more efficient operations among businesses. Consequently, the collaboration among farmers, processors and distributors boosts productivity and competitiveness, enhancing the economic and environmental sustainability of the area (Mazzocchi et al., 2021).

4.4 Territorial and local dimensions of biodistricts

A crucial aspect emerging from the literature that requires more discussion is the territorial and local dimension of Italian biodistricts, since it still remains insufficiently explored in theoretical terms. Although biodistricts are described as place-based configurations that integrate organic agriculture with sustainable territorial development (Mazzocchi et al., 2021), the question of *how* they are territorially defined (whether through physical, administrative, or relational boundaries) still remains contested. Some scholars tend to define the biodistrict as a spatially bounded innovation, grounded in a specific landscape or cluster of municipalities (Guareschi et al., 2020), whereas others suggest a more fluid and process-based interpretation, in which the biodistrict emerges from immaterial networks, social ties and shared governance practices (Pugliese et al., 2015; Favilli et al., 2020). Trough this approach, the biodistrict is not simply a geographic container but a negotiated social space shaped by power dynamics, institutional arrangements, and actor-driven coordination.

Despite institutional definitions that often rely on administrative borders, the actual spatial coherence of biodistricts is debated. In several cases, biodistricts encompass heterogeneous territories where not all actors adopt organic methods, raising concerns about inclusivity and the dilution of agroecological aims (Passaro & Randelli, 2022). Furthermore, while scholars praise the participatory governance of biodistricts, critical research points to the risk of dominant stakeholders, such as charismatic local leaders, strong mayors or elites, monopolizing agenda-setting processes, particularly in the early stages (Stefanović & Agbolosoo, 2023; Favilli et al., 2020). These power dynamics can lead to uneven participation or exclusion of marginal actors, contradicting the inclusive ethos of bottom-up governance. Moreover, biodistricts lack formal planning authority and often operate without stable funding, limiting their ability to influence territorial governance in practice (Schermer et al., 2007). Consequently, although they are frequently praised as integrated territorial strategies, many biodistricts rely on informal arrangements and soft coordination, making their institutional sustainability and

scalability uncertain. These critical points highlight the need for further empirical research on the spatial logics, institutional robustness and governance practices that underpin the territorial functioning of Italian biodistricts.

5. Case-studies analysis

5.1 Case study 1: Cilento Biodistrict (Campania)

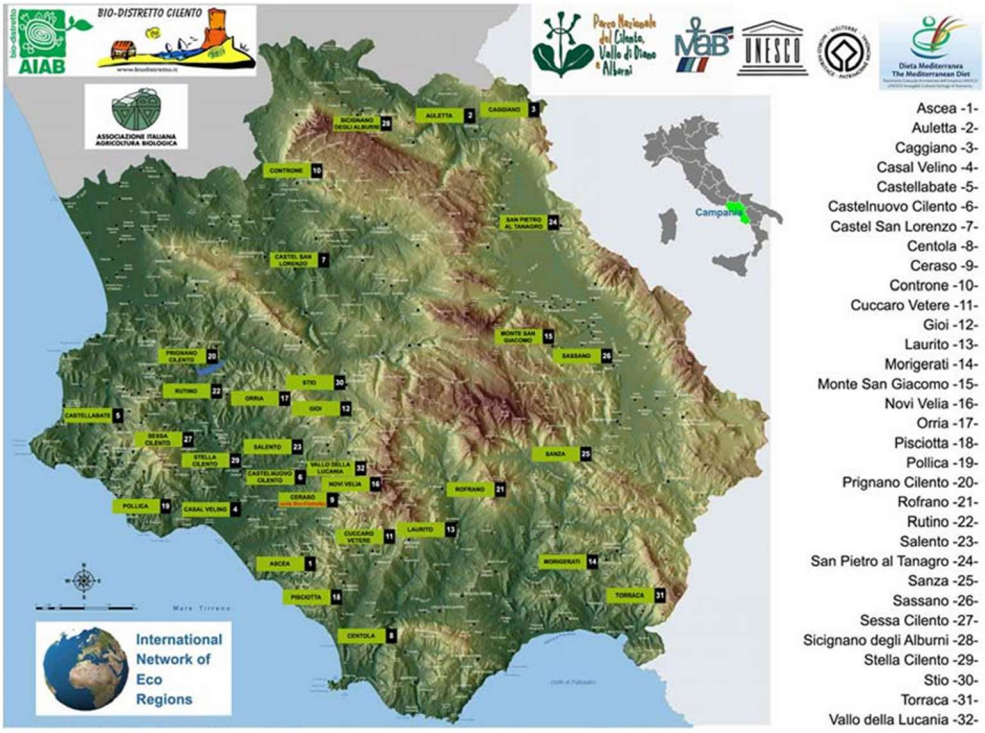

Figure 2: Geographical location of the Bio-distretto Cilento (source: Pugliese, P., Antonelli, A., & Basile, S. (2015). Full Case Study Report: Bio-Distretto Cilento – Italy. CIHEAM Bari & AIAB)

5.1.1 Geographic and socio-economic context

It is not a chance that the first Italian biodistrict was born in Cilento, in southern Campania within the National Park of Cilento, Vallo di Diano and Alburni, a region recognized by UNESCO for its cultural and natural heritage (IDEASS, n.d.). It spans over 3,000 km² of mostly rural terrain, encompassing over 30 municipalities and numerous small villages. Traditionally, Cilento's economy has centered on small-scale agriculture, olive groves, pastoralism, and local fisheries, with a rich food culture, being the home of the Mediterranean-diet concept, but also a history of rural poverty and youth out-migration. By the early 2000s, local stakeholders saw organic farming and sustainable tourism as opportunities to revitalize the area's economy while preserving its environmental assets. In 2004 a public process was launched to form a "bio-distretto" in Cilento: Italy's first example of organic district (IDEASS, n.d.). The Campania Region formally recognized the Cilento Biodistrict in 2009, through an act establishing it as the first multi-sector European biodistrict integrating agriculture, environment, social goals, eco-tourism, food, and wine. The non-profit Associazione Bio-Distretto Cilento was then founded in 2011 to coordinate stakeholders and initiatives. This context of a protected area with high

biodiversity, strong local food traditions, but socio-economic challenges (aging population, marginal farms) set the stage for the biodistrict's development.

5.1.2 Contributions to sustainable agriculture and local food systems

Since its inception, the Cilento Biodistrict has dramatically expanded organic agriculture and short supply chains in the region. As of the 2010s, about 400 farms in Cilento have converted to organic methods, representing approximately 23% of all organic producers in Campania. These farms are mostly not too extended (averaging 5 hectares each) and diversified, cultivating olives, figs, grapes, vegetables and raising small herds of cattle, goats, sheep, and buffalo for cheese. By joining the "*Patto per il Bio-distretto*" (Biodistrict Pact), farmers commit to organic, GMO-free production rooted in local traditions. This commitment has enabled the entire output of these farms to be marketed as organic, where previously only a portion was sold with organic premiums. The biodistrict has actively built local food systems linking producers to consumers. For instance, it enhanced the establishment of farmers' markets and Solidarity Purchase Groups (GAS) where consumer cooperatives buy directly from local farms. The first GAS in Cilento was launched in 2009 with support from regional authorities. Such initiatives shorten the supply chain so that local residents and tourists can access fresh, seasonal foods with known origin. A "Cilento shopping basket" was created to promote iconic local products, including heirloom legumes (Controne beans, Cicerale chickpeas), the white figs of Cilento, extra-virgin olive oil, wildflower honey, buffalo mozzarella, artisanal salumi, and Cilento DOC wines. By branding and jointly marketing these organic products, the biodistrict adds value to traditional agriculture and incentivizes farmers to continue sustainable practices. Beyond production, the Cilento Biodistrict integrates farming with other sectors to reinforce a community-based food system. It partnered with local restaurants, school canteens, and even beach resorts to create demand for organic food. By the mid-2010s, at least 20 restaurants and 10 seaside bathing establishments had signed on to feature Cilento organic produce in their menus. Consequently, residents and tourists can eat locally sourced and organic meals, from farm-to-table agritourism dinners to organic school lunches for children. Indeed, the biodistrict also works with public authorities to run nutrition education in schools and incorporate organic foods in public procurement. Thus, these efforts improve local food security by ensuring a portion of the community's food supply is produced and consumed locally under safe and sustainable conditions. In this context, consumers benefit from healthier diets and a closer connection to where their food comes from.

5.1.3 Governance, partnerships and community engagement

The governance model of the Cilento Biodistrict is highly participatory and multi-level. It is administered by a multi-stakeholder association (Associazione Bio-distretto Cilento APS) that includes

organic farmers' networks, consumer groups, tourism operators, local administrators, and NGOs. The Italian Association for Organic Farming (AIAB) was essential in the biodistrict's formation and continues to provide technical coordination. The municipalities play a fundamental role: 30 town councils are formal members of the biodistrict, and the town of Ceraso hosts its headquarters, serving as a hub for meetings and agritourism visits. Local governments support the biodistrict by co-organizing events, disseminating information, and adopting organic and eco-friendly practices (e.g. some have declared their territory GMO-free and shifted municipal land to organic use). Regional and provincial authorities are also partners: indeed, the Province of Salerno and Campania Region have provided funding and aligned rural development programs to biodistrict goals. This vertical integration of governance (local-provincial-regional) ensures institutional recognition and resources for the initiative. At the same time, horizontal engagement is essential: farmers, citizens, and small businesses are encouraged to take part through public forums, annual assemblies, and thematic working groups (e.g. on agrotourism, farmers' markets, educational farms). Early on, a series of public meetings and forums (promoted by AIAB between 2004 and 2007) enabled local actors to collectively design the biodistrict's strategy. Thus, this community-driven planning fostered trust and a shared vision and the result is a "pact" for sustainable resource management that is locally tailored, an example of community-based governance of the food system. According to recent research, stakeholders in Cilento report that the biodistrict has created a tight-knit network and improved collaboration across sectors: for instance, between farmers, tour operators, educators, etc. (Stefanovic & Agbolosoo-Mensah, 2023). By providing a platform for exchange and collective action, the biodistrict governance strengthens social capital and collective efficacy in the region. Partnerships have extended beyond the immediate community as well. The Cilento biodistrict is a founding member of the national and international networks of biodistricts (the IN.N.E. R network), sharing best practices with other regions and even advising new biodistricts abroad (e.g. in Tunisia). It also collaborates with universities and research centers on innovation – for instance, testing new organic methods and simplified certification systems suited for small farmers. Community engagement is further visible in the volunteer-driven promotional activities: local youth have been trained as "Bio-ambassadors," lifeguards, and guides to champion organic culture. During summers, the biodistrict sets up stands on popular beaches with "Bio-lifeguards" offering tastings of local organic food to tourists. Similarly, "Bio-trails" have been mapped out, guiding hikers from coastal resorts into inland farms and villages, thereby engaging both residents and visitors in the biodistrict experience (IDEASS, n.d.). These creative outreach efforts are well-received and have built broad community support, evidenced by the growing number of towns petitioning to join the biodistrict after seeing its success.

5.1.4 Implementation of circular economy principles

Circular economy ideas are linked with Cilento's biodistrict model because they emphasize resource efficiency and waste reduction in the local food system. One example is the promotion of organic waste composting and recycling in participating "Bio-cities." Several municipalities in the biodistrict have improved waste separation and support on-farm composting of food scraps, which returns nutrients to the soil and reduces landfill burden. The biodistrict's charter encourages using organic agricultural waste (olive pomace, grape marc, etc.) to produce compost or animal feed, thereby closing the loop between production and consumption. There is also an effort to integrate livestock and crop farming to recycle manure as fertilizer naturally. Moreover, the biodistrict aligns with the "reduce, reuse, recycle" approach by favoring short supply chains (which cut down food miles and packaging) and by reviving disused land. Farmers in the Cilento pact pledge to manage land sustainably through practices like crop rotations, maintaining hedgerows, and conserving water: all of which are circular approaches in agriculture (preserving ecosystem services that in turn support farming). Some villages have introduced small-scale renewable energy systems (solar panels on farm buildings or agritourism facilities), using abundant sun energy to power agrifood processing and agritourism lodgings. While Cilento's circular economy initiatives may be less industrial and more community-scaled, they are significant: local organic production minimizes the need for chemical inputs and fossil-fuel-intensive distribution, creating a regenerative local economy. An emblematic project is the annual "Cilento Biofestival," where reusable or biodegradable dishware is mandated and any food waste from the event is collected for compost, demonstrating a zero-waste mindset in practice. Basically, the biodistrict functions as a living lab for circular practices, testing ideas like bioenergy from farm by-products or cooperative packaging reuse, and then scaling up those that work through the network of municipalities.

5.1.5 Impacts on food security and local resilience

The Cilento Biodistrict has had measurable positive impacts on local food security and community resilience. First, by boosting organic yields and enabling farmers to earn premium prices, it has made local food production more economically viable, ensuring that farmland remains in use and productive. A case study reported that within a few years of the biodistrict's creation, farmers' average turnover from organic sales had increased by 20%, thanks to new local markets and tourism demand (IDEASS. n.d.). This income stability helps keep farm families on the land and attracts younger farmers, safeguarding the community's ability to feed itself. Indeed, organic farming areas in Cilento are expanding each year, reversing decades of agricultural decline. From the consumption side, the biodistrict has improved access to healthy, culturally appropriate food. Residents (including

schoolchildren) can obtain fresh organic produce, dairy, and meat from local sources at farmers' markets or through the GAS groups on a weekly basis. This reduces dependence on long supply chains and external supermarkets, which is crucial during disruptions. Notably, the biodistrict proved its resilience during recent crises: for example, during the COVID-19 lockdowns, Cilento's established network of local food deliveries (through the GAS and farm co-ops) continued to supply communities when larger distribution faltered. This kind of redundancy and self-reliance is a key aspect of food security. Additionally, the emphasis on agri-diversity (multiple crops and products) provides a buffer against single-crop failures or market price swings. Beyond food availability, food quality and nutrition have improved. Organic methods mean reduced pesticide residues and a safer environment. Local surveys indicate that awareness of healthy diets has grown; families involved in biodistrict activities report consuming more vegetables, legumes and olive oil (Mediterranean diet staples) which has long-term health benefits. The biodistrict's social programs, such as community gardens and "social farming" projects for vulnerable groups, further contribute to food security by directly engaging disadvantaged residents in growing food and receiving shares of the harvest. These initiatives, supported by the biodistrict in collaboration with NGOs, have increased social inclusion and provided food assistance in dignified ways. In terms of broader resilience, Cilento is now more resilient economically and environmentally. Environmentally, organic farming has preserved soil fertility and biodiversity (e.g. bees, wild plants), which underpin agricultural productivity. It has also protected water quality in this important watershed area by eliminating agrochemical runoff. Such ecosystem services improvement makes the territory more resilient to climate change and extreme weather. For instance, healthier soils retain water better, helping crops endure droughts. Socially, the biodistrict has inspired a sense of pride and identity around sustainable food that allows the community to be more likely to collectively tackle future challenges. The region has also diversified its economy through eco-tourism: agritourism farms, organic food festivals, and farm tours now draw visitors year-round, increasing tourist flows by as much as 500% outside the traditional summer season. This extended tourism season brings additional income and jobs (hospitality, guiding, food services) that are tied to local food and land stewardship. Such diversified livelihoods make the community less vulnerable to any single economic downturn. All these factors – economic vitality, environmental health, and social cohesion – contribute to a robust local food system. Recent evaluations conclude that the Cilento Biodistrict has "generated loyal customers [for local organic products] …boosting development in the sector, with more farms converting to organic" and encouraged tourists to explore inland villages and foods, thereby spreading economic benefits. In summary, Cilento demonstrates how a biodistrict can enhance food security not merely by increasing food output, but by connecting agriculture into a larger strategy of community resilience and sustainable development.

5.1.6. Conclusive remarks

The biodistrict analyzed below stands as a comprehensive and pioneering model where sustainable agriculture, participatory governance and circular economy practices converge to strengthen local food security. Its wide territorial coverage and multi-sectoral integration demonstrate how a biodistrict can scale agroecological principles across an entire rural region. Indeed, by embedding organic practices in local markets, schools, and tourism, Cilento not only reinforces food availability and quality, but also builds community resilience and institutional capacity, perfectly aligning with the multidimensional vision of food security explored in this research.

5.2 Case study 2: Panzano in Chianti Biodistrict (Tuscany)

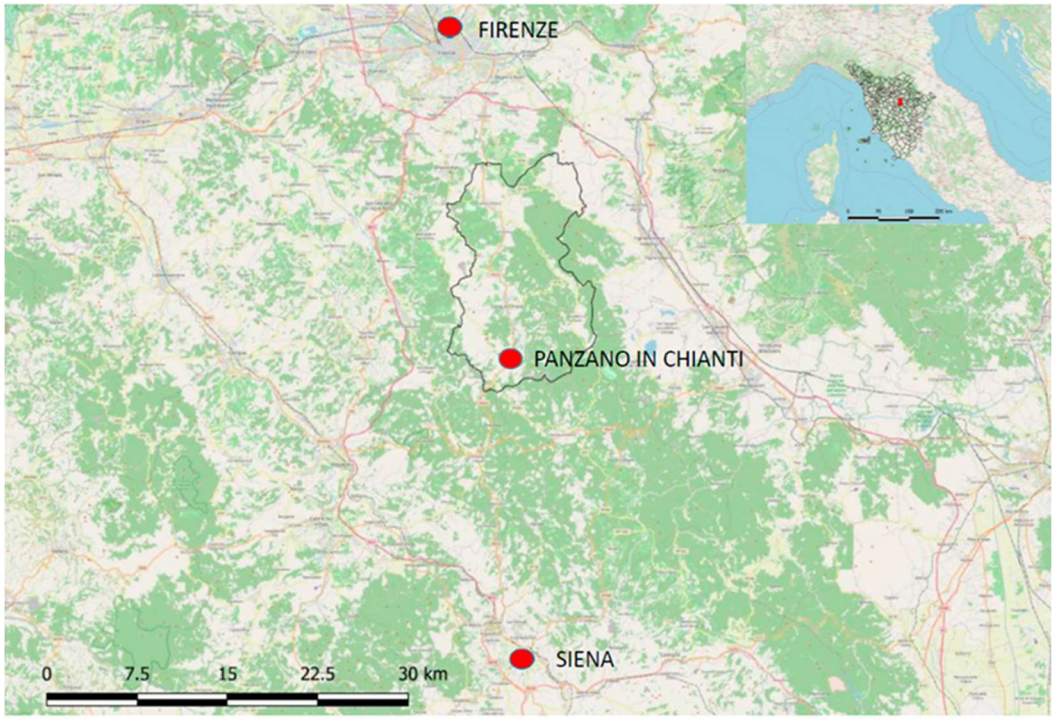

Figure 3: geographical location of Panzano in Chianti biodistrict (source: Chaminade, C., & Randelli, F. (2020). The Role of Territorially Embedded Innovation Ecosystems Accelerating Sustainability Transformations: A Case Study of the Transformation to Organic Wine Production in Tuscany, Italy)

5.2.1 Geographic and socio-economic context

Panzano in Chianti is a small hill town in Tuscany, set in the heart of the Chianti Classico wine region. Unlike Cilento's broad territory, the Panzano Biodistrict began as a very localized initiative: essentially a cluster of vineyards and farms in and around Panzano (an hamlet of Greve in Chianti) committed to

organic practices. The Chianti area is world-famous for its wine and picturesque landscapes. However, by the 1990s even this prosperous wine country faced challenges: concerns over chemical pesticide use in vineyards, the need to adapt to climate change, and a desire among some vignerons to protect the land for future generations. In 1995–1996, a group of forward-thinking winemakers in Panzano formed the Unione Viticoltori di Panzano (Panzano Winegrowers Union) with the vision of preserving their territory through sustainable viticulture (Maurilli, 2024). These were mostly small-to-medium winery owners who lived in Panzano and felt a strong attachment to its land. Over the next decade, they spearheaded a transition from conventional to organic farming across nearly all local vineyards. This grassroots movement allowed the foundation of one of Italy's first biodistricts focused on a single sector (wine). Formally, the Bio-Distretto di Panzano was recognized in 2012, when the municipality of Greve in Chianti, backed by the regional organic association (AIAB) and a local experimental viticulture station, passed a resolution establishing the biodistrict of "Greve in Chianti and the organic wine excellence area of Panzano" (IN.N.E.R., 2018). In 2013, a neighboring Chianti town (Gaiole) also created a biodistrict, and eventually these efforts merged into a broader Chianti Biodistretto by 2016 covering most Chianti Classico communes. For this case, we focus on Panzano's experience as the pioneering core. Panzano's socio-economic context is characterized by a mix of traditional winemaking families and newer investors in wine estates; it's relatively affluent, but that prosperity hinges on wine monoculture and tourism. The biodistrict concept in Panzano aimed to show that even in a high-value, export-oriented wine region, a shift to organic, community-based agriculture could enhance sustainability and resilience.

5.2.2 Contributions to sustainable agriculture and local food systems

The Panzano Biodistrict has made Chianti a model of sustainable winegrowing. By the early 2020s, virtually all vineyards in Panzano (approximately 500 hectares of vines) are farmed organically or biodynamically, representing a remarkable transformation from the mid-1990s when only a few pioneers were organic. Now, joining the local vintners' union requires each member to hold organic or biodynamic certification. As a result, Panzano is considered the first wine region in Italy to achieve near 100% organic viticulture coverage. Sustainable agriculture practices go beyond eliminating chemicals: Panzano's winegrowers have collaboratively implemented integrated pest management and climate-resilient techniques. With support from the biodistrict, the community established a shared monitoring system for vineyard pests and diseases. Since 2009, the Panzano growers have funded SPEVIS (Stazione Sperimentale per la Viticoltura), a local experimental station led by the agronomist Ruggero Mazzilli, which coordinates vineyard monitoring and research. This station has enabled the use of advanced forecasting models (developed with the University of Milan) to predict outbreaks of

grape mildew and other diseases, so that treatments (even organic ones like copper sulfate) can be minimized. Such precision farming reduces environmental impact significantly. In terms of local food systems, Panzano's biodistrict is somewhat unique because its primary "food" product is wine: much of which is sold globally (Maurilli, 2024). However, it still reinforces local food security and sustainability in several ways. Firstly, many Panzano wineries also grow olive trees for oil and keep kitchen gardens or livestock, diversifying local production. The biodistrict encourages this diversification and the preservation of Chianti's traditional polyculture. There are examples of vineyards introducing beehives, vegetable plots, or heritage breed pigs fed on grape pomace, creating a micro-ecosystem of food production on winery estates. Secondly, Panzano's organic wineries have formed partnerships with local restaurants and agritourism farms to promote a farm-to-table experience for visitors. Tourists coming for wine tastings in Panzano are also exposed to local organic foods (cheese, salumi, olive oil) produced in the surrounding area, strengthening the market for those products. The biodistrict has supported local farmers' markets in Greve/Panzano where organic producers (from wine to honey to vegetables) sell directly to residents. It also works with the Slow Food network and nearby biodistricts to organize events like the "Vino e Bio" festival, which highlights organic wines alongside other local foods, thus embedding Panzano's wine in a broader local food context. While Panzano itself is small, the extension of the biodistrict to the entire Chianti Classico area means broader contributions to sustainable food systems. The Chianti Biodistrict (formally constituted in 2016) includes eight municipalities and dozens of organic farms beyond just vineyards. This larger biodistrict is fostering organic grain and vegetable production in Chianti (for instance, some wine estates rent unused land to young farmers for organic horticulture) and has plans for organic school canteens similar to Cilento's model. Thus, what started as a wine-focused project in Panzano is evolving into a multi-product local food system across Chianti. In Panzano itself, a tangible outcome is safer, healthier local food and environment: the shift to organic viticulture means residents are no longer exposed to pesticide drift, and local water sources are less polluted by farm chemicals. The land now produces grapes, olive oil, and other foods with organic integrity, contributing to the long-term food security of the community (in terms of quality and environmental sustainability, if not volume).

5.2.3 Governance, partnerships and community engagement

The governance of the Panzano biodistrict has been a blend of bottom-up initiative by farmers and supportive local government policy. Initially, the Winegrowers Union of Panzano (a private association of vintners) acted as the de facto governing body guiding the transition to organic. This union fostered a strong peer network: as a matter of fact, the more than 20 wineries share knowledge, mentor each other, and even coordinate harvest and pest control schedules. Hence, the success of this informal

governance paved the way for formal recognition. In July 2012, Greve in Chianti's council held an extraordinary open meeting in the town square (with citizens participating) to declare the establishment of the biodistrict. This symbolic act signaled public-sector endorsement of what the farmers had started. Soon after, an official association was created to manage and promote the Chianti biodistrict (with representatives from Panzano's union, other organic producers, and municipalities). Leadership in the Panzano case has come from key individuals in partnerships: the agronomist Ruggero Mazzilli provided technical support, the mayor of Greve provided political backing, and winery owners like Giovanni Battista d'Orsi (current union president) championed the cause among peers (Maurilli, 2024). This triangulation of expertise, government, and producers formed an effective governance ecosystem. Partnerships have been crucial. The biodistrict collaborates closely with scientific institutions, notably the University of Florence and University of Milan for research on organic viticulture and climate adaptation (e.g. the epidemiological model for mildew control). It also works with the Consorzio Chianti Classico (the wine consortium) to align the prestigious Chianti Classico denomination with sustainability goals. For example, large wine companies in the region, which initially were less involved, have come on board through partnerships: Forbes noted that the Chianti Biodistrict persuaded some big producers to contribute marginal lands or support rewilding efforts in exchange for ecosystem benefits (Gordon, 2021). Additionally, the biodistrict is part of Tuscany's regional network of organic districts and has received advisory input from older biodistricts like Cilento and Varese Ligure. Community engagement in Panzano has been more focused on the producer side (as the general public was perhaps less directly involved than in Cilento). However, the open meetings in 2012 and ongoing community interactions (like public talks on organic farming, winery open-door days for locals) have kept residents informed and supportive. Panzano's citizens have expressed pride that their village became a sustainability leader within Chianti. The union's long-standing motto – "Excellence, Sustainability, and Friendship" (Maurilli, 2024) – hints at the tight social bonds that underlie the governance: many of these wine producers grew up together and their families are rooted in Panzano, making the commitment to collective well-being personal. The governance structure also incorporates private-public collaboration for funding and infrastructure. The installation of a dense network of weather stations in 2019 to aid disease forecasting was a joint effort: wineries funded equipment, while the data is shared with public research (University of Milan) for mutual benefit. Moreover, Greve municipality helped secure some regional rural development funds to support organic conversion and farm diversification projects around Panzano. The Chianti biodistrict's board includes mayors or their delegates from member towns, ensuring alignment with local policies (e.g., Greve and neighboring councils have since integrated the biodistrict's goals into their land use plans, promoting organic farming and restricting urban sprawl on ag land). Overall, Panzano's experience

demonstrates that even a small community can mobilize a robust governance network when there is a common goal (in this case, protecting the terroir and wine quality through organic practices). It started informally with farmers' self-organization and evolved into a formal biodistrict with multi-stakeholder governance, showing flexibility and growth.

5.2.4 Implementation of circular economy principles

Circular economy principles are evident in how Panzano's biodistrict approaches farming and resource use.

One key practice is the recycling of organic matter within the viticulture system. Many Panzano wineries now compost grape pomace (skins and seeds left from winemaking) along with pruning residues and manure from any farm animals, creating organic fertilizer that is returned to the vineyards, reducing waste and closing the nutrient loop, and improving soil health naturally. Indeed, on-farm composting has become common: as emerged during the interview, several wineries practice composting for the recovery of biomass for energy and fertilization of vineyards. Some estates have even achieved partial energy self-sufficiency by installing solar photovoltaic panels on winery roofs; a few have small bio-digesters or use biomass boilers fed by vineyard wood cuttings. For instance, a winery might use solar power to run its wine cellar cooling systems and electric vehicles, and use pruned vine canes as fuel for heating, thereby reducing fossil fuel use. The biodistrict also encourages a circular approach to water and biodiversity: vineyards in Panzano increasingly plant cover crops (grasses and legumes) between vine rows, which prevents erosion, enhances soil water retention, and provides habitat for beneficial insects, which is a form of regenerative agriculture turning "waste" (e.g. winter rains) into an input (stored soil moisture) and fostering natural pest control.

Another circular strategy is integrated livestock grazing; a few vineyards have reintroduced sheep or chickens that graze between vines, eating weeds and fertilizing the soil with manure, thus substituting for mechanical mowing and chemical fertilizers. At a larger scale, the Chianti Biodistrict as a whole has looked at landscape-level circularity. For example, marginal lands or abandoned plots in the area are being restored either to productive use (orchards, forage) or to natural vegetation. In Panzano, land not suitable for vines is sometimes used to grow fodder crops or woodland which can be harvested for sustainable timber or firewood, ensuring no parcel is wasted and the community has local wood resources. Partnerships with the local olive mill mean even olive pits and wastewater are repurposed (pits can fuel biomass heaters; the vegetative water is composted) instead of becoming pollutants.

These efforts reflect a "bio-circular economy" mindset: minimize waste, loop resources locally, and create value from by-products. Economically, the Panzano biodistrict exemplifies circular economy

by retaining more value locally. Organic certification and the strong local brand (Panzano is now known among wine enthusiasts for sustainability) allow producers to fetch higher prices, which then get reinvested in the community (in jobs, local services). Also, through agritourism and direct sales, money spent by visitors on wine and food circulates in the local economy rather than leaking to outside distributors. While small in scale, Panzano's circular initiatives contribute to its resilience. As Giovanni B. d'Orsi (a local wine producer) noted, respecting the environment "is the only way to coexist with it… organic agriculture is the first form of sustainability": this philosophy has guided how resources are managed in a more circular and respectful way.

In summary, by reducing external inputs (chemicals, energy) and turning "waste into resources," the Panzano Biodistrict has lowered its environmental footprint and created a virtuous cycle where the by-products of one process (like winemaking) become the inputs for another (compost for farming, or grape seeds into grapeseed oil, etc.). These circular practices ensure long-term fertility and productivity of the land, which is fundamental for sustaining local food (and wine) security.

5.2.5 Impacts on food security and local resilience

The Panzano biodistrict's impact on food security must be viewed in a nuanced way, given the dominance of wine grapes in the local agriculture. In terms of food availability, Panzano itself is not a major producer of staple foods, but the biodistrict indirectly enhances regional food security by maintaining agricultural land in productive use (preventing land abandonment) and inspiring organic transitions in neighboring farming sectors. The biodistrict's success with organic wine has created a ripple effect: other farms in Chianti, seeing the market and environmental benefits, have converted to organic vegetable gardening and livestock rearing. Thus, the Chianti biodistrict now includes organic grain and pasture that contribute to Tuscany's food supply (e.g. organic flour, meat, and olive oil from Chianti).

Locally, Panzano's residents benefit from access to organic olive oil, honey, and garden produce from the area. The biodistrict producers often share or sell these products within the community, which is a qualitative improvement in food security (better quality and trust in safety). A critical impact is on economic access to food and livelihoods. The shift to organic and the biodistrict's reputation have strengthened the local economy. Panzano's wines command premium prices and global recognition, which has led to stable or rising incomes for farming families. This, in turn, means these families have more secure livelihoods and can afford a good standard of living (including nutritious food). Moreover, new employment opportunities have emerged: organic viticulture is more labor-intensive than

conventional, so it has created farm jobs (for pruning, manual weeding, etc.) and attracted skilled young agronomists to work with SPEVIS.

Agri-tourism linked to the biodistrict also generates income – e.g., vineyard tours, wine tastings, and farmstays bring revenue that diversifies farmers' income. This diversification is a resilience factor: if the wine market faces a downturn, income from tourism or secondary crops can help cushion the impact. In terms of local resilience, the Panzano biodistrict has several noteworthy contributions. Environmentally, the near elimination of synthetic pesticides and fertilizers has improved ecosystem health, making agriculture here more resilient to shocks. For instance, soils with higher organic matter (thanks to compost and cover crops) are better at retaining moisture during droughts, which have become more frequent with climate change. This was evident in recent dry summers where Panzano's organically managed vines showed more resilience and consistent yields compared to chemically managed vineyards outside the biodistrict. The collaborative pest monitoring network also means the community can respond swiftly to emerging threats (like an invasive insect or a new plant disease), sharing solutions in real time – a collective defense mechanism that enhances resilience.

Socially, the unity forged among Panzano wine producers and the trust built with local institutions create a strong support network. During challenges such as extreme weather or market volatility, biodistrict members band together – for example, by pooling resources to invest in a new water reservoir for irrigation during a drought, or collectively marketing their wines when sales were hurt by the pandemic. This social cohesion and shared purpose represent the hallmark of biodistricts and directly contributes to resilience. While food security in the conventional sense (sufficient calories) is not a pressing issue in Chianti, the biodistrict addresses food system sustainability, which is a long-term foundation for food security. By proving that high-quality production can go hand-in-hand with environmental care, Panzano's example contributes to the security of the regional food supply in the face of climate change. Additionally, the biodistrict's influence has reached local policy: Tuscany region's 2020 rural plan cites the Chianti biodistrict as a model for integrating organic farming into territorial planning (Tuscany Region, 2020). This means the Panzano experience is helping shape a policy environment that favors sustainable food systems, potentially benefiting food security at a broader scale.

Lastly, the Panzano biodistrict has heightened community awareness about sustainability and health, an often-underappreciated aspect of food security. Residents and producers alike have learned the value of clean water, biodiversity, and healthy food through the biodistrict's initiatives (like workshops,

vineyard walks, organic food festivals). This cultural shift ensures that future decisions by the community will likely continue to prioritize food system resilience.

In summary, Panzano in Chianti's biodistrict may be smaller in scale, but it demonstrates how focusing on sustainable agriculture (even one crop like wine) can have multiplier effects: preserving rural livelihoods, encouraging diversification, protecting the environment, and embedding the local economy in a resilient, circular framework. These outcomes collectively enhance the long-term food security of the area, understood as the ability to produce and procure food in sustainable ways for generations to come.

5.2.6. Conclusive remarks

Although smaller in scale and focused primarily on viticulture, the Panzano in Chianti biodistrict illustrates how a sector-specific initiative can catalyze broader sustainable transformations. Through organic certification, producer collaboration and strong ties to local governance, it enhances environmental sustainability and economic viability. Its contribution to food security is less about volume and more about long-term land stewardship, quality production, and socio-economic resilience, offering an alternative pathway to territorial food system sustainability.

5.3 Case study 3: Val di Vara Biodistrict (Liguria)

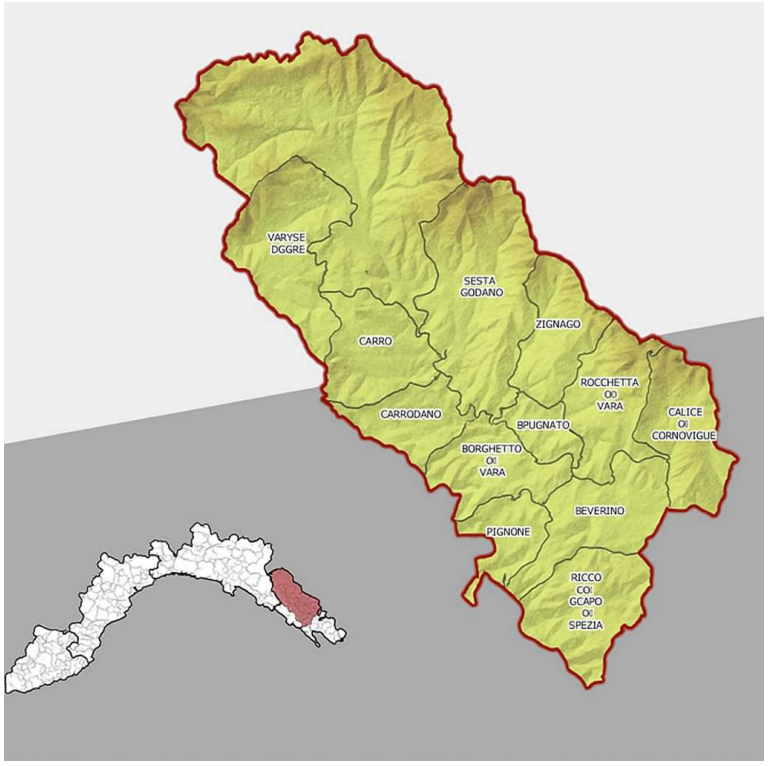

Figure 4: geographical location of Val di Vara biodistrict (source: Regione Liguria – *Area Interna Val di Vara)*

5.3.1 Geographic and socio-economic context

The Val di Vara Biodistrict is located in the inland valley of the Vara River in Liguria (northwest Italy). Centered around the town of Varese Ligure in La Spezia province, this biodistrict covers a cluster of 7 rural municipalities, namely Carro, Carrodano, Maissana, Rocchetta di Vara, Sesta Godano, Varese Ligure, and Zignago (Il Biodistretto – Val di Vara, n.d.). The Val di Vara is often also referred to as "La Valle del Biologico" ("the Organic Valley") due to its pioneering role in organic farming. The area is mountainous, sparsely populated (several thousand residents spread across the communes), and was historically quite isolated and economically depressed.

By the late 1980s, the valley faced severe decline: industries were absent, young people were leaving, and villages were at risk of emptying out (Carter, 2016). For instance, Varese Ligure's population rapidly decreased from around 6,000 to just over 2,000 inhabitants. Amid this crisis, local leadership saw an opportunity in what outsiders viewed as weaknesses. The valley's isolation meant its environment was still unspoiled (pristine air, clean rivers, traditional farming without heavy chemical use). In the early 1990s, Mayor Maurizio Caranza of Varese Ligure launched an ambitious plan to reinvent the local economy around organic agriculture and renewable energy, thereby turning Val di Vara into a self-sufficient "green island". By 1999, Varese Ligure became the first municipality in Europe to obtain ISO 14001 certification for environmental management (Guevara-Stone, 2024) and one of the first "organic municipalities" with the majority of farmers certified organic. Building on this success, the Biodistretto Val di Vara was formally established in 2013 as an association uniting multiple communes and producers under the organic and sustainable development ethos (Il Biodistretto – Val di Vara, n.d.). The socio-economic transformation in Val di Vara – from a near "ghost town" scenario to a vibrant eco-tourism and organic farming hub – provides rich context for this biodistrict.

5.3.2 Contributions to sustainable agriculture and local food systems

The Val di Vara Biodistrict has dramatically increased the prevalence of sustainable agriculture in the region. As of its founding, over 55% of all agricultural land in these municipalities was certified organic: an exceptionally high share, making it one of Italy's most organic-intensive territories. This includes dozens of family farms producing milk, cheese, meat, honey, and vegetables without synthetic chemicals.

In Varese Ligure alone, 108 organic farms supply 98% of the town's food products, effectively achieving near self-sufficiency in local, organic food. Key to this was converting small livestock operations to organic husbandry and traditional mixed farming. Two cooperatives were formed to support farmers: one focusing on organic dairy and cheese production, and another on organic meat and salumi. These co-ops enabled small farmers to process and market their products collectively,

reaching bigger markets while adhering to organic standards (The American Magazine, 2010). The biodistrict, through the municipality's earlier efforts, invested in a modern dairy facility and a slaughterhouse meeting organic protocols, so that value could be added locally rather than shipping animals elsewhere (Italy Magazine, 2006). As a result, Val di Vara today offers a range of local food products that are both organic and artisanal: from Parmigiano-style organic cheese and ricotta made at the local creamery, to grass-fed beef and pork (the beef is famously served in Genoa's school cafeterias as a quality local food, to heirloom beans and chestnuts grown in the valley. These products are available directly to consumers in multiple ways. The biodistrict has supported farm-direct sales at on-farm shops, agriturismi (farm stay inns), and weekly organic markets in the area (Il Biodistretto – Val di Vara, n.d.). Tourists and residents can visit farms to buy cheese or yogurt, taste honey at an apiary, or pick vegetables from a farm stand. There is a growing agritourism network (farms offering lodging and meals) which acts as another outlet for local organic produce. Moreover, some of Val di Vara's organic foods are distributed regionally: as noted, the organic meat is used in school meal programs beyond the valley, and organic cheeses are sold in supermarkets across Liguria.

While exporting products might seem to contradict the local food system focus, it actually strengthens the economic viability of farms, allowing them to thrive and continue feeding the local community. Importantly, the biodistrict model ensures that even exported food is produced sustainably, contributing to broader food system sustainability. The local food system in Val di Vara has a strong community-based orientation. The Environmental Education Center (CEA) founded in 1996 in Varese Ligure has taught generations of local children about organic farming, even taking them on tours of the valley's farms and cooperatives (Guevara-Stone, 2024). This ingrains an appreciation for local food from a young age and often inspires youth to engage in the food system (several young people have started niche businesses like organic jam-making or agritourism ventures after growing up with the biodistrict ethos). Community events such as the "Valle Bio Festival" celebrate seasonal harvests and organic food, bringing farmers and citizens together to share local meals. Through these events and direct sales, consumers have a face-to-face connection with producers, reinforcing trust and mutual support.

During the biodistrict's early years, when organic methods were new to many, the community collectively learned and adapted – experienced farmers mentored others on organic techniques, and town meetings were held to discuss progress and address skepticism. The outcome is a localized food system where a high proportion of what is consumed in the valley is also produced there, under safe and sustainable conditions. This not only reduces dependency on external food supplies but also

maintains the cultural food heritage of Liguria (like chestnut flour, pestos, etc. made from local organic ingredients).

5.3.3 Governance, partnerships and community engagement

The governance of the Val di Vara Biodistrict is a standout example of integrating local government initiative with grassroots participation. It originated from the strong leadership of Mayor Caranza and his council in the 1990s, who set a strategic vision and rallied the community behind it. The approach was deeply community-engaged: the administration asked residents to commit to renovating their historic houses and adopting sustainable practices, in exchange for public investment in infrastructure (roads, water, etc.). This social contract required extensive dialogue and trust-building.

Over time, the formal biodistrict association established in 2013 created a platform where farmers, local mayors, tourism operators, and citizens' representatives sit together to make decisions. The association's board includes the mayors of the seven member communes (or their delegates), leaders of the cooperatives, and representatives from environmental groups and Slow Food. This ensures that diverse interests are balanced from an economic, social, and environmental point of view.

One defining feature is partnership with external entities to reach goals that a small community could not achieve alone. For instance, the renewable energy projects (wind turbines, solar panels) were realized through partnership with the regional utility company (ACAM). ACAM co-invested in four large wind turbines on communal land; in return, it manages them and shares profits with Varese Ligure (about $30k/year plus services like waste management). This innovative public-private partnership essentially turned Val di Vara's natural wind resource into a steady revenue stream and service improvement for the community.

Similarly, to fund farm transition and co-op facilities, the municipality tapped European Union rural development funds and national grants. The success of these applications was bolstered by the unified vision of the biodistrict – it was easier to justify funding an organic dairy plant or a training program when almost the entire town was on board to utilize it. Community engagement has been continuous. The Environmental Education Center (CEA) is actually a community-run institution (with support from Liguria Region) that not only educates youth but also hosts town meetings, sustainability workshops, and visiting delegations (Guevara-Stone, 2024). It acts as a knowledge hub and a point of pride. Farmers in the biodistrict meet regularly (formally through the co-ops and informally at local bars or each other's farms) to share experiences: this peer network was crucial in converting skeptical older farmers to try organic methods in the 90s. The biodistrict's ethos has also been codified in local policies: for example, Varese Ligure's land use plan protects agricultural land from development, and

the communes give tax breaks to organic farmers or agritourism enterprises as incentives. Since the majority of citizens supported the “green” direction (seeing it revives their towns), these policies had broad acceptance. An important partnership is with Slow Food and other eco-gastronomy movements. Val di Vara hosts a Slow Food “Presidia” (presidium) for a local cheese, and the Slow Food organization often highlights Varese Ligure in its events as a model community. This has brought international attention and connections to other like-minded regions. The biodistrict is also part of the Italian biodistricts network, sharing insights with areas like Cilento. In 2014, leaders from Val di Vara traveled to other Italian regions and even abroad to present their model, effectively acting as ambassadors of the biodistrict concept (Val di Vara Biodistretto, 2015). Through such exchanges, they gain new ideas (for instance, adopting agritourism best practices learned from Tuscany, or new composting techniques from Austria).

Hence, governance here is not static: it is an adaptive, learning network deeply rooted in local community engagement and extended through partnerships at regional, national, and international levels.

5.3.4 Implementation of circular economy principles

The Val di Vara biodistrict embodies circular economy principles perhaps more comprehensively than any other, aiming for self-sufficiency in food and energy and minimal waste. A striking example is in energy and resource loops: by the mid-2000s, the four wind turbines in Varese Ligure produced three times more electricity than the town needed, covering not just local demand but also supplying surplus power to surrounding communities. The town also equipped public buildings with solar panels (town hall, school, wastewater plant) to further harness renewables. This means the valley is largely independent of external electricity supply and actually contributes clean energy to the grid, a circular model of a community both consuming and producing sustainably.

In water management, as early as the 1990s, Varese Ligure built an innovative aqueduct and water purification system that uses ultraviolet light rather than chlorine for disinfection, avoiding chemical inputs in the water loop (Italy Magazine, 2006). With 21 mountain springs feeding it, the system ensures pure water is circulated to households and then treated naturally, protecting the water cycle from pollutants.

Agriculturally, circularity is seen in how the biodistrict manages nutrients and waste. Livestock manure is composted and returned to pastures and crop fields, reducing the need for synthetic fertilizer. Crop rotations and the use of nitrogen-fixing plants (like clover in pastures) naturally replenish soil fertility. The dairy cooperative collects milk from organic farms within the valley, processes it locally, and the

whey by-product from cheesemaking is often fed to pigs or used as fertilizer: nothing is wasted. The "waste" from one production becomes input for another: e.g., cow manure fertilizes fields that grow feed crops; cheese whey feeds pigs; slaughter waste is composted or converted to biogas in a small facility (experimental). On the end, recycling and waste management have improved: by 2006 citizens were already recycling about one-third of their waste, and initiatives since then have aimed to increase that percentage (with compost bins distributed to households for organic scraps). The presence of a local waste treatment plant allows the community to handle its own refuse, potentially converting organic waste into compost that goes back to farms. The biodistrict's principles also promote localizing production and consumption, which is a form of circular economy in socio-economic terms: money spent on food stays circulating in the local economy rather than "leaking" out. For instance, when Genoa's schools buy beef from Val di Vara ranchers, the revenue supports those families who then spend in the local area, and the cattle are raised on local feed, continuing the cycle.

Another aspect is resilience through diversity: the valley did not focus on a single crop but rather multiple complementary lines (organic veg, organic meat, dairy, honey, renewable energy, eco-tourism). These form a kind of circular portfolio where each sector's outputs support the others – e.g., tourism provides a market for farm products; farms provide landscape beauty and experiences for tourism.

By implementing these circular practices, Val di Vara has reduced dependence on external inputs (like chemical fertilizers, imported feed, fossil fuel energy) and minimized outputs that are waste (pollution, emissions). It is noteworthy that Val di Vara was sometimes called an "eco-island" because theoretically it could be cut off and still sustain itself on its own food, water, and power. While not entirely autonomous in every aspect, this highlights just how circular and self-contained the system has become. It is a real-life demonstration of a circular economy at territory scale – something policymakers often speak of in theory. The biodistrict shows that through community will and smart investment, a local economy can close loops and function in a regenerative way, from farm to table to energy production and back.

5.3.5 Impacts on food security and local resilience

The transformation of Val di Vara has had profound impacts on food security and resilience, turning a vulnerable area into a robust community. Food security in the valley improved in all its dimensions:

- *Availability*: There is now an abundant local production of a variety of foods. Where once the area might have depended on imports for basics, it now produces surplus dairy, meat, and vegetables. The statistic that 98% of the town's food can come from local organic farms

(Guevara-Stone, 2024) speaks to a high degree of self-sufficiency. This greatly insulates the community from external food supply disruptions. For example, during road closures or market shortages, Val di Vara residents still have local milk, cheese, meats, and produce to rely on. The community's gardens and farms ensure year-round food: milk and cheese daily, seasonal meats, winter vegetables (cabbages, potatoes) and summer produce, plus preserved goods (chestnut flour, jams).

- *Access*: The biodistrict has helped maintain economic and physical access to food for locals. Economically, the revitalized farm sector created jobs: as a matter of fact, roughly 140 new jobs were created in the valley as a result of these initiatives (from farming to processing to tourism). Unemployment dropped and many families saw their income rise with organic premiums and tourism influx. This improved income means less poverty and better ability to purchase food. Physically, remote hamlets now have nearby farms or weekly markets where they can obtain fresh food, reducing the need to travel far or rely on packaged foods. The presence of co-ops also stabilizes prices; farmers get fair prices, and the community gets quality products at reasonable cost (as middlemen are eliminated).
- *Utilization (nutrition):* The switch to organic and local foods has benefits which are related to nutrition and health. The food is fresh, minimally processed, and free of chemical residues, contributing to better diet quality. The valley's residents have access to traditionally healthy foods like pastured meat and dairy, chestnuts, greens, and beans, aligning with the Mediterranean diet. There is also anecdotal evidence (from local health center reports) that respiratory and other health issues linked to pollution have declined since the elimination of chemical sprays and since air quality improved due to renewable energy replacing diesel generators and/or heating. Healthier people are an indicator of improved food utilization and overall well-being.
- *Stability*: Perhaps most importantly, the biodistrict has increased the stability and resilience of the community's food system. By diversifying income streams (farms don't only rely on one crop, towns don't only rely on one industry) and by securing local resources, Val di Vara can better withstand shocks. The 500% increase in tourism since the late 1990s brought in new revenue (Guevara-Stone, 2024), but even if tourism fluctuates (as it did during COVID-19 when travel stopped), the community still has its agriculture and energy to fall back on. The population, which was falling, stabilized and even grew slightly (many sources note that after 20 years of decline, Varese Ligure's population stabilized at approximately 2400 and some

younger families have returned). A stable or growing population means more hands to work the land and keep the system going – a critical factor in long-term food security for rural areas.

- *Resilience that goes beyond food*: the biodistrict improved the overall community resilience. Environmentally, Val di Vara is now much better prepared for climate-related challenges. Its forests and organic farms act as carbon sinks and protect against landslides (a common hazard in deforested mountain areas). The renewable energy infrastructure means that even if the main grid fails, the valley has power. The community recycles and manages waste locally, so it is less affected by wider waste management crises. All these contribute to autonomy and adaptability. Social resilience has also been strengthened. The once-decaying villages have been renovated, fostering a pleasant living environment that people want to care for. Social cohesion is high – the shared success story gives the community confidence to face future challenges collectively. As Mayor Marcone (Caranza's successor) highlighted, "*rather than being an economic burden, [the green outlook] proved a winning card in the battle for survival*" (Italy Magazine, 2006). The community has seen that sustainable choices pay off, which reinforces a proactive attitude. When times get tough, the community can recall how they overcame the 1990s crisis and use that playbook again (diversify, cooperate, innovate sustainably). In quantifiable terms, Val di Vara's revival through the biodistrict led to increased local revenue (an extra €514,000 in annual tax revenue was recorded, thanks to new businesses and residents). This revenue supports services like healthcare, education, and public transportation, which are crucial for maintaining community welfare and access to food. The biodistrict also achieved a roughly 25% recycling rate of waste by mid-2010s and likely higher now, meaning the community is moving towards environmental sustainability goals that will keep it livable and agriculturally productive in the future.

  In summary, the Val di Vara Biodistrict significantly enhances food security by making a once-fragile community largely self-reliant in food and energy, and by embedding that self-reliance in strong local institutions and networks. It illustrates how sustainable agriculture, when coupled with local governance and community engagement, can not only feed a community but save it from socio-economic collapse. The impacts are seen in full grocery stores and farmers' markets, in repopulated villages, in thriving schools, and in the confidence of residents who know they can provide for themselves and their neighbors through their own local, green economy.

5.3.6. Conclusive remarks

The Val di Vara biodistrict exemplifies a deeply integrated local food system, where organic agriculture, energy autonomy, and community engagement merge to create a self-reliant and adaptive rural territory. Provided with high levels of local production and consumption, extensive social cohesion, and diversified rural livelihoods, Val di Vara reflects how biodistricts can directly contribute to all four dimensions of food security (namely, availability, access, utilization, and stability), thereby fulfilling the systemic and territorial promise of the biodistrict model.

6. Discussion: comparing outcomes and governance models across the three biodistricts

The three biodistricts – Cilento, Panzano in Chianti, and Val di Vara – each demonstrate how territorially-focused organic agriculture initiatives can enhance food security, though they do so in different contexts and through varied governance models. In this discussion, through the conducted interviews and state-of-the-art research, their outcomes and structures are compared to condense insights about the role of biodistricts in sustainable food systems in Italy. To visually summarize the comparative findings, the following summary matrix offers an overview of the three case studies, highlighting their governance structures, community engagement, sustainability practices, and alignment with EU visions of territorial food systems, before delving into them more specifically in the following paragraphs.

CATEGORY	CILENTO	PANZANO IN CHIANTI	VAL DI VARA
GOVERNANCE MODEL	Multi-level participatory (30+ municipalities, AIAB coordination)	Farmer-led + local council (hybrid public-private)	Municipality-led with cooperative networks
COMMUNITY ENGAGEMENT	Strong (forums, youth programs, trails)	Moderate (producer network, agritourism)	Strong (education center, town initiatives)
SCALE OF ORGANIC FARMING	400+ farms, 23% of Campania's organic	Approximately 100% organic vineyards (~500 ha)	55% land organic, 98% local food supply
FOOD OUTCOMES	High: improved access, local markets, education programs	Moderate: high-quality products, less volume impact	Very high: local supply, nutrition, food self-sufficiency
RESILIENCE	Crop diversity, multi-sectoral integration, tourism	Certification system, vineyard monitoring	Local autonomy, job creation, eco-design
ALIGNMENT WITH EU FOOD SYSTEM VISION	Strong: mirrors Farm to Fork and Green Deal goals	Partial: excels in quality and resilience, less emphasis on inclusive governance	Very strong: holistic model aligning with CAP, Farm to Fork, and territorial resilience goals

Table 1. Comparative summary of governance, community engagement, organic farming, food outcomes, resilience, and EU policy alignment across the three biodistricts

6.1 Scale and focus of sustainable agriculture

One notable difference is scale. The Cilento Biodistrict covers a broad area (more than 3,000 km²) with dozens of villages and a wide range of crops and products, essentially a diverse rural territory approach. In contrast, Panzano's Biodistrict began as a micro-level initiative (a single village focused on one main product, namely wine) that later expanded into the Chianti multi-communal biodistrict. Val di Vara's scale is intermediate – a cluster of small towns in one valley, united by a common strategy. Despite these differences, all three biodistricts fundamentally promote sustainable agriculture anchored in organic practices and agroecology. Cilento's diversity (fruits, olives, grains, livestock) and Val di Vara's mixed farming mean their biodistricts tackle an entire local food web. Panzano's narrower focus on viticulture shows that even a single-sector biodistrict can have cascading benefits (as organic wine led to improvements in local environment and diversification into other foods through agritourism).

6.2 Local food systems and food security outcomes

Each case confirms that biodistricts can strengthen local food systems, albeit with different emphases. In Val di Vara, the biodistrict has directly increased local food security in a tangible way – the region can feed itself with its own organic produce to a very high degree. The outcome is a near self-sufficient community resilient to external shocks, as evidenced by stable population and increased food-related jobs.

Cilento's biodistrict also improved food security, though more by increasing the quality and sustainability of the local food supply than by achieving self-sufficiency. Cilento integrated organic food into schools and local markets, ensuring access to healthy food for the community (including vulnerable groups via social farming) and giving farmers steady outlets. The presence of more than 400 organic farms means a significant share of Cilento's food (olive oil, produce, dairy, etc.) is local and organic, but Cilento still participates in wider markets and is not as isolated as Val di Vara. Its food security impact is seen in improved nutrition and economic viability of farming.

Panzano in Chianti presents a slightly different picture: food security is addressed in terms of long-term sustainability and resilience. While Chianti imports many staples (given its specialization in wine), the biodistrict's environmental benefits (cleaner water, healthier soils, diversified secondary crops) contribute to the foundational capacity of the land to produce food and support livelihoods. Panzano's case highlights that even where a biodistrict does not aim for self-reliance in all foods, it still enhances food system resilience by promoting sustainable land management and local economic strength. Notably, all three biodistricts have boosted local economies: 20% revenue growth for Cilento

farmers (IDEASS, n.d.), new jobs and tourism in Val di Vara, premium markets in Chianti, which improves the community's ability to access food.

6.3 Governance models: bottom-up, top-down or hybrid?

Governance across the cases ranges from grassroots-driven (Panzano) to institution-driven (Val di Vara's municipal push) to a hybrid network (Cilento).

Panzano in Chianti's biodistrict governance was initially bottom-up, started by a union of winemakers with support from a technical expert (SPEVIS) and later acknowledged by the municipality. This model relied on producer cohesion and shared private goals (maintaining wine quality and land health) to drive public good outcomes, with the government playing a facilitating role.

However, Val di Vara's governance began top-down with visionary local government leadership (the mayor rallying citizens to a sustainability plan), but it was successful because it quickly became community-owned: villagers participated in the plan (renovating homes, forming co-ops, etc.) and eventually a formal association with multi-stakeholder membership took over day-to-day management. It shows a model where strong policy direction and community buy-in went hand in hand. Cilento's governance is a true multi-level partnership: initiated by a mix of an NGO (AIAB) and local actors, requiring coordination among many municipalities, and obtaining regional policy support early on. Cilento's biodistrict functions like a regional development program managed through an association that links local councils, farmers, and civil society. This has the advantage of pooling resources and influencing higher-level policy (indeed, Campania region incorporated the biodistrict into its statutes), but it also means more complex coordination.

Despite these differences, common governance features emerge: indeed, all biodistricts rely on collaboration across sectors (public, private, civic) and foster a sense of shared mission. Each biodistrict created a formal or informal platform for stakeholders to meet and plan together – whether it's Panzano's vintner meetings, Cilento's permanent workshop of ideas, or Val di Vara's cooperative assemblies. This collaborative governance leads to better outcomes because it leverages local knowledge and distributes responsibilities. Another commonality is leadership and champions. Each case presents its key champions: Cilento had AIAB activists and supportive mayors (like Pollica's famous mayor who embraced the Mediterranean diet heritage), Panzano had Ruggero Mazzilli and passionate vintners, Val di Vara had Mayor Caranza and later Mayor Marcone. These leaders were able to articulate a vision of a sustainable food community and mobilize others: a critical factor in biodistrict success which formal governance structures alone cannot ensure.

6.4 Community engagement and social capital

All three biodistricts deeply engaged their communities, but in somewhat different ways.

Cilento actively involved citizens as consumers and co-promoters through GAS groups, educational initiatives, and events like bio-beaches that target the public. This created a strong local consumer base for organic products and a culture of sustainability among residents and visitors. The outcome is a broad-based movement where farmers and consumers see themselves on the same side (a hallmark of food sovereignty efforts).

Val di Vara's engagement was also broad: essentially the entire community underwent a cultural shift to "go green," including retrofitting homes and adopting recycling, not just farming. The establishment of the Environmental Education Center ensured generational continuity of engagement. The result is high social capital – people trust and help each other, as seen when citizens invested their own money alongside EU grants to renovate the town, feeling accountable to the collective project.

Panzano's engagement was initially narrower (focused on producers), but it fostered an intense professional community of practice among those producers. Over time, as the biodistrict expanded, it began to involve the broader community with events and shared identity as an "organic territory." For example, by the time the Chianti biodistrict was launched in 2016, it was celebrated publicly with the presence of Italy's Prime Minister and community festivities, indicating local pride had extended beyond the vineyards. In terms of outcomes, strong community engagement translates to resilience: high levels of trust and cooperation mean these communities can better coordinate responses to threats (whether an agricultural pest or an economic downturn). This aligns with scholarly observations that biodistricts deliver "important social outcomes enabling the creation (or strengthening) of a tight-knit community in rural areas" (Stefanovic, L., & Agbolosoo-Mensah, 2023).

Each of the three cases exemplifies that Cilento built networks between coastal and inland communities, Panzano united farmers in common cause, and Val di Vara literally prevented community dissolution by binding people together around a new identity.

6.5 Partnerships and multi-sectoral integration

The cases also underscore that biodistricts thrive on partnerships and the integration of agriculture with other sectors (tourism, education, energy, etc.).

In Cilento, agriculture was tied to eco-tourism (bio-trails, gastronomy tourism), to culture (Mediterranean diet heritage), and to social sectors (e.g., social farming for inclusion). This multi-vocational approach meant the biodistrict influenced not just farming techniques but also how tourism

is done (more sustainably) and how social services operate (school canteens sourcing local organic). The impact is a diversified rural economy – farmers do not just produce food, they provide experiences and services, which enhances their income and the region's attractiveness.

Val di Vara connected agriculture with renewable energy and infrastructure development; its biodistrict experience shows that investing in one domain (like energy independence) can synergistically support food and agriculture (the revenue from selling surplus electricity was used to fund farm projects and infrastructure). It is also integrated with public health (clean water, no chemical exposure) and education directly.

Panzano's biodistrict linked agriculture with scientific research (partnership with universities) and with the branding of an internationally known product (Chianti Classico wine). By doing so, it ensured that sustainability in farming became part of the business model of wineries, not just an altruistic endeavor – an integration of environmental goals with economic strategy.

Across all three, partnerships with institutions (regional governments, EU programs, or utilities) provided critical technical and financial support. For instance, Cilento got regional funds for farmer training; Panzano tapped into academic expertise for pest modeling; Val di Vara secured EU funds for infrastructure. These partnerships increased what local communities could achieve alone, indicating a best practice: biodistricts flourish when they are embedded in supportive networks beyond their immediate borders.

6.6 Circular economy and environmental resilience

A comparative point is how each biodistrict implements circular economy principles, which in turn bolster resilience.

Val di Vara takes the lead in circularity – achieving cycles in energy, water, and nutrients at a territory level (e.g., wind powering the valley, local feed–livestock–fertilizer loops).

Cilento emphasizes circularity in the socio-economic sense: keeping value addition local (through short chains and local processing) and recycling initiatives like composting and community gardens.

Panzano shows circularity in a specialized context: reusing organic waste in vineyards, reducing external inputs drastically, and some energy self-generation.

All the three cases have improved their environmental sustainability: organic farming in all three reduced pollution and improved biodiversity. This environmental stewardship is directly linked to long-term food security: healthier ecosystems can continue to provide food and livelihoods. We see concrete evidence of improved resilience: for example, Panzano's organic vineyards better withstand

climate stresses according to local vintners (Maurilli, 2024), and Val di Vara's forests and organic soils prevent erosion in heavy rains that regularly impact Liguria. Furthermore, by cutting reliance on external resources (namely fertilizers, fuel, long supply chains), these communities are less exposed to global market volatility. For instance, the spike in fertilizer prices in 2022 had a minimal impact on these farmers since they were not using synthetic fertilizers, which is a clear resilience advantage of circular and organic systems.

6.7 Food security through local governance and community food systems

Stepping back to the research question of this thesis – "*What role do biodistricts play in enhancing food security through sustainable agriculture, local governance, and community-based food systems in Italy?*" – the comparative answer is: biodistricts serve as catalysts and frameworks for integrating sustainable agriculture into local governance structures, thereby creating community-based food systems that strengthen food security.

In all three cases, the biodistrict model provided a formal mechanism to align farmers' practices with community needs and public support. This alignment is crucial. Without biodistrict coordination, organic farmers might struggle alone to find markets or recognition, and local governments might lack the means to influence agricultural practices. Biodistricts bridge that gap by institutionalizing the partnership – as one definition puts it, they are a "governance space placed between the farm and the territory" (Stefanovic, L., & Agbolosoo-Mensah, 2023), which allows for collaborative management of resources and food systems. Through this governance space, biodistricts in Italy have revitalized rural communities and made them more food-secure not by increasing sheer output, but by relocalizing and improving the quality of food production and consumption. They operationalize the concept of food security in a qualitative, sustainable sense: it is not just about having enough to eat, but ensuring the food system is ecologically sound, economically fair, and locally controlled to an extent. As noted in a recent study of Cilento, biodistricts turned rural areas into "attractive multifunctional spaces with a tight-knit community". That attractiveness and cohesion mean people stay, farms stay active, and innovation continues, all of which contribute to the stability of food production locally.

Comparing outcomes, Val di Vara's biodistrict shows the most dramatic turnaround – from decline to self-sufficiency – highlighting the potential of biodistricts to address rural food security in marginal areas. Cilento's biodistrict illustrates broad regional impact, influencing a large territory and even policy, showing that the model can be scaled and replicated (indeed, Italy now counts numerous biodistricts covering ~30% of its territory). Panzano (Chianti) demonstrates that biodistrict principles are applicable even in wealthy, export-oriented contexts, suggesting that food security and

sustainability are relevant goals for all communities, not only impoverished ones. In Chianti, the benefit is maintaining the long-term productivity and reputation of the land (a form of safeguarding food security for the future). In terms of governance models, one size does not fit all, but successful biodistricts tend to share a visionary impetus, be it from community leaders or farmer coalitions, followed by a formalization that allows inclusive governance. They become vehicles for local communities to take control of their development pathway, with food and agriculture at the core. This local governance of food systems about deciding collectively to go organic, to shorten circuits, to invest in local processing is a common feature in enhancing food security in a way that purely market-driven or central policies often cannot achieve. Thus, this governance structure is all about community empowerment in food systems.

7. Challenges and lessons

It is worth noting that while these cases own valuable lessons that align with broader EU policy frameworks and illuminate the conditions under which the biodistrict model can be scaled or replicated in other territories, biodistricts face also challenges. In the paragraphs that follow, we distinguish between internal and external challenges, analyse the lessons from the case studies to key EU policies (European Green Deal, Farm to Fork Strategy, and CAP Strategic Plans), and discuss insights on scalability and replicability.

7.1 Internal challenges: governance and participation

Internally, biodistricts must develop effective governance models and maintain participatory structures that keep the community cohesive. Each case study faced such challenges. To make an example, the Cilento biodistrict had to ensure that its rapidly growing network of municipalities and stakeholders did not lose cohesion or weaken its founding organic vision. Panzano in Chianti needed to persuade all local growers to comply with organic standards and deal with any non-compliant members, representing a challenge addressed through strong social pressure and community monitoring. In Val di Vara, the biodistrict grappled with keeping farmers engaged over time and balancing diverse stakeholder interests. From a governance point of view, all three cases needed to balance the priorities of different groups (e.g. small vs. large producers in Chianti, or tourism-oriented businesses vs. farmers in Cilento) within an inclusive decision-making process.

These examples highlight how internal governance structures and participatory processes are critical to biodistrict success. A shared visionary idea, often initiated by community leaders or a coalition of organic producers, was key to getting started, but this had to be followed by a formal institutional framework that could include broad participation and conflicts' management. Practically, each biodistrict established an association or cooperative governance body to coordinate activities, demonstrating the need for institutional capacity at the local level to preserve the impetus. The cases show that one size does not fit all in terms of governance; nonetheless, successful biodistricts converge on a model of adaptive and inclusive governance that empowers local actors. This internal governance capacity enabled them to navigate challenges such as merging or expanding organizations: for instance, the Chianti biodistrict merged two adjacent districts into one unified entity for efficiency, Cilento continuously expanded its membership while preserving a common identity, and Val di Vara updated its strategies (e.g. adopting an "Organic Valley" branding initiative) to keep participants engaged. In other words, these adaptive measures illustrate how strong local institutions and participatory governance can address internal challenges.

Another internal challenge is preserving the agricultural workforce and know-how in the long term. For instance, Val di Vara faced an aging farming population as many farmers were near retirement, posing a risk to continuity. Consequently, attracting new generations of farmers and entrepreneurs became an urgent internal challenge for this biodistrict: indeed, the need for generational renewal and capacity-building in sustainable farming is an internal issue shared across many rural areas in Italy and biodistricts must invest in education, mentorship, and incentives for youth to take up farming. This challenge ties directly into institutional capacity: without local training programs or support for young entrants, biodistricts risk losing their progress as older members retire.

In the cases studied, there are few signs of progress as newcomers are slowly arriving in Val di Vara to take up farming, drawn by the biodistrict's reputation and support network, but the effort to cultivate new leadership and skills internally is ongoing. Notably, this internal challenge aligns with broader policy goals: the EU's CAP identifies supporting generational renewal as a priority (European Commission, 2023a), and the biodistricts' focus on youth engagement serves as a local-level response to that need.

7.2 External challenges

Beyond their internal dynamics, biodistricts operate within a broader external context that presents additional challenges.

Market volatility represents an example of such challenge, since local producers are still subject to fluctuations in market demand and prices. For instance, in the case of Panzano in Chianti's wine growers, global market trends for wine (and organic products) can influence their income stability. Economic shocks or shifts in consumer preference, such as a sudden drop in tourism or price competition from non-organic producers, can test the resilience of these local systems. Thus, biodistricts must develop strategies to cope with market uncertainty: for example, by diversifying products, developing local processing and direct-to-consumer sales, or building a strong territorial brand, as seen with Val di Vara's "Organic Valley" marketing, which helps differentiate and add value to its products.

Climate impacts pose another external challenge. All three biodistricts, like other agricultural communities, are increasingly exposed to climate change effects such as unpredictable weather, droughts, floods, and shifting growing conditions. These environmental stresses can threaten crop yields and food production stability. For instance, a severe drought or extreme weather event in Cilento or Chianti could impact harvests of key crops, like olives, grapes, or vegetables, testing the community's food security. While organic and agroecological practices promoted in biodistricts may

improve resilience (through healthier soils, diversified crops, etc.), climate variability remains a significant external risk. To highlight the importance of this issue, it is underscored by EU policy: the European Green Deal and the new CAP both emphasize climate action and environmental sustainability as core objectives (European Commission, 2023b). Biodistricts align with these goals by reducing reliance on synthetic fertilizers and adopting eco-friendly farming, but they still must continuously adapt to climate impacts: for example, by exploring climate-resistant crop varieties or water-saving techniques to ensure long-term viability.

Furthermore, the policy and regulatory environment can either enable or hinder biodistricts, and dealing with it is an external challenge. As outlined above in the section on the legal framework, in Italy, biodistricts initially emerged as bottom-up innovations and only later received formal legal recognition (the term *organic district* was officially included in national law in 2017). This delay in institutional recognition was a hurdle in the early years as without a clear legal status, accessing public support or funding was challenging. Regulatory complexity, such as the bureaucracy of organic certification, or compliance with various EU and national standards, can disproportionately burden small producers in biodistricts. Moreover, if broader agricultural policies favor industrial farming, biodistricts may face an external policy bias.

However, the trend in recent years has been positive: Italian regional and national authorities, as well as the EU, have increasingly acknowledged and supported biodistricts. Still, external regulatory challenges remain in terms of ensuring that top-down policies (e.g. sanitary regulations, market rules, land use laws) accommodate and encourage these community-led initiatives. The need for multi-level coordination is evident: biodistricts thrive when local, regional, and national policies are aligned in support of organic, short supply chains and rural development. This coordination challenge reflects a broader tension between innovative local models and existing regulatory frameworks: one that requires continuous dialogue between biodistrict leaders and policymakers.

7.3 Lessons and alignment with EU policy frameworks

Despite the challenges outlined above, the three case studies demonstrate that biodistricts have the capacity to deliver outcomes highly consistent with the EU's current policy priorities. As a matter of fact, the lessons learned from Cilento, Chianti, and Val di Vara illustrate how biodistricts operationalize the goals of the Farm to Fork Strategy, EU Green Deal and key objectives of the CAP Strategic Plans. They show that local action can drive progress toward a "*fair, healthy and environmentally-friendly food system*," as envisioned by the European Green Deal (European Commission, 2019), by integrating sustainable farming, community welfare, and environmental stewardship.

7.3.1. From strategy to practice: biodistricts and the Farm to Fork Strategy

All three biodistricts put organic and agroecological practices at the center of their development, directly supporting the EU Farm to Fork Strategy's target of 25% of agricultural land under organic cultivation by 2030 (European Commission, 2020).

Panzano in Chianti famously achieved a 100% conversion of its vineyards to organic production, showing how even in a high-value, export-oriented context, farmers can collectively eliminate synthetic pesticides and fertilizers.

Similarly, Cilento and Val di Vara expanded organic farming across dozens of farms and thousands of hectares.

These cases provide valuable empirical evidence for EU policymakers: given the right community mobilization and support, the ambitious organic expansion goals are attainable. Indeed, biodistricts have been identified at the EU level as a concrete tool to promote organic conversion and shorten supply chains (Stefanović & Agbolosoo, 2023). By fostering local organic food networks (e.g. farm-to-consumer direct sales, organic public canteens, and agritourism), the biodistricts realize the Farm to Fork principle of shortening food circuits and improving access to nutritious and local food, contributing to food security in a qualitative sense by providing not just sufficient calories, but nutritious and sustainably produced food, aligning with the EU's vision for food system sustainability.

7.3.2. From strategy to practice: biodistricts and the EU Green Deal

The biodistrict model also aligns closely with the European Green Deal's climate and environmental aims. Through their emphasis on organic agriculture, biodiversity conservation, and resource cycling, biodistricts help reduce pollution and greenhouse gas emissions from farming, contributing to climate mitigation and healthier ecosystems. For instance, organic viticulture in Chianti avoids chemical inputs that can harm soil and water, and several farms in Val di Vara have adopted renewable energy solutions (solar panels, bioenergy from farm waste) in line with the Green Deal's push for clean energy transitions.

The EU Green Deal calls for integrated strategies to protect biodiversity and ensure the longevity of natural resources; in the cases analyzed, local actors integrated conservation with production (Cilento, located partly in a national park, leveraged its cultural and natural heritage to promote sustainable land use). These biodistrict experiences illustrate how the Green Deal's goals can be translated into actionable community initiatives, being living laboratories of the this policy instrument, showing how rural communities can pursue climate-friendly agriculture while also creating socio-economic value. Indeed, this synergy was recognized by EU institutions: for instance, the European Committee of the

Regions highlighted how biodistricts represent innovative governance tools for a greener and fairer food future, echoing Green Deal principles (European Commission, 2019; Poponi et al., 2021).

7.3.3. From strategy to practice: biodistricts and the CAP

As already stated, the new Common Agricultural Policy (2023–2027) and its national Strategic Plans emphasize a range of objectives, many of which are mirrored in biodistrict outcomes, including supporting fair farmer incomes, strengthening the position of farmers in the food chain, generational renewal, vibrant rural areas, environmental care and innovation (European Commission, 2023a).

The case studies provide tangible examples for each: by organizing collectively and focusing on quality, local biodistrict farmers can obtain better prices and a fairer share of value (e.g. Chianti's organic wine has a market premium, and Val di Vara's cooperative marketing improves farmer incomes), which speaks to fair income and supply chain positioning. Biodistrict governance councils and cooperative structures improve farmers' bargaining power and enable them to add value locally, aligning with CAP goals of improving farmers' positions and fostering knowledge and innovation as many biodistricts facilitate knowledge-sharing on organic techniques and business innovation. More specifically, Cilento and Val di Vara have combated rural exodus, thereby revitalizing rural communities, which resonates with the CAP's priority of vibrant rural areas and social cohesion. Val di Vara's efforts to bring in young farmers address the CAP priority of generational renewal, as noted earlier. Moreover, all three biodistricts contribute to climate and environmental objectives through organic farming and landscape stewardship, exactly as CAP's eco-schemes and agri-environment measures intend (European Commission, 2023a; 2023c).

7.3.4. Biodistricts and EU policy frameworks: final considerations

Crucially, these alignments are not just coincidental as EU policy is increasingly supportive of the biodistrict approach. Italy's national CAP Strategic Plan explicitly includes the promotion of Bio-districts and Food Districts as a rural development tool, with the expectation of reaching roughly 56% of rural residents through such local initiatives (European Commission, 2025).

This policy support validates the lesson that emerged from the field: local and integrated food governance can be a powerful means to achieve policy goals that are hard to reach through top-down measures alone. Biodistricts demonstrate how organizing farmers, citizens, and municipalities around organic production and short supply chains can simultaneously advance multiple EU objectives from an environmental, social and economic point of view. The cases thereby inform policy by providing models of holistic implementation. In summary, the lesson from Cilento, Panzano, and Val di Vara is

that biodistricts serve as practical engines for EU strategies like the Green Deal and Farm to Fork, translating high-level targets into community action and tangible outcomes.

7.3.5. Biodistricts scalability and replicability

A significant question arising from these case studies is whether the biodistrict model can be generalized or adopted in other territories. The Italian experience suggests that scalability and replicability are feasible under certain conditions, and indeed we are already witnessing growth in the number of biodistricts. From the first biodistrict established in 2009 (Cilento), the concept spread to 26 biodistricts by 2017 (Giuca et al., 2017) and 41 by 2021 (Basile et al., 2021). As of 2023, biodistricts (and similar organic districts) cover roughly 30% of Italy's agricultural land or territory (Poponi et al., 2023), and the model has begun to inspire regions in other European countries. This rapid proliferation indicates a degree of scalability, but it has been facilitated by specific factors.

Firstly, one key condition is supportive policy frameworks: the formal recognition of biodistricts in Italian law (2017) and the inclusion of biodistrict funding in rural development programs provided a crucial framework for replication. When local initiatives know they have government backing, through technical assistance, favorable policies and incentives, or direct funding, they are more likely to take root and flourish. Thus, an enabling policy environment (from municipal up to EU level) is fundamental for scaling up biodistricts.

Secondly, another essential condition is the presence of strong local leadership and social capital. The case studies reveal that biodistricts often start with a coalition of motivated actors (whether visionary mayors, active farmers' associations, such as AIAB in Italy, or civil society), who can mobilize the community and articulate a common vision. This leadership then requires to be institutionalized into a multi-actor governance structure (a committee, association, or consortium) to manage the initiative over time. Regions that wish to replicate the biodistrict model must invest in building these networks of trust and collaboration among farmers, local businesses, citizens, and authorities. Without a committed core group and a participatory governance mechanism, the biodistrict model may not gain enough traction. Conversely, given a committed local stakeholder base, even very different territories can adapt the model: for example, affluent Chianti's wine growers and marginal Val di Vara's mixed farmers both succeeded once a collaborative governance platform was established, each leveraging their unique local resources.

Thirdly, adaptation to local context represents another lesson on replicability. The three Italian biodistricts show that while the underlying principles (organic agriculture, local circuits, community decision-making) are constant, the implementation must be tailored to local cultural, economic, and

ecological conditions. Cilento capitalized on its rich cultural heritage and tourism potential, being in a national park and the cradle of the Mediterranean diet, to define its biodistrict identity. Panzano in Chianti built on a globally recognized wine appellation, integrating biodistrict ideals with the goal of protecting the long-term reputation and terroir of Chianti Classico wines. Val di Vara, lacking such advantages, focused on becoming an "Organic Valley," using renewable energy projects and cooperative marketing to turn a remote area into a self-sufficient green economy. These examples suggest that replicability requires flexibility: communities should identify their own strengths (be it a famed product, a tourism appeal, or a tradition of cooperation) and frame the biodistrict around those assets. The model is thus highly generalizable, but not a rigid blueprint: it is a framework that other territories can adopt under the condition that they mold it to fit their local circumstances.

Finally, the cases highlight the importance of scalability with integrity. As biodistricts grow in membership or as more regions create biodistricts, maintaining the core values and cohesion is a challenge that must be managed. A lesson from Cilento is that scaling up (covering dozens of municipalities) requires extra effort in communication, consensus-building, and equitable benefit-sharing, so that all participants remain committed. Mechanisms like regular assemblies, transparent rules, and shared projects (e.g., collective brands or festivals celebrating the biodistrict's products) can help preserve a cohesive community even as numbers increase. Similarly, networking between biodistricts, through national or international networks (such as the International Network of Eco-Regions, IN.N.E.R.), can support replication by sharing best practices and preventing each new biodistrict from "reinventing the wheel", contributing to the standardization of certain guidelines and promoting the concept externally, attracting new regions to adopt it.

7.4 Concluding remarks on lessons and challenges in biodistrict development

In conclusion, the challenges and lessons from the Italian biodistricts underscore that the model is not without difficulties, but it offers a compelling pathway toward sustainable local food systems. Internally, effective governance, community participation, and building local capacity are vital to overcome challenges like stakeholder conflicts or generational turnover. Externally, biodistricts must weather market and climate uncertainties and work within (or to change) the regulatory landscape. The experiences of Cilento, Panzano in Chianti, and Val di Vara show that when these internal and external challenges are met, biodistricts can achieve robust positive outcomes: environmental regeneration, social cohesion, and improved food security. These outcomes strongly resonate with EU policy objectives: indeed, biodistricts can be seen as microcosms of the European Green Deal and Farm to Fork ideals, delivering greener and fairer food systems at the local level. The fact that EU and national policies are now actively supporting biodistricts is both a result of these successes and a facilitator for

future expansion. The lesson on scalability is optimistic: with enabling conditions in place, the biodistrict approach is replicable in other territories, provided there is a committed community and a willingness to adapt the model to local realities. In essence, biodistricts demonstrate that communities can "*feed themselves by sustaining themselves*," offering a replicable model for sustainable development that bridges grassroots action and high-level policy goals.

8. Conclusion

This thesis explored how biodistricts enhance food security in Italy through the interplay of sustainable agriculture, local governance, and community-based food systems. By integrating insights from literature, a comparative case study methodology, and analysis of three biodistricts (Cilento, Panzano in Chianti, and Val di Vara), the research confirms that biodistricts serve as catalysts for more resilient local food systems. Each case demonstrated that when farmers, local authorities, businesses, and citizens collaborate under a biodistrict framework, they embed sustainable agriculture into the fabric of local governance and society. This coordination provides a formal mechanism to align farming practices with community needs and public support, thereby directly strengthening food security at the community level. Importantly, the evidence shows that biodistricts achieve this not simply by increasing food output, but by relocalizing production and consumption, improving the quality of food, and ensuring more equitable access, hence a qualitative improvement in food security that encompasses environmental, economic, and social dimensions. The literature review underscored that conventional top-down approaches often overlook such local capacities; this study's findings fill that gap by illustrating the tangible benefits of a bottom-up and place-based approach to food security.

According to the three diverse regions studied, biodistricts enhanced food security via three interlocking pathways. Firstly, they promoted sustainable agricultural practices, notably widespread organic and agroecological farming, which preserve the natural resource base (soil, water, biodiversity) and improve the nutritional quality and safety of food. Secondly, they established inclusive local governance arrangements that integrate food system priorities into community decision-making. In practice, each biodistrict created participatory institutions (associations or councils) that empowered local actors to co-manage resources and set common goals, such as organic conversion or farm-to-school programs. This bottom-up governance of food systems enabled communities to make collective choices (e.g. to go fully organic or to invest in local processing facilities) that would be hard to achieve through market forces or fragmented policies alone. Thirdly, they fostered community-based food networks: for example, through farmers' markets, solidarity purchasing groups, agritourism and educational initiatives, that shortened supply chains and strengthened the bonds between producers and consumers. These networks improved the availability and accessibility of local and healthy food, while building social capital and trust at the same time. Notably, each biodistrict tailored these principles to its unique context: Cilento leveraged its rich cultural heritage and gastronomic traditions as a model of the Mediterranean diet and a UNESCO-recognized area to promote organic tourism and local identity; Panzano in Chianti built on its prestigious wine economy by converting vineyards to organic methods, showing that even affluent, export-oriented areas can embrace sustainability for long-

term benefits; and Val di Vara focused on self-sufficiency in a remote mountain valley, coupling organic farming with renewable energy projects to create a circular economy. Despite their differing local realities, all three case studies converged on common outcomes: revitalized rural communities, stronger local economies, and more robust food security characterized by diversified food sources and greater resilience to external shocks.

The research also identified challenges and conditions necessary for biodistricts to succeed, providing an analytical and critical perspective to the optimistic findings. Internally, effective governance and broad community participation emerged as vital. Each biodistrict had to overcome issues like stakeholder coordination, power imbalances, and generational turnover in the farming sector. For instance, maintaining a cohesive vision as membership expanded in Cilento, enforcing organic standards among all producers in Chianti, or keeping small farmers engaged in Val di Vara required adaptive and inclusive governance structures. A committed core leadership and institutional support, as the creation of a multi-stakeholder association, were key to managing conflicts and guaranteeing the biodistrict's success. Furthermore, investing in human capital through the education and incentivization of youth and new farmers represented an important step to address the aging workforce and ensure continuity of sustainable practices. Externally, biodistricts faced market and environmental pressures. Price volatility and global market trends (e.g. for wine or dairy) could threaten farmer incomes, and climate change (e.g. droughts, floods) tested the robustness of local agroecosystems. Moreover, working within (and sometimes pushing against) existing regulatory frameworks posed challenges, as innovative local models are not always fully supported by traditional agricultural policies. The case studies showed that strong local institutions, coupled with supportive regional and/or national policies, help mitigate these external risks. When internal cohesion and external support aligned, the biodistricts achieved notable positive impacts: from environmental regeneration (e.g. improved soil health, biodiversity conservation) to social cohesion (e.g. community pride, reduced out-migration) and economic vitality (e.g. higher added value for local products, agri-tourism income). These benefits underscore that the biodistrict model, while not a silver bullet, offers a viable pathway toward sustainable food security. The challenges highlighted act as valuable lessons for scaling up the model: they emphasize the need for context-sensitive approaches, capacity-building, and continuous stakeholder engagement to replicate success in other regions.

To conclude, this thesis situates the findings within broader EU policy debates, reflecting on how biodistricts contribute to European policies' goals such as the Green Deal, Farm to Fork Strategy, and the reformed CAP. The Italian biodistrict experiences effectively translate high-level strategies into on-the-ground action. All three cases advanced the Farm to Fork Strategy's vision by dramatically

expanding organic agriculture (one even reaching 100% organic viticulture) and by shortening food supply chains, thereby contributing to the EU's 2030 target for organic land and ensuring consumers have access to nutritious and locally produced food. In doing so, they show policymakers that community mobilization can achieve ambitious sustainability targets. Similarly, the biodistricts align with the European Green Deal's aims by implementing climate-friendly farming (reducing chemical inputs and embracing renewable energy), preserving biodiversity (through organic and place-based practices in ecologically sensitive areas), and showing how rural communities can generate socio-economic value while lowering their environmental footprint. Thus, they act as living laboratories of the Green Deal, illustrating how a "fair, healthy and environmentally-friendly food system" can be built from the ground up. Furthermore, the cases touch on key priorities of the CAP Strategic Plans, such as supporting vibrant rural areas and generational renewal. For example, the emphasis on local processing and direct sales in biodistricts echoes the CAP's support for short supply chains and value-adding in rural communities, and the proactive engagement of young farmers in biodistrict initiatives addresses CAP's call for generational renewal in agriculture. This research thus contributes evidence to EU-level discussions by showing that integrated, place-based approaches like biodistricts can complement top-down policies. Notably, Italy's policy landscape has already begun to recognize this: national legislation now formally acknowledges organic districts, and CAP-funded programs are channeling support to such districts in Italian regions. The synergy between grassroots innovation and policy support suggests a fertile ground for replication across Europe. In conclusion, the role of biodistricts in Italy has proven to be transformative as they empower communities to secure their own sustainable food futures by weaving together ecological practices, local governance and social inclusion. This holistic model not only fosters food security in the communities directly involved, but also serves as a blueprint for sustainable development that can inform wider European efforts to build resilient, sovereign and sustainable food systems.

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ANNEX

Interviews with biodistricts' representatives

1) Please describe how the idea of establishing a biodistrict emerged in your territory. Who were the key actors or institutions that promoted it in the beginning, and what motivated the initiative?
2) Can you please explain how the biodistrict is currently governed? What kind of structure is in place, and how are local farmers, municipalities, associations, and citizens involved in the decision-making and operational processes?
3) Outline the main results achieved in terms of organic farming. How many farms have been involved, what changes have occurred in agricultural practices, and what impact has the biodistrict had on land use and local production systems?
4) Can you please describe the main circular economy strategies adopted in your biodistrict? How are resources reused, waste minimized, or renewable energy integrated into the local agri-food system?
5) Please share how the biodistrict has contributed to strengthening food security and community resilience. Has it improved local food availability, access, and nutritional quality? How did it respond to challenges such as the COVID-19 pandemic or climate impacts?
6) What are the main challenges your biodistrict is currently facing, and what goals or future strategies are planned to enhance its sustainability, scalability, and long-term impact?

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