

**PROMOTING THE TERRITORY
THROUGH ITS AGRI-FOOD EXCELLENCE:
THE EXPERIENCE OF THE WHITE TRUFFLE
OF ALTO MONFERRATO
IN THE SCIENTIFIC RESEARCHS
OF EASTERN PIEDMONT***

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1. Introduction: the Progressive Integration of the Tourism and Agri-Food Sectors in European Regulation and in the Data of the Main Italian Tourism Observatories.

Over the past twenty years, the relationship between the tourism sector and the agri-food sector has undergone increasing integration within both European policies and national territorial development strategies.

This is not the result of spontaneous convergence, but rather of a regulatory and programmatic evolution.

This shift has progressively acknowledged high-quality agricultural products as pivotal to both territorial cultural identity and tourist appeal.

The European Union's Common Agricultural Policy has long expanded its scope of action, moving from a model originally

centred on commodity productivity to a system that integrates sustainability, biodiversity protection, technological innovation and multifunctionality into agricultural enterprises¹.

The *European Green Deal* (2019)² provided a strategic framework that further accelerated this transformation, defining environmental, economic and social objectives poised to have a profound impact on agri-food supply chains.

¹ The relationship between Agricultural Policy and multifunctionality dates back in time and the literature on the subject is too extensive to be usefully summarized here. By way of example, see L. CASINI, *Multifunzionalità e riforma della Politica Agricola Comune*, in *Nuovo diritto agrario*, 2003, pp. 17 ff.; AA. VV., *Riforma della PAC e multifunzionalità: l'agricoltura tra nuove sfide e nuove opportunità*, in *Rivista di economia agraria*, 2005, pp. 185 ff.; J.M. PETERSON, R. N. BOISVERT, H. DE GORTER, *Multifunctionality and Optimal Environmental Policies for Agriculture in an Open Economy, Agriculture and the New Trade Agenda, Working Papers 127701*, Cornell University, Department of Applied Economics and Management, 2004, pp. 458–483; G. SKOGSTAD, A. VERDUN, *The Common Agricultural Policy Policy Dynamics in a Changing Context*, London, Routledge, 2010; C. POTTER, *Agricultural multifunctionality, working lands and public goods: Contested models of agri-environmental governance under the Common Agricultural Policy*, in J. A. MCMAHON, M. N. CARDWELL (eds.), *Research Handbook on EU Agriculture Law*, London, Edward Elgar, 2015; M. LOVEC, *The European Union's Common Agricultural Policy Reforms. Towards a Critical Realist Approach*, London, Palgrave Macmillan, 2016; K., ERJAVEC, E. ERJAVEC, *Agriculture and environment: friends or foes? Conceptualising agri-environmental discourses under the European Union's Common Agricultural Policy*, in *Agric Hum Values* 41, 147–166 (2024); Y.E., DOUKAS, I. VARDOPOULOS, P. PETIDES, *Challenging the Status Quo: A Critical Analysis of the Common Agricultural Policy's Shift Toward Sustainability*, in A. RIBEIRO HOFFMANN, P. SANDRIN, Y.E. DOUKAS (eds.) *Climate Change in Regional Perspective*, United Nations University Series on Regionalism, vol 27. Springer, Cham, 2024; A. FRASCARELLI, S. CILIBERTI, P.E. BARTOLUCCI, et al. *The CAP coherence between redistributive and environmental goals: do the allocation criteria for direct payments play a role?* in *Agric Econ* 13, 15 (2025).

² Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions *The European Green Deal*, COM (2019) 640 final, Dec. 11th, 2019.

The *Farm to Fork*³ and *Biodiversity 2030*⁴ strategies, integral components of the *Green Deal*, explicitly stress the need to strengthen the relationship between sustainable food systems, local economies and forms of tourism linked to nature and rural landscapes.

They emphasise that the quality of typical products cannot be separated from the overall quality of territories, including the protection of ecosystems, the management of natural resources and the safeguarding of intangible cultural heritage.

The new Common Agricultural Policy (CAP) for the 2023–2027 programming period, implemented through National Strategic Plans (NSPs), has contributed to a stronger integration between rural development policies and tourism, although this integration is not framed as a standalone tourism policy. Instead, tourism is embedded within a broader territorial and multifunctional approach to rural development, reflecting a significant shift in how rural areas are conceived within EU policy.

Under the new CAP architecture, rural development is no longer treated as a separate pillar but is fully integrated into a single strategic framework together with direct payments and market measures. This integration has given Member States greater flexibility to design interventions that respond to local needs and territorial specificities. Within this framework, tourism emerges as a complementary economic activity that supports the resilience, diversification and attractiveness of rural areas rather than as an end in itself.

The NSPs explicitly recognise tourism—particularly sustainable and rural tourism—as a tool for enhancing the socio-economic

³ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system*, COM (2020) 381 final, May 20th, 2020.

⁴ See the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions *EU Biodiversity Strategy for 2030: Bringing nature back into our lives*, COM (2020) 380 final, May 20th, 2020.

vitality of rural territories. Tourism is closely linked to the valorisation of natural landscapes, cultural heritage, traditional agricultural practices and high-quality agri-food products. By reinforcing these territorial assets, tourism contributes to making rural areas more attractive both to visitors and to residents, thereby addressing long-standing challenges such as depopulation, ageing and limited employment opportunities.

One of the main ways in which the CAP 2023–2027 encourages this integration is through the promotion of diversification and multifunctionality in agriculture. Farmers and rural enterprises are incentivised to expand their activities beyond primary production, for example by developing agritourism, educational farms, experiential tourism, or nature-based and cultural services. These activities generate additional income streams and strengthen the economic sustainability of farms, while at the same time reinforcing the connection between agriculture, territory and tourism.

Moreover, the new CAP places strong emphasis on territorial development, social inclusion and local value creation. Tourism-related initiatives are often included under interventions aimed at improving the quality of life in rural areas, enhancing local services, and fostering entrepreneurship. In this sense, tourism is treated as part of a wider rural economy that includes services, small businesses and community-based initiatives, rather than as a sector isolated from agriculture and land management.

Another important element is the role of place-based and participatory approaches, particularly through LEADER and Community-Led Local Development (CLLD). These instruments continue to play a key role in the 2023–2027 period and frequently support integrated local strategies where tourism, agriculture, environmental protection and cultural heritage are jointly addressed. Such strategies encourage cooperation among farmers, local authorities, tourism operators and civil society, reinforcing policy coherence at the local level.

This approach has been further reinforced by Regulation (EU)

2024/1143 on quality schemes of foodstuff⁵, which introduces tools to support the international recognition of typical products and strengthen the governance of territorial supply chains.

The regulation assigns a central role to the synergy among agriculture, tourism, culture and sustainability, recognising that contemporary tourist experiences are increasingly tied to the authentic narrative of places and their gastronomic specificities, and entrusting producer groups with the task of promoting both the product and its territory of origin.

In this perspective, Geographical Indications become not only instruments for protecting quality and origin but also fundamental elements of territorial marketing strategies and of new models of visitor engagement.

In the same vein of European regulation, data produced by the main Italian tourism observatories confirm the emergence of a model of territorial engagement based on the integration of natural heritage, food culture and local identity.

Recent reports on food and wine tourism by ENIT, ISNART and Unioncamere show a steady increase in the percentage of tourists who choose a destination on the basis of experiences related to typical products and agri-food traditions⁶.

⁵ See the Regulation (EU) 2024/1143 of the European Parliament and of the Council of 11 April 2024 on geographical indications for wine, spirit drinks and agricultural products, as well as traditional specialities guaranteed and optional quality terms for agricultural products, OJ, April 23rd, L 32024R1143.

⁶ See, by way of example, the report *Italy as a tourist destination 2017* — ISNART / Unioncamere, online; *Monitoring of the intermediated travel market with a focus on food and wine tourism proposals* (2022) — ENIT / ISNART, online; *The Italian Food and Wine Tourism Report 2023*, edited by R. GARIBALDI, at <https://www.robertagaribaldi.it/en/rapporto-sul-turismo-enogastronomico-italiano2023/>, as well as, ID., *The Report on Italian Food and Wine Tourism 2024*, ONLINE, to which are added the first Report on PDO Tourism, which reports similar growth trends in interest in the integration of the two supply chains and ENIT data on the impact of Italian food and wine in the tourism choices of foreigners <https://www.enit.it/it/il-turismo-enogastronomico-fra-ipacchetti-con-maggiore-appeal-del-mercato-internazionale>.

This is no longer a niche segment but a structural trend in demand, which sees food not only as an element of pleasure but as a tool for understanding a territory.

According to these analyses, over 55% of Italian and foreign travellers include at least one food-and-wine experience among the main reasons for their trip, while 70% express a positive evaluation of destinations offering certified or recognisable agricultural products.

The rise of experiential tourism — including activities such as visits to farms, guided tastings, explorations of woodland areas, participation in events and workshops — has helped create new forms of territorial economy in which producers, institutions and tourism operators collaborate to develop integrated offers.

Today's tourist seeks authenticity, sustainability, direct contact with local communities and credible narratives connected to visited places.

This shift in expectations has led rural territories to enhance their specificities, recognising in high-quality agricultural products an defining feature of local identity capable of distinguishing them in an increasingly competitive tourism market.

The synergy between tourism and agri-food therefore assumes strategic significance: it reinforces the perception of the territory as a living cultural space, supports its economic vitality and contributes to preserving traditions and natural ecosystems.

Within this context lies the experience of the *Tartufo Bianco Pregiato dell'Alto Monferrato*, a paradigmatic example of how agri-food excellence can become the engine of an integrated process of tourism development, cultural enhancement and technological innovation.

It shows how the protection and promotion of agricultural products can generate positive effects well beyond the economic dimension, contributing to the reshaping of territorial identity and the creation of new forms of local cooperation.

2. Enhancing the Territory Through Its Excellent Products and Guaranteeing Authenticity and Genuineness.

The *Tartufo Bianco Pregiato dell'Alto Monferrato* is one of the most significant examples of how a natural product can shape the identity of a territory and become its distinctive hallmark.

The white truffle — a non-cultivable species highly dependent on the quality of woodland ecosystems — serves both as an indicator of environmental health and as a cultural and gastronomic resource of extraordinary value.

In Alto Monferrato, a geographical area located between the provinces of Alessandria and Asti in Piedmont, the historical presence of truffle grounds is widely documented by local sources and oral testimonies, which attest to their importance as early as the 18th and 19th centuries, when the product began circulating in the kitchens of the Savoy courts.

The night-time harvesting performed by truffle hunters — often accompanied by their children in an intergenerational cultural dialogue — and the use of trained dogs have acquired such anthropological and cultural relevance that in 2021 UNESCO recognised the practice as Intangible Cultural Heritage.

The UNESCO dossier describes these practices as «a set of traditional knowledge and skills orally transmitted for centuries» that reflect «the rural life of an entire community» and require profound knowledge of climate, environment, vegetation, soil and the relationship between humans and dogs in truffle hunting⁷.

⁷ The "truffle hunting and extraction" in Italy was officially inscribed in 2021 on the UNESCO Representative List of the Intangible Heritage of Humanity. For more details, you can consult the online dossier at <https://ich.unesco.org/en/RL/truffle-hunting-and-extraction-in-italy-traditional-knowledge-and-practice-01395>. In the academic articles, see, *ex multis*, A. PIERONI, *The changing ethnoecological cobweb of white truffle (Tuber magnatum Pico) gatherers in South Piedmont, NW Italy*, *Journal of Ethnobiology & Ethnomedicine*, 2016. DOI:10.1186/s13002-016-0088-9; M. ALRHOUN, M. ZANARIA, F. ELIA, N. SULAIMAN, A. PIERONI, P. CORVO, *It's Years of Walking, of Reading the Forest*:

The recognition underscores how the practice contributes to preserving biodiversity and local natural ecosystems while highlighting its ethno-anthropological and social importance: truffle hunting is inseparably linked to seasonality, orally transmitted stories, local festivities centred around the product, territorial identity and, consequently, community cohesion.

Beyond its unquestionable social value, this hypogeous fungus has an extraordinarily high economic value, supported by steady global demand from affluent and expert consumers.

Since it is harvested and consumed in its natural form, without undergoing industrial processing, the white truffle is perceived by consumers as the epitome of naturalness, purity and authenticity — characteristics that facilitate its integration into local agritourism activities.

Its exceptional organoleptic qualities blend with an immense range of typical gastronomic recipes that have gradually attracted increasing international attention.

Despite this deep-rooted tradition, truffles from Alto Monferrato have not benefited proportionally from the general recognition of the product's value.

This is due both to the lack of transparency in the supply chain — which often fails to guarantee the true origin of marketed products — and to the presence of more commercially established traditions in neighbouring geographical areas (such as Alba white truffles), which enjoy greater visibility and market presence.

This overlap has often resulted in Monferrato truffles being sold

White Truffle Hunters' Perception of Socio-Ecological Change in Langhe and Roero, NW Italy, *Sustainability*, 2025, 17(17):8053. DOI:10.3390/su17178053; A. GARNERONE, I. ZAINUB, *The Alba White Truffle Festival and Preserving Cultural Heritage*, *Tourism Cases*, CABI, 2025, doi:10.1079/tourism.2025.0040; G. GUALANDI, *Traditional Environmental Knowledge and Trees Conservation: The Example of the White Truffle (Tuber Magnatum Pico) in Italy*, in M. N. SUNEETHA, M. SUBRAMANIAN, P. VARGHESE (eds.), *Business and Biodiversity. Reciprocal Connections in the Context of Socio-Ecological Production Landscapes and Seascapes (SEPLS)*, Springer, Tokyo, Japan, 2025.

under the Alba denomination⁸, preventing the territory from developing its own autonomous identity and attracting tourism flows comparable to other truffle-producing areas in Piedmont or elsewhere in Italy.

The lack of a defined identity has thus limited opportunities for tourism promotion and local cultural enhancement linked to the product, penalising an area endowed with significant environmental, historical and gastronomic resources.

The need to reverse this trend prompted local authorities (mainly municipalities and the Chamber of Commerce), territorial stakeholders and other interested parties to develop initiatives aimed at establishing scientifically validated certification and authentication systems, thereby restoring identity and visibility to the *Tartufo Bianco Pregiato dell'Alto Monferrato* and promoting the area as an attractive tourist destination known for its natural heritage and its gastronomic “gem”.

2.1. The NODES Project – *Nord Ovest Digitale e Sostenibile* in This Context.

The NODES Project (Nord Ovest Digitale e Sostenibile)⁹ embraced this challenge by promoting a path toward building a strong local identity around the truffle tradition, supported by irrefutable analytical evidence.

The project stemmed from an innovation ecosystem involving

⁸ See, in this regard, the issues addressed in the television programme Report, broadcast on RAI on 1 February 2026, concerning the authenticity and origin of high-quality white truffles, particularly those from the Alba area. The programme prompted numerous reactions from major local and national stakeholders, as well as from several political figures, who called for greater transparency along the supply chain and for stricter rules on traceability controls. The video of the programme is available online on the broadcaster's official website <https://www.raiplay.it/video/2026/01/Tartufo-tra-sogno-e-realta---Report-01022026-ddabfc2c-fb40-4ea7-bf01-cdc37935802a.html>.

⁹ See the website <https://ecs-nodes.eu/>.

Piedmont, the Aosta Valley and the westernmost provinces of Lombardy (Como, Varese and Pavia), bringing together representatives of various local innovation actors, including universities, innovation hubs, research centres, competence centres and territorial public bodies.

The project's central objective was to develop research and entrepreneurial supply chains within the seven thematic "spokes," aligned with the ecosystem's aptitudes: Industry 4.0 for mobility and aerospace, industrial sustainability and green technologies, cultural and tourism industries, digital and sustainable mountain areas, health industry and silver economy, primary and processing agro-industry.

The goal was to enhance ideas and skills already present in the territories while introducing new ones, transfer the necessary know-how for startup development and ensure the creation of future initiatives, thereby strengthening territorial identity through sustainability, tourism and culture.

Special attention was given to the impact of new technologies and digital methods functional to achieving these goals.

In this framework, Spoke 3 aimed to support tourism and cultural development through sustainability, the promotion of *Made in Italy*, and the enhancement of local (including gastronomic) traditions; to create cultural routes and slow, high-end tourism; and to build territorial identity by uniting local actors around the project's values and objectives.

Within this scope, the flagship project TOEP – *Tourism Open-ended Experimentation Platform* sought to collect, through collaborative and crowdsourced processes, proposals for integrated and sustainable tourism that would enhance local excellence.

For the Alto Monferrato land, the challenge lay in transforming a product of excellence — the white truffle harvested in the area — into a true identity banner capable of narrating the history, geology and biodiversity of a specific territory, distinguishing it from neighbouring areas and giving it distinct positioning in the global market of experiential tourism.

3. The Use of New Technologies and Product Traceability to Guarantee Transparency and Authenticity.

One of the project's core concepts was that attracting tourist flows required enhancing the link between gastronomy and territory by offering authenticity guarantees for the emblematic product, thereby appealing to high-end tourism.

The choice of the “white truffle” product involved the challenge arising from the absence of objective traceability systems based on scientifically analysable elements rather than on commercial “trust.”

However, this apparent difficulty concealed an extraordinary opportunity: identifying an “analytical” method to guarantee product origin would attract exceptional public interest and provide an added value currently unmatched by any other truffle-producing area in the world.

To address this challenge, the project adopted a multidisciplinary approach, integrating advanced genomic and geochemical analysis techniques with distributed-ledger data management systems (blockchain).

Traditional identification methods — based on smell, morphology and tissue structure — are often unreliable for precisely determining geographic origin within the same species.

On the analytical front, the study conducted by the CNR and the University of Eastern Piedmont developed an innovative methodology based on data fusion combining two different information sources: the genetic profile and the elemental soil fingerprint¹⁰.

For genetic characterisation, microsatellite markers (SSRs – *Simple Sequence Repeats*) were identified and used: highly polymorphic DNA sequences that allow the creation of a unique genetic fingerprint for each individual.

The research identified 24 new SSR markers on the *T. Magnatum*

¹⁰ Cfr. F. GULINO, E. CALÀ, L. GARRUTO, C. TOSO, G. LINGUA, P. CESARO, V. RUBINO, M. ACETO, *On the traceability of truffles by means of the lanthanides distribution*, *Journal of Food Composition and Analysis*, 139 (2025) 107068.

genome, which, added to the 8 already available in the literature, enabled high-resolution genotyping.

Analysis was performed through *High Resolution Melting* (HRM), a rapid and sensitive quantitative-PCR-based method that detects differences in DNA melting curves.

However, genetics alone - while distinguishing population clusters (e.g. separating samples from Emilia-Romagna and Piedmont) - proved insufficient for perfectly discriminating all geographical origins due to genetic admixture among populations.

To overcome this limitation, genetic data were integrated with geochemical analysis, based on the principle that the composition of micro-elements in fungi — particularly the distribution of rare earth elements — reflects that of their growth soil, providing a “geochemical fingerprint” of the territory.

Trace and ultra-trace elements were measured using ICP-MS (*Inductively Coupled Plasma Mass Spectrometry*), a technique ensuring high sensitivity and precision.

The integration of the two datasets (genetic and chemical) was achieved through advanced multivariate statistical methods: *Multiple Factor Analysis* (MFA) for data exploration and *Linear Discriminant Analysis* (LDA) for classification.

Results demonstrated that the data-fusion approach enables far superior geographical discrimination compared to either technique used alone.

The final LDA model, based on the first six MFA dimensions, achieved 97.80% accuracy in cross-validation, clearly distinguishing Alto Monferrato samples from those of other Italian regions and from abroad.

Specific ratios of elemental concentrations (including *Hafnium*, *Chromium*, *Dysprosium* and *Holmium*) were identified as key to geographic classification.

In parallel, the project explored the implementation of block-chain technology as a tool to guarantee the immutability and transparency of information along the supply chain.

As illustrated by *Marco Guidi* in his 2024 study published in *Alimenta*¹¹, adopting a distributed digital ledger represents a major innovation for the truffle sector.

Blockchain allows for tamper-proof documentation of every step, from harvesting to consumption, recording key data such as geographical origin, harvest date and hunter identity.

In a market vulnerable to fraud, this technology offers a significantly stronger guarantee than traditional paper-based systems or centralised databases, both subject to manipulation.

Guidi highlights how integrating blockchain with instruments such as a collective trademark can substantially strengthen origin protection, turning traceability into a strategic asset for territorial marketing.

The final consumer, by scanning a QR code, can access a “digital identity card” of the truffle certifying its authenticity, supported by the scientific analyses described above.

While blockchain alone cannot prevent origin fraud, its use within a regulated and publicly overseen trust-based supply chain — such as that developed in the NODES project — creates a virtuous ecosystem of transparency, combining ex-post analytical verifiability with the guarantee of no product substitution along the commercial chain, thus providing the highest level of assurance currently conceivable on the market.

4. The Achievements of the NODES Project.

The implementation of the scientific and technological strategies described above enabled the NODES project to achieve tangible results of significant social and economic impact for the Alto Monferrato area.

The most important achievement was undoubtedly institutional

¹¹ M. GUIDI, *La blockchain quale soluzione per la tracciabilità alimentare e la certificazione di origine. Il caso del Tartufo bianco pregiato dell'Alto Monferrato*, *Alimenta*, 2024, pp. 379 ss.

and community aggregation: as many as 21 municipalities across the provinces of Alessandria and Asti¹² overcame administrative fragmentation to form an Association (ATS), joining forces around the shared objective of enhancing the local white truffle quality and value.

This cohesion — far from obvious in areas marked by strong localism — represents the essential social foundation for any territorial marketing project.

From a promotional and positioning standpoint, the project established the “*Tartufo Bianco Pregiato dell’Alto Monferrato Day*,” an annual itinerant event celebrating both the product and the territory and involving high-profile sporting ambassadors such as basketball legend *Dino Meneghin*, football player *Pietro Vierchowod*, triathlon champion *Marta Menditto* and Duathlon World Champion (Elite category) *Giorgia Priarone*.

The association between the values of sport and those of truffles — genuineness, nature, excellence — has proved a successful communication strategy.

A dedicated website¹³ and social media pages publish constant updates about the product and territory.

A logo was created to mark the product and promote the initiative, with the potential to evolve into a collective trademark certifying products from the area subjected to authenticity and origin verification through the analytical method developed by the University of Eastern Piedmont.

A series of increasingly visible initiatives followed, including:

- guided tours of natural truffle grounds with trained dogs;
- cycling tours along “truffle routes” (*trifola tours*);

¹² The municipalities involved are: *Alice Bel Colle; Acqui Terme; Nizza Monferrato; Bistagno; Cassine; Castel Boglione; Castel Rocchero; Castelletto Molina; Fontanile; Maranzana; Mombaruzzo; Montechiaro d’Acqui; Morsasco; Orsara Bormida; Pareto; Ponti; Prasco; Quaranti; Ricaldone; Trisobbio; Visone.*

¹³ See the website at www.tartufobiancomonferrato.com.

- lotteries awarding local truffles;
- literary meetings with authors in Alto Monferrato municipalities;
- gastronomic weekends in local restaurants featuring dedicated menus;
- installation of territorial branding signs marking truffle areas;
- participation in the *Annual Conference of the Chamber of Commerce* (Alessandria and Asti) during the *Fiera di San Baudolino*;
- organisation of the 1st *Tartufo Bianco Pregiato dell'Alto Monferrato* fair in Nizza Monferrato, with renowned chef Gianfranco Vissani;
- welcoming of the “*Orient-Express Rome – Nizza Monferrato*” (the Truffle Train);
- participation in the 2025 “*Camicissima*” charity auction, where the product was auctioned to support the Maria Letizia Verga Foundation;
- radio interviews and television features.

5. Future Challenges: Climate Change Risks and Adaptation Strategies for Natural Truffle Areas.

Despite the successes in cultural enhancement and traceability, the future of the *Tartufo Bianco Pregiato dell'Alto Monferrato* is not free from threats, the most insidious of which is climate change.

Tuber magnatum is an ectomycorrhizal fungus whose fruiting depends on an extremely delicate ecological balance influenced by soil-climate factors and host-plant interactions.

Rising average temperatures and altered rainfall patterns — with increasingly prolonged and intense summer droughts — jeopardise the survival of the mycelium and the productivity of natural truffle grounds.

Scientific evidence shows that water and heat stress can

irreversibly compromise the micro-climatic soil conditions required for ascocarp development.

In this scenario, adaptation strategies become crucial to safeguarding production.

The project laid the groundwork for addressing these challenges through the identification and protection of the most resilient truffle areas.

One proposed line of action concerns the recovery and enhancement of valley bottoms, areas which, thanks to their geomorphological features, tend to maintain higher soil moisture and milder temperatures than exposed slopes, providing a refuge for truffles even under adverse climatic conditions.

Thanks to the project's efforts, the Alto Monferrato municipalities' ATS successfully applied for a regional funding scheme dedicated to maintenance management of woodland truffle areas, ranking first.

In addition, "restricted-access truffle fields" (controlled and mapped natural truffle grounds) were created in the project areas, meeting both commercial traceability requirements and the need for more attentive agronomic and forestry management.

In these areas, naturalistic truffle hunting practices can be implemented: selective thinning to favour symbiotic plants, shallow soil processing to improve aeration and water retention, and, where possible, emergency irrigation.

The scientific approach promoted by the project — integrating genomic and soil knowledge — provides the necessary tools to monitor the health of fungal populations and plan targeted conservation interventions, ensuring that this biodiversity heritage can be passed on to future generations despite increasing environmental pressures.

6. The Legacy of the NODES Project.

The NODES project endows the Alto Monferrato territory with

an invaluable heritage of knowledge, relationships and operational tools that extends far beyond the formal duration of its funding.

The establishment of a structured network of university researchers, local administrators and private stakeholders constitutes an extraordinary social capital that has overcome the isolation of individual municipalities and projected the area onto a supra-local dimension.

The most tangible legacy is the ongoing process leading to the creation, in 2026, of a private association that will institutionalise public-private collaboration, ensuring the financial and operational sustainability of future initiatives.

Ambitious challenges lie ahead.

First, the certification system must be consolidated through the registration of a collective trademark incorporating the scientific analysis protocol (*DNA and rare-earth markers*) as a compliance requirement, alongside an operational blockchain for public traceability.

At the same time, research must continue to define more precisely the organoleptic and olfactory characteristics that distinguish Alto Monferrato truffles, creating a scientific dossier supporting their uniqueness and developing seasonal “selections” that highlight their qualities during specific harvest periods.

From a socio-economic perspective, the challenge is to extend the virtuous model tested with truffles to other local excellence supply chains, creating a genuine “district of quality and sustainability” integrating agriculture, tourism and culture.

The ultimate goal is to anchor scientific know-how within the territory, transforming Alto Monferrato into an international competence centre for truffle cultivation and sustainable forest-resource management, capable of attracting not only tourists but also researchers and industry professionals.

Finally, it will be necessary to translate these results into concrete social and cultural impacts through coordinated truffle-related events, Educational outreach via open calls, photography contests,

literary competitions and sustainability initiatives, as well as educational activities aimed at younger generations.

This will include the creation of a naturalistic and ethno-anthropological museum on the history of truffle hunting in Alto Monferrato, local gastronomic traditions and guided visits to educational truffle grounds.

In conclusion, the experience of the *Tartufo Bianco Pregiato dell'Alto Monferrato* highlights how the alliance between science, technology and the local community can transform a vulnerable natural resource into a powerful engine of sustainable development, capable of meeting the challenges of the global market even in times that are difficult to decode, such as those we are experiencing.

Vito Rubino

ABSTRACT:

The intersection of cultural heritage, environmental sustainability and local development has become a strategic focus within contemporary European territorial policies. High-quality agri-food products increasingly serve as symbolic resources capable of structuring local identity and experiential tourism, especially within frameworks such as the European Green Deal and the renewed regulatory architecture for Geographical Indications. This article analyses the case of the Tartufo Bianco Pregiato dell'Alto Monferrato, exploring how scientific innovation, participatory governance and cultural enhancement can converge to strengthen rural development trajectories in under-promoted regions.

*The white truffle (*Tuber magnatum* Pico), a non-cultivable species dependent on fragile ecosystems, has long been embedded in the intangible cultural heritage of Alto Monferrato. Despite this heritage, administrative fragmentation and a lack of supply-chain transparency have hindered the area's efforts to build a coherent territorial brand. The NODES (Nord Ovest Digitale e Sostenibile) project offered a multi-actor governance platform that enabled the articulation of a coordinated development strategy linking environmental knowledge, digital tools and cultural narrative.*

A central innovation was the creation of a scientific authentication protocol combining genetic and geochemical profiling, developed by the National Research Council and the University of Eastern Piedmont. Through integrated data analysis, the model reliably distinguishes Alto Monferrato truffles from those of other origins, offering a robust basis for future certification schemes. Complementarily, the introduction of blockchain-based traceability supports transparency, enhances consumer trust and enables new forms of digital heritage communication.

Equally significant were the project's socio-institutional outcomes: 21 municipalities established a shared governance structure, developing coordinated cultural events, thematic tourism itineraries and a

common communication strategy. These initiatives strengthened territorial cohesion and positioned the truffle as a unifying narrative for sustainable development.

The study highlights broader implications for SH scholarship, illustrating how place-based innovation, heritage practices and environmental constraints interact in shaping contemporary rural transitions.

PAROLE CHIAVE:

White Truffle - Territorial Development - Cultural Heritage - Sustainable Tourism - Product Traceability.