

Panel 81. Technoscience and the Future of Agricultural Ecosystems

Convenors:

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Keywords: European Green Deal, agrifood, agroecology, smart farming, sustainability

Technoscience is currently engaged to intervene in agrifood systems to help build for them a sustainable future, meeting the requirements of the 2030 Agenda for Sustainable Development of United Nations and the European Green Deal. These policy directions mostly rely on technoscience to improve innovations in agriculture as well as to design ways of making it more sustainable. Through the lens of STS, the above challenges can be traced following the relationships between humans and non-humans and the variety of hybrids (Latour, 1991) that result in configurations of agents and agencies. These work as assemblages (Latour, 2005) and crystallise in practices that pertain to the agrifood sector as well as to the sciences, involving different species like humans, plants, animals and micro-organisms and the effort of technologies to arrange and rearrange such multispecies configurations (Haraway, 2008). Over the last decades, examples of these configurations emerged dramatically in the strategies of crop production that foster environmental sustainability, albeit with diverse orientations. On the one hand, these strategies rely overtly on bringing technological developments in agricultural practices, like soilless systems (e.g. hydroponic farming), indoor assemblages with advanced lighting infrastructure (e.g. vertical farming), or the use of information technologies to cope with uncertainty (e.g. variability in weather conditions). On the other hand, some strategies try to cope or harmonise with ecosystems and their inherent multispecies configurations, e.g. by minimising the use of chemicals through holistic approaches or by pursuing an agroecological perspective for farming (Altieri et al., 2015; Galt et al., 2024), which is key to addressing the "material dependency" in the route to sustainable agriculture (Pellizzoni and Centemeri, 2022).

Research in STS makes it possible to look at the future of agriculture and food systems, dealing with their complexities and facets and the diverse scales and modes of production (Iles et al., 2016). Hence, the panel intends to welcome contributions that address the future of agrifood systems in the perspective of STS, aiming to shed light on how technoscience is involved in the configurations of those systems, covering (but not limited to) the following areas and topics:

- information technologies in agriculture (e.g. smart farming, precision agriculture, etc.) and related opportunities and challenges;
- agroecological practices and perspectives;
- environmental policy frameworks at the European (or international more broadly) level;
- inequalities and critical facets of agrifood systems;
- sustainable strategies in food supply chains;
- discourse and communication regarding sustainability;
- agrifood markets and socioeconomic inequalities.



ID 247 - How innovative technologies could foster a more sustainable and efficient agri-food system: the strategies applied in the wheat chain.

Cecilia Rasetto, Università di Pisa

Keywords: Precision Farming, Smart Agriculture, Digital tools, Supply chain, Wheat chain

The digitalization of agriculture in Europe holds significant potential to enhance efficiency, effectiveness, sustainability, and competitiveness across the sector. The European Commission's Political Guidelines for 2024-2029 emphasize this potential by prioritizing support for the entire food value chain through investment and innovation on farms, cooperatives, agri-food businesses, and SMEs.

Digital technologies in agriculture can increase farm performance by enhancing sustainability, productivity, and resilience, especially through Internet of Things (IoT) technologies, sensors, data analytics (e.g., based on Artificial Intelligence), and decision support systems. This can lead to more tailored and precise farming operations. The use of digital technologies in agriculture can bring several benefits, such as production optimization, enhanced animal welfare, increased working conditions, increased transparency, and increased competitiveness.

Despite the benefits, challenges remain, such as a lack of awareness and skills, digital divides, lack of cost-effectiveness, the need for trust in data sharing, and shortcomings in interoperability. With a critical approach, despite the many benefits, digitalization can also create digital divides, such as between farmers with access to cutting-edge technologies and those without. These divides can be influenced by remoteness, holdings turnover, skills, and farmers' age. By the way, the European agricultural sector can maximize the benefits of the digital age, improving sustainability and profitability while addressing pressing issues such as food security and climate change.

In this context, through technological innovation, there is the possibility of developing innovative and environmentally sustainable cultivation systems. In addition, the application of innovative methodologies in the agricultural sector has led to the development of sustainable agriculture capable of various forms of quality certification. All the technological tools applied in agriculture converge in the definition of so-called Precision Agriculture (PA) or Site Specific Crop Management (SSCM). When 'remote' or 'proximal sensing' sensors are used for the realization of the latter, we enter the field of Digital Precision Agriculture.

To explore this topic in more detail, this contribution looks specifically at the wheat supply chain where, at least, two types of innovative interventions through the use of technology have taken place.

The first one. Three Italian strategies are acting on the wheat production cycle, such as: (i) the strategy developed by the University of Siena, Florence, and CNR called "Innovacereali", (ii) the strategy developed by CREA who use technologies for assisted evolution ("Cisgenesis"), (iii) the organic farming - "bio drum project" - for strengthening organic durum wheat production systems with the use of clustering, image processing, and drones.

The second one. There is a second group of innovative actions planned to instead act on the traceability of the supply chain. The most innovative example is the strategy made by Pastificio De' Campi company "Pasta di Gragnano with Autentico Software".



11 JUNE 2025 09.00 - 11.00

ID 249 - Bridging Scientific Indicators and Regulatory Choices: A Case Study of the Nature Restoration Law and Agro-ecosystems

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Eleonora Ciscato, Università degli Studi di Milano Statale

Keywords: Environmental law, Ecosystem Restoration, Agricultural ecosystems, Science and policy

This paper aims to explore the intricate relationship between science and agri-food and environmental law. At the European level, the discussion on how to mediate this complex relationship reached a significant milestone in 2021 with the European Commission's adoption of the Better Regulation Guidelines. This instrument seeks to provide a regulatory framework ensuring that European legislation is increasingly grounded in scientific evidence, both procedurally and substantively. Thus, every European policy is proposed based on careful impact assessments, which rely on predictive scenarios supported by the most up-to-date scientific data. The ultimate goal is to ensure objective truth and validity of decisions in light of the considered premises, thereby ensuring policy legitimacy and reducing, at least apparently, the weight of choices based on value considerations.

Concurrently, in the scientific world, there is growing awareness that the phenomena under study are so complex and opaque that their unambiguous description becomes difficult – if not impossible. In this context, it becomes crucial to examine how the use of data and evidence, along with procedural choices related to the involvement of specific epistemic communities, influence the policies themselves.

This paper uses EU Regulation 2024/1991, known as the Nature Restoration Law, as a case study to investigate and clarify the complex relationships between science and agri-food and environmental law. This regulation, a cornerstone of the European strategy to address climate crises and biodiversity loss, underwent a long and troubled journey before receiving final approval on 24th June 2024, following two years of intense negotiations between European institutions, experiencing numerous and substantial modifications from its initial proposal. This paper aims to investigate the use of scientific evidence, focusing on two central aspects: on one hand, the involvement (more or less institutionalised) of interested social actors; on the other, the significant impact of the agricultural sector on ecosystems, which makes agricultural restoration a particularly controversial topic. The research questions that guided this work are specifically: how was stakeholder involvement organised in the preparatory phase of the act? which scientific knowledge was considered in determining objectives and indicators? how was scientific data mediated during the negotiation phases until the final version of the regulation was reached?

To answer these questions, the methodology adopted is based on an in-depth analysis of the regulation text, the initial proposal, the impact assessment and related annexes, as well as semi-structured interviews with European Environment Agency officials and various other stakeholders. The paper aims to highlight potential criticalities in the use of scientific knowledge as a basis for environmental policy-making. The intention is thus to contribute to the improvement of the European regulatory process, promoting accountability and transparency.

11 JUNE 2025 09.00 - 11.00

ID 356 - Performative representations of genetic biotechnologies in European agri-food systems

Federica Peluso, Università di Roma La Sapienza

Keywords: zoecapital, performativity, genetic biotechnology, multispecies relationships

Genetic biotechnologies are profoundly transforming animal bodies, enhancing their productivity and adapting them to new economic and environmental demand. CRISPR-Cas9, for example, has been used in a wide range of genetic modification projects, such as creating disease-resistant cattle, faster-growing pigs and even hornless cattle to reduce the risk of injury on farms. Often framed as solutions for efficiency and



sustainability, these technologies raise crucial questions about how technoscience is reconfiguring agri-food systems and multispecies relationships.

Rather than being mere technical innovations, genetic biotechnologies function as performative practices that actively shape their own legitimacy. Scientific, political and media discourses do not merely describe these technologies; they actively shape the ways in which these modifications are perceived, legitimated, contested, while marginalising the resistance-existence of non-human animals. These technologies are not neutral applications but intra-active processes, in which humans, non-humans, and biotechnologies co-constitute each other through material-semiotic entanglements.

Drawing on the concept of zoecapital, I analyse how these biotechnologies reduce animal life to programmable biological matter, embedded in a neoliberal system of governance that prioritises economic efficiency over multispecies cohabitation. As Melinda Cooper observes, the biotechnological revolution has shifted economic production to the genetic and cellular level, integrating life itself into capitalist circuits of value. However, rather than a neutral optimisation of livestock production, genetic biotechnologies generate multi-species hybridisations that disrupt conventional binaries such as nature and technology, human and non-human, organic and artificial. These hybrid emerge within relational assemblages shaped by technoscientific infrastructures, economic interests and discursive practices, but these relationships are not always reciprocal.

Bringing together perspectives from zoepolitics and performativity, this paper explores how genetic biotechnologies are not just a tool of intervention, but actors in the ongoing negotiation of agri-food futures. By interrogating how these technologies are materially applied and performatively represented, I highlight the power dynamics shaping which futures become thinkable, desirable and politically viable..

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11 JUNE 2025 09.00 - 11.00

ID 578 - Preparing the Field for AI and Data Intensive Agroecological Research

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Keywords: field, data-intensive research, agroecology, pest-plant interactions, environment

In this paper, I explore what it means to prepare the field and its objects for AI and data intensive agroecological projects. Conducting research in the field demands choosing or modifying natural places to tailor them to machines and quantitative measurements, ensuring the production of reliable, consistent data



while navigating the myriad challenges inherent in unpredictable environments where unexpected occurrences are commonplace (Kohler, 2002). This process involves the preparation of the field and the meticulous construction of objects that can be investigated. Although not always acknowledged as scientific labor, such activity plays a pivotal role in laying the foundation for meaningful research outcomes. Drawing parallels with scholarly insights into fossil construction, focusing particularly on the work of Wylie (2015), this presentation unravels the complexities of this essential yet often overlooked task. I ground my reflections on six months of ethnographic work and collaborations with an agroecological interdisciplinary project dealing with a plethora of objects such as data, insects, and fruits: Haly.Id. Haly.Id is a Horizon based in Northern Italy that develops innovative technologies like drones and camera traps for a targeted monitoring of the presence in crop fields of the brown marmorated stink bug *Halyomorpha Halys* (*H. halys*) – a highly invasive pest that feeds on fruits and seriously harms production in southern Europe, the United States, and eastern Asia (Bariselli, Bugiani and Maistrello, 2016; Ferrari et al., 2023; Giannetti et al., 2024).

The discussion is centred around three key dimensions that significantly influence the process. The first one pertains to the intricate tapestry of social relations. This includes how the division and integration of labor and expertise, along with the resulting dynamics, shape the direction of object construction and field preparation. In Haly.Id, for instance, decisions are fragmented across disciplines and skills, often resulting in the loss of farmers' input by the time engineers design monitoring equipment. The second axis revolves around the environment. The preparation and construction of field and objects for automated agroecological research are shaped by factors such as unpredictable weather patterns and complex environmental interactions. Being concerned with natural fields rather than controlled lab environments, researchers have limited control over parameters such as temperature, humidity, and light exposure (Knorr-Cetina, 1992; De Bont, 2015). In Haly.Id, freezing days during fruit flowering and local floodings significantly influenced the development of pears as objects of study in plant-pest interactions. The third dimension I consider is the methods employed. Decisions regarding which aspects to monitor and how to integrate technologies with field elements such as territory, species composition, ecology, and climate greatly influence the preparation of the field and the construction of the objects involved. In Haly.Id, for example, these were shaped by the need to create a system that was not only technically achievable but also useful given pest control methods already on the ground.

11 JUNE 2025 09.00 - 11.00

ID 804 - Integration of agro-ecological criteria into PDOs and PGIs. Following negotiations to redefine the PDO and PGI landscape in the Walloon vineyards.

Helene Dodion, Université de Liège

Keywords: PDO/PGI, interspecific/hybrid grape varieties, SustainablePracticesInVineyard

Little known for its wine, Wallonia (the southern region of Belgium) has seen its vineyards expand rapidly in recent years. Climate change and the arrival of hybrid grape varieties (hybridisation of two old varieties to create a variety that is less susceptible to certain pests and more vigorous at low temperature) are the two main arguments put forward to explain this trend. Unconstrained by a legacy of practices and standards, a recent report by GVER (a group of eco-responsible winegrowers - coordinated by an agronomy researcher) shows that there is a craze for agro-ecological practices in Walloon vineyards (Stalport, 2024). The desire to move towards more environmentally-friendly vineyards is also reflected in the negotiations to define new Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) certifications. PDOs and PGIs are instruments of the European Union's quality policy, classifying wines according to specific geographical areas, but also according to practices and know-how. They are therefore both indicators of a geographical area and a guarantee of product quality (Laurent, 2022).

There are already 3 PDOs and 1 PGI in Wallonia, but they are currently being renegotiated. Three years ago, a working group coordinated by the Walloon administration and made up of a wide range of players in the sector (winegrowers, oenologists, sommeliers and researchers) was set up to define the new contours of these PDOs and PGIs and submit new specifications to the European Union. The aim of this working group



was to incorporate eco-responsible criteria into the specifications to encourage Walloon winegrowers to adopt or continue to adopt more environmentally-friendly practices. On the basis of what criteria have the various players reached agreement? What levers and obstacles have they come up against? On the basis of what definition(s) of 'eco-responsible' or 'agro-ecological' practices did they work, and what were their limitations? How did these discussions translate into EU regulations such as specifications and their procedures? This presentation will attempt to answer these questions.

In order to answer these questions, the researcher followed the meetings of this working group for a year and carried out ethnographies and auto-ethnographies (Pitard, 2017) using a multi-sensory approach (Pink, 2009). She also followed the transformation path of a wine that received certification (from the vineyard on which the grapes grew to the tasting panel (carried out by the Walloon administration) where it was awarded a PDO). This methodology was inspired by the work of Appadurai (1988) and Tsing (2021). In addition, the researcher also conducted several exploratory and confirmatory semi-directive interviews to detail these ethnographies and autoethnographies.

11 JUNE 2025 09.00 - 11.00

ID 865 - Just sustainability in Calabrian Transformative Agriculture

Francesco Saverio Oliverio, Università della Calabria

Stefano Oricchio, Università di Napoli Federico II

Keywords: Transformative agriculture, just sustainability, climate change, commons

For a deeper understanding of the concept of sustainability, it is significant to enquire how bottom-up solutions to socio-environmental problems work. This contribution is based on a research delving into these solutions in the context of transformative agriculture in Calabria (Southern Italy).

On the one hand, agriculture is a sector strongly affected by global warming, as temperature is a direct factor in agricultural production (Deschênes, Greenstone, 2007). On the other hand, in the European Union, the agricultural sector produces more than 10 per cent of total greenhouse gas emissions. A report published by the FAO emphasises the polarisation of the agricultural system with, on one side, intensive, yield-focused agriculture and, on the other side, diversified and small-scale farming systems: the former would have neglected the impacts of agrochemicals on the reproducibility of resources; the latter would be highly vulnerable as they are unable to provide sufficient incomes (Arnés García, Santivañez, 2021). It is in this context that alternatives to the current food production system have been developed such as bottom-up solutions of conversion to the peasant way of farming through the care of the commons (Ploeg, 2018). These are innovative practices that implement agroecology, regenerative, natural or bio-dynamic agriculture.

Recently, a vision has emerged that sees agriculture also as a provider of environmental public goods such as carbon sinks and biodiversity. Thus, on the one hand, agriculture is among the largest polluting sectors; on the other hand, it is recognised as having a role in mitigating climate change. Within the framework of this ambivalence, the research focused on agricultural producers experimenting sustainable rural alternatives as units of analysis. In this research, sustainability is understood both in ecological terms (i.e., reducing impact and pressure on the environment) and in social terms (i.e. social functions of agriculture, implementation of socio-political changes, and integration with community management). On an empirical level, it is a matter of understanding attempts to relate to nature that are not dominated by instrumental reason or the subjugation of the natural environment to the technical domain (Pellizzoni, 2023).

Further aspects will also be discussed in relation to justice in distributive, procedural and recognition terms (Bennet et al., 2019), such as: a) distribution of benefits and disadvantages; b) levels of participation in choices and inclusiveness in decision-making processes; c) recognition of worldviews and cultures. This discussion responds to one of the objectives of the research project, that is to incorporate justice into the notion of sustainability.



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