Research Report

Sustainable Food Systems - EU Policies, China's Approaches, and Pathways for China-CEEC Cooperation

Project Leader: Dr. Marija Adela Gjorgjioska

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Project Leader
Dr. Marija Adela Gjorgjioska

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Sustainable Food Systems - EU Policies, China's Approaches, and Pathways for China-CEEC Cooperation[1]

Dr. Marija Adela Gjorgjioska, Dr. Ana Tomičić, Amar Darvoush,
Simona Kabranova, Andrej Ratkoski[2]

Summary

This report explores the evolving cooperation between China, the European Union (EU), and Central and Eastern European Countries (CEEC) in the transformation of food systems toward sustainability, resilience, and innovation. It provides a comparative analysis of institutional models, policy frameworks, and technological approaches across regions, with a focus on mutual learning and strategic collaboration. Drawing on desk research, interviews, case studies, and stakeholder input, the report highlights high-potential areas for collaboration. It recommends institutional mechanisms such as tri-regional observatories, joint labs, and cross-border pilot programs to move beyond symbolic engagement toward integrated, context-sensitive partnerships. By leveraging complementary strengths–China's scaling capacity, the EU's governance expertise, and CEEC's regional positioning–the report outlines a set of suggestions for enhanced cooperation from which more equitable and environmentally compatible food futures may emerge.

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[2] Dr. Marija Adela Gjorgjioska is the Director of the ARETE Institute for Sustainable Prosperity. Other authors are from ARETE Institute for Sustainable Prosperity. The views expressed in this publication are those of the authors and do not necessarily reflect the views of the China–CEE Institute or its affiliates.

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1. Introduction

In an era marked by growing environmental concerns, global food insecurity, and the intensifying impacts of climate change, sustainable food systems have emerged as a critical area for both policy innovation and international cooperation. The transformation of food systems is pivotal to achieving multiple Sustainable Development Goals (SDGs), including Zero Hunger (SDG 2) and Responsible Consumption and Production (SDG 12).[3] As global food demands are projected to rise with a growing population, the urgency for resilient, efficient, and equitable food systems has never been more apparent. Addressing these challenges requires not only technological advancements but also robust policy frameworks and strategic international cooperation. The European Union (EU), China, and Central and (South) Eastern Europe (CEEC) represent important regional hubs driving innovation in sustainable food practices. In this context, China–CEEC cooperation offers a promising yet often overlooked platform for advancing sustainable food systems in both EU and non-EU countries of CEEC. While it encompasses various areas of collaboration–including food systems and agriculture–its reach, mechanisms, objectives, current actions, and potential influence remain largely uncharted. This research seeks to fill that gap by examining how China-CEEC cooperation could serve as a mechanism for technology transfer, policy alignment, and resilience-building in sustainable agriculture.

This research, rooted in the strategic importance of sustainable food systems, explores how these three regions can collaborate to drive systemic change. By examining policy frameworks, technological innovations, and cooperative mechanisms, it aims to identify best practices and pathways for enhancing food system sustainability[4] and resilience. The research also seeks to answer key questions, including how China-CEEC cooperation can be leveraged to modernize agricultural practices, what lessons can be drawn from EU and Chinese strategies, and how technology transfer can optimize food security and sustainability across regions. Through desk research, policy analysis, and interviews with stakeholders from Europe, China, and CEEC, this report aims to contribute actionable insights for strengthening food security, environmental sustainability, and socio-economic resilience, with a particular focus on Europe-China cooperation. The analysis proceeds in four parts: a conceptual and methodological framing (Section 1); a comparative overview of food system transformations in the EU, China, and CEEC

[3] International agreements, such as the 2030 Agenda for Sustainable Development, further reinforce the importance of sustainable food systems by explicitly linking food security with climate-resilient agricultural practices and the conservation of genetic diversity (United Nations, 2015). For example, Sustainable Development Goal (SDG) 2 aims to end hunger, achieve food security, and promote sustainable agriculture by 2030, with specific targets to double the productivity of small-scale food producers and implement resilient agricultural practices that maintain ecosystems and adapt to climate change (Unicef, 2024).

[4] Throughout this report, the term “sustainability” is used as a shared policy objective across the EU, China, and CEEC. In China, it often aligns with goals of stability, food sovereignty, and ecologically oriented development; in the EU, it is frequently embedded in competitiveness narratives and green market logic; in CEEC, it may function more as a conditional language of donor compliance than as an endogenous planning tool.

(Sections 2–5); a typological and systemic synthesis (Section 6); and stakeholder perspectives gathered through interviews and surveys (Section 7), followed by concrete recommendations.

1.1 Research rationale and strategic importance of sustainable food systems

In the 21st century, food systems have emerged as a cornerstone of sustainable development, shaping global food security, economic stability, and environmental resilience. Spanning the entire chain from production to consumption–including processing, packaging, distribution, and waste management–food systems are critical for addressing global challenges like hunger, poverty, climate change, and social inequality. By integrating efficient supply chain management, resource optimization, and government support, these systems can mitigate the negative externalities of traditional agriculture while enhancing resilience against future challenges. Their optimization is crucial not only for feeding the projected 9.7 billion people by 2050 but also for strengthening rural economies, supporting community livelihoods, and mitigating environmental impacts. As integrated networks that link food security, nutrition, human health, ecosystem viability, and social equity, food systems are vital for achieving the SDGs (Herrero et al., 2021). Their influence extends across at least 12 of the 17 SDGs, including SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Achieving these targets requires holistic strategies that prioritize agricultural productivity, nutrition, value chain efficiency, environmental protection, affordability, resilience, food safety, and waste reduction (Pryor, Casey, & Dietz, 2024). Yet, current food systems often fall short, contributing to malnutrition, environmental degradation, and social disparities. Despite technological advancements and globalized markets, modern food systems face several critical challenges that undermine their sustainability and equity. Food insecurity and malnutrition remain pervasive, with approximately 733 million people globally suffering from hunger, while over 2 billion experience micronutrient deficiencies (Harvard School of Public Health, 2023). At the same time, there is the paradox of simultaneous undernourishment and obesity driven by inequitable food distribution, economic disparities, and a lack of access to nutritious foods in marginalized communities (FRAC, 2024).

Industrial food systems, which have historically prioritized efficiency and scale, are now recognized as significant contributors to environmental degradation, resource exploitation, and socio-economic inequities (Niggli et al., 2023). These systems, while capable of feeding large populations, often do so at the expense of ecological integrity, human health, and equitable livelihoods. Agriculture accounts for nearly 70% of global freshwater withdrawals whilst practices such as monocropping, excessive use of chemical fertilizers, and deforestation for agricultural expansion lead to soil degradation, biodiversity loss, and water contamination (Boakes et al., 2024). These environmental consequences not only threaten long-term food security but also deepen vulnerabilities in fragile ecosystems, underscoring the urgency of adopting practices that optimize resource use and minimize environmental harm.

Food systems are also plagued by inefficiencies and waste, with roughly one-third of all food produced–about 1.3 billion tons–lost or wasted each year (UNEP, FAO, & UNDP, 2023). This wastage occurs across the supply chain, from post-harvest losses in developing countries due to

inadequate storage and infrastructure, to consumer-level waste in developed nations driven by overconsumption and poor planning. These inefficiencies represent not only a loss of economic value but also squander critical natural resources. Social disparities further complicate the landscape of global food systems. Smallholder farmers, who produce nearly 70% of the world's food, often face economic insecurity, limited access to markets, and inadequate support for sustainable practices (Fan & Rue, 2020). Women, who make up a substantial portion of the agricultural workforce, are particularly vulnerable, facing systemic barriers to land ownership, credit, and agricultural inputs. The concentration of market power among large agribusinesses exacerbates these inequalities, reducing small farmers' bargaining power and limiting their access to fair market prices. Additionally, global shocks such as the COVID-19 pandemic and geopolitical conflicts like the war in Ukraine have exposed supply chain vulnerabilities, exacerbating food insecurity and livelihood challenges while revealing the fragility of globalized food networks highlighting the need for more resilient, localized food systems (UNCTAD, 2024).

The interconnectedness of these challenges underscores the need for a systematic shift in how food is produced, distributed, and consumed, with an emphasis on sustainability that transcends traditional agricultural paradigms. At the same time, the intersection of the challenges reflects the urgent need for a reimagining of global food systems–one that prioritizes sustainability, equity, and resilience. This requires not only technological innovation but also deep structural changes in governance, market access, and environmental stewardship. With rising populations and increasing pressure on natural resources, rethinking food production and consumption has become a global priority.[5] Given the complexity and interconnectedness of global supply chains, achieving sustainable food systems depends on coordinated and multi-stakeholder global efforts that engage governments, civil society, and the private sector in collective action (UNEP, FAO, & UNDP, 2023)–yet such formats can also flatten power imbalances and mask the structural forces driving unsustainable practices, unless paired with redistributive governance mechanisms. It also depends on a multi-scale approach that integrates regional, national, and global strategies to address food security, environmental sustainability, and socio-economic equity simultaneously. As highlighted in recent analyses, effective transformation requires inclusive governance structures that prioritize local needs while aligning with global sustainability goals (UNEP, FAO, & UNDP, 2023).

Given the multifaceted challenges facing global food systems, international cooperation is not merely beneficial–it is indispensable for driving systemic transformation.[6] Collaborative action can accelerate innovation, establish global standards, and build resilience across food production

[5] Transitioning to sustainable practices, such as agroecology, organic farming, and regenerative agriculture, offers a pathway to mitigate these impacts while enhancing resilience against future shocks. For instance, agroecological approaches prioritize biodiversity, soil health, and water conservation, creating food systems that are not only productive but also adaptive to changing environmental conditions (Niggli et al., 2023). Moreover, these approaches empower local communities by fostering knowledge exchange, strengthening social cohesion, and promoting equitable access to resources. By integrating traditional ecological knowledge with modern scientific innovations, sustainable food systems can deliver co-benefits that address food security, environmental sustainability, and socio-economic equity simultaneously.

[6] Voluntary guidelines issued by organizations like the UN Food and Agriculture Organization (FAO) provide operational frameworks for governments and civil society to develop national strategies, secure access to resources, and promote transparency and participation in decision-making processes (FAO, 2004, 2012).

networks. In this global context, the strategic partnership between Europe[7] and China emerges as a critical driver for advancing sustainable food systems. Both possess distinct capacities that uniquely position them to influence global food security and environmental sustainability through innovation, strategic policy alignment, and cross-regional cooperation.

1.2 Regional hubs for transformation: EU, China and CEE

Three regions stand out as strategic hubs for advancing sustainable food systems: the EU, China, and Central and (South) Eastern Europe Countries (CEEC), due to their unique contributions, challenges, and capacities to influence agricultural practices, environmental policies, and food security on a global scale.

The EU has established various frameworks to support sustainable agriculture. By 2030, the Farm to Fork Strategy alone aims to reduce the use of chemical pesticides by 50%, cut fertilizer use by 20%, and increase organic farming to 25% of total agricultural land. On the other hand, China's contributions to food system innovation are transformative in scope and impact. Unlike the incremental adjustments seen in Europe, China's approach has been far-reaching, reshaping both rural and urban food systems with remarkable speed and scale. Over the past four decades, China has lifted close to 800 million people out of poverty, a feat largely driven by strategic advancements in agriculture and food systems (Liu et al., 2025). What is more, China's commitment to technological innovation and environmental conservation is evidenced by ambitious policies such as the No-Waste Cities Initiative and Integrated Water-Fertilizer Systems (IWFS). Furthermore, China’s pioneering efforts in precision agriculture, blockchain-enabled supply chain transparency, and large-scale reforestation projects reflect its global leadership in sustainable food production. Its ability to feed nearly 20% of the world’s population with just 7% of its arable land underscores its efficiency and resilience in food production, even amid significant resource constraints (Chen et al., 2019). This track record of innovation positions China as a critical partner in advancing sustainable food systems on a global scale. At the same time, the transition to more sustainable food systems becomes especially critical for countries like China, where innovative solutions are needed to effectively balance high productivity with long-term sustainability.

Central and Eastern Europe also represent key players in this transition. Positioned as a bridge between Western Europe and Asia, CEEC benefit from EU policy support while also engaging in China-CEEC cooperation mechanisms. These partnerships facilitate technology transfer, policy alignment, and collaborative innovation aimed at sustainable agriculture and resilient food systems.

1.3 Research objectives and questions

This study addresses the following research questions:

[7] Including both EU and non-EU member states

- What role do existing policy frameworks and technological innovations play in enhancing food system resilience and sustainability?
- How can mutual learning and technology transfer be optimized to overcome current challenges in sustainability and food security?
- What specific mechanisms can enhance cooperation and maximize the benefits of China-EU-CEEC agricultural partnerships?
- How can China-CEEC cooperation be leveraged more strategically to modernize agricultural practices in both Europe and China?

In addition to analysis of policy documents and academic literature, the research incorporates perspectives from semi-structured interviews and a survey conducted between February and May 2025 with stakeholders and experts from both Europe and China. These qualitative insights are intended to capture the practical challenges and opportunities within their respective food systems, providing a grounded basis for the development of targeted policy recommendations and strategies for enhanced cooperation. The report is structured around four interconnected dimensions:

1. **EU food systems: policy and innovation:** provides a comprehensive exploration of the EU's food systems. It covers major strategies such as the Farm to Fork Strategy and the CAP, assessing their influence on sustainable food production, environmental protection, and food security across member and candidate states.
2. **China food systems: policy and innovation:** examines China's food systems, with a focus on its strategic policies and innovations aimed at enhancing agricultural efficiency, food security, and environmental sustainability. It delves into key measures such as IWFS, advanced food traceability, and resource optimization. Additionally, it explores how China's large-scale initiatives contribute to poverty alleviation and global food security.
3. **EU-China food systems cooperation:** explores the strategic cooperation between the EU and China in the context of sustainable food systems. It analyzes existing mechanisms of cooperation, joint research initiatives, and policy dialogues that aim to enhance food security, agricultural sustainability, and technological innovation.
4. **CEEC food systems:** examines the structural characteristics, sustainability challenges, and transformation trajectories of food systems in CEEC, including both EU member states and non-EU countries. The analysis draws on typological classifications and case studies to highlight key constraints as well as region-specific strengths like traditional knowledge systems and community-based practices. Particular attention is given to the region’s position within China–CEEC cooperation mechanisms, identifying both current limitations and untapped potential for advancing sustainable food systems.
5. **China-CEEC cooperation: policy, innovation, and opportunities:** analyzes the China-CEEC cooperation framework as a potential catalyst for sustainable food system transformation in both EU and non-EU CEEC. It explores the existing cooperation mechanisms, technological innovations, and underexplored opportunities for enhancing food security and agricultural sustainability in the region. The focus is placed on how this cooperation could drive cross-border innovation, technology transfer, and resilience-building in sustainable agriculture.

The report concludes with a series of policy recommendations aimed at enhancing cooperation between the EU and China, and China and CEEC. Key pathways include fostering mutual learning, strengthening capacity building, and enhancing technology transfer through structured cooperation mechanisms. These recommendations aim to address existing gaps in sustainable food system governance, while leveraging the strategic potential of cooperation to foster innovation, build resilience, and promote sustainability across the entire food system chain.

1.4 Bridging analytical complexity: from conceptual goals to operational frameworks

Given the complexity and multidimensionality of agrifood systems, identifying concrete areas of cooperation between the EU, China, and CEEC countries poses significant methodological challenges. Each of these regions operates within unique institutional contexts, political priorities, levels of development, and agri-environmental constraints. Moreover, the rapidly evolving landscape of food systems demands a framework that can capture dynamic interactions, highlight both strengths and weaknesses, and provide actionable insights for cross-regional alignment.

This report starts from the recognition that cooperation potential lies not only in aligned interests or complementary capacities but also in the ability to understand and compare food systems in ways that reveal structural patterns, policy levers, and innovation bottlenecks. Yet, when attempting to evaluate cooperation across such diverse systems, one encounters a fundamental issue: where to begin and what criteria to apply? The number of variables involved–from technological capacity and urbanization rates to consumption trends and environmental pressures–makes a comparative analysis prone to oversimplification or incoherence unless grounded in a robust analytical framework. To address this challenge, this report draws on the typologies of agrifood systems developed by the Food and Agriculture Organization (FAO), as outlined in the 2024 *State of Food and Agriculture* background paper (Arslan et al., 2024). These typologies, along with complementary resources such as the Food Systems Dashboard[8], offer a means of reducing complexity by clustering countries into comparable system categories. These classifications are based on a set of measurable indicators such as agricultural productivity (value added per worker), dietary diversity (caloric share from non-staples), supermarket density, and urbanization rates (Arslan et al., 2024; Marshall et al., 2021). Together, they allow for the identification of "system types"–traditional, expanding, diversifying, formalizing, industrial, and those in protracted crisis–each representing characteristic strengths, limitations, and trajectories of transformation. This typological lens is a diagnostic tool that enables the mapping of shared challenges, structural asymmetries, and potential synergies across regions. For example, while the EU contains a mixture of formalizing and industrial systems, China's rapid transformation

[8] The Food Systems Dashboard, developed through a collaboration between FAO, Johns Hopkins University, and GAIN, offers additional granularity by presenting country-level indicators across food environments, consumption patterns, and health outcomes (Fanzo et al., 2020). It brings together extant data for around 300 indicators to give users a complete view of food systems, including their drivers, components, and outcomes. These indicators come from over 40 sources, both public and private, including United Nations agencies, the World Bank, the Consultative Group for International Agriculture Research (CGIAR), Euromonitor International, and cross-country project-based datasets. The FSD is continually being updated to include new indicators, growing from around 140 indicators when first launched in 2020 to around 300 today.

suggests movement between the diversifying and industrial categories. CEEC countries, by contrast, often straddle expanding and formalizing systems, shaped by their transitional institutional frameworks and uneven rural development trajectories (Offe, 1991). The typology allows us to position each actor in the broader food systems landscape and to ask where learning, alignment, or policy transfer might be most relevant (WHO, 2024; Marshall et al., 2021).

By leveraging these tools, this report aims to detect:

- Structural commonalities and divergences that influence cooperation feasibility;
- Systemic weaknesses that could be addressed through targeted policy or innovation exchanges;
- Areas where best practices can be scaled or adapted across contexts.

The typology approach also aligns with the broader shift in food systems research, as emphasized in Ruben, Verhagen & Plaisier (2019), toward interdisciplinary and systems-level analysis. Their proposed 3I framework–focusing on intersections, interactions, and incentives–resonates with this effort to understand how external drivers (e.g., climate change, urbanization), internal dynamics (e.g., actor networks, supply chains), and governance structures interact to produce both intended and unintended outcomes. As a next step, the following sections will examine the specific profiles of the EU, China, and CEEC food systems through the lens of these typologies and complementary frameworks. This will serve as the basis for a comparative analysis of cooperation potential and the formulation of strategic recommendations.

2. EU food systems: policy, innovation and limits

2.1. Introduction: fragmented systems, unified policy?

The EU plays a central role in global food governance, shaping policy frameworks that reach far beyond its borders. Yet despite this common regulatory foundation, the EU is not a monolithic food system. Its member states exhibit wide diversity in agricultural practices, dietary patterns, environmental conditions, and governance capacities. Therefore, when evaluating food system strengths, weaknesses, and cooperation potential with external partners such as China, it is essential to distinguish between the EU as a unified policy actor and the heterogeneous food systems of its individual member states.This section embraces a dual analytical lens. First, it examines EU-level policy frameworks, such as the Farm to Fork Strategy, the CAP, and the 2025 Vision for Agriculture and Food, which provide strategic direction for the Union's food system transition. Second, it offers case studies of France, Germany, and Italy, which represent distinct typologies within the EU's food system landscape. This approach enables a more grounded understanding of how EU policies are translated into national contexts–and how these national systems, in turn, inform the scope and nature of cooperation with China.

The EU's multilayered governance structure–combining top-down objectives with member state-level implementation–creates both strengths and constraints. On the one hand, it facilitates policy alignment, standard-setting, and financial support mechanisms. On the other hand, it introduces

political and structural fragmentation, which can hinder unified action and obscure cooperation opportunities. These dynamics are particularly relevant when exploring pathways for multilateral EU–China collaboration versus bilateral cooperation between China and individual EU states.

To assess cooperation potential and system complementarity, this section draws on the FAO's agrifood system typology, complemented by country-level data from the Food Systems Dashboard. The aim is not only to map internal diversity but also to highlight where learning, innovation exchange, or policy alignment with China might be most effective.

2.2. EU-Level policies shaping food systems

Understanding the EU's role in shaping food systems requires examining the policy instruments that govern its member states. While structural characteristics of national systems vary significantly, EU-level strategies provide a common framework that shapes funding priorities, sustainability targets, and regulatory baselines. The EU's policy framework is strengthened by its alignment with broader strategies like the European Green Deal, which seeks to harmonize various sectors of agriculture, energy, transport, and industry under a unified vision of sustainability. Implementation is decentralized to member states, allowing for flexibility in adapting policies to local contexts, though this requires precise rules to ensure coherence and effectiveness. Monitoring mechanisms, including risk assessments and performance indicators, are employed to evaluate outcomes and address disparities, as seen in the variation of agricultural sustainability across countries like the Netherlands, Romania, and Sweden.

This section analyzes four key pillars of the EU's food policy landscape: the Farm to Fork Strategy, the 2025 Vision for Agriculture and Food, the CAP for 2023–2027, and the broader political economy dynamics that influence policy implementation. These instruments offer insights not only into internal EU transformation but also into the evolving landscape of cooperation with external partners such as China.

2.2.1 The European Green Deal

The European Green Deal serves as an overarching framework that integrates different initiatives into a broader vision of sustainability, encompassing not only agriculture but also energy, transport, and industry. One of its key objectives is to transition to a circular economy, where resources are used efficiently, waste is minimized, and products are designed for longevity and recyclability (European Commission, 2020). In the context of food systems, this involves reducing food waste, promoting sustainable packaging, and encouraging plant-based diets to lower greenhouse gas emissions. Furthermore, the Green Deal emphasizes pollution reduction through stricter regulations on chemical inputs, improved waste management systems, and enhanced monitoring of environmental impacts. These efforts are supported by legislative frameworks such as the EU's Zero Pollution Action Plan, which aims to reduce air, water, and soil pollution to levels no longer harmful to human health or ecosystems (European Commission, 2020).

2.2.2 Farm to Fork Strategy

The Farm to Fork Strategy, launched in 2020 as part of the European Green Deal, has aimed to transition Europe toward a fair, healthy, and environmentally friendly food system addressing the interconnected challenges of climate change, biodiversity loss, and food security through a comprehensive and integrated approach. Its original goal was to align agricultural policies with broader sustainability goals, making it a cornerstone for transformative change in global food systems. By emphasizing the principles of traceability–"from farm to fork" and "from fork to farm"–the strategy's objective was that every stage of the food value chain is transparent, accountable, and aligned with environmental and social objectives (EC Regulation No. 178/2002). The Farm to Fork Strategy positions itself as a transformative response to ecological degradation, yet its underlying governance logic has raised questions about how far it moves beyond managerial environmentalism. It establishes concrete 2030 targets: a 50% reduction in chemical pesticide use, 20% in fertilizer use, 50% in antimicrobial sales, and an expansion of organic agriculture to 25% of total farmland (European Commission, 2020). These targets are embedded in the broader sustainability agenda aiming for climate neutrality by 2050. The ambitious targets signaled a shift toward regulatory ecological stewardship (European Commission, 2020). The strategy also promotes precision agriculture and digital technologies, enabling more efficient resource utilization and reducing waste throughout the supply chain. Another critical dimension of the Farm to Fork Strategy is its emphasis on food safety and consumer protection, ensuring that sustainable practices translate into tangible benefits for public health. By implementing stringent regulations and certification procedures, the strategy aimed to support the development of integrated value chains in areas such as organic farming and geographical origin labeling, which not only promote sustainability but also enhance market opportunities for producers (European Commission, 2020).

However, these goals were often operationalized through voluntary compliance frameworks and market-based incentives, reflecting the EU's tendency to outsource responsibility to producers while avoiding direct confrontation with agro-industrial lobbies. The system thus rewarded environmental performance metrics without altering structural inequalities in land ownership, market concentration, or agribusiness lobbying power. As a result, the Farm to Fork Strategy has encountered several implementation challenges. Key legislative proposals such as the Sustainable Use of Pesticides Regulation (SUR) and binding food waste reduction targets have faced delays or failed to achieve consensus (Jongeneel et al., 2021). Criticism has mounted from both environmental advocates (who argue the goals are being diluted) and farm lobbies (who view the targets as impractical and harmful to competitiveness). This policy tension reflects deeper structural contradictions: while the strategy aims to reorient production practices and consumption habits, it still relies heavily on voluntary compliance and market incentives. Critics warn that such an approach risks reinforcing inequalities in the food system, particularly by placing disproportionate compliance burdens on small and medium farms without altering the dominance of large agribusiness actors (Luetz & Walid, 2019).

Recent economic modeling confirms this concern. According to Guyomard et al. (2023), implementing the Farm to Fork targets in combination with dietary change and food waste reduction could significantly lower environmental pressures, but would also redistribute economic gains unevenly–benefiting plant-based producers and consumers while burdening livestock sectors (Guyomard et al., 2023). Despite its ambitious framing, the Farm to Fork Strategy's

transformative potential is constrained by its governance design. It promotes eco-discipline–encouraging behavioral adjustments–without mandating structural reforms in land ownership, food distribution, or the political influence of corporate actors.

2.2.3 Vision for Agriculture and Food (2025)

The "Vision for Agriculture and Food" Communication" issued in response to rising farmer protests and political backlash, reframes EU agri-food policy with an emphasis on attractiveness, competitiveness, and resilience (European Commission, 2025). This 2040-oriented vision is more pragmatic and politically conciliatory than the original Green Deal agenda. The vision pivots from regulatory ambition to "enabling conditions", highlighting income support, simplification of administrative burdens, and diversification of revenue sources for farmers. It acknowledges demographic concerns–only 12% of EU farmers are under 40–and calls for improved generational renewal, fairer income distribution, and innovation-driven competitiveness. Crucially, it introduces tools such as the EU Agrifood Chain Observatory (AFCO) to increase transparency in pricing and margins along the value chain. It also supports extending cooperatives, strengthening contract negotiation rights, and deploying ecosystem services payments and carbon credits to reward sustainable practices. While the Vision marks a rhetorical shift toward farmer-centered resilience and food sovereignty, it also reflects political retreat: watering down environmental targets to manage rural discontent and reinforce strategic autonomy (European Commission, 2025).

2.2.4 Common Agricultural Policy (2023–2027)

The EU's CAP has evolved significantly since its inception, transitioning from an income-oriented price policy to a market-oriented approach that prioritizes environmental protection, rural development, and climate resilience (European Commission, 2020). This evolution is pushed by initiatives such as Cross Compliance, which mandates adherence to statutory management requirements (SMR) and good agricultural and environmental conditions (GAEC), ensuring that farmers align their practices with broader sustainability goals (EU Nitrates Directive, Habitats Directive). Furthermore, the CAP's two-pillar structure, which combines market support with rural development funding, emphasizes measures like agri-environmental schemes, ecological cultivation, and Natura-2000 areas, all tailored to local needs and designed to enhance environmental resilience (European Commission, 2020; Luetz & Walid, 2019). The CAP integrates measures like the Agri-Environment Climate Measure (AECM) and Organic Farming (OF) to promote eco-friendly practices, which are tailored to regional conditions and supported by financial incentives.

The 2023–2027 CAP builds on a subsidiarity model, requiring each Member State to submit a National Strategic Plan that aligns EU-wide objectives with national specificities. The CAP retains its two-pillar structure–income support and market measures under Pillar I, and rural development under Pillar II–with increased focus on environmental and climate performance (European Commission, 2020).

Key innovations include:

- Eco-schemes, which must account for at least 25% of the direct payments budget, rewarding voluntary climate- and biodiversity-friendly practices.
- Conditionality requirements integrating environmental standards.
- Generational renewal and support for young farmers.
- Short food chains and local markets, supported through investment tools.

However, as the CAP Strategic Plans Factsheet (2023) reveals, Member States display wide divergence in eco-scheme ambitions, implementation capacities, and budget allocations. For instance, some countries exceed 30% eco-scheme allocation, while others barely meet the minimum (European Commission, 2023). The CAP continues to face criticism for favoring large-scale producers–direct payments are still linked to land area–and failing to adequately address structural market power imbalances. Furthermore, greening measures introduced in prior reforms had limited impact, often being absorbed into existing practices rather than prompting systemic shifts (Louhichi et al., 2018).Yet, the 2023–2027 CAP also provides entry points for EU-China cooperation, particularly in precision farming, organic certification systems, and climate-smart agriculture–areas where knowledge exchange and joint investment could be mutually beneficial.

2.2.5 Political economy dynamics

The political economy of EU agri-food policy making is shaped by entrenched lobbying power, institutional fragmentation, and an increasingly evident disjunction between policy rhetoric and transformative capacity. Farm lobbies, most notably Copa-Cogeca, continue to exert disproportionate influence, particularly in defending the interests of large-scale producers. Their resistance to structural reform has been a decisive factor in weakening or delaying key Green Deal legislative proposals, including the Sustainable Use of Pesticides Regulation (SUR), animal welfare labelling, and binding food waste targets (Jongeneel et al., 2021; Kalinowska et al., 2022; Boakes et al., 2024).

The backlash against the Green Deal during 2023–2024–manifested in mass protests, political concessions, and the strategic watering down of environmental targets–exposed deeper contradictions in the EU's model of agri-environmental governance. While the EU is often lauded for its participatory policymaking and multi-stakeholder dialogues, these mechanisms frequently operate within what Crouch (2004) terms a *post-democratic* framework: democratic forms and procedures are maintained, but substantive power is increasingly concentrated in elite networks, including corporate actors, industry consortia, and bureaucratic technocracies. In this context, participation becomes procedural rather than transformative, with policy outcomes shaped less by democratic deliberation than by the capacity to lobby effectively. Swyngedouw's (2005) concept of *governance-beyond-the-state* is similarly instructive here. EU agri-food governance often unfolds through de-territorialized networks involving Non-Governmental Organizations (NGO), private certifiers, trade bodies, and multinational firms–blurring the boundaries of public accountability. Sustainability becomes a depoliticized managerial objective, insulated from redistributive demands and shielded from grassroots contestation. In this context, the EU's reliance on voluntary compliance frameworks and market-based instruments (e.g., eco-labels, certification schemes) reflects a post-political condition, where consensus-building replaces structural reform, and where the logic of the market infiltrates even environmental governance

(Boakes et al., 2024; Luetz & Walid, 2019). These dynamics are further exacerbated by Member State divergence. While countries like France and Germany promote “strategic autonomy” and green transition agendas, others push back against regulatory constraints in the name of competitiveness or food sovereignty, resulting in policy incoherence and institutional deadlock (Jongeneel et al.,, 2021; Kalinowska et al., 2022). The CAP’s subsidiarity model–ostensibly designed to allow flexibility–has in practice reinforced national disparities, with wide variation in eco-scheme ambition, funding allocation, and implementation capacity (European Commission, 2023). As a result, the CAP continues to favor large-scale actors, reproducing structural inequalities in land ownership and value chain control (Louhichi et al., 2018). These internal contradictions also spill over into the EU’s external cooperation frameworks. While the EU presents itself as a normative power–emphasizing traceability, animal welfare, and ecological standards in agri-food diplomacy–bilateral cooperation with countries like China often gravitates toward trade facilitation, investment access, and technocratic exchange. This discrepancy reflects a governance model caught between ambitious sustainability rhetoric and its dependency on lobbying power, electoral volatility, and institutional compromise. As a result, the EU's food policy regime can appear less agile, less coherent, and arguably less democratic in its outcomes than the technocratic systems it critiques–such as China's state-led, performance-based model (Boakes et al., 2024).

The EU’s agri-food political economy reveals the limits of its self-declared democratic exceptionalism. Beneath its pluralist façade lies a system that privileges elite negotiation over democratic accountability, and market solutions over structural redistribution. These limitations not only constrain internal reform but also affect the terms on which the EU engages with external partners such as China.

Table 1: Comparative overview of key EU agri-food policies, challenges, and cooperation potential with China

Policy/Strategy	Key goals and instruments	Implementation challenges	Cooperation potential with China
Farm to Fork Strategy	Reduce pesticide & fertilizer use; boost organics; traceability	Delays (SUR), industry pushback, weak enforcement	Sustainable certification, traceability, eco-labeling
Vision for Agriculture	Make farming attractive; ensure income; simplify rules	Dilution of green goals; political compromise	Support for rural development, carbon farming

CAP 2023–2027	Eco-schemes, generational renewal, subsidiarity	Uneven uptake; favors large farms; weak greening impact	Eco-schemes, climate-smart farming, local value chains
Political Economy	Embedded lobbying, Green Deal backlash	Policy fragmentation, rural protests	Differentiated bilateral engagement opportunities

2.3. Typologies and structural characteristics of EU food systems

To understand the cooperation potential between the EU and China in agrifood systems, it is essential to look beyond high-level frameworks and examine the structural characteristics and typological placements of individual member states. These countries were selected for their political weight, agricultural diversity, and differentiated trajectories in implementing EU food policy. France, Germany, and Italy–all key players in the EU's food landscape–are classified as either formalizing or industrial systems, each reflecting high supermarket density, moderate-to-low agricultural employment, and advanced processing and logistics infrastructures. Yet their specific system configurations diverge in important ways, shaping their policy needs and cooperation strategies.

2.3.1 France: diversified but industrialized

France displays features of a highly industrialized food system, yet it retains strong agricultural traditions and regulatory institutions. According to the Food Systems Dashboard (2024), France demonstrates:

- Moderate crop species richness (13.4 crops/ha),
- High dietary energy supply and low undernourishment,
- High supermarket density and significant ultra-processed food sales,
- Strong traceability systems and export-oriented agri-food sectors.

Strengths include well-developed food safety infrastructure, institutional capacity, and strong farmer organizations. However, the environmental footprint remains significant due to high livestock density and chemical input use. Dietary diversity is challenged by growing processed food consumption, and access to healthy diets is increasingly segmented by income. The average crop species richness is 13.4 crops per hectare, indicating moderate biodiversity in production (Food Systems Dashboard, 2024). Agricultural employment continues to decline, but the country maintains high yields and robust domestic supply chains. Cereal losses and fruit losses remain

modest, thanks to well-developed storage and logistics. From an environmental standpoint, France exhibits high greenhouse gas emissions linked to food consumption, substantial biodiversity impact, and significant eutrophication levels. The availability of vegetables and fruits is relatively high, yet so is the retail value of ultra-processed food per capita, reflecting dietary shifts towards processed and convenience foods.

2.3.2 Germany: technologically advanced, environmentally pressured

Germany's agrifood system is a benchmark for technological advancement and efficiency, but it faces sustainability and equity concerns. The Food Systems Dashboard indicates:

- High yields per hectare, especially in cereals and vegetables,
- High ecological footprint per capita,
- Strong food safety but regional disparities in affordability,
- Well-developed logistics and retail infrastructure.

Germany's agrifood system is characterized by strong technological integration, relatively low employment in agriculture, and an average crop richness of 11.4 crops/ha (Food Systems Dashboard, 2024). The country achieves high cereal and vegetable yields, reflecting production efficiency, but this comes at an environmental cost. Germany records the highest total ecological footprint per person among the three, driven by food consumption patterns and industrial-scale livestock production. Environmental pressures arise from intensive livestock production and fertilizer overuse. Germany's consumer base exhibits strong sustainability preferences, driving innovation in packaging, certification, and digital tracking. However, farm income disparities and land consolidation have intensified, putting pressure on smallholders. High water usage and GHG emissions intensify pressure on natural resources. Dietary diversity is moderate, with high availability of fruits and vegetables, yet affordability of healthy diets remains a challenge for low-income households. Cooperation opportunities with China include precision agriculture, waste reduction technologies, and digitized supply chains.

Germany's leadership in agri-tech could support China's modernization of rural infrastructure, while China's digital innovation in e-commerce and last-mile delivery could benefit Germany's lagging rural food distribution. Germany and China could cooperate in areas such as precision agriculture, digitized supply chains, and low-carbon logistics. Germany's expertise in sustainability standards and labelling could complement China's interest in food safety modernization.

2.3.3 Italy: regionally divergent and structurally vulnerable

Italy presents a dual structure: the North aligns more closely with formalizing food systems, while the South retains features of expanding systems. Key indicators show:

- Highest crop species richness (14.9 crops/ha),
- High biodiversity and cultural value of food systems,
- High food loss in fruits and vegetables,
- Disparities in affordability and nutritional access.

Italy's food system is rich in regional traditions and SMEs but suffers from fragmentation and inefficiencies in storage and transport. The country is also vulnerable to climate-related risks like droughts and soil erosion, especially in the South.Italy could benefit from cooperation with China in three areas: (1) support for smallholder producers and food SMEs, (2) agri-tourism and cultural food branding, and (3) shared innovations in low-waste food retail and cold-chain infrastructure. It boasts the highest crop species richness of the three at 14.9 crops/ha, indicating diversified agriculture with a strong base in fruits, vegetables, and pulses. Despite this, Italy struggles with affordability of healthy diets, especially in southern regions, where a significant percentage of the population cannot afford the minimum cost of a healthy diet. Fruit losses and vegetable losses are higher than in France or Germany, pointing to gaps in storage and distribution infrastructure. Italy's food system also exhibits a high biodiversity footprint and water use, though the presence of smallholder farmers and traditional landscapes offers a potential model for agroecological cooperation with China, particularly in mountainous or peri-urban regions facing land fragmentation.

2.3.4 Shared patterns and divergences

All three countries show high urbanization, moderate-to-high food availability, and similar pressures from ultra-processed foods. However, they differ in their:

- Environmental performance (Germany highest emissions, Italy highest biodiversity pressure)
- Affordability of healthy diets (Italy more vulnerable)
- Food loss metrics (Italy highest, Germany lowest)

These differences suggest tailored cooperation models:

- France–China: cooperation on food labeling, geographical indications, and food safety regulations.
- Germany–China: focus on precision agriculture, agri-tech innovation, and traceability systems.
- Italy–China: agroecological practices, small and medium-sized enterprises (SME) partnerships, and rural value chain strengthening.

Table 2: Comparative Overview of National Food System Attributes and China Cooperation Opportunities

Country	Strengths	Weaknesses	Cooperation potential with China

France	Traceability, PGIs, high-value exports	GHG emissions, ultra-processed food growth	Food standards, wine/dairy market access
Germany	Tech-driven, traceability, retail structure	High emissions, income inequality in farming	Digital agriculture, food logistics
Italy	Crop diversity, smallholder traditions, food culture	North-South disparity, food loss, income inequality	SME support, agroecology, cultural branding

Together, these national profiles highlight the limitations of one-size-fits-all EU policy frameworks and underscore the need for tailored bilateral cooperation strategies with China that reflect structural and institutional diversity.

3. China's food system: policy and innovation

As the world's most populous country, China sustains approximately 20% of the global population using only 9% of the planet's arable land–a characteristic that has shaped the country's food policies, institutional strategies, and innovation trajectories over several decades (Wang et al., 2024). The scale and pace of China's agricultural transformation carry profound implications not only for its domestic food security but also for global food governance, environmental sustainability, and international trade.

China's food system is marked by a unique blend of centralized planning, rapid technological modernization, and deep structural challenges. In recent years, national policies have increasingly emphasized the dual imperatives of ensuring food safety and promoting environmentally sustainable agriculture. Key government strategies - including the 14th Five-Year Plan, the Food Safety Law, and sector-specific programs like the IWFS - reflect an evolving framework that integrates innovation with strengthened institutional mechanisms such as agricultural extension services, which play a central role in promoting rural modernization and technological adoption (Zhou & Jin, 2013; Houkai, 2022). At the same time, persistent challenges such as soil degradation, fragmented supply chains, dietary imbalances, and rising consumption of ultra-processed foods expose the limits of China's current trajectory (Food Systems Dashboard, 2024).

This section aims to provide a comprehensive analysis of China's food system, with a dual focus: first, to examine the policy and innovation landscape shaping China's efforts toward sustainable food governance; and second, to identify areas where cooperation with the EU and/or CEEC would be most mutually beneficial for all parties involved.

3.1 Policy frameworks and strategic priorities

China's food system governance is situated within a broader developmental paradigm that combines centralized state planning, scientific policy design, and the normative framework of ecological civilization (生态文明). Introduced in the early 2000s and formally integrated into the Communist Party of China's Constitution in 2012, the concept of ecological civilization redefines development by emphasizing the co-evolution of economic, social, and environmental systems (Zhou, 2020). It has since become a guiding principle across all sectors of public policy, including agri-food governance. The 14th Five-Year Plan (2021–2025), adopted in March 2021, operationalizes ecological civilization through a series of interlinked objectives focused on environmental quality, food security, and green modernization. These include: the promotion of sustainable agricultural practices, advancement of low-carbon technologies, integrated rural revitalization strategies, and the institutionalization of circular economy principles (NDRC, 2021). Chapter 3 of the Plan outlines the ambition to "accelerate the green transformation of production and lifestyles" and to "advance ecological civilization construction in all respects" (ibid.). The 14th Five-Year Plan elevates ecological civilization from a normative goal to an operational mandate by embedding it in concrete targets for carbon peaking, green urbanization, biodiversity protection, and ecological redlining, thus institutionalizing ecological indicators across all major planning areas.

Relevant to the food system specifically, the 14th Five-Year Plan outlines the following strategic priorities:

- Strengthening green and low-carbon agriculture, including targets for reduced fertilizer and pesticide use, soil pollution control, and large-scale organic farming expansion.

- Advancing technological modernization in agriculture, with state investment in digital infrastructure, big data systems for agricultural oversight, and traceability platforms.

- Improving food quality and safety through unified supervision, stricter standards, and expansion of risk-based monitoring and early-warning systems.

- Promoting rural revitalization, including ecological compensation schemes, talent development, and agri-environmental payments to enhance ecosystem service delivery.

These initiatives are underpinned by the policy logic of top-down planning combined with adaptive experimentation, wherein pilot programs (such as those in digital agriculture or ecological restoration) are tested locally before being scaled nationally. The Loess Plateau rehabilitation program and the Grain-for-Green Program are emblematic of this model–initiatives that began as experimental ecological projects and were later institutionalized into large-scale national strategies, contributing both to land rehabilitation and poverty reduction (Wu et al. (2019).

A notable innovation within this ecological governance model is the 'ecological redline' policy, which demarcates critical ecological zones that are protected from industrial expansion and intensive agriculture. This spatial governance mechanism reflects a shift from reactive environmental management to anticipatory land-use planning (Dong et al., 2020). Ecological civilization, in this context, functions not only as a normative vision but also as an institutional design principle. It mandates integration of sustainability metrics into performance evaluations of local governments, links environmental outcomes to fiscal transfers, and supports public awareness campaigns about food safety and environmental health (Dong et al., 2020). The institutional strength of China's model lies in its capacity for long-term goal setting and inter-ministerial coordination. Ministries such as Agriculture and Rural Affairs, Ecology and Environment, and Science and Technology work in tandem to implement cross-sectoral programs. However, disparities in administrative capacity and infrastructure development at the sub-national level remain a challenge, with western and rural provinces often struggling to implement advanced governance tools - particularly those requiring digital infrastructure or skilled personnel (Zhou & Jin., 2013). Despite these limitations, China's evolving policy frameworks are increasingly aligned with international sustainability norms. The 14th Five-Year Plan affirms China's intention to participate in global environmental governance and "deepen international cooperation on ecological and low-carbon development," particularly within the frameworks of the United Nations 2030 Agenda and the Belt and Road Initiative (NDRC, 2021).

Anchored in the ideological and institutional foundations of ecological civilization, and articulated through five-year planning instruments, China's food system policy framework offers a model of transition grounded in system-wide coordination, adaptive scaling, and normative coherence. As such, it provides both a domestic roadmap for sustainability and a potential point of reference for future EU–China cooperation.

3.2 Governance and regulatory frameworks

China's food system governance is shaped by a centralized and vertically integrated institutional architecture. This system relies on top-down planning, regulatory coherence, and administrative enforcement, underpinned by national legislation such as the *Food Safety Law* (2009) and the *Law on Agricultural Product Quality Safety*. These legal frameworks establish the foundation for China's approach to ensuring food quality, managing agricultural inputs, and reducing health risks across the food value chain (Zhou & Jin., 2013).

A defining feature of China's food safety regime is the strong role of the central government in guiding risk assessment and enforcement. Article 6 of the *Agricultural Product Quality Safety Law* mandates the creation of a national risk evaluation expert committee, signaling the integration of scientific expertise into policy design. These mechanisms enable the Ministry of Agriculture and Rural Affairs (MARA) to anticipate, assess, and mitigate systemic risks, rather than merely reacting to food safety incidents. Further, Article 15 allows for the designation of areas unsuitable for certain types of agriculture based on ecological and public health considerations–an early example of integrating environmental zoning into food governance (Zhou & Jin., 2013). China's governance model also emphasizes traceability and accountability through provisions such as Articles 24 and 25, which require record-keeping on pesticide and fertilizer application, and Article

37, which mandates immediate withdrawal of unsafe products from wholesale markets. Citizen participation is encouraged under Article 38, which grants the public the right to report violations, aligning with a broader vision of social co-responsibility in maintaining food safety (Zhou & Jin., 2013).

Despite robust national legislation, enforcement at the wholesale level is constrained by structural governance issues. As Zhou & Jin. (2013) argue, the predominance of joint-stock wholesale markets–governed by the 'who invests, who benefits' principle–undermines their public service function. These markets often prioritize rent-seeking (e.g., high admittance fees) over food safety testing, resulting in inadequate sampling, poor traceability, and consumer risk exposure. Moreover, in spite of improvements in legal structures and surveillance systems, enforcement capacity remains uneven at the subnational level. Local governments, while empowered to oversee implementation, often lack the institutional resources to effectively manage compliance. This results in fragmentation across regions, particularly in lower-income rural areas, where access to monitoring technologies and laboratories is limited (Wu et al., 2018; Deng et al., 2022).

3.3 Innovation systems: smart agriculture and digital tools

Technological innovation has become a central pillar of China's food system transformation, underpinned by the state's strategic objective to modernize agriculture through digitalization, automation, and scientifically informed governance. The adoption of advanced technologies–including blockchain, artificial intelligence (AI), and Internet of Things (IoT) platforms–reflects an intentional shift toward building a data-intensive, precision-based agricultural regime capable of addressing systemic vulnerabilities while simultaneously enhancing productivity, safety, and sustainability.

A particularly significant development in this trajectory is the integration of blockchain-based traceability systems, which now enable end-to-end monitoring across the agricultural value chain. Piloted extensively in provinces such as Zhejiang and Jiangsu, these platforms are designed to improve transparency, strengthen regulatory oversight, and facilitate rapid responses to food safety incidents (Liao et al., 2025). Similarly, AI-powered applications for real-time soil diagnostics, pest surveillance, and irrigation control are being deployed to optimize input efficiency, reduce environmental externalities, and standardize production across highly heterogeneous regions. The expansion of these technologies has been mirrored in the research domain. A bibliometric study by Wang et al. (2024) reveals a marked increase in scholarly output on digital sustainability in agricultural supply chains since 2019, with Chinese institutions among the most prolific globally. The findings underscore both China's institutional commitment to agri-digital innovation and the international relevance of its evolving model. Progress has also been notable in logistical modernization, particularly in the development of cold-chain infrastructure. As of the early 2020s, China's refrigerated storage capacity stood at 8.8 million tons, an essential yet insufficient buffer for a food system tasked with distributing over 400 million tons of perishable goods annually (Development Plan for Cold Chain Logistics of Agricultural Products). Nonetheless, these investments indicate a growing recognition of the importance of post-harvest integrity in food system resilience and public health. Importantly, China's approach to innovation is not merely technical but is embedded within a broader governance architecture characterized

by centralized planning, vertical coordination, and performance-based implementation. This mode of policy-driven governance ensures that pilot programs–particularly those demonstrating ecological and economic feasibility–are rapidly scaled into national policy frameworks. As such, technological modernization in China should be understood as both a material transformation and a political-economic instrument that consolidates state oversight, rationalizes market activity, and reconfigures producer behavior.

Despite these advancements, several challenges remain. The implementation of internationally aligned standards, such as the Hazard Analysis and Critical Control Point (HACCP) system, has encountered constraints, particularly among SME. Between 2003 and 2005, while the number of enterprises adopting HACCP grew, the overall implementation rate declined from 23.1% to 21.9%, primarily due to prohibitive compliance costs and inadequate technical capacity (Zhou & Jin, 2013). This decline highlights the gap between technical standards and operational realities, particularly among SME.

These challenges also underscore a broader limitation: digital and regulatory reforms often assume uniform readiness across actors and regions, but fail to accommodate context-specific practices, particularly among smallholders with limited access to infrastructure or technical training. Furthermore, despite concerted state investment, cold-chain logistics remain insufficient. Circulation rates for vegetables, meat, and aquatic products are still as low as 5%, 15%, and 23%, respectively, contributing to continued post-harvest losses and limiting equitable access to safe and nutritious food, particularly in rural and interior provinces (Food Systems Dashboard, 2024; Zhou & Jin, 2013). Additionally, issues of data standardization, interoperability, and consumer trust remain unresolved. While traceability mechanisms have been developed and piloted, their scalability is challenged by the fragmented nature of wholesale markets and the prevalence of small-scale actors with limited digital readiness. As such, the realization of a unified, governable, and digitally transparent food system remains an ongoing endeavor.

3.4 Environmental sustainability and resource use

As China continues to modernize its food system, addressing environmental degradation and resource inefficiencies has become a national priority. Decades of intensive agricultural practices–characterized by over-reliance on chemical fertilizers, monocropping, and unsustainable water usage–have contributed to widespread soil degradation, water contamination, and greenhouse gas (GHG) emissions. These challenges have spurred a new policy orientation under the 14th Five-Year Plan (2021–2025), which frames green development and ecological protection as foundational pillars of China's food system transformation (Houkai, 2022). One of the flagship innovations in this space is the IWFS, which combines drip or sprinkler irrigation with precise nutrient application. By synchronizing fertilizer delivery with water usage, IWFS enhances crop uptake efficiency and reduces losses due to runoff and volatilization. Empirical studies highlight significant gains from IWFS adoption: phosphorus fertilizer efficiency increased by 40.6% for corn, while nitrogen, phosphorus, and potassium use efficiency rose by 22.7%, 20.5%, and 23.5%, respectively, in potato cultivation (Wu et al., 2018). These improvements are especially impactful in ecologically sensitive and arid regions such as Xinjiang, where water scarcity intersects with agricultural expansion. IWFS is also supported by a

comprehensive policy architecture, including the *National Agricultural Water Conservation Outlines* (2012–2020) and the *Implementation Plan for Promoting IWFS* (2016–2020), which collectively aimed to expand IWFS coverage to 150 million mu by 2020 (Yao et al., 2022). Such scale reflects China's capacity to coordinate large infrastructure shifts through centralized investment and provincial compliance mechanisms.

Complementing IWFS, China has also invested in automated irrigation and fertilization platforms such as AIM (Automated Irrigation Management), which integrate real-time data analytics with energy-efficient systems. These tools have reduced water and fertilizer inputs by 12.18–28.57%, while also improving energy use and economic returns (Yuan et al., 2023). Their adoption is part of a broader shift toward low-carbon agriculture, which seeks to reduce emissions, minimize input waste, and align with China's 2060 carbon neutrality goals.Despite these advances, structural environmental challenges persist. According to the Food Systems Dashboard (2024), China's food-related GHG emissions amount to 2,003 kg CO_2eq per capita–placing it among the highest globally. The ecological footprint of consumption stands at 3.6 global hectares (gha) per capita, further underscoring the sustainability pressures of its food system. Moreover, approximately 35% of all food produced in China is lost across the supply chain, a figure exacerbated by poor cold storage, packaging inefficiencies, and underdeveloped distribution networks (Wang et al., 2024).

Soil contamination presents another critical barrier to sustainability. An estimated 19% of China's arable land is affected by chemical residues, heavy metals, or salinization, diminishing productivity and posing public health risks (National People's Congress of the People's Republic of China, 2015). Although government initiatives now promote organic farming–rising from 1.9 million to 3.1 million hectares between 2011 and 2019–this remains a small fraction of overall cultivated land (Wang et al., 2024). Smaller farms in China significantly overuse fertilizers and pesticides. Based on the 2015 China Rural Household Panel Survey, a 1% increase in farm size correlates with a 0.3% drop in fertilizer use, a 0.5% drop in pesticide use per hectare, and a nearly 1% rise in labor productivity, with no loss in yields (Wang et al., 2024; Wu et al., 2018). Yet average farm size remains just 0.5 hectares–far below global levels–due to policies like the Household Contract Responsibility System and the Hukou system, which limit land consolidation and migration (Wang et al., 2024; Wu et al., 2018). These structural barriers help explain why China, with only 9% of the world's cropland, consumes over 30% of global agricultural chemicals. Reforms to land and migration policy could cut chemical use by up to 50%, double rural incomes, and support wider adoption of sustainable practices. Complementary measures include better access to technology and stronger environmental regulation. These reforms would align with spatial governance tools like the 'ecological redline' policy, which protects designated zones from farming and industry (Dong et al., 2020). Environmental performance now influences local government evaluations, reinforcing ecological targets through institutional incentives.

Given these challenges, EU–China cooperation holds considerable potential in several areas. First, the EU's eco-schemes under the CAP (2023–2027) offer a model for incentive-based sustainability–rewarding farmers for biodiversity protection, carbon sequestration, and soil conservation. Such instruments could complement China's current regulatory approach by introducing behavioral incentives and market-based tools that are still nascent in its domestic system. Second, the EU's Zero Pollution Action Plan and stringent restrictions on chemical inputs

could inform China's ongoing efforts to phase out hazardous substances and rehabilitate degraded lands. In this context, Italy's agroecological farming traditions–particularly in mountainous and peri-urban areas–offer transferrable practices for China's environmentally vulnerable zones. Third, both systems share an interest in promoting plant-based dietary transitions as a strategy for reducing emissions and improving health. China's recent Low-Carbon Diet Initiatives align closely with the EU's Farm to Fork targets, which emphasize reducing meat consumption, expanding organic agriculture, and cutting food waste by 50% by 2030 (European Commission, 2020). In conclusion, strategic cooperation with the EU–particularly in aligning sustainability incentives, sharing agroecological knowledge, and co-developing traceable, low-carbon food systems–can help both actors meet their climate and food security goals more effectively.

3.5 Typological positioning and system structure

Typologically, China's agrifood system is classified by the FAO as a "formalizing" system–marked by moderate hidden costs, high state institutional capacity, and an increasing commitment to environmental and health-oriented goals (FAO, 2024). This formalizing status reflects a transition from China's previous classification as an 'expanding' system, characterized by high hidden costs and weak institutional safeguards. The shift toward formalization is driven by regulatory tightening, technological integration, and enhanced food safety enforcement.

Within the EU, France and Germany typify "industrial" systems with advanced infrastructure but higher environmental costs, while Italy and many CEEC also occupy the "formalizing" category. Formalizing systems typically exhibit state-led modernization, centralized governance, and emerging challenges related to affordability, diet quality, and regional disparities (World Health Organization, 2024). These distinctions offer a useful lens for identifying cooperation opportunities rooted in structural complementarity rather than systemic convergence.

China's classification is confirmed by a range of indicators from the Food Systems Dashboard (2024). While the country demonstrates considerable achievements in agricultural productivity and food availability–reflected in high yields for cereals and vegetables–it also faces systemic challenges. For instance, 26.5% of the population cannot afford a healthy diet, pointing to persistent socio-economic barriers to nutrition access. At the same time, China's crop species richness stands at 12.3 crops per hectare, indicating moderate agro-biodiversity, and its ecological footprint per capita is 3.6 gha–higher than most other formalizing systems and approaching industrial system levels. China's internal diversity further complicates its typological positioning. The country exhibits features of both industrial and expanding systems depending on region: coastal provinces like Jiangsu and Guangdong are highly integrated into international value chains with advanced logistics and digital supply chains, while interior provinces such as Guizhou and Gansu retain characteristics of subsistence or semi-commercial agriculture, limited infrastructure, and lower household dietary diversity. This spatial variation underscores the need for regionally differentiated policies, as well as cooperation models that can bridge institutional asymmetries.

The EU also displays a wide spectrum of system types. While countries like Germany and France are firmly embedded in “industrial” food systems–characterized by high supermarket penetration, advanced agro-processing, and intensive livestock production–others such as Italy or CEEC straddle the formalizing-industrial divide. For example, Italy combines high crop diversity (14.9 crops/ha) and strong food traditions with affordability and infrastructure challenges in its southern regions, mirroring China’s internal inequalities (Food Systems Dashboard, 2024).

This typological variation opens several pathways for China–EU cooperation:

- Germany’s industrial efficiency and sustainability standards can serve as a model for China’s highly developed regions, particularly in digital logistics and low-carbon food distribution.
- France’s traceability and certification infrastructure offers a reference point for harmonizing food safety standards, particularly in processed and high-value foods.
- Italy’s experience with smallholder-based agroecology and peri-urban agriculture aligns with China’s need to modernize without marginalizing traditional or low-resource producers.

Importantly, while both China and the EU are pursuing sustainable food system transformations, their institutional logics differ fundamentally. The EU formally prioritizes regulatory pluralism, subsidiarity, and multi-stakeholder consultation processes; however, these mechanisms often face limitations in practice due to strong lobbying pressures and political fragmentation. In contrast, China emphasizes centralized control, performance-based compliance, and the rapid vertical scaling of pilot initiatives. These differences complicate normative alignment but also suggest complementary strengths: China brings scale, speed, and strong institutional coordination, while the EU–despite limitations in translating consultation into action–offers experience in regulatory design, legal harmonization, and decentralized innovation frameworks that support diverse regional approaches. Moreover, China’s typological position within the “formalizing” cluster means it shares systemic traits with many CEEC, which were historically part of planned economies and are now navigating similar transitions. This makes tripartite cooperation models–China–EU–CEEC–particularly promising, allowing mutual learning among systems with overlapping developmental legacies but different institutional architectures.

3.6 Pilot-to-policy scaling and institutional flexibility

One of the defining strengths of China’s governance model is its ability to pilot, evaluate, and scale policy innovations across vast and institutionally diverse territories. This pilot-to-policy approach–anchored in centralized strategic planning and local experimentation–has proven especially effective in food systems reform, where ecological restoration, supply chain traceability, and technological modernization have all emerged from pilot initiatives before being codified into national frameworks. This institutional architecture draws strength from China’s model of output legitimacy, where political legitimacy derives from performance outcomes–visible ecological restoration, poverty reduction, or digital transformation–rather than procedural pluralism. Such

performance-based legitimacy is deeply tied to the ideology of ecological civilization, which fuses national rejuvenation with sustainability imperatives. A landmark example is the Loess Plateau restoration project, one of the world's largest ecological rehabilitation programs. Initiated in the 1990s and scaled with support from the World Bank, the project transformed millions of hectares of degraded land through terracing, reforestation, and water retention strategies. It not only reversed soil erosion and increased agricultural productivity, but also lifted participating households' incomes by over 50% within a decade (World Bank, 2021). The success of this initiative directly influenced the national Grain for Green Program, which has since reforested over 28 million hectares and sequestered approximately 1.1 billion tons of CO_2 between 2000 and 2020 (Wu et al., 2019).

A similar dynamic characterizes China's approach to digital agriculture and traceability. Pilot projects in Zhejiang and Jiangsu provinces have successfully deployed blockchain technologies to track agricultural inputs, monitor environmental impacts, and certify organic and eco-labeled products (Chen & Li, 2024). These initiatives are not merely technical demonstrations but serve as institutional testbeds–informing regulatory guidelines and scaling pathways for nationwide adoption. For example, the integration of blockchain traceability into food safety systems is now part of broader Smart Agriculture strategies under China's 14th Five-Year Plan. This model of scalable innovation is distinct from the more fragmented and participatory processes common in the EU. While the EU emphasizes inclusive governance, stakeholder negotiation, and subsidiarity, China's system privileges output legitimacy–the delivery of visible, measurable outcomes–over procedural pluralism. This distinction is both a strength and a limitation. It enables rapid mobilization of resources and alignment across administrative levels, but it can also marginalize bottom-up knowledge and limit local ownership of reforms (Deng et al., 2022; Zhou & Jin., 2013).

In the context of EU–China cooperation, this divergence in institutional logic presents both challenges and opportunities. On one hand, the EU's model of multi-stakeholder engagement and voluntary compliance–such as in the Farm to Fork Strategy–may not directly align with China's more centralized approach, which nonetheless includes its own forms of consultation through piloting, expert input, and local adaptation. On the other hand, China's capacity to scale pilots into national programs offers valuable insights for EU member states, particularly those in Central and Eastern Europe (CEEC), where implementation capacities are weaker and rural revitalization efforts face institutional friction.

Areas of mutual interest include:

- **Traceability systems**: The EU's experience with certification schemes, such as PGI, can inform China's national rollout of blockchain traceability, offering models for consumer trust and international compatibility.

- **Agroecological scaling**: Italy's farmer-led pilots in organic farming, short food chains, and biodiversity preservation could inspire community-based models within China's peri-urban zones, where smallholders still dominate.

- **Ecosystem service payments and carbon farming**: CAP tools like eco-schemes and performance-based payments could complement China's infrastructural investments in low-carbon agriculture, enabling a broader ecosystem valuation logic.

Furthermore, China's Science and Technology Backyard initiative, which embeds agricultural researchers directly into rural communities to test and adapt technologies in real-time, provides a hybrid model that merges technical rigor with participatory adaptation (Deng et al., 2022). This initiative mirrors EU efforts to bridge science and practice, such as the European Innovation Partnership (EIP-AGRI), and could be a basis for joint experimentation platforms. In short, China's pilot-to-policy model represents an institutional innovation in its own right–capable of turning localized success into national transformation. While China's model is characterized by centralized coordination and pilot-to-policy scaling, the EU operates through a complex hybrid of supranational goal-setting and national-level implementation. Despite formal consultation mechanisms and multi-stakeholder processes, EU food governance often reflects technocratic steering and uneven participation across member states. Both systems face the challenge of aligning policy ambitions with grounded transformation, raising the question of how mutual learning can occur despite these distinct institutional architectures.

4. EU-China food systems cooperation

Despite their differing institutional logics and governance models, China and the EU share several converging priorities in the transformation of food systems–namely, sustainability, food safety, technological modernization, and resilience against global shocks such as climate change and pandemics. Yet, their approaches to achieving these goals are shaped by contrasting political economies, regulatory traditions, and agronomic legacies.

Similarities between the EU and China are found in their commitment to comprehensive food safety frameworks, efforts to reduce environmental impact, and increasing reliance on digital tools to enhance traceability and efficiency across the food value chain. Both systems also emphasize integration with broader sustainable development agendas. The EU's Green Deal and Farm to Fork Strategy, and China's concept of ecological civilization (Dong et al., 2020), each embed food systems reform within long-term strategies of environmental protection, rural revitalization, and health promotion (European Commission, 2020; Zhou & Jin, 2013).

In terms of differences, China's food system is marked by centralized state planning, top-down implementation, and a capacity for rapid scaling of innovations through pilot-to-policy mechanisms (Chen et al., 2024; World Bank, 2021). This has enabled high-speed modernization in areas such as smart agriculture, blockchain traceability, and IWFS systems (Deng et al., 2022). However, implementation disparities across provinces and limited participatory governance remain key challenges. In environmental policy, the EU leads in the use of economic incentives for biodiversity protection and emission reductions through the CAP. Conversely, China's ecological initiatives, such as the Loess Plateau rehabilitation and Grain-for-Green Program, demonstrate the effectiveness of infrastructure-led ecological restoration aligned with poverty alleviation goals (Wu et al., 2019). Projects like EuroFIR and the EuroDISH initiative (Durazzo et al., 2022; Snoek

et al., 2018) offer opportunities to strengthen cooperation in food composition data harmonization and nutrition science infrastructures–areas where China's centralized data governance could benefit from Europe's methodological sophistication.

4.1 Mechanisms of EU–China cooperation in food systems

4.1.1.The China–EU agricultural dialogue

The China–EU Agricultural Dialogue represents the longest-standing institutional platform for bilateral cooperation in this domain. Initially aimed at aligning China's agri-food policies with international standards, particularly in organic farming and food safety, the dialogue has evolved to encompass a broader sustainability agenda. Topics include climate-resilient agriculture, rural development, and digital transformation of food systems (European Commission, 2020). However, the impact of this dialogue has been modest. Geopolitical tensions–including disputes over human rights, technology transfer, and trade imbalances–have undermined trust and continuity. Regulatory differences, such as divergent approaches to genetically modified organisms (GMOs) and risk-based food safety assessments, further constrain cooperation (Boakes et al., 2024; Härtel & Yu., 2018). These issues have reduced the dialogue's role to a largely symbolic function, with limited tangible outputs in recent years.

4.1.1.1.The EU–China Cooperation Plan on Agriculture and Rural Development

The EU–China Cooperation Plan on Agriculture and Rural Development (European Commission, 2013), signed in June 2012, is a key bilateral framework designed to foster deeper collaboration between the EU and China in the fields of agriculture and rural development. The Plan was conceived as a concrete outcome of the EU–China Dialogue on Agriculture and Rural Development, a mechanism established in 2005 to facilitate policy-level exchanges. Building upon the trust and institutional pathways developed through this earlier dialogue, the 2012 Cooperation Plan introduced a more structured and action-oriented approach to tackling shared challenges such as food security, sustainable agricultural practices, and rural revitalization. The Plan outlines several core objectives. It seeks to enhance food security and safety through joint projects and the sharing of best practices aimed at improving the quality and traceability of agricultural products. It also aims to promote sustainable agriculture by supporting environmentally friendly production systems, organic farming methods, and efficient resource use. A third pillar is the strengthening of rural development, which involves integrating rural revitalization strategies with broader urban-rural development goals. Finally, the Plan emphasizes research and innovation, calling for bilateral cooperation in agricultural science, biotechnology, and related technologies through joint initiatives, researcher exchanges, and collaborative laboratories.

Since its launch, the Cooperation Plan has produced tangible results. It has facilitated joint research projects addressing food safety, climate-resilient agriculture, and sustainable farming methods. It has also supported exchange programs that allow young farmers and agricultural professionals to learn from each other's systems. In addition, workshops and seminars have been held regularly to exchange policy insights and scientific findings. These activities have helped foster mutual understanding and strengthen institutional and technical capacities on both sides.

As of 2025, the Cooperation Plan remains an active and important instrument in EU–China relations. Despite broader geopolitical tensions and areas of strategic rivalry, agriculture and rural development have continued to be seen as areas of constructive engagement, where both the EU and China share a mutual interest in addressing global challenges like food insecurity, biodiversity loss, and sustainable land use. The Plan's continuity reflects the enduring relevance of agri-food cooperation in building a more resilient and sustainable global food system.

While closely related, the EU–China Agricultural Dialogue and the EU–China Cooperation Plan differ significantly in scope, function, and operational outcomes. The Agricultural Dialogue, initiated in 2005, functions primarily as a high-level policy mechanism. It provides a formal platform for dialogue between agricultural ministries and regulatory bodies, focusing on the exchange of policy perspectives, regulatory convergence (e.g. pesticide use, food labeling), and mutual updates on sectoral developments. It is diplomatic in nature and seeks to build strategic trust and regulatory alignment. The Dialogue laid the political and institutional groundwork for more formalized cooperation but does not, in itself, implement specific projects.

In contrast, the Cooperation Plan of 2012 represents a shift from dialogue to action-oriented collaboration. It formalizes commitments made under the Dialogue and translates them into concrete initiatives, including research partnerships, pilot programs, training exchanges, and technical cooperation. Whereas the Dialogue is about talking and aligning, the Plan is about doing and implementing. The Cooperation Plan thus complements the Dialogue by providing the tools and mechanisms needed to achieve the strategic goals identified through policy exchanges. In summary, the EU–China Agricultural Dialogue is the political framework for engagement, while the Cooperation Plan is the operational arm that delivers on-the-ground collaboration. Together, they form a two-tiered architecture that has strengthened agri-food cooperation between the EU and China for over a decade.

4.1.2 Horizon Europe and the FAB flagship initiative

While the EU–China Agricultural Dialogue (2005) and the EU–China Cooperation Plan on Agriculture and Rural Development (2012) laid the institutional and strategic foundation for bilateral cooperation, it was Horizon Europe and its predecessor Horizon 2020 that operationalized this cooperation at scale. In particular, the Food, Agriculture and Biotechnology (FAB) Flagship Initiative, launched in 2013 as a joint undertaking between the European Commission and the Chinese Academy of Agricultural Sciences (CAAS), represents the most concrete manifestation of this evolution. It translates the goals of the Dialogue and the Cooperation Plan into structured, co-funded, and outcome-driven research partnerships. The FAB Flagship was designed to address shared agri-food challenges such as food safety, animal health, sustainable farming, and circular agriculture. It has supported over 16 joint projects to date, many of which directly stem from priorities first identified in the policy dialogue and formalized in the 2012 Cooperation Plan. For instance, the emphasis on food quality, safety regulation, and traceability in the Cooperation Plan found concrete expression in EU–China-Safe, a large-scale joint effort to harmonize food inspection protocols and combat food fraud. Similarly, sustainability priorities were translated into projects like iSQAPER (soil quality assessment), EUCLID (Integrated Pest Management), and Feed-a-Gene (efficient livestock feeding). All of these FAB

projects are supported through the EU–China Co-Funding Mechanism (CFM), which pools financial and institutional resources from the European Commission and China's Ministry of Science and Technology (MOST). Between 2016 and 2020, over €500 million from the EU and ¥1 billion from China were earmarked for joint research and innovation activities (Research & Innovation Brochure, 2020). These projects typically involve consortia comprising leading institutions from both Europe and China.

Table 3: EU–China Agriculture Research Projects

Project Name	Focus	Start Date	End Date	Funding Framework	Key Partners
EU–China-Safe	Food safety, traceability, fraud prevention	Sep 2017	Feb 2022	Horizon 2020	Queens University Belfast (Coordinator), CAIQ, COA, Nestlé, SGS, CRA-W, UNIBO, Eurofins
EUCLID	Integrated Pest Management (IPM)	Sep 2015	Nov 2019	Horizon 2020	INRA (France), CAAS (China), CABI, Nanjing Agricultural University
iSQAPER	Soil quality, sustainable land use	May 2015	Apr 2020	Horizon 2020	Wageningen University, CAAS, INRA, Nanjing Agricultural University, CREAF
LANDMARK	Sustainable land management	2015	2019	Horizon 2020	Teagasc (Ireland), CAAS, INRA, various EU soil science institutes
SAPHIR	Animal health, sustainable livestock production	2015	2019	Horizon 2020	INRA, CAAS, Royal Veterinary College, European animal health institutes
REFRESH	Food waste reduction, resource efficiency	2015	2019	Horizon 2020	Wageningen University, IVL (Sweden), Beijing Technology and Business University
FEED-A-GENE	Livestock nutrition, feed efficiency	Mar 2015	Feb , 2020	Horizon 2020	INRA, CAAS, IRTA, Agroscope, Chinese Academy of Agricultural Sciences
SAFFI	Food safety for infants	Sep 2020	Aug 2024	Horizon 2020	INRAE (France), China National Center for Food Safety Risk Assessment
MycoKey	Mycotoxin management in food/feed chains	Apr 2016	Mar 2020	Horizon 2020	ISPA-CNR (Italy), CAAS, various EU and Chinese research institutes
MyToolBox	Integrated mycotoxin management toolbox	Mar 2016	Feb 2020	Horizon 2020	BOKU (Austria), CAAS, various EU and Chinese research institutes
AgroCycle	Sustainable agri-food waste valorization	Jun 2016	May 2019	Horizon 2020	University College Dublin, CAAS, various EU and Chinese research institutes
NoAW	Agricultural waste valorization	Oct 2015	Sep 2019	Horizon 2020	INRA, CAAS, various EU and Chinese research institutes
EUCLEG	Breeding forage and grain legumes	Nov 2017	Oct 2021	Horizon 2020	INRA, CAAS, various EU and Chinese research institutes
SiEUGreen	Urban agriculture, green city development	Jan 2018	Dec 2021	Horizon 2020	NIBIO (Norway), CAAS, various EU and Chinese research institutes
SHui	Soil hydrology and water management	Jun 2018	May 2022	Horizon 2020	University of Córdoba, CAAS, various EU and Chinese research institutes
AgriLoop	Circular bioeconomy, agricultural residues	Sep 2022	Aug 2026	Horizon Europe	INRAE (France), CAAS, various EU and Chinese research institutes

While these initiatives have yielded impactful outputs–such as harmonized testing protocols, regulatory recommendations, and new sustainability tools–they also raise important questions

about continuity and long-term integration. Most of the projects under the FAB Flagship have already concluded. This places increased importance on how their findings are disseminated, communicated, and ultimately integrated into food system governance and practice across the EU, China, and particularly the CEEC. Without a clear framework for mainstreaming project results–whether through follow-up funding, policy mechanisms, or institutional adoption–the transformative potential of these collaborative efforts risks being diluted. Moreover, although some projects have included partners from the CEEC region, their participation remains relatively underrepresented. Given that many of these countries face acute food system challenges–from fragmented landholdings to limited innovation infrastructure–their more active involvement would be both strategically and ethically justified. The current imbalance suggests the need for either (1) greater inclusion of CEEC institutions in future FAB calls and consortia or (2) the creation of a dedicated, FAB-style funding mechanism for China–CEEC agricultural cooperation, possibly modeled on the EU–China Co-Funding Mechanism (CFM). In essence, the FAB Flagship Initiative has provided a powerful illustration of how policy frameworks like the EU–China Agricultural Dialogue and the 2012 Cooperation Plan can evolve into structured, co-funded, and outcome-driven research partnerships. Its design–combining joint priority setting, co-financing, and institutional cooperation–has helped translate abstract goals into concrete outcomes across shared agri-food challenges such as food safety, animal health, sustainable farming, and circular bioeconomy. Yet moving forward, two critical issues must be addressed: ensuring the continuity and impact of completed projects, and expanding participation from less-represented regions like the CEEC. Without these adjustments, the FAB Flagship risks becoming a one-off success rather than a lasting mechanism for equitable, systemic transformation in global agri-food cooperation.

4.1.3 Other collaborative frameworks

Beyond Horizon Europe, the EU–China 2020 Strategic Agenda for Cooperation includes agriculture and rural development as focal areas. It encourages projects on water and soil conservation, agroecological practices, and sustainable land management. Platforms such as PIANO–SRIA[9] have facilitated joint efforts in water governance, particularly addressing irrigation efficiency and pollution control (Marinelli, 2020). In the context of the Belt and Road Initiative (BRI), agricultural cooperation has also gained traction. While largely driven by China, BRI-related food security collaborations have involved knowledge exchange and institutional engagement with EU stakeholders in Central and Eastern Europe. However, political sensitivities and diverging strategic interests limit deeper alignment on standards and governance practices (Tortajada & Zhang, 2021). Projects like EuroDISH (Snoek et al., 2018), which seek to build a pan-European research infrastructure across determinants, intake, status, and health (DISH), also offer a model for integrated food, health, and sustainability science that could be extended to future EU–China–CEEC collaborations. These could be especially relevant in developing a common approach to food systems transformation that is evidence-based, inclusive, and adaptable across contexts.

[9] https://cewp.eu/sites/default/files/files/PIANO-SRIA.pdf

4.1.4 The Comprehensive Agreement on Investment (CAI)

The Comprehensive Agreement on Investment (CAI), concluded in principle between the EU and China in December 2020, aimed to improve market access and ensure fair treatment for investors. While not focused specifically on agriculture, its broader provisions–such as commitments to sustainable development, regulatory transparency, and fair competition–held potential for strengthening cooperation in food systems. The CAI could have facilitated EU agri-food investment in China, supported joint efforts in sustainable agriculture and food safety, and improved regulatory dialogue. Though the agreement remains unratified, its framework highlights how structured investment deals can advance agri-food cooperation, particularly if adapted to China–CEEC relations, where investment and technology transfer could support food security, rural development, and economic integration. Reviving and adapting such initiatives could strengthen EU-China relations and support the development of resilient, sustainable food systems in the EU and CEEC region.

4.2 Comparative analysis of cooperation potential across systems

The preceding sections have shown that while the EU and its member states have made considerable progress in advancing sustainable, resilient, and diversified food systems, the internal heterogeneity of those systems necessitates differentiated cooperation models with China. Bilateral engagement offers more tailored and flexible opportunities than multilateral frameworks alone. Moreover, when structural strengths–such as the EU's regulatory capacity, technological innovation, and cultural heritage–are paired with China's strategic priorities and scaling capabilities, the potential for mutually beneficial cooperation is substantial.

In summary, cross-system complementarities in traceability, agroecology, rural revitalization, and low-waste logistics offer fertile ground for building a resilient and equitable global food future. This section synthesizes the primary opportunities and challenges for cooperation between the EU, China, and CEEC. What remains under-explored in current literature–and is surfaced here–is the triangular dynamic in which CEEC function not only as cooperation targets but also as testing grounds for EU–China alignment. In this model, China may bypass Brussels by building strategic rapport with CEEC, while the EU simultaneously expands its influence via regulatory harmonization. This triangulation suggests that CEEC are not just beneficiaries, but intermediaries whose alignment choices may shape the future of food governance on the continent. It identifies cross-cutting areas of synergy and constraint, with a view toward designing feasible and differentiated cooperation frameworks.

4.2.1 Strategic outlook and future cooperation

As global food systems confront mounting pressures from climate change, resource scarcity, population growth, and shifting consumption patterns, the relationship between China and the EU holds significant strategic weight. While much analysis of EU–China cooperation focuses on what China can learn from Europe–especially in sustainability standards, traceability, and participatory governance–this view overlooks the lessons and innovations that China can offer to the EU in return.

The EU and China share overlapping policy ambitions in food system transformation: climate-resilient agriculture, food safety modernization, biodiversity protection, and digital innovation. However, their respective food systems reflect markedly different institutional models, regulatory cultures, and structural compositions.

- The EU emphasizes regulation, subsidiarity, and public accountability, with wide member-state divergence.
- China emphasizes state coordination, long-term planning, and technological deployment, often top-down in design.

The systemic differences on the other hand complicate joint standard-setting but create room for complementary exchange in innovation, certification, and traceability. One of China's most important contributions lies in its ability to scale pilot programs into systemic change. The transformation of the Loess Plateau and the nationwide expansion of the Grain for Green Program show how targeted ecological interventions, when supported by state-led investment and cross-sectoral coordination, can produce landscape-level outcomes. This offers a powerful contrast to the EU's often fragmented pilot landscape, where promising agroecological and social farming projects remain confined to local contexts due to short funding cycles, administrative burden, or lack of national alignment. This reflects a broader friction noted earlier–between long-term sustainability ambitions and the short-term logic of funding mechanisms, which tend to favor measurable deliverables over structural resilience. For EU policymakers, China's success with vertically integrated implementation may serve as a compelling counter-model–one that emphasizes long-term vision, policy continuity, and high-level political backing.

China also offers a lesson in the strategic use of digitalization to increase system legibility. Blockchain-enabled traceability, real-time monitoring of agricultural inputs, and smart agriculture platforms are being piloted and, in some regions, institutionalized through Smart Agriculture programs. In contrast, many EU member states–particularly in Southern and Eastern Europe–face ongoing challenges in digitizing rural economies or ensuring that digital tools are affordable and inclusive. Here, China's investment-heavy, tech-driven model–particularly in cold chain logistics, mobile-based traceability, and e-commerce integration–demonstrates how the state can accelerate the adoption of innovation in even low-resource contexts.

In terms of governance, China's "output legitimacy" model–focused on measurable results, rapid delivery, and integrated monitoring–contrasts with the EU's emphasis on procedural legitimacy through multi stakeholder negotiation and decentralized implementation. China's system offers insights into how state coordination can overcome institutional fragmentation, particularly when responding to urgent sustainability challenges like food waste, soil degradation, or carbon emissions. The No-Waste Cities initiative and rapid expansion of IWFS are examples of how national goals are embedded at the municipal level through a policy architecture that is both centralized and adaptive (Wang et al., 2024; Houkai, 2022). Moreover, China's linkage of food policy with strategic geopolitical goals–such as rural revitalization, carbon neutrality by 2060, and the Belt and Road's Green Silk Road initiative–demonstrates a degree of policy integration that remains elusive in many EU member states, where agri-food policy is often siloed from energy, environmental, and trade agendas. This holistic framing may offer the EU a conceptual lesson:

that food systems should not only be ecological and nutritional in focus, but also deeply embedded in broader questions of territorial cohesion, technological sovereignty, and climate diplomacy.

That said, China also benefits from targeted engagement with European expertise. The EU's traceability regulations, PGI, and consumer trust mechanisms remain a benchmark for transparent and accountable labeling–especially in processed and value-added food sectors. The CAP's eco-schemes and performance-based payments offer potential inspiration for how China might further align farmer incentives with sustainability goals without relying solely on enforcement. In domains such as animal welfare, dietary transitions, and public deliberation on agrochemicals, the EU's normative frameworks provide ideas that China may selectively adapt.

Constructive cooperation between China and the EU requires institutional sensitivity, recognition of systemic differences, and frameworks that allow for mutual learning rather than one-sided transfer.

Strategically, this could take the form of:

- **Joint innovation platforms** that include partners from CEEC,
- **Triangular cooperation** with CEEC as intermediaries and testbeds,
- **Mutual market access strategies** for sustainable and certified food products,
- **Bilateral exchanges** in pilot governance, food waste reduction, and SME digitalization.

By embracing this logic of differentiated reciprocity, China and the EU can help shape a more resilient, equitable, and sustainable global food order–one that leverages the strengths of two vastly different but increasingly interdependent systems.

4.2.2 Areas of high cooperation potential

1. Food safety and traceability: France and Germany offer models for labeling, PGI protection, and consumer assurance systems. China is investing heavily in these domains.
2. Precision agriculture and digitalization: Germany and the Netherlands are EU leaders in agri-tech, with platforms and startups China can engage through co-investment or R&D partnerships.
3. Organic and agroecological transitions: Italy's traditional and small-scale farming systems offer insights for China's peri-urban agriculture and biodiversity-friendly landscapes.
4. Food waste reduction and logistics: EU's data infrastructure and carbon accounting tools could be leveraged in China's retail and supply chain optimization, especially in cold storage and e-commerce.

5. Rural development and youth inclusion: The EU's experience with generational renewal policies (e.g., CAP funding for young farmers) could inspire Chinese rural revitalization initiatives.

4.2.3 Barriers to deeper cooperation

Despite these synergies, several factors may inhibit stronger cooperation:

- Geopolitical tensions and strategic distrust limit institutional engagement.
- Asymmetrical power relations and trade defensiveness within the EU, particularly concerning imports.
- Fragmented governance in both regions, complicating enforcement and mutual recognition.
- Environmental vs. economic priority clashes, e.g., where the EU pushes for emissions cuts and China emphasizes productivity.

4.2.4 The Role of CEEC as a bridge

The CEEC can serve as intermediaries in this evolving relationship. As EU members with historical ties and cooperation frameworks with China (e.g., China–CEEC 17+1 initiative), they:

- Share institutional similarities with China (e.g., post-socialist transition economies),
- Are receptive to investment in agriculture, logistics, and research,
- Have untapped potential for joint pilot programs in sustainable production and rural regeneration.

Policy mechanisms such as the EU–China Strategic Dialogue, the Green Development Partnership, and Belt and Road-aligned food trade agreements can all be channeled through CEEC-specific platforms, enabling regionalized cooperation experiments. As typological analysis suggests, CEEC and China–both classified as formalizing systems (World Health Organization, 2024)–face similar structural constraints and opportunities. This opens pathways for greater alignment and mutual learning compared to core EU countries like France and Germany, whose industrial food systems differ markedly in institutional logic and capacity.

4.3. Concluding insights on EU–China–CEEC food system cooperation

The comparative overview of China and the EU's food systems, coupled with an assessment of their cooperation mechanisms, reveals both the promise and the complexity of building a shared path toward sustainability, resilience, and innovation. While their institutional architectures diverge, both are invested in transforming food systems in ways that are technologically advanced, environmentally responsible, and socially inclusive. What emerges from this analysis is that the most promising opportunities for cooperation may lie in leveraging their complementary strengths–China's scaling capacity, digital infrastructure, and state-led innovation on one side, and the EU's participatory governance, regulatory frameworks, and agroecological diversity on the other. Within this broader relationship, CEEC occupy a particularly strategic position. Sharing

typological features with China's "formalizing" food system–such as institutional fluidity, dual priorities of productivity and sustainability, and under-resourced rural areas–CEEC may serve not only as beneficiaries of enhanced cooperation, but also as experimental spaces where hybrid models of food system transition can be piloted and refined. The following section therefore turns its focus to the CEEC region, examining its food system challenges, current levels of engagement with China–particularly through the China-CEEC Cooperation framework–and its potential to act as both a bridge and a laboratory for scalable, context-sensitive cooperation in sustainable agriculture and food governance. While much of the existing analysis has focused on EU–China engagement at the supranational level, China has also developed a parallel track of cooperation with CEEC. The next section examines the China–CEEC cooperation dynamic, exploring whether these partnerships simply reflect pragmatic diversification of engagement channels–or whether they offer untapped potential for localized innovation and structural transformation in food systems.

5. Central and (South) Eastern European food systems: challenges, typologies, and strategic cooperation with China

Central and (South) Eastern Europe represents a complex mosaic of agrarian structures, shaped by post-socialist transitions, accession trajectories, uneven modernization pathways and institutional capacity. CEEC are often framed as intermediary zones within broader geopolitical and economic dynamics between China and the EU. However, this positionality deserves more nuanced theorization. As semi-peripheral actors with post-socialist legacies, CEEC navigate food governance through a unique mix of inherited institutional architectures, market liberalization pressures, and fragmented development pathways. Rather than merely adopting or mediating external models, CEEC often engage in selective adaptation, experimentation, or resistance. Their food system trajectories reveal tensions between integration and autonomy, tradition and modernization, as well as local embeddedness and global alignment. The region encompasses both EU member states (such as Poland, Croatia, Hungary, and Romania) and non-EU countries (such as N. Macedonia, Serbia, and Albania), forming a heterogeneous landscape of agricultural development and policy integration, which results in significant disparities in food security, agricultural productivity, and environmental outcomes. These asymmetries are not only internal to the region but also reflect the broader center–periphery dynamics within the EU itself (Gorton et al., 2009; Kalinowska et al., 2022). The countries from the region face acute structural challenges: fragmented landholdings, aging rural populations, insufficient infrastructure, and underdeveloped food system governance. Nonetheless, framing CEEC solely through the lens of transition and convergence with Western policy models overlooks the distinctive food provisioning systems and sustainability practices that characterize the region. As Jehlička et al. (2020) argue, Eastern European societies exhibit diverse and hybrid models of food self-provisioning, foraging, and informal sharing. These systems, while often invisible to mainstream policy, contribute significantly to food security, ecological sustainability, and community resilience–suggesting that the region offers not only problems to be solved but knowledge to be valued. The region is also linked through its participation in the China–CEEC cooperation mechanism. This format has served as a diplomatic and economic platform for advancing infrastructure development, trade expansion, and more recently, agriculture. This section

examines broad regional characteristics and key food system indicators, then zooms into three national case studies - Poland, Croatia, and N. Macedonia–analyzing their challenges, progress, and cooperation potential with China in building sustainable food systems.

5.1. Structural constraints and missed opportunities in CEEC Food System integration

The food systems of CEEC are shaped by persistent structural vulnerabilities and incomplete integration into EU policy frameworks. The EU's CAP, while offering substantial funding opportunities, often fails to accommodate the unique socio-economic conditions of CEEC. Many countries in the region benefit from the CAP, yet the policy's architecture remains poorly aligned with the socio-economic realities of smaller, often subsistence-oriented farms that dominate the rural landscape, sidelining the small-scale, often subsistence-oriented household farms prevalent in Eastern Europe. For instance, in Romania, nearly half of the four million farms operate on plots under 1 hectare, rendering them ineligible for CAP subsidies. (Gorton et al., 2009). This structural bias is compounded by underutilization of CAP's Pillar II, which is intended to support rural development and agri-environmental investments. In CEEC, limited administrative capacity, burdensome co-financing requirements, and weak institutional coordination inhibit effective absorption of these funds. Candidate countries such as N. Macedonia face even greater hurdles in accessing EU pre-accession assistance (IPA), where support is contingent upon institutional performance standards that must first be externally developed (Gjorgjioska, 2021). The consequences of these gaps are visible across multiple dimensions. According to the Food Systems Dashboard (2024), CEEC like N. Macedonia and Romania exhibit high food loss, low dietary diversity, and widespread inability to afford healthy diets. Meanwhile, environmental sustainability metrics remain poor across the region, with countries like Bulgaria and Lithuania recording high ammonia emissions, limited uptake of agroecological practices, and excessive fertilizer use (Kalinowska et al., 2022).

Yet, the region's relatively low level of industrial agriculture and its rich biodiversity represent a significant, underexploited opportunity for agroecological innovation. Transitioning toward more sustainable, nature-based food systems will require context-sensitive policy frameworks that address entrenched rural poverty, demographic decline, and ecological degradation, while also strengthening local governance and rural cooperatives (Tribaldos & Kortetmäki, 2022). Moreover, framing CEEC solely through the lens of "lagging convergence" with Western Europe risks overlooking their distinctive food provisioning systems. As Jehlička et al. (2020) emphasize, alongside formal agricultural systems, many CEEC continue to sustain widespread and resilient informal practices such as food self-provisioning, foraging, and communal sharing. These include home gardens, foraging, informal preservation, and neighborhood exchange. Rather than being residual or marginal, these systems contribute significantly to household-level food security and reduce dependence on industrialized supply chains. Jehlička et al. (2020) argue that these practices represent a form of 'quiet sustainability,' offering insights for more localized, resilient food systems globally. Although often invisible to mainstream policy, these systems contribute meaningfully to food security, ecological sustainability, and social cohesion–offering not only challenges to be addressed but models to be recognized and scaled. Despite their ecological and

social benefits, these practices are largely invisible to EU policy metrics and funding schemes, which remain oriented toward formalized production and export capacity.

5.2. Production systems and land use

Agricultural production in CEEC is marked by fragmented landholdings, outdated machinery, and varying levels of crop diversification. For instance, countries like Croatia and Poland retain relatively high crop species richness (14 and 11.6 crops/ha, respectively), while others like N. Macedonia remain well below the EU average (8.8 crops/ha) (Food Systems Dashboard, 2024). Many of these systems operate below their productivity potential due to limited investment in infrastructure, research, and extension services. Furthermore, Kalinowska et al. (2022) highlight a Europe-wide trend toward modernization and mechanization, with a 7.7% reduction in agricultural employment between 2011 and 2018. This transition has been uneven across CEEC, often excluding smallholders and regions with weaker governance structures. CAP reforms have done little to adapt to these disparities, and the current policy model continues to overlook the need for structural transformation tailored to small-scale farmers. Yet, as previously discussed, these constraints do not render CEEC passive. Rather, the region's fragmented but adaptive governance structures often foster bottom-up innovations, hybrid institutional forms, and contestation of dominant models–particularly when external frameworks fail to address local food security, sovereignty, or cultural resilience.

5.3. Food security and sustainability outcomes

Access to healthy diets varies widely across the region. According to the Food Systems Dashboard (2024), one-third of the population in Macedonia cannot afford a healthy diet, and the situation is similar in Romania and parts of Bulgaria. These trends are further exacerbated by high levels of food loss and low vegetable availability–symptoms of underdeveloped supply chains and food system infrastructure. Environmental indicators are similarly divergent. While some CEEC have made progress in reducing ammonia emissions and pesticide use, others lag significantly. Kalinowska et al. (2022) report that Lithuania and Romania rank lowest in environmental sustainability, while the Netherlands and Germany continue to lead. These disparities underscore the continued ecological marginalization of peripheral EU states and candidate countries.

CEECconsistently lag behind in sustainable development, particularly in environmental performance. High ammonia emissions, low uptake of agroecological practices, and continued fertilizer overuse are prevalent issues . However, the region's low levels of industrial agriculture and rich biodiversity present unique opportunities for transitioning toward nature-based solutions. Unlocking this potential requires policy frameworks that are sensitive to local contexts while addressing entrenched rural poverty and institutional weaknesses.

5.4 CEEC comparative advantages and China-CEEC agri-food cooperation potential

Beyond internal diversity, the CEEC region presents opportunities for cooperation with external partners, notably China. The China-CEEC cooperation mechanism, while initially focused on infrastructure and trade, has expanded to agriculture in recognition of the region's ecological

assets and complementary food systems. This is particularly relevant given China's constrained agricultural resource base–including limited per capita arable land and water scarcity–and the relative abundance of these resources in CEEC (Guo, Qiu & He, 2021). Agricultural land per capita in CEEC is, on average, more than twice that of China, with countries like Lithuania offering up to 7.6 times more arable land per person. Typological analysis further reveals that many CEEC share more institutional, historical, and systemic similarities with China than with core EU states like France or Germany. As formalizing systems (World Health Organization, 2024), CEEC and China face similar challenges around regulatory enforcement, institutional capacity, and agroecological diversity–making them fertile ground for targeted, region-specific cooperation.

In terms of comparative advantages, the region's climatic and geographical diversity supports a wide range of crops and livestock systems. Poland and Romania have emerged as agricultural powerhouses in cereal and dairy production, while Bulgaria and Hungary play key roles in fruit, vegetable, and wine exports. As noted in Guo, Qiu & He (2021), production of oilseeds, pulses, sunflower seed oil, and pork has grown steadily across the region, and several countries have specialized production profiles suited for export diversification. Crucially, the comparative advantage of CEEC is not only in land or climate. Institutional and technical complementarities also exist. The region benefits from close access to EU markets, relatively low labor costs, and high levels of education in the agri-food sector. At the same time, countries like Albania, N.Macedonia and Montenegro maintain strong traditions in organic farming, foraging, and artisanal food production–providing niches for sustainability-focused collaboration. Recent evaluations of cooperation potential have identified Estonia, Latvia, and Lithuania as having the strongest complementarity with China’s agri-environmental resource needs, followed by Slovenia, Albania, and Croatia (Guo, Qiu & He, 2021).

Moreover, forest cover across CEEC is among the highest in Europe, with countries like Slovenia and Montenegro exceeding 60%, contributing to the preservation of biodiversity and ecosystem services–factors increasingly prioritized in China's outbound investment under the Green BRI framework. Access to fishery resources, particularly along the Adriatic and Baltic coasts, further reinforces the region's potential as a strategic agri-food partner for China.

Despite these advantages, challenges remain. Many CEEC have underdeveloped irrigation systems (with actual irrigation rates below 1% of agricultural land in countries like Latvia and Poland), low adoption of mechanization, and limited access to capital. Fiscal expenditures on agriculture have declined in some key countries, such as Hungary and Poland, reducing public investment in research and infrastructure (Guo, Qiu & He, 2021). Nonetheless, as the Guo, Qiu & He (2021) study concludes, agricultural cooperation potential is high across nearly all CEEC when assessed through a multidimensional model that accounts for political relations, economic complementarities, natural resources, institutional compatibility, and trade dynamics. From the perspective of resource complementarity, the CEEC region offers both a testing ground and a partner base for China’s internationalization strategy in agriculture. As such, mapping food system disparities and structural conditions across CEEC is not merely an academic exercise, but a strategic step toward realizing sustainable, long-term cooperation.

5.5 Country case studies

5.5.1 Poland's food system

Poland's food system is one of the most dynamic and export-oriented in Central and Eastern Europe, shaped by deep agricultural traditions, EU integration, and rapid modernization. It reflects a complex dual structure that combines large-scale agro-industrial production with a still-significant smallholder sector, both increasingly engaged in sustainability and innovation discourse. As a major agricultural exporter and an EU member with growing interest in green transitions, Poland presents a compelling case for analyzing structural food system characteristics and international cooperation potential–particularly with China. This case study draws on academic research, the Food Systems Dashboard, and trade policy insights to assess Poland's food system performance, key challenges and strengths, and identifies strategic opportunities for collaboration with China in areas such as agricultural technology, sustainability, and circular food systems.

5.5.1.1. Structural characteristics of the Polish food system

Poland's food system stands as one of the most dynamic and export-oriented in Central and Eastern Europe. With deep agricultural traditions, a strong food industry base, and a growing focus on sustainability and innovation, Poland offers a unique case for examining structural characteristics, recent developments, and international cooperation potential–especially with China. Poland's agri-food sector is a cornerstone of its economy, contributing approximately 3.2% of GDP and employing 9.1% of the workforce–well above the EU average (Dudek & Śpiewak, 2022). Poland's food system is marked by diversity in farm size and production models. The vast majority of the 1.4 million farms are small and family-run, with only about 20% categorized as economically strong–yet these account for most of the country's agricultural output (Dudek & Śpiewak, 2022). These larger farms are often market-oriented, increasingly specialized, and integrated with broader agri-food chains, including export markets. Social and environmental disparities are exacerbated by unequal CAP support. While Poland's administrative infrastructure allows for absorption of EU funds, distribution remains skewed toward larger entities. Though agricultural modernization has advanced significantly since accession, fragmented holdings and underdeveloped value chains persist.

The sector is marked by:

- A dual-track structure: An advanced, export-driven agro-industrial sector operates alongside a large population of small-scale, often subsistence-oriented family farms. Around 99% of all farms are family-owned, yet only 20% are economically strong and market-integrated.

- High export performance: Poland's agri-food exports grew sixfold between 2004 and 2019, reaching €31.8 billion.

- Low farmer cooperation: Only 15% of Polish farmers are involved in agricultural cooperatives, limiting access to markets and shared innovation.

- Modernization and concentration: Supported by CAP funds and EU market access, Poland has seen rising specialization and foreign investment, particularly in food processing.

However, this transformation has left gaps. Agricultural land remains highly fragmented, and small farms often struggle with access to capital, infrastructure, and value-added chains (Dudek & Śpiewak, 2022).

Key Features:

- High employment in agriculture: 9.1% of the workforce in 2019.
- Agri-food export growth: From €5.2 billion in 2004 to €31.8 billion in 2019.
- Low social capital: Only 15% of farmers belong to cooperatives.
- Underdeveloped organic farming: Organic farming represents less than 3% of arable land, despite EU targets of 25% by 2030 (Dudek & Śpiewak, 2022).

Drawing from the Food Systems Dashboard (2025), Poland shows mixed results in terms of sustainability and food access:

Strengths:

- Moderate crop species richness: 11.6 crops/ha, comparable to China's 12.3 crops/ha.
- High yields: Particularly in cereal and vegetable production.
- Low cereal losses: Efficient post-harvest management for staples.
- Good availability of fruits and vegetables: Robust domestic supply

Challenges:

- High greenhouse gas emissions from food consumption.
- Increasing consumption of ultra-processed foods.
- Dietary inequality: A healthy diet remains unaffordable for certain population groups.
- Soil biodiversity threats and ecological degradation in areas of intensive farming.

5.5.1.2 The role of short supply chains

Short food supply chains (SFSCs)–including farmers' markets, direct-to-consumer sales, and regional brands–have grown significantly in Poland, offering sustainable and health-oriented alternatives to industrial food systems.

- Benefits: SFSCs increase producer margins, provide fresher food to consumers, and strengthen food sovereignty (Drejerska & Sobczak-Malitka, 2023).

- COVID-19 resilience: These chains proved vital during the pandemic, offering continuity and adaptive capacity when global supply chains faltered (Dudek & Śpiewak, 2022).

- Challenges: Limited production scale, logistical infrastructure, and policy coordination restrict broader impact.

While SFSCs are growing, they require continued investment and supportive regulation to compete with dominant retail chains and global suppliers.

5.5.1.3 Sustainability and equity considerations

Poland's agricultural sector faces serious challenges related to both sustainability and equity:

- Unequal CAP support: Despite effective fund absorption, distributions favor larger entities. This entrenches disparities and slows transformation in smaller farms (Dudek & Śpiewak, 2022).
- Decline in organic farming: Less than 3% of arable land is organic, far from the EU's 25% by 2030 goal.
- Underdeveloped value chains: Many small farms lack access to processing and distribution networks.
- Social capital deficits: Farmer cooperation remains weak, reducing resilience and innovation capacity (Drejerska & Sobczak-Malitka, 2023).

While Poland's agri-food exports to the EU and neighboring markets have flourished, its trade relationship with China–particularly in the meat sector–has proven unstable and politically sensitive. In 2013, pork exports to China reached €67 million, representing one of Poland's most promising non-EU markets. However, over the past decade, this trade has repeatedly been disrupted by disease outbreaks and shifting regulatory frameworks. A central challenge has been sanitary and phytosanitary (SPS) restrictions, including blanket import bans following outbreaks of African Swine Fever (ASF), avian influenza (H5N1), and bovine spongiform encephalopathy (BSE). These bans have halted not only affected regional producers but the entire country's exports, regardless of the localized nature of the health incidents.

5.5.1.4. Opportunities for future cooperation beyond meat trade

Despite these frictions, Poland and China still hold significant potential for collaboration–particularly in domains beyond raw meat trade. With a strong agricultural research sector, EU-aligned regulatory environment, and modern infrastructure, Poland is well-positioned to serve as a testbed for bilateral innovation partnerships.

Priority areas for cooperation include:

- **Smart agriculture:** Deployment of AI-driven irrigation systems, precision farming technologies, digital soil monitoring, and satellite-based yield mapping can boost climate resilience and productivity.
- **Technological exchange in cold chain development:** Joint investment in temperature-controlled logistics for fresh produce, dairy, and processed foods would reduce losses and open opportunities for perishable exports to China. China's advancements in smart logistics and food tracking could benefit Poland's perishable supply chains (especially for fruits and vegetables, where losses are high)
- **Agri-food e-commerce:** Chinese demand for premium, certified, traceable products presents an opening for Polish specialty foods–such as honey, dairy, and organic products–through digital retail platforms. Building platforms for traceable, certified Polish products (especially dairy, honey, cereals) to enter niche segments in China's online retail market.
- **Circular agriculture and sustainability innovation**: Both countries could benefit from shared R&D in low-waste production, resource-efficient nutrient cycles, and regenerative practices that align with EU Green Deal goals and China's ecological civilization agenda.
- **Functional and organic foods:** China's demand for health-conscious, functional foods aligns with Poland's strengths in dairy and berries. Policy coordination is needed to resolve certification barriers.
- **Regionalization and disease management cooperation**
  Bilateral veterinary agreements and shared protocols could enable regionalization acceptance, opening export pathways even during localized disease outbreaks.

In sum, while past efforts to expand meat exports to China have encountered roadblocks, the future of Sino-Polish agri-food collaboration lies in diversified, forward-looking cooperation grounded in shared challenges and mutual strengths–particularly in sustainability, technology, and food system modernization. Given its strong infrastructure and innovation ecosystems, Poland is well-positioned to pilot joint agricultural technology ventures with China, including AI-driven irrigation, remote sensing, and yield mapping systems. To ensure inclusive outcomes, however, sustainability must be embedded from the outset–both environmentally and socially–to prevent the further marginalization of small-scale farmers and ensure that technological advancement contributes to broader food system resilience.

5.5.2 Croatia's food system

5.5.2.1 Structural characteristics of Croatia's food system

Historically, Croatian agriculture has been shaped by the post-socialist transition and land reforms. Following independence in 1991, the sector experienced significant disruptions–farmland was abandoned, rural infrastructure deteriorated, and the system struggled to adapt to global market competition (Crane et al., 2021). EU membership in 2013 brought much-needed investment through access to CAP funds and rural development programs, aimed at modernizing the country's food system (Crane et al., 2021).

Today, Croatia's agriculture is defined by small, family-run farms and highly fragmented landholdings. With an average farm size of 8.6 hectares–roughly half the EU average–and over 40% of farms operating on less than 2 hectares, the sector faces severe constraints in achieving economies of scale (Crane et al., 2021). Productivity remains relatively low due to limited mechanization, underinvestment in irrigation (with only 1% of land irrigated), and constrained technological uptake, which collectively leave production vulnerable to climate shocks such as droughts.These structural limitations are directly linked to Croatia's pronounced food trade deficit. Although the country is self-sufficient in a few staples like wheat, corn, poultry, eggs, and wine, it remains heavily reliant on imports for most processed and value-added food products. The 2024 *Future of Food and Retail* conference reinforced this concern, highlighting the continued rise in food imports and the stagnation or decline in exports as indicators of systemic imbalance (Pedersen, 2024). In response, several forward-looking proposals and trends emerged from the conference. These include calls to regulate the duration of frozen meat storage–referred to as the "frozen dinosaurs" issue–to ensure product quality and consumer safety, as well as a renewed focus on food waste reduction as a pillar of sustainability. The role of technology and AI was emphasized as a means to increase agricultural productivity while aligning with environmental goals. Notably, the conference also pointed to a growing momentum for farmer collaboration through cooperatives and joint marketing initiatives–potentially offering a route to scale, resilience, and market competitiveness in a sector long dominated by fragmentation and underinvestment.

Taken together, Croatia's food system reflects both entrenched structural vulnerabilities and nascent signs of transformation. Bridging the gap between small-scale production and competitive, sustainable food systems will require strategic investment in technology, cooperative development, and trade-balancing reforms–aligned with both EU policy frameworks and emerging domestic priorities.

5.5.2.2 Key challenges and vulnerabilities

Croatia's food system faces major challenges:

- Heavy Import Reliance: Croatia relies on imports for a large share of its food supply, making it vulnerable to external shocks. Over 35% of the country's food supply is imported, including large quantities of meat and dairy (Pedersen, 2024).
- Small-Scale Farm Viability: Many Croatian farmers struggle with low incomes and productivity. Agricultural income per worker is only about 36–44% of the national average wage (Crane et al., 2021).
- Lack of Farmer Organization: Only about 0.23% of registered producers are in cooperatives or formal producer organizations. This legacy of the past (distrust of cooperatives post-socialism) means most farmers act individually (Crane et al., 2021).
- Food Waste and Losses: The "Future of Food and Retail" conference highlighted the issue of food waste. Large quantities of food are lost or wasted even as the country struggles to raise production (Pedersen, 2024).
- Climate and Environmental Vulnerabilities: Croatia's food sector faces erratic weather, rising sea levels, and land degradation. Recent years have seen severe droughts and floods affecting agricultural output (Crane et al., 2021).

5.5.2.3 Food systems dashboard indicators for Croatia

According to the Food Systems Dashboard (2024):

- Crop species richness in Croatia is 14 crops per 10x10 km area, slightly above China's 12.3.
- Fruit availability is around 270–300 grams per capita per day; vegetables around 800–900 grams.
- Dietary energy availability is over 3,300 kcal per capita per day.
- The cost of a healthy diet is $4.29 per person per day (PPP), with only 1.8% of the population unable to afford it.
- The greenhouse gas emissions from food consumption amount to 2.16 metric tons CO_2e per person annually.

These indicators show Croatia has ample availability and relatively affordable access to food but a high environmental footprint due to diet composition.

5.5.2.4 Opportunities for cooperation with China

Croatia and China's food systems are highly complementary, offering multiple avenues for mutually beneficial cooperation, particularly through platforms like the China–CEEC framework. As Croatia seeks to modernize its agricultural sector while maintaining ecological integrity, China's expertise in technological innovation, logistics, and digital infrastructure presents significant potential for targeted collaboration.

AI-driven agriculture is a key area of synergy. Croatia's pressing need to boost productivity–given its fragmented landholdings, low mechanization, and limited irrigation–can be addressed through Chinese leadership in precision farming, crop disease prediction, and data-driven resource management. Pilot programs involving Croatian universities and agricultural cooperatives could facilitate effective knowledge transfer and adaptation to local conditions.In the realm of cold-chain development, China's advances in RFID technology and smart logistics offer pathways to reduce food waste and enhance the integrity of perishable goods distribution. These innovations could play a pivotal role in improving Croatia's food trade balance and enabling more efficient rural–urban supply chains. Food traceability also presents an important opportunity. Blockchain-based platforms already deployed in China can help Croatian agri-food exporters meet rising consumer expectations for transparency in both China and the EU. Such systems could strengthen Croatia's competitiveness in high-value markets by certifying origin, quality, and sustainability. Circular agriculture offers another area of alignment. China's experience with nutrient recycling, waste-to-energy systems, and ecological zoning could be adapted to Croatia's Mediterranean agro-ecological context. At the same time, Croatia's rich traditions in organic and low-input farming offer valuable models that could inform China's own sustainability transitions–pointing to a two-way exchange of best practices. In terms of trade, Croatia is well-positioned to export niche, high-quality products–such as wine, olive oil, honey, and tuna–to the Chinese market. Conversely, China can serve as a key partner for delivering agri-tech inputs, logistics solutions, and digital infrastructure to Croatian producers and processors.

To ensure inclusive and context-sensitive outcomes, cooperation efforts should prioritize localized pilot programs, particularly those co-developed with Croatian research institutions and smallholder cooperatives. Agroecological demonstration zones tailored to Mediterranean crop systems could serve as innovation hubs for adapting Chinese models to the Croatian landscape. By leveraging its EU membership and strategic position in the Adriatic, Croatia can act as both a recipient and transmitter of sustainable agri-food innovations within broader Europe–China cooperation frameworks.

5.5.3 N. Macedonia's food system

As a non-EU candidate country, N. Macedonia illustrates the compounded effects of weak institutional capacity, limited funding access, and dependency on volatile trade flows. According to the Food Systems Dashboard, it registers low crop species richness (8.8 crops/ha), poor vegetable availability, and high levels of cereal and fruit losses. Alarmingly, one-third of the population cannot afford a healthy diet.

Key challenges include administrative blockages in IPA fund utilization and fragmented coordination across ministries and stakeholders. Agricultural modernization is stalled by reliance on traditional methods, limited mechanization, and insufficient rural extension services. Supply chains remain underdeveloped, and compliance with EU food safety and sustainability standards is often aspirational rather than operational.The country's nutritional indicators are among the worst in the region, with high child stunting and low vegetable consumption. Yet, ultra-processed food consumption remains relatively low–offering a strategic opportunity to steer diets toward healthier alternatives.

5.5.3.1. Structural characteristics and key challenges

Macedonia is a traditionally agrarian country, yet it imports around 70% of its agricultural products, including basic food staples such as meat and grains. This high import dependency stems from decades of ineffective agricultural policies and insufficient systemic support, which have weakened domestic production. The livestock sector, in particular, is in steady decline, with domestic beef and poultry production unable to meet market demand. The agricultural sector is characterized by extreme land fragmentation. Over 55% of land parcels are between 2 and 5 hectares in size, and less than 0.2% of farmers operate more than 50 hectares. This fragmentation limits economies of scale, discourages mechanization, and reduces competitiveness. Additionally, approximately 32% of arable agricultural land is abandoned, particularly in mountainous regions and areas with poor soil quality. The food processing industry, one of the more robust sectors, still struggles with raw material shortages, particularly in meat processing. This is compounded by outdated technology and limited investment, hindering the sector's growth and competitiveness.

5.5.3.2. Food systems performance and indicators

According to the Food Systems Dashboard, Macedonia has moderate crop diversity, with 12.6 crops per 10x10 km area. However, the affordability of healthy diets remains low, with over 25%

of the population unable to afford a healthy diet. The country exhibits high greenhouse gas emissions from food consumption relative to its income level. While there is moderate availability of fruits and vegetables, there is a high import dependency on meat, cereals, and soy. Public health challenges persist, including infant dietary diversity, and anemia in women. Meanwhile, adult and child obesity and diet-related non-communicable diseases are rising, signaling the growing influence of processed foods.

5.5.3.3. Policy environment and institutional capacity

As a candidate for EU membership N. Macedonia is aligning its agricultural policy with the EU. However, significant gaps remain (Dimitrievski & Kotevska, 2008). The implementation of the Instrument for Pre-Accession Assistance in Rural Development (IPARD III) faces challenges, including delayed payments and insufficient administrative capacity. These challenges reflect deeper institutional capacity gaps that undermine the implementation of sustainability-oriented reforms. North Macedonia's agricultural institutions often lack the technical expertise and organizational coherence necessary to adopt and enforce EU-aligned practices (Gjorgjioska 2023). Although frameworks like the *Green Agenda for the Western Balkans* (Ciglovska, 2018) offer strategic vision, their operationalization is inconsistent across regions due to weak coordination among government bodies, civil society, and private actors. The absence of comprehensive monitoring systems further impedes accountability and progress tracking (Stojcheska et al., 2024). Moreover, funding constraints–rooted in the paradoxes of EU pre-accession aid–further limit policy impact. Access to mechanisms like IPA and IPARD is formally inclusive, but effectively contingent on pre-existing administrative capacity that smaller states like North Macedonia often lack (OECD, 2024). This results in donor-driven compliance, where reforms are shaped more by the logic of accession than by domestic needs.

Efforts to modernize agriculture include digitalization initiatives, support for young farmers, and rural development programs offering up to 90% cost coverage for cooperative investments. However, trust in cooperatives is low, and farmer organization remains weak. There is currently no law facilitating land consolidation, which remains a key obstacle to increasing productivity. In response to rising food prices, the government attempted multiple price freezes in 2024 and 2025 on products such as bread, dairy, vegetables, and fruit. However, these measures were largely ineffective, leading to dissatisfaction among both consumers and vendors. The underlying issue remains the country's high dependency on food imports (Gjorgjioska, 2023).

5.5.3.4 Trade orientation and processing potential

N. Macedonia’s agri-food trade is dominated by exports to the EU (50.5%) and Central European Free Trade Agreement (CEFTA) countries (32%). Key export products include tobacco, wine, lamb, and processed vegetables. However, the country imports most of its meat, dairy, cereals, and soy. North Macedonia’s trade dependencies expose its food system to external shocks. The COVID-19 pandemic and the Russia–Ukraine war disrupted input supply chains and raised fertilizer and energy costs (Gjorgjioska, 2021), underlining the fragility of its import-reliant model. At the same time, aligning with EU trade standards–which include strict food safety and environmental criteria–places additional pressure on small producers with limited technical or

financial means to comply (Ciglovska, 2018; Mazzucco et al., 2022). These dynamics create a dual burden: the need to maintain competitiveness in export markets while ensuring food affordability for domestic consumers. The food processing sector includes over 50 companies with the capacity to process 180,000 tons of fruit and vegetables per year. However, production is highly seasonal and constrained by lack of investment, raw material instability, labor shortages, and outdated technology.

5.5.3.5. Innovation and sustainability gaps

Despite growing awareness, sustainable practices remain underdeveloped. Organic agriculture is slowly expanding, with 913 registered organic operators in 2022, mainly in dairy, honey, and grains. However, pesticide misuse, weak enforcement of food safety rules, and low adoption of agroecological practices persist. Digitalization is gaining attention, and the country has a strong digital public infrastructure. Yet, precision agriculture and traceability systems are rarely used on farms. Climate adaptation and water management systems remain underdeveloped, and only one-third of wheat demand is met through domestic production.

5.5.3.6. Opportunities for cooperation with China

In light of the structural and policy constraints facing N. Macedonia's food system, strategic cooperation with China offers several high-potential avenues. As part of the China-CEEC cooperation mechanism, N. Macedonia can explore strategic partnerships with China in:

- **Agri-tech transfer and mechanization**: Given land fragmentation and limited mechanization, partnerships with Chinese firms could facilitate access to affordable machinery, irrigation systems, and digital tools. These could boost smallholder productivity and support precision farming.

- **Digital traceability and certification systems**: Chinese innovations in blockchain and smart logistics could help North Macedonia overcome weaknesses in food safety enforcement and build reliable systems for export certification–particularly important for penetrating higher-value markets.

- **Organic and export niches**: As demand in China grows for premium organic, and traditional products, N. Macedonia could position its lamb, honey, and wine as high-value exports. Support in certification processes and targeted joint marketing campaigns could catalyze market access.

- **Cold chain development**: Investment in storage and temperature-controlled logistics could help address post-harvest losses and extend the reach of perishable exports like fruit, vegetables, and meat.

- **Public-private innovation funds**: Joint R&D or co-financing schemes between Chinese investors and Macedonian agribusinesses could support adoption of agroecological

methods, seed innovation, or biotech applications for climate adaptation.

- **Capacity building and training**: China could assist in technical capacity development, particularly in agricultural engineering, climate-smart practices, and digital agriculture–helping N. Macedonia reduce dependency on external consultants and donors.

As N. Macedonia seeks to reduce its dependence on EU pre-accession aid and navigate rising geopolitical uncertainties, diversifying its partnerships–including through the China-CEEC platform–offers a pathway toward a more resilient and autonomous food system. Having analyzed the distinct trajectories and cooperation frameworks across the EU, China, and CEEC, we now shift to a more integrative view. The next section uses comparative typologies to map structural similarities and divergences across these regions–laying the groundwork for assessing the feasibility and strategic value of cross-regional cooperation.

6. China–CEEC cooperation in food systems: current trends and future prospects

The CEEC region's classification–straddling formalizing and expanding systems–is not only a technical categorization, but reflects its transitional political economy. The interplay of post-socialist restructuring, EU accession pressures, and recent reorientations toward China has produced uneven institutional development, making CEEC food systems sites of dynamic friction and experimentation. As Wallerstein (1979) and Silver (2003) have argued, semi-peripheral regions often function as zones of both instability and innovation, where structural dependencies coexist with opportunities for strategic maneuvering. Similarly, the legacy of post-socialist transformation introduces institutional ambiguity and heterarchical governance (Stark, 1996), where overlapping norms, fragmented authority, and path-dependent choices shape food system reforms. As Offe (1991) noted, transitions from state socialism are inherently improvisational and often marked by the coexistence of incompatible institutional logics. These characteristics warrant closer attention when assessing the region's cooperation potential. The China-CEEC cooperation mechanism, originally launched as "16+1" in 2012 and later expanded to "17+1", has played a central role in structuring relations between China and the CEEC. While the format encompasses diverse sectors–from infrastructure to cultural exchange–agriculture and food systems have emerged as a domain of growing significance. Driven by shared concerns around food security, climate resilience, and sustainable development, both sides have increasingly turned to agriculture as a focal point of engagement. According to the China–CEEC Cooperation framework, this format serves to coordinate China's policies toward individual Central and Eastern European countries and provides strategic direction for the further development of bilateral relations. Moreover, as emphasized by Beijing, China–CEEC cooperation aligns with broader China–EU relations and reaffirms a shared commitment to deepening the partnership for peace, growth, reform, and civilization. This cooperation is grounded in the principles of equality, mutual respect, and trust, and contributes–where appropriate–to the implementation of the EU–China 2020 Strategic Agenda for Cooperation (APACCCEEC, 2025).

Since its 2012 launch, the China–CEEC Cooperation (17+1) initiative has facilitated numerous investments in transport, energy, and logistics. Agriculture has also emerged as a sector of mutual interest, resulting in demonstration zones such as the agricultural science and technology parks in Plovdiv (Bulgaria) and Romania. These zones highlight China's advances in smart agriculture–agro-drones, remote sensors, precision irrigation–which could offer benefits for CEEC countries facing outdated practices and low technological penetration (Bharti & Singh, 2024). However, critics argue that the focus on demonstration zones over long-term capacity-building results in symbolic rather than transformative impact. Moreover, they argue that technology transfers lack the necessary educational and governance frameworks to ensure uptake and long-term integration (Stojcheska et al., 2024). Effective cooperation must include participatory knowledge transfers, targeting not only productivity but equity, climate resilience, and institutional learning.

6.1. Institutional foundations for food systems cooperation

6.1.1 China-CEEC framework and agricultural engagement

Established in 2012, the China-CEEC format aimed to deepen connectivity and practical cooperation in areas such as trade, transport, education, and agriculture. Agriculture was included in the initial roadmap due to the perceived resource complementarity between China's demand for diversified food sources and CEEC agricultural export capacity (Guo, Qiu & He, 2021).

Multiple platforms have since institutionalized food systems collaboration:

- Ministerial dialogues on agriculture and rural development
- Agri-science symposia and technology exhibitions
- Joint educational and research frameworks, such as the China-CEEC Modern Agricultural Science and Education Innovation Alliance established in 2024, led by Shandong Agricultural University with liaison offices in Hungary, Bulgaria, Slovenia, and Greece.

These mechanisms are designed to facilitate scientific exchange, food security policy dialogue, and market integration between China and CEEC stakeholders.

6.1.2 Political and strategic rationale

The strategic imperative for China is reinforced by domestic shifts in food security strategy–especially diversification of food import sources and investment in overseas agricultural production–as emphasized in the BRI and subsequent policy documents (Tortajada & Zhang, 2021). From the CEEC perspective, the cooperation mechanism is an opportunity to position their agri-food sectors within China's expanding markets and global connectivity projects. Moreover, the cooperation is part of China's new type of international relations, centered on mutual benefit, openness, and sustainable development (Liu, 2017).

6.1.3 Agricultural trade and investment dynamics

Between 2012 and 2019, trade volume between China and CEEC expanded from $52.06 billion to $95.45 billion, with bilateral agricultural trade forming a growing component (Liu, 2020). Countries such as Poland, Hungary, Romania, and Serbia have emerged as key players. For example, Polish agricultural exports to China increased from $242 million in 2009 to $316 million in 2018, while Chinese imports from Poland grew tenfold during the same period (Guo, Qiu & He, 2021). Serbia and Bulgaria have also begun exporting niche products such as wine and honey to Chinese markets.

According to Vidnjevic and Kralj (2024), the China–CEEC trade dynamic exhibits pronounced mutual complementarity, particularly between labor-intensive and capital-technology-intensive industries. Agriculture represents a prime sector where both sides possess comparative advantages. CEEC offer niche, high-quality products (e.g., organic honey, dairy, wine, and meat), while China contributes through large-scale logistics, technology, and investment capacity.

Nonetheless, a large trade asymmetry remains, with China maintaining a considerable surplus. CEEC stakeholders often express concern about limited reciprocity and persistent barriers to market entry in China. Key challenges include:

- Stringent food safety and certification protocols, which often disadvantage smaller CEEC exporters unfamiliar with Chinese regulatory requirements.
- Limited brand recognition for CEEC products in Chinese consumer markets.
- Underdeveloped cold-chain logistics, which hamper the competitiveness of perishable goods exports.

To address these barriers, several mechanisms have emerged:

- Cross-border e-commerce platforms, increasingly used to market CEEC goods directly to Chinese consumers.
- Expansion of China-Europe freight train corridors, which are now tailored to accommodate agri-food shipments through cold-chain integration, thus reducing transit time and spoilage risk.

On the investment side, Chinese agricultural investment in CEEC has grown but remains selective. By 2018, total investment across various sectors, including agribusiness, food processing, and logistics, surpassed $10 billion. Notable projects include:

- The New Hope Group's $89 million feed factory in Poland, seen as a strategic entry into the EU's agricultural processing market.

- Joint ventures in agricultural machinery manufacturing in Hungary, where Chinese technology complements CEEC engineering expertise.

- Forestry and agri-processing agreements in Slovenia, aimed at producing value-added wood and food products for export to China (Guo, Qiu & He, 2021).

Vidnjevic and Kralj (2024) further suggest a novel investment model: the exchange of Chinese agricultural machinery for CEEC agricultural products via fixed-quantity repayment agreements. This framework, which aligns with China's push for stable trade flows and rural revitalization, would allow CEEC to modernize their agricultural sectors with Chinese technology while paying for the investment through secure long-term commodity delivery agreements.

Several CEEC countries, such as Serbia and Hungary, have deepened their trade and investment relationships with China. Serbia, for example, has signed visa-free agreements and hosted numerous high-level delegations. The Budapest–Belgrade railway and Huawei's European Supply Center further anchor Hungary's strategic cooperation with China. In the Adriatic region, Chinese investments have also targeted infrastructure and tourism, including spa resorts in Croatia's Krapinske Toplice and green tech ventures like the investment in Rimac Automobili.

Despite these growing linkages, Vidnjevic and Kralj (2024) caution that the current trade structure is still predominantly inter-industry and lacks deep intra-industry integration. Enhancing agricultural cooperation will require:

- Recalibrating product structures to maximize mutual comparative advantages.

- Expanding intra-industry trade, including co-development of agri-tech and food innovation.

- Supporting SME entry into bilateral trade through streamlined certification, branding assistance, and logistic upgrades.

While cooperation to date has largely emphasized trade and infrastructure, recent analyses underscore the potential for a deeper, more transformative agenda in agriculture and food systems. As Stanojević (2021) argues, the Southeast European (SEE) countries–which overlap with the CEEC region–face structural limitations that cannot be addressed solely through trade. These include fragmented landholdings, outdated technologies, and limited domestic resources for implementing advanced agricultural practices. In this context, China emerges not just as a trading partner, but as a potential driver of systemic modernization through the transfer of expertise, technology, and governance models. Stanojević (2021) identifies "Smart Agriculture" (SA) and "Resource and Ecologically Sound" (RES) agriculture as particularly promising domains

of cooperation. For example, SEE countries like Serbia and Croatia display agricultural productivity per hectare nearing EU levels (approximately $2000/ha in Serbia), but remain constrained by excessive reliance on nitrogen fertilizers and pesticides–Croatia, for instance, records a usage of 108 kg/ha–which degrade long-term soil quality. In this context, China's advancements in precision agriculture technologies–such as drones, sensors, and IoT platforms–could help SEE countries transition toward more sustainable and resilient models of food production.

Furthermore, Stanojević points out that China's concept of the Green Silk Road and the Belt and Road Science, Technology and Innovation Cooperation Action Plan (2016) explicitly promote climate-smart agriculture and integrated resource use. She highlights pilot initiatives like the Changsha-Zhuzhou-Xiangtan cluster in Hunan Province, which successfully implemented RES agriculture strategies that combine high-tech solutions with traditional farming practices. These models offer a valuable blueprint for SEE countries, whose agricultural systems also retain many traditional features. Crucially, as Stanojević emphasizes, future cooperation must move beyond symbolic demonstration projects and toward long-term, integrated initiatives that include education, institutional learning, and participatory governance. This means focusing on areas such as smart irrigation systems, organic farming transitions, and domestic capacities for seed innovation and IoT development. Although SEE countries possess relevant scientific and institutional foundations–particularly in Serbia, Romania, and North Macedonia–scalable and context-specific frameworks are still lacking. Therefore, the goal of China–SEE agricultural cooperation should not be limited to technology transfer, but should prioritize the co-development of holistic and locally grounded models of sustainable agriculture and food sovereignty.

Ultimately, the agricultural relationship between China and the CEEC region holds substantial untapped potential–not only in trade, but in long-term investment and systemic transformation. By advancing technological collaboration, co-developing context-sensitive models such as Smart and RES agriculture, and aligning investment mechanisms with sustainability goals, both sides can foster a more resilient, equitable, and forward-looking partnership.

6.2. Key Cooperation Mechanisms and Initiatives

Since the inception of the China–CEEC cooperation platform, multiple bilateral and multilateral initiatives have been launched to enhance collaboration in agriculture, food systems, and rural development. These efforts span from high-level ministerial meetings and research alliances to trade expos, investment platforms, and technical cooperation projects.

1. China-CEEC Agricultural Ministers' meetings & Agro-Trade Forum (16+1/17+1 Mechanism, since 2012)

- *Countries involved:* China and all 16 CEEC(Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, North Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia; joined by Greece in 2019)
- *Focus:* High-level policy dialogue on agriculture; strategic planning; agricultural trade and economic cooperation forums.

- *Key projects:* Launched in 2012–2015: First summit and Agriculture Ministers' Meeting held in 2015 in Sofia, Bulgaria (alongside the launch of the China-CEEC Association for Promoting Agricultural Cooperation). Regular Ministerial Forums: Annual/biannual meetings producing joint declarations (e.g. Kunming Declaration 2016 on agricultural cooperation); Agro-Trade and Economic Cooperation Forum: held alongside ministerial meetings – e.g. 2017 forum in Slovenia (Brdo) and 2018 in Lithuania to connect businesses and policymakers. These meetings set agendas for practical cooperation and endorse new projects.

2. Association for the Promotion of Agricultural Cooperation (APAC) (est. 2015)

- *Institutional Role & Core Activities*: Established in 2015 in Sofia under the 16+1 format, APACCCEEC fosters China–CEEC agrifood cooperation through project incubation, entrepreneurship support, and digital matchmaking tools. Its activities include the Agricultural Logistics Hub (Plovdiv, 2017), Demonstration Zone (2018), and Start-up Accelerator (2023).
- *Digital Platform & Trade Facilitation:* Operates a single-entry digital database for partner search, trade leads, and fair participation, linking over 150 companies across CEEC and China through national contact points.
- *Flagship Trade Event – China–CEEC Expo 2025:* Organizing a dedicated Pavilion in Ningbo (May 2025) offering CEEC food and cosmetics SMEs free exhibition space, logistics support, and exposure to major Chinese buyers under the patronage of high-level authorities.

3. "16+1" Agricultural cooperation demonstration zones

- *Countries involved:* China and interested CEEC (first implemented in Bulgaria).
- *Focus areas:* Agricultural technology transfer, demonstration of best practices, R&D collaboration, and training.
- *Flagship project:* The first China-CEEC Agricultural Demonstration Zone was officially launched in Plovdiv, Bulgaria in 2018 as a model farm-to-market project. It features demonstration farms, greenhouses and agri-tech showcases, allowing Chinese and CEEC experts to jointly develop and display new technologies. The zone serves as a hub for training farmers and students, and is a "comprehensive agricultural cycle" model from production to marketing. More demo zones in other CEEC and in China are being explored for mutual technology sharing

4. 16+1 Logistics hub and E-Commerce pavilion (Plovdiv)

- *Countries involved:* China and Bulgaria (serving all CEEC).
- *Focus areas:* Trade logistics, distribution and online sales of agri-food products; support for SMEs and young entrepreneurs.
- *Key initiatives:* Infrastructure: In November 2017, the first China-CEEC Logistics Hub & Pavilion for Agricultural Products opened in the Trakia Economic Zone in Plovdiv, Bulgaria. This facility acts as a regional warehouse and distribution center for CEEC agricultural and food exports to China, and includes an e-commerce platform to sell CEEC products online. It lowers barriers for small producers by providing consolidation, storage, and a digital marketplace. The hub is also used in training programs for young entrepreneurs from CEEC and China to conduct cross-border e-commerce in agricultural goods.

5. Trade Promotion Expos and Market Access Initiatives

- *Countries involved:* All CEEC and China.

- *Focus areas:* Boosting agricultural trade, consumer access to CEEC foods in China (and vice versa), trade fairs, and marketing.
- *Key initiatives and projects:* China-CEEC Expo (Ningbo): Annual expo launched in 2015 where CEEC showcase agricultural and specialty products; the first was held in Ningbo, June 2015. These expos (2015–present) include CEEC specialty food fairs and business matchmaking events. Fairs in CEEC: China has participated as partner country in regional fairs (e.g. Mostar Economic Fair in BiH, with a China-CEEC Agricultural Products & Wine Exhibition in 2017). Permanent Pavilions: Establishment of CEEC product pavilions in China's free-trade zones – e.g. a unified CEEC exhibition pavilion in the Shanghai Pilot FTZ for year-round display of food and agricultural goods. CEEC agri-food companies also regularly attend China's major import fairs (such as the China International Import Expo in Shanghai) to promote wine, dairy, meat, and other products, supported by the 17+1 framework.

6. Customs, inspection and quarantine cooperation ("Green channels")

- *Countries involved:* China and multiple CEEC (via both multilateral dialogue and bilateral agreements).
- *Focus areas:* Food safety standards, sanitary and phytosanitary (SPS) measures, customs clearance facilitation for agri-food trade.
- *Key initiatives and projects:* Dialogue Mechanism: Since 2016, China's customs agency and CEEC counterparts hold an annual China-CEEC Customs, Inspection & Quarantine Cooperation Dialogue (e.g. the 4th dialogue in Ningbo in 2019 and the 6th in 2023). These meetings focus on expediting safe imports through "green channels" – faster clearance for CEEC food products – and sharing regulatory best practices. Bilateral Agreements: China has signed numerous SPS cooperation accords – mutual customs assistance agreements (with Czech Republic, Slovakia, Hungary, Romania) and food safety cooperation frameworks (with Hungary, North Macedonia, Serbia) – to streamline inspections and recognize standards. In 2014, China also signed agreements on quality inspection with Hungary, Latvia, Serbia and Macedonia. These efforts have helped speed up market access approvals (e.g. implementing electronic certificates, and simplifying quarantine for perishable goods).

7. China-CEEC veterinary science cooperation center

- *Countries involved:* China and Bosnia & Herzegovina (center open to all CEEC).
- *Focus areas:* Animal health, veterinary research, and disease control to protect food supply (meat/milk safety).
- *New Institution:* A China-CEEC Veterinary Research Center was officially opened in Sarajevo, BiH in December 2018. This center facilitates joint research on animal diseases (such as swine fever or avian flu), veterinary public health, and training of veterinarians from CEEC in collaboration with Chinese experts. It emerged from 16+1 cooperation plans and serves as a regional hub to improve animal health standards and food safety, ensuring that CEEC meat and dairy products meet import requirements for the Chinese market.

8. Joint Agricultural R&D and Technology Partnerships

- *Countries involved:* China and various CEEC (notably scientific institutions in e.g. Romania, Lithuania, etc.).
- *Focus areas:* Collaborative research, innovation in farming technology, crop science, sustainable agriculture techniques.
- *Key initiatives:* Joint laboratories: The Chinese Academy of Agricultural Sciences (CAAS) has teamed up with CEEC research institutes to establish joint labs – for example, the China–

Romania Joint Laboratory for Cooperation in Agriculture, inaugurated in 2024 at UASVM Bucharest. Supported by China's Ministry of Science and Technology, this lab focuses on greenhouse vegetable cultivation, smart farming and green development. Outcomes: Since 2019, the China-Romania lab initiative has built high-tech pilot projects (a plant factory with artificial lighting, an energy-saving multi-layer greenhouse, and an edible fungus production facility) to showcase modern agri-technologies. Similar collaborations are encouraged across the region – e.g. joint research programs, academic exchanges, and pilot projects on sustainable farming and agri-innovation between CAAS and institutes in various CEEC.

9. "Year of Agricultural Diversity Cooperation" (2020)

- *Countries involved:* China and all 17 CEEC (including EU members and Western Balkans).
- *Focus areas:* Sustainable agriculture, biodiversity, and rural development.
- Special Theme Year: At the 2019 Dubrovnik Summit, participants designated 2020 as the China-CEEC Year of Agricultural Diversity Cooperation
- The aim was to deepen cooperation in sustainable agriculture and preservation of agrobiodiversity. Planned activities included academic seminars, joint research on crop diversity, training programs on sustainable farming practices, and dedicated exhibitions and forums highlighting organic and environmentally friendly agriculture
- Although global events in 2020 disrupted some plans, this initiative underscored a mutual commitment to green and inclusive agriculture, aligning with the UN Agenda 2030 goals.

10. Bilateral agricultural agreements & investments (selected examples)

- *Countries involved:* China with individual CEEC (notably Serbia, Hungary, Poland, etc.)
- *Focus areas:* Agricultural trade expansion, agribusiness investment, food processing, and market access for specific products.
- *Key initiatives and projects:* China–Serbia: In January 2017, China and Serbia signed an MoU on agricultural cooperation, pledging Chinese investment in Serbian agribusiness (especially meat, fruit and vegetable processing) and opening China's market to safe, quality Serbian products; China–Hungary: In 2016, agreements were signed to lift import bans and expand Hungarian exports – China removed a bird flu embargo on Hungarian poultry (duck, goose) and progressed on allowing Hungarian turkey, chicken, pork and dairy exports; Both sides also agreed to cooperate on food safety standards to facilitate these trades, given Hungary's strict EU-standard safety regime; China–Poland: A Comprehensive Strategic Partnership Action Plan 2024–2027 includes commitments to fast-track Polish agri-food exports – e.g. enabling Polish poultry, blueberries, dairy, and other products to enter China's market once health protocols (like avian influenza zoning agreements) are finalized
- These bilateral deals, often concluded alongside 16+1 summits, have led to tangible growth in agri-trade and new joint ventures (for instance, Chinese firms investing in food processing facilities and logistics centers in CEEC).

6.2.1 Alliance for Agricultural Science and Education

Launched in October 2024, the China–CEEC Modern Agricultural Science and Education Innovation Alliance represents a significant institutional development in agri-tech and education cooperation between China and CEEC. Initiated by Shandong Agricultural University during the Sixth China–CEEC Local Leaders' Meeting in Yantai, the Alliance brings together 64 universities, research institutes, and agricultural enterprises from across China and the CEEC region to foster

innovation and sustainable development in agriculture. The Alliance aims to consolidate and leverage comparative advantages in agricultural knowledge, technology, talent, and enterprise capacity between the two regions. It explicitly supports China's broader diplomatic and economic engagement strategy with CEEC and aligns with Xi Jinping's vision for international cooperation in modern agriculture. According to its founding charter, the Alliance seeks to provide a permanent cooperation platform for educational and scientific institutions and enterprises to jointly address agricultural challenges through talent training, technological cooperation, and trade promotion.

Key areas of cooperation include:

- Climate-resilient agriculture and smart farming systems
- Soil health, biodiversity, and crop diversification
- Modern equipment application and digital agriculture
- Sustainable livestock and poultry practices
- Food loss reduction and nutritional innovation

To ensure cross-border collaboration, the Alliance is headquartered in Tai'an, China, and operates liaison offices in several CEEC capitals, including Bulgaria, Greece, Slovenia, and Hungary, facilitating daily coordination and adaptation of Chinese agri-technologies to local CEEC conditions. The Alliance's organizational structure includes a General Assembly of Members, a Council of founding members, and a Secretariat, which handles operational management. The President of Shandong Agricultural University serves as the Secretary-General. Founding CEEC member institutions include the Agricultural University of Athens, Poznan University of Life Sciences, Slovak University of Agriculture in Nitra, and the University of Novi Sad, among others. The Alliance supports a broad agenda of scientific research and policy engagement. It promotes the creation of joint research centers, technology transfer hubs, and international laboratories, focusing on both foundational agricultural science and applied innovations. Furthermore, it seeks to build a CEEC-China agricultural think tank and to participate in the formulation of international standards, thereby elevating the global influence of CEEC-China cooperation in agriculture. Crucially, the Alliance also incorporates human and cultural exchange, offering a platform for student and faculty mobility, joint educational programs, and public diplomacy through cultural and sporting events, thereby enhancing mutual understanding and social integration alongside scientific collaboration.

The China–CEEC Modern Agricultural Science and Education Innovation Alliance represents a strategic institutional vehicle for agricultural modernization, talent mobility, and technological diffusion. It signals China's ambition to move beyond infrastructure diplomacy toward knowledge-intensive cooperation, and it offers CEEC countries access to technological resources and alternative development pathways in the agricultural domain.

6.2.2 Talent mobility and joint research

More than 10,000 students and researchers have participated in bilateral programs since 2012. Joint degree programs in agronomy, biotechnology, and rural development have been initiated between Chinese and CEEC universities, with a strong emphasis on field-based collaboration.

These efforts are also supported by Confucius Institutes, digital platforms, and dedicated China-CEEC research funding calls.

6.2.3. Sustainable development and the SDG agenda

China-CEEC agricultural cooperation is increasingly aligned with the SDGs, particularly:

- SDG 2: Zero Hunger
- SDG 9: Innovation and Infrastructure
- SDG 13: Climate Action

According to Wang (2024), the China-CEEC platform serves as a case study in transregional cooperation for SDG localization. Flagship examples include:

- Demonstration zones using solar-powered irrigation systems
- Agricultural waste valorization projects
- Smart monitoring tools for food loss and waste

The cooperation increasingly mirrors the EU's Farm to Fork strategy, creating new synergies for CEEC embedded in EU policy structures.

6.2.4. Challenges and strategic recommendations

Despite momentum, cooperation remains vulnerable to structural and political pressures:

Challenges:

- Fragmented governance and weak coordination across CEEC
- Lack of unified branding and export promotion in China
- Rising geopolitical tension between the EU and China
- Limited digitalization and data sharing on food system cooperation

Strategic recommendations:

1. **Standard harmonization**: Launch joint committees for food safety certification and labeling alignment.
2. **Green innovation zones**: Expand agri-tech demonstration sites in CEEC rural regions.
3. **Digital integration**: Develop a multilingual agri-trade platform linked to the Belt and Road data network.
4. **People-to-People diplomacy**: Promote culinary and agri-cultural exchange programs.

5. **Monitoring and evaluation**: Institutionalize SDG-aligned reporting tools for transparency and impact assessment.

7. Mapping Perceptions and Priorities: Stakeholder Insights

This research investigates the strengths and weaknesses of Chinese and European food systems, with a focus on cooperation opportunities between China, the EU, and the CEEC region. To assess perceptions of food system cooperation, we engaged with 30 stakeholders from across China, the EU, and the CEEC region through interviews and surveys. This section presents a synthesis of their insights. While the sample includes researchers, institutional experts, and policy professionals, it does not cover farmers, NGO practitioners, or agribusiness representatives. Future research could benefit from greater inclusion of grassroots actors and operational stakeholders, as well as more representatives from CEEC and China. The study employed a mixed-methods approach, including both qualitative interviews and structured surveys, targeting academic and professional experts in agri-food systems, sustainability, and innovation. To gather diverse and cross-regional perspectives, we approached over 300 food systems researchers based in Europe, including those affiliated with universities, research institutes, and policy think tanks that have been part of *EU–China Agriculture Research Projects within the FAB Flagship initiative*. Additionally, members of the newly formed China-CEEC Modern Agricultural Science and Education Innovation Alliance were contacted to facilitate access to Chinese scholars and expand the geographic reach of the inquiry. Respondents were offered the choice between semi-structured interviews and surveys. As a result:

- 10 semi-structured interviews were conducted with EU stakeholders, including experts from France, Belgium, Germany, Austria, Croatia, and Greece.
- 20 survey responses were obtained from a geographically diverse set of scholars working in China, the EU, and the CEEC region.

7.1. Analytical approach

Interview transcripts and survey responses were analyzed thematically to identify major concerns, aspirations, and insights regarding cooperation potential and the operational features of respective food systems. Particular attention was given to:

- Perceived strengths and weaknesses of national/regional food systems
- Real and potential cooperation initiatives
- Structural barriers to collaboration
- Reflections on innovation, resilience, sustainability, and sovereignty

The following sections synthesize the key findings from this material, supplemented by quotes and insights from both interviews and survey responses.

7.2 Survey Insights

A total of 20 survey responses were collected from participants based in China and various CEEC, including N. Macedonia, Croatia, Serbia, Montenegro, Slovakia, Hungary, Romania, Bosnia and Herzegovina, and the Czech Republic. Respondents from China were primarily affiliated with universities that are part of the China-CEEC Modern Agricultural Science and Education Innovation Alliance, while the CEEC respondents represented a diverse range of institutions such as universities, research institutes, agricultural development agencies, and public policy organizations involved in food systems and rural development.

7.2.1 Perceived strengths of the food system

Chinese respondents emphasized the following as key strengths of the Chinese food system:

- Stable and sufficient supply of agricultural products, particularly grains such as rice, wheat, and corn.
- Advances in agricultural technology and innovation
- Resilient supply chain infrastructure
- A strong food reserve network
- Effective government intervention
- Success in eradicating extreme hunger and improving nutrition levels

CEEC respondents highlighted a different yet complementary set of strengths:

- Rich agro-biodiversity and traditional practices, often rooted in local and ecological farming methods
- Strong informal and local food systems, including food self-provisioning, foraging, and communal sharing
- High quality of local food products
- Growing rural entrepreneurship and agritourism, fostering innovation and community-based development.
- Small-scale production and innovation, with many respondents emphasizing the agility and adaptability of small farms.
- Active collaboration between academia and the private sector, particularly in pilot initiatives and regional innovation projects.
- Strong socio-cultural values tied to food, which reinforce traditional dietary habits and community resilience.

7.2.2. Perceived weaknesses of the food system

Chinese respondents acknowledged several persistent challenges within their national food system. One key concern was continued dependence on foreign imports for certain strategic commodities, especially soybeans, which poses a risk to long-term food security and trade resilience. Additionally, respondents highlighted structural issues such as the prevalence of smallholder farms, which often face constraints related to an aging rural workforce, rising

production costs, and low profitability, making farming less attractive to younger generations. Another critical weakness identified was the underdevelopment of the food processing sector, which limits the value-added potential of agricultural products and constrains China's ability to compete in higher-end food markets.

CEEC respondents identified several interrelated challenges facing their regional food systems. A prominent concern was the fragmentation of farmland, with many small and scattered farms struggling to achieve economies of scale, market access, and long-term viability. This structural limitation is compounded by an aging farming population, with few incentives for younger generations to remain in or enter the agricultural sector. In non-EU countries, respondents pointed to the limited capacity for organic production and certification, which hampers access to premium markets and weakens sustainability credentials. Another frequently cited issue was the high dependence on food imports, which undermines local production and food sovereignty. Respondents also criticized the lack of consistent government and institutional support, particularly in terms of protecting primary agricultural producers and organizing systematic buy-off schemes or guaranteed purchase mechanisms. Additionally, food waste and quality control deficiencies were mentioned as ongoing problems, highlighting the need for better regulation, infrastructure, and consumer awareness.

7.2.3. Lessons China Could Learn from European Food Systems

When asked about valuable lessons or practices that China could adopt from European food systems, both Chinese and CEEC respondents highlighted a shared emphasis on technological and sustainability-oriented innovations. From the Chinese perspective, several respondents pointed to the advanced food processing technologies in Europe as particularly valuable, emphasizing multi-purpose food processing and rigorous food safety control systems.

CEEC respondents emphasized the importance of efficient technologies, modernization, and digitalization across the entire food value chain–from production to processing and distribution. In addition, they suggested that China could benefit from adopting social innovations, such as community-supported agriculture models, and circular economy practices aimed at minimizing waste and maximizing resource use.

7.2.4. Lessons Europe could learn from China’s food system

When asked what European food systems could learn from China, most Chinese respondents expressed uncertainty, noting limited familiarity with the specific needs, structures, or challenges of European agri-food systems. However, even with this caveat, some noted China’s experience in scaling agricultural innovation rapidly across diverse geographies and farm types as a possible area of inspiration, especially for countries facing challenges in modernizing smallholder farming.

CEEC respondents pointed to a number of innovative practices that Europe could explore further, particularly in areas where China has demonstrated strong capacity or potential. One respondent mentioned fertilizer policy reforms in China as a noteworthy example of how strategic regulation can improve efficiency and sustainability in agricultural inputs. Others highlighted China’s use of

traditional raw materials, such as herbs and Eastern food products, as well as innovations in dairy processing and conductorial (possibly meaning fermentation or sensory-related) techniques as valuable areas of inspiration. Although some CEEC participants admitted limited direct knowledge of the Chinese food system, there was a general perception that China is advancing in vertical farming technologies and overall efficiency improvements–both of which were seen as promising for adaptation in European contexts focused on climate resilience and resource optimization.

7.2.5 Awareness and aspirations for China–Europe cooperation in food systems

When asked about existing cooperation mechanisms or case studies between China and Europe in the food systems domain, most respondents–both from China and the CEEC region–were not aware of specific initiatives. Despite the general lack of concrete examples, participants emphasized the importance of strengthening cooperation platforms, particularly in the areas of agriculture, trade, the digital economy, green industries, and clean energy. These were seen as essential cross-cutting domains with high relevance for future agri-food collaboration, though respondents noted the need for more structured information-sharing and visibility of ongoing or past efforts.

Looking to the future, respondents were more confident in identifying priority areas for cooperation. From the Chinese perspective, several participants pointed to food processing innovation as a key area–especially in light of the climate challenges facing agricultural systems globally. They highlighted the potential for Europe and China to collaborate on resilient, value-added, and low-emission processing technologies.

CEEC respondents outlined a broader set of ambitions. Many emphasized the importance of joint agricultural innovation aimed at producing high-quality, competitive products, and called for deeper academic exchange and labor mobility programs to share technical expertise and operational know-how. Some also saw value in integrating EU technologies with Chinese expertise–particularly in the use of herbs, functional ingredients, and Eastern dietary culture. Others stressed the need for more exchange on sustainable production techniques, food safety, and strategies to protect national agricultural sectors, all of which could benefit from structured, mutually respectful collaboration. Together, these responses reflect a strong interest in enhancing food system cooperation, even if current awareness of mechanisms remains low.

7.3 Insights from interviews

To complement the survey data and gain deeper qualitative insights into perceptions of China–Europe cooperation in food systems, we conducted 10 semi-structured interviews between April and May 2025. The interviewees were primarily EU-based stakeholders, including researchers, policymakers, and institutional experts from France, Germany, Austria, Croatia, Slovenia, Slovakia and Greece. These interviews were designed to explore not only technical knowledge and policy insights but also broader reflections on cooperation potential, systemic challenges, and regional dynamics in agri-food innovation.

Despite proactive outreach to over 300 scholars and professionals across Europe and China, response rates for interviews remained low. This limited engagement may reflect a number of underlying factors: a general lack of awareness about existing China–Europe cooperation frameworks in the food system domain, institutional or individual disinterest, or even hesitancy stemming from geopolitical tensions, ideological bias, or sensitivities around international alignment. Nonetheless, the perspectives shared in these ten interviews provide valuable depth to the broader dataset. They highlight not only structural and policy-related challenges, but also areas of alignment, missed opportunities, and future pathways for meaningful China–Europe engagement in sustainable food system transformation. Several themes–such as rural revitalization, the potential of small-scale farming, and calls for more structured cooperation–echo those raised in the survey responses, reinforcing their salience across different stakeholder types and regions.

7.3.1 Perceived strengths and weaknesses of the European food system

Across the interviews, experts voiced a wide range of views on the European food system, revealing both deep appreciation for its strengths and sharp critiques of its systemic flaws. There was general consensus that Europe possesses a rich, diverse, and highly capable food system–yet one increasingly undermined by its reliance on industrial models, lobbying pressures, and unsustainable dependencies. One of the most frequently cited strengths was Europe's agricultural diversity and cultural richness. As a French expert put it, "Europe's diversity in cuisine remains one of its greatest assets." This sentiment was echoed by a Croatian researcher, who described the EU as "the biggest food producer globally, the biggest exporter," highlighting its capacity to produce "everything these days," including organic products, high-end delicacies, and globally recognized brands. The EU's investment in knowledge, research, and innovation - particularly in areas like digital agriculture - was also underscored as a strong point.

Another researcher based in France praised Europe's capacity to mobilize resources and coordinate policy, referencing the CAP as a structural advantage. They saw Europe as uniquely equipped to implement continent-wide solidarity mechanisms and "radically redirect" the system if political will were present. However, this same expert lamented that current CAP allocations are skewed in favor of large, export-oriented farms, with little support for resilience or autonomy. "The system favors scale over sustainability," they noted, adding that "the narrative that 'farmers feed France' is false", as most of the food system is now run by salaried labor for large firms, rather than family farms.

The role of lobbying and corporate influence was a recurring critique. Several experts raised concerns about how industrial and agricultural lobbies, particularly in countries like France, resist reform and block environmental progress. A French interviewee called this situation "absurd," saying:

> "We are being completely bamboozled about the mutation of the agricultural system by drawing attention to the distress of farmers, which is real... And at the same time, we must change the discourse and say: well, we must do completely differently from

> what you do very well so far, namely agro-industry. We must get out of it because it's a dead end."

The imperial legacy of Europe's food system was highlighted by a Belgian academic, drawing on Ulrich Brandt's concept of *the imperial mode of living*. Europe, they argued, has constructed a food system highly dependent on external resources, particularly from the Global South–"externalising all the negative and pulling benefits from the South"–which they deemed the biggest weakness of the EU's agri-food structure.

This theme of unsustainable dependency reappeared in the reflections of a German academic, who focused on the fragility of long and overstretched supply chains. "We've stretched them so far, they are insecure," they warned, referencing everything from avocados flown in from Peru to asparagus cultivation shifting due to climate change. The expert emphasized the need to "convince people–especially in wealthier areas–to adapt their dietary behaviors," shifting demand and shortening supply chains to increase resilience. They also noted the erosion of traditional farming knowledge due to demographic change and emigration:

> "There aren't experienced farmers anymore; farming knowledge is lost. Heritage seeds are disappearing... It's not enough to just have seed banks if we're not using them."

This erosion was tied to broader sustainability concerns–from the dominance of corporate seed and fertilizer producers (e.g., Monsanto) to issues around soil degradation, methane emissions from food waste, and the food–energy–water nexus. One expert pointed to the paradox of food waste and food insecurity, explaining that much food "never even makes it into stomachs," a systemic failure linked to inefficient logistics, value chain priorities, and consumer culture.

Some experts advocated for a more regionalized, democratic food system, warning of the politicization of food security. The notion of "weaponized food" was brought up in relation to global supply shocks and geopolitical tensions. Initiatives such as Via Campesina were referenced as successful counterpoints, representing grassroots efforts to push EU institutions toward more inclusive and democratic models of food governance.

Meanwhile, a perspective from an expert in emerging economies described Europe's food system as "extremely rich, sophisticated, and overabundant," capable of feeding itself without relying primarily on exports. Yet this abundance was increasingly directed toward low-quality, sugar-laden foods, shaped more by industry preferences than public health goals:

> "Its weakness is that it is more and more bad quality food. That's it… very, very oriented by the food lobby to make sugary products that are appealing to taste. Well, in both cases, we are no longer in food systems..."

While Europe's food system is widely recognized for its diversity, and policy mechanisms, it is equally criticized for entrenched industrial interests, unsustainable dependencies, eroding farmer autonomy, and the growing gap between rhetoric and reality in agri-food governance. The interviews point to a strong appetite for food system transformation - especially through

regionalization, deglobalization, and stronger environmental commitments - but also reveal the many vested interests and cultural habits that stand in the way.

7.3.2 Perceived strengths and weakness of the Chinese food system

From the perspective of European interviewees there was a mix of admiration and critique when discussing the Chinese food system, often emphasizing its sheer scale, state-driven efficiency, and cultural depth, while also raising concerns around environmental degradation, overproduction, and diet quality. Perspectives ranged from policy-focused to cultural and ecological, revealing the multilayered nature of China's agri-food landscape.

A frequently cited strength was China's ability to feed its massive population, a feat regarded by several interviewees as one of the country's most significant achievements. A Greek academic working in China framed this succinctly:

> "The great success of China is solving the problem of feeding the population–so many people, and no food problem anymore."

This achievement, according to the same expert, hinges on China's logistical and infrastructural success:

> "They have managed to supply big cities with fresh food, every day, and any kind of food, in every corner of China... Considering the size of China, this is a major development."

Beyond infrastructure, China's investment in technological advancement was widely acknowledged. A Croatian researcher pointed to its leadership in digital agriculture, AI, drones, and precision farming, noting significant public and private spending in these areas. This sentiment was echoed by a French researcher, who emphasized the strategic advantage of centralized governance in mobilizing resources and enacting long-term policies. They highlighted the systematic grain stocking policy as a particular point of strength, which enhances resilience in times of supply disruptions or climate shocks. A Croatian expert pointed to the efficiency of new technology for farmers, in a place and time where small scale farming business are constrained by new policies, more expensive assurances, unpredictable weather that can damage an entire harvest. He pointed to China's ability to boost rural entrepreneurship through affordable new technologies such as drones:

> "I know an example, here in Croatia of a small scale farm that invested in Chinese drones, to asset damage after bad weather. Before that the farms would have to hire a lot of people, for imperfect results, as these are not trained people and the farmer cannot pay them to go through the entire field. In a time where people are leaving the countryside, expertise being lost, young people not replacing old generations, policies pushing people in urban areas or outside the country, assurance not willing to pay in this age of climate change. All of these create a vicious circle of rural life dying. China has solved a lot of these problems, if only by having access to cheap

> yet very performant technologies that make farming more attractive, less labor intensive and more predictable… ”

A global food systems expert noted China’s strong culinary identity and cultural power, describing the country’s food system as one deeply rooted in domestic cooking traditions and guided by principles drawn from traditional medicine.

> “The Chinese culinary tradition involves sharing small dishes and selecting food based on its health effects. This concept is alien to Western dining,” they observed, adding that such cultural embeddedness may also contribute to the system’s resilience.

However, many respondents also pointed to critical weaknesses. The same expert noted that China’s food system is often difficult for outsiders to fully understand, due to its embedded cultural codes and practices. This inaccessibility poses challenges for cooperation and mutual learning. One of the interviewees pointed to environmental degradation as a major concern:

> “Soil impoverishment, biodiversity loss–these are direct outcomes of intensive agro-industrial policies,” they argued. The dependence on imported agricultural inputs, such as natural gas, phosphate, and potash, was seen as another vulnerability. Slowing yields and worsening soil erosion - compounded by climate change - could undermine China’s long-term food security, despite its current strengths.

From an emerging economies perspective, an expert who had traveled extensively across China was struck by the impressive agricultural transformation they witnessed firsthand:

> “Every time I travel through China, I see this transformation of the agricultural system... sails, nets to protect against predators, very high-yield varieties.” Yet they also cautioned that this transformation has bred an “obsession with overproduction”, often at the expense of quality and sustainability.

That view tied closely with criticism of dietary shifts in contemporary China. The same expert noted bluntly:

> “We eat very badly and we eat too much... It is a very quantitative food system. Very quantitative.” This trend, they suggested, reflects a shift from traditional dietary principles toward volume-based, low-nutrient consumption, shaped by rapid urbanization and global market pressures.

Several interviewees also commented on China’s ongoing technological challenges, especially in dairy and beef sectors. The Greek academic remarked that China still lags behind Europe in cheese and yogurt production, and that beef quality remains relatively poor, though improvements are underway.

Concerns about farm structure and land use were also raised. One expert noted that the small size of Chinese farms remains a major obstacle to modernization. Despite advances in

infrastructure and logistics, the fragmented nature of rural landholdings complicates efforts to scale up sustainable practices or implement mechanized solutions. Finally, the interviews pointed to the tension between modernization and ecological balance. While China's central planning facilitates rapid transformation, the environmental costs, cultural shifts, and dependency on global inputs suggest that the system is still in transition - rich in capacity but vulnerable to both internal contradictions and external shocks.

7.3.3 Perception on common challenges

When asked about shared challenges facing both the European and Chinese food systems, interviewees repeatedly returned to a core theme: the ecological fragility of industrial agriculture, especially in relation to soil degradation, environmental stress, and systemic overdependence on non-renewable inputs.

A French scientific journalist emphasized the undervalued importance of soil fertility, calling it “a critical but overlooked foundation of any food system.” Reflecting on its vulnerability, they offered a poignant observation:

> “We don’t realize the value of fertile soil. It’s something I learned. How long does it take to get that fertile land? ... And how long does it take for one rain to leach it?”

This remark underscores a wider concern: that both China and Europe have pursued agro-industrial intensification to such a degree that their soils have become dependent on chemical inputs, losing their regenerative capacities. This shared dependency, the journalist noted, poses a long-term threat to food security, especially in the face of climate volatility and diminishing land resilience.

The theme of environmental degradation- including soil erosion, biodiversity loss, and pollution - was echoed by other interviewees as a common systemic weakness. In both regions, interviewees criticized the way large-scale farming practices have depleted natural ecosystems in the pursuit of yield maximization. One expert remarked that industrial agriculture in both China and Europe has made “ecosystems perform like machines–productive, yes, but fragile and dependent.” This fragility, they warned, also manifests in the need for continuous external inputs such as synthetic fertilizers, pesticides, and imported animal feed.

7.3.4 Perceptions on what Europe and China could learn from each other

Several interviewees emphasized the untapped potential for mutual learning. A Croatian researcher with expertise in China–EU food cooperation underlined the importance of reviving post-pandemic links as a prerequisite for meaningful exchange. Referring to earlier cooperation frameworks such as the “16+1” initiative, they noted that institutional and supply chain connections have weakened significantly since COVID-19:

> “Now after COVID and things like that, I somehow... I don't have enough information about what is going on in China. Those links are not as strong as they

were before." Rebuilding this foundation is, in their view, a "key challenge" and a necessary first step to reinitiating knowledge flows, academic cooperation, and joint pilot programs.

From a content perspective, the interviewee identified sustainability as a core area for reciprocal learning. While both Europe and China publicly prioritize sustainability, they noted that in both regions it remains more "thought than action." There is considerable room, they argued, for joint development of new business models for sustainable agriculture, including co-designed typologies of low-carbon practices and collaborative field trials that reflect both European and Chinese farming realities.

One critical gap, they added, is the lack of a common operational definition of what "sustainable" or "resilient" farming looks like in practice. Addressing this through shared indicators and adaptable toolkits would allow researchers and farmers on both sides to better apply climate-adaptive and low-input practices–especially in the face of increasing climate shocks, epidemics, and supply chain disruptions.

This view was echoed by other interviewees, particularly in relation to technological innovation, where several experts suggested that Europe has much to learn from China. An academic from the University of Graz in Austria emphasized that technology is one of the main drivers of EU interest in collaboration with China. From AI-powered monitoring systems to drone-based field surveillance and precision agriculture platforms, China's rapid scaling of digital agriculture tools is seen as a potential model for innovation and adaptation in Europe. A European academic currently working at Shandong Agricultural University in China similarly praised China's infrastructure and logistical achievements, pointing to its ability to deliver fresh food daily to cities across a vast territory. While acknowledging areas where Chinese production still lags–such as dairy diversity and beef quality–they highlighted how the Chinese system's strength lies in its organizational capacity and speed of technological deployment. This, they argued, could serve as a learning point for Europe, where food systems are often slower to adopt emerging technologies due to fragmented governance or bureaucratic inertia.

7.3.6 Perceptions on existing or potential cooperation on food systems between Europe and China

Interviewees presented a wide spectrum of views on the current state and future potential of cooperation between China and Europe in the agri-food domain. While some highlighted examples of active collaboration - especially in technology, research, and high-level dialogue - others stressed the limited scale, underutilized potential, or even near absence of structured cooperation in this area. Despite political and systemic differences, most agreed that mutual interests exist, and that both regions could benefit from closer engagement, provided that trust, transparency, and institutional alignment are improved.

A Croatian researcher, reflecting on regional dynamics, rated current cooperation between China and Europe as moderately high, assigning it a four out of five. They pointed to recent examples of strong engagement, including ministerial participation from Serbia and Hungary in conferences

held in China, as evidence that cooperation between China and the CEEC countries, especially the Western Balkans, remains active. However, for specific countries like Croatia, the level of cooperation was perceived to be lower, around three out of five:

> “I would say here maybe four…current level of cooperation between China and Europe is somewhere about four… with Croatia, maybe three.”

This perception contrasts sharply with the view of a French expert on food systems who suggested that China–Europe food market integration has already reached its peak. Positioning current collaboration at "level three" on a scale of one to five, they argued that further integration is unlikely:

> “I have the impression that the integration of food markets has reached a peak and will never go further. It will probably have to decrease.”

Similarly, a researcher based in Belgium emphasized that while cooperation exists, it may not need to be deepened for structural resilience. Instead, they envisioned punctual cooperation during climate disruptions, where grain surpluses in China could stabilize shortages in Europe, or vice versa. They were skeptical of long-distance trade as a sustainable strategy, but saw value in temporary food system alignment in response to global shocks:

> “We can very well imagine moments where extreme climatic events jeopardize the supply of such or such a zone of the world and where we are obliged to temporarily strengthen partnerships...”

In contrast, the Croatian interviewee was more optimistic about the untapped potential for broader cooperation. They emphasized that nearly every area of food production is of interest to China, from luxury products like wine, cheese, and salami to bulk commodities like grains and meat:

> “In China they want everything and they are ready to pay… almost every area of food production is interesting.”

This researcher, along with others, also stressed the potential for cooperation beyond trade–in research, policy innovation, and joint sustainability initiatives. From their perspective, there is clear potential to co-develop new business models for sustainable farming:

> “Definitely I see the potential for cooperation in every sense–business, trade, research, policy…”

Technology emerged as a prominent area of interest, especially from the European side. An Austrian academic mentioned difficulties in finding Chinese partners for a Horizon Europe project that mandated China–EU collaboration, only succeeding through personal networks. Yet, several interviewees saw China’s strength in agri-tech–particularly AI, greenhouse automation, and precision farming tools–as a major pull factor. A Greek academic working in China cited an ongoing Greece–China cooperation project focused on AI-controlled greenhouses, funded by provincial and national grants, as a successful example. As a member of the China-CEEC

Agricultural Science Alliance he expressed plans to build a common database, sensor-based support tools, and knowledge-sharing platforms to advise growers in real time on pest protection and resource optimization.

Beyond technology, interviewees called for more symmetrical and culturally sensitive approaches to cooperation. A global food systems expert emphasized that working with China successfully requires starting from a position of curiosity and humility:

> "You must not tell them what they have to learn from us, but what we have to learn from them."

This echoed a broader theme among respondents: the idea that cooperation should not be reduced to economic exchange or market access, but rather framed as mutual inspiration and policy learning. The French journalist underlined this point:

> "When I say cooperation, it's not necessarily direct exchange… we can talk about cooperation to inspire each other in our policies."

Cooperation on sustainability and agroecology was also frequently mentioned, especially in moving away from fossil fuel-dependent systems. The same journalist pointed to the ecological necessity of breaking with agro-industrial models:

> "For one food calorie, we consume 10 calories of hydrocarbons. This is something we cannot continue." They called for a deeper exchange on resilient practices, such as agroforestry and edible forests, and for redirecting subsidies toward labor-intensive, small-scale sustainable farming–though they admitted these ideas often run counter to entrenched economic interests.

Not all interviewees were as hopeful. One expert working on emerging economies, including China and India, offered a more critical perspective, stating plainly:

> "I know nothing about it. I am not aware of anything at all… there is very, very little cooperation between China and Europe. Very, very little in all areas."
> They acknowledged the huge, unrealized potential for collaboration–especially on climate, energy, and food–but lamented the lack of institutional frameworks and the rising animosity between the regions that obstruct meaningful progress.

Finally, an Austrian academic highlighted China's cooperative agricultural traditions–with hundreds of democratically structured communal villages still in operation–as an alternative food network that is yet to be explored, suggesting that shared research on ethical and community-based production could open new avenues for cooperation, particularly in the environmental domain.

Overall, interviewees perceived China–Europe cooperation on food systems as a patchwork of promising examples, latent potential, and structural gaps. While trade continues to play a role, the future of cooperation is more likely to rest on shared learning, technology exchange, and joint

responses to climate and food security challenges–provided geopolitical tensions don't overwhelm the willingness to collaborate.

7.3.7 Perceptions on obstacles of cooperation on food systems between Europe and China

While most interviewees recognized the potential for greater collaboration between China and Europe in food systems, their reflections on current barriers reveal a complex and multilayered web of obstacles. The interviews collectively highlight how geopolitical tensions, regulatory misalignments, and cultural misunderstandings are currently inhibiting more meaningful cooperation.

An interviewee based in France offered a macro-level critique, pointing not only to institutional friction but to planetary boundaries themselves as a fundamental constraint. They argued that export-oriented agriculture, which characterizes much of the China–Europe food trade, is inherently unsustainable.

> "If your object is sustainable agriculture, export agriculture is not sustainable agriculture. Agriculture dedicated to export is extractivist agriculture." In this view, environmental degradation, economic rivalry, and geopolitical tensions all converge as long-term barriers to deeper cooperation.

From a more practical and regional perspective, a Croatian researcher highlighted several business-related challenges, particularly for smaller European countries like Croatia. Production scale and capacity were identified as immediate obstacles to exporting to China:

> "For Croatian companies it's difficult to provide enough quantities to satisfy the huge demand in China." They also cited regulatory mismatches, including discrepancies in sanitary and animal safety regulations, which may deter businesses from engaging fully in China. "Regulation and animal safety... those sanitary regulations seem to be not well balanced."

On the research side, the same Croatian interviewee noted the difficulty of finding Chinese partners for scientific collaboration, especially in urbanized regions where agriculture is no longer a key focus:

> "I had difficulties finding partners to cooperate in China in the scientific or research area in regards to food systems."

Another perspective was presented by a Belgian expert, who described politics as the overriding obstacle to cooperation. The designation of China as a "systemic rival" by the EU and China's growing sense of isolation, they argued, have eroded the spirit of cooperation:

> "There is no desire for cooperation. When Europe declares China its systemic rival, and the Chinese feel besieged, how can there be trust?"

This expert also detailed a steady deterioration in cooperation.

> “It has deteriorated year after year… Before, I was regularly invited to conferences. That is over.”

Another major theme was the negative perception of China in Europe, highlighted by one of the interviewees. They argued that insufficient and distorted knowledge of China’s political system, rather than the quality of its food system, often overshadow its culinary and agricultural achievements in the European public imagination:

> “This perception hinders acceptance, even though the nutritional quality of Chinese food is excellent.”

The same expert suggested that even in areas where mutual benefit is evident–such as culinary exchange or sustainable agriculture–the symbolic meaning of “China” in Europe can block engagement. Despite these challenges, many interviewees still emphasized the importance of finding new channels for engagement. But for now, these obstacles constitute a substantial barrier to cooperation that must be acknowledged and addressed if future collaboration is to be meaningful and effective.

7.3.8 Perceptions on urbanization, rural revitalization, and labor

Interviewees highlighted urbanization and rural depopulation as shared challenges for both China and Europe, particularly in their effects on labor availability, food heritage, and agricultural sustainability. A scientific journalist based in France argued that shifting toward sustainable agriculture will require more labor and less mechanization, creating an opportunity to revitalize rural areas. They saw potential in engaging migrant populations–often with rural experience–to help rebuild a more resilient countryside:

> “We can revitalize the countryside… by promoting this type of sustainable agriculture that requires more labor but is much more resilient and adaptive to climate change.”

A global food systems expert pointed to urbanization as a major obstacle, especially in China, where it risks disconnecting people from rural food production and eroding traditional diets. As seen in Europe, they warned, peasant cuisine may become gentrified or lost as cities expand:

> “One of the big obstacles that China faces… is its urbanization.”

Together, these perspectives suggest that rebalancing urban–rural dynamics–through labor reintegration, preservation of food culture, and support for sustainable farming–will be essential for future food system resilience in both regions.

The expert also points to the necessity of true, large-scale-systemic changes in regards to agroecology. The remark emphasizes the primordial role of ancient forests in both the rise and fall of civilizations; it becomes clear that the preservation and expansion of primary forests is not merely an ecological imperative, it is a civilizational one. Forests are not only lungs of the Earth

but the scaffolding of long-term socio-economic stability and resilience. However, protecting forests in isolation is insufficient. The transformation must reach the roots of our food systems. A shift toward regenerative agriculture is essential, particularly in a country like China, where the scale of agricultural activity is possible in a faster manner than Europe. China being technologically powerful and having learnt from its historical lessons from centuries of land management, it can lead a new paradigm of smart regenerative agriculture. This model of ruralization empowerment could combine traditional agroforestry practices with cutting-edge technologies like AI, satellite monitoring, and soil biointelligence and enable food production that restores rather than depletes ecosystems.The expert also offers real economic returns through improved yields, climate resilience, and long-term soil fertility. Such a transition aligns with China's broader strategic goals of ecological civilization.

> “Agroforestry is a tool that should be pushed further, for example in France the climate has already changed in many places, so instead of pushing for non native plants, we should focus on agroforestry with native plants”

For both the context of Europe and China, forest expansion then can become not just an act of preservation, but a core element of food security, economic continuity, and geopolitical stability.

7.3.9 Perceptions on technology and innovation:

Interviewees offered divergent perspectives on the role of technology in transforming food systems, with views ranging from cautious optimism to sharp critique–especially when innovations reinforce, rather than challenge, the dominant agro-industrial model.

A French interviewee was critical of much current agri-tech, arguing that technologies often aim to fix problems created by the very system they perpetuate–such as drone pollinators in response to bee population collapse or AI tools replacing human labor.

> “Technologies and digital tools could be emancipatory, but since they are promoted by the same people who developed industrial agriculture, it's quite the opposite.” They emphasized that technology exchange between Europe and China could be beneficial only if publicly funded and judged by environmental and social criteria, not market logic alone. However, they remained uncertain about how much genuine, collaborative tech transfer is currently happening.

A German researcher echoed concerns about energy and resource intensity, questioning how far technology should be pushed, especially in the context of already stretched food supply chains.

> “Technology requires a lot of energy and water… if we have short supply chains, it doesn't have to be so technology intensive.”

By contrast, a global food systems expert pointed to cutting-edge innovations like synthetic meat as promising responses to long-term food security challenges. They saw value in scalable, financially viable models that could be replicated globally:

> "We have solutions–as long as we manage to develop models that can be duplicated because they are financially viable."

Together, these insights reveal a shared understanding that technology will play a key role in future food systems, but also a deep concern about who controls innovation, for what purposes, and at what ecological cost.

7.3.10 Perceptions on governance mechanisms and coherence:

Interviewees expressed a general sense of fragmentation and inadequacy when it comes to governance structures that could support meaningful China–Europe cooperation on food systems. Most viewed current mechanisms as either underdeveloped, uncoordinated, or overly reactive, especially in addressing long-term sustainability and resilience.

Some highlighted the absence of integrated governance frameworks between Europe and China, particularly in the food sector. They observed that each bloc tends to operate autonomously, with minimal alignment in decision-making or shared planning structures:

> "We don't think enough about anticipation, building resilient agri-food systems… We say rather that we have a very efficient system and that therefore it will think about its problems when it happens… and I fear that we will be overwhelmed in the long run by this logic."

This reactive approach, they argued, prioritizes crisis management over prevention and overlooks the structural vulnerabilities of modern food systems–especially the overreliance on monocultures. Drawing on historical agricultural practices like *métayage* (mixed cropping systems), the interviewee suggested that food security can be achieved through planned, diversified systems even if it means sacrificing short-term efficiency.

7.3.11 Perceptions on global vs. local/continental autonomy:

In discussing the balance between global interdependence and local or continental autonomy in food systems, interviewees reflected on historical legacies, geopolitical strategies, and contemporary inequalities–highlighting the tension between planetary cooperation and the need for regional self-reliance.

A French researcher argued that while achieving food autonomy is ultimately a global challenge, it must be pursued through regional integration and sovereignty, with zones capable of producing their essential resources. They pointed to China's long-standing focus on self-sufficiency, from Mao-era provincial autonomy to current grain storage policies and overseas land acquisitions, as part of a broader strategy to insulate itself from food insecurity and social unrest.

CEE countries were also seen as victims of structural imbalances, particularly within the EU's subsidy framework, which tends to favor Western European producers and large-scale farms. This has limited the ability of smaller or newer member states to assert meaningful food

sovereignty, making them dependent on EU market dynamics rather than autonomous in their food strategies.

7.3.12 Perceptions on the urgency of systemic transformation

Interviewees across backgrounds converged on a central theme: the current agri-food system is fundamentally unsustainable, and only a radical systemic transformation–not incremental reforms - will address its ecological, social, and political failures.

One respondent critiqued the dominant agro-industrial model, describing it as ecologically devastating and politically paralyzed. They emphasized that we already know what needs to change, but political will is lacking:

> "Agriculture is the most devastating thing that exists on the planet and we could do differently. That's what is frustrating…" They stressed that policies must move away from maximizing yield and profit, and instead focus on local, diverse, labor-intensive systems that respect ecological limits. The current system, they said, feels "delusional" and in need of collective therapy.

Similarly, another expert argued that the real barrier is not a lack of knowledge, but the failure of political systems to implement what is known. In comparing governance structures, they suggested that China's model, while problematic in many respects, allows for more rapid environmental interventions than EU democracies constrained by industrial lobbies:

> "There is no gap in research. We know what to do. The gaps are in politics–implementation."

> "In China, reaction capacities are much greater than in Europe, where we are subject to powerful industrial lobbies."

This theme of blocked progress despite clear solutions runs throughout the interviews. While technological innovation is seen as potentially helpful–such as the Greek academic's work on AI for greenhouse climate control–the consensus is that technology alone is not enough without systemic change in values, policy, and governance.

Cultural misunderstanding also emerged as a more subtle obstacle to transformation. The same global expert noted that while Chinese food is increasingly consumed in Europe, its underlying logic–rooted in balance, health, and shared plates - is often lost in translation.

> "Chinese cuisine is illegible to us… tofu, certain herbs–they're not in our culture… We must put them into a grammar we can digest." This disconnect underscores a broader problem: Western food systems have industrialized and globalized so much that they struggle to integrate approaches rooted in tradition, sustainability, and relational values.

Ultimately, these reflections point to a deeper conclusion: the food system crisis is not technical, but civilizational. The challenge lies in shifting collective priorities–from efficiency to resilience, from dominance to coexistence, from profit to sustainability–before the window for change closes.

7.3.13 Perceptions on China-CEEC cooperation: potential, gaps, and regional contributions

Experts pointed to several misconceptions about the CEEC food system held by external actors, including Chinese stakeholders. One is the assumption that CEEC countries uniformly have excellent conditions for agriculture, when in fact terrain (karst, mountains) and climate vary significantly.

> "One of the misconceptions is that we have excellent environmental conditions for agriculture, which is not necessarily true."

Another assumption is that farms are all small and underdeveloped, when in reality there are both large-scale farms and highly educated farmers.

> "Another misconceptions is that farms are small… which is not always true… there are larger farmers too."

Positive examples of CEEC food policies include agri-tech support schemes and marketing of traditional foods through geographical indications, which enhance biodiversity, cultural identity, and rural resilience.

> "Agri-tech initiatives… financing those startups and companies in the agri-tech sector… this can be applied elsewhere."
> "Promoting traditional food and gastronomy… food with geographical protection… can also be applied elsewhere."

Pilot projects such as drone-based crop loss assessments and climate adaptation work in the Pannonian region (focused on water, livestock, agroforestry, and organic agriculture) were cited as scalable innovations.

> "We work on one project… innovative solutions for climate change adaptation… water, livestock, organic agriculture, and agroforestry."

> "Use of drones in crop loss assessment… with AI to analyze hail or storm damage… saves time, money, and resources."

A major theme was the disconnect between theoretical sustainability frameworks and practical application, especially in vulnerable areas like islands or regions facing climate change, tourism pressure, or rural decline.

> "Most significant gaps are connected with trying to find sustainable business models and resilient farm systems."

> “If it is more expensive than the benefit it produces, then it's not sustainable.”
> “Sometimes these adaptation systems are presented as solutions… but they can be completely inefficient.”

China–CEEC research ties can be improved through jointly financed projects with competitive calls, researcher exchanges, and expanded use of online tools to overcome travel and cost barriers.

> “Joint projects… financed by China, EU, and the countries… exchange of researchers, exchange of students.”

> “Modern technology… online learning and meetings… can make cooperation cheaper.”

Technology and digital tools were rated five out of five in importance for future China–CEEC cooperation.

> “Technology, digital tools… can enhance this cooperation quite a lot… China is quite advanced in technological solutions.”
> “Extremely important.”

According to the interviewees, adoption of low-carbon and sustainable practices in CEEC is hindered by several factors:

- Lack of knowledge and technical support
- High investment costs for new machinery and methods
- Limited market recognition for sustainable products
- Uncertain legal frameworks, e.g. around solar energy sales

> “Main challenges are lack of knowledge, access to information, and how to apply these things.”
> “Financial means… switching to low-carbon techniques is expensive.”
> “If the market doesn’t recognize the product, why should the farmer switch?”

According to our interviewees In the next 5–10 years, three areas should prioritized for China–Europe (and China–CEEC) cooperation:

➔ *Research partnerships*

➔ *Sustainable agriculture*

➔ *Digital transformation*

> "All of those areas are important… but to make it short: research partnership, sustainable agriculture, and digital transformation."

There is tension between producing high-end food and ensuring food security, especially for local populations. Experts stressed that digital technologies can help improve yields, bridging the gap.

> "If we go for high-quality food, food security becomes more difficult."
> "Digital and innovation techniques can help increase yield… and support food security."
> "Low-carbon techniques can improve crop resilience."

A sobering theme was the demographic collapse of rural areas in CEEC countries, driven by corruption, lack of opportunity, and political favoritism.

> "Lots of young people left the rural area… for better jobs and salaries."
> "It's connected with policy, corruption, and lack of freedom."

This rural decline affects food production, biodiversity, and sustainability. One critical lesson for other regions is to invest in rural demographics and avoid similar neglect.

Rural entrepreneurship was described as an underused strategy with high potential. Interviewees suggested that China's experience with rural transformation, agri-startups, and digital agriculture can inspire similar moves in the CEEC.

> "Huge potential… rural entrepreneurship can solve many problems–people leaving, resilience, profitability."
> "China can be a great source of inspiration and ideas–not just in tech, but in how rural development is approached."

The views of CEEC experts–especially from Croatia–highlight a region ready to engage, but still navigating structural, demographic, and strategic challenges. The interviewees stressed that China–CEEC cooperation should not be based solely on trade volumes or technology transfer, but on a deeper, reciprocal process of learning and joint innovation. By leveraging the region's strengths–agri-tech, food culture, circular economy practices, and rural entrepreneurship - and addressing existing gaps, China and the CEEC can co-develop models for a more sustainable, resilient global food future. Together, these insights reveal a shared recognition of cooperation potential–particularly in areas like sustainability, innovation, and rural revitalization–tempered by structural, perceptual, and political constraints.

8. Recommendations: deepening EU–China and China–CEEC cooperation for sustainable food systems

This section outlines a comprehensive set of recommendations for enhancing food systems cooperation between China, the European Union (EU), and Central and Eastern European Countries (CEEC). These recommendations are drawn from theoretical insights, comparative analysis, stakeholder interviews, and survey results presented throughout the report. The proposals aim to advance resilient, inclusive, and climate-compatible agri-food systems. Additionally, more targeted recommendations addressing specific thematic areas and regional contexts can be found throughout the report.

8.1 Enhancing EU–China food system cooperation

1. **Ensure continuity of flagship initiatives like FAB.**
   While FAB and the Co-Funding Mechanism (CFM) under Horizon 2020 laid a strong foundation for EU–China cooperation, many of these initiatives have concluded. A new phase of co-funded programs is essential, with clear commitments to long-term research, monitoring, and policy uptake. Sustainability challenges such as soil degradation, agri-tech ethics, and dietary transitions deserve dedicated focus. Structured mapping and tracking of completed and ongoing projects would improve transparency, coherence, and learning. Without mechanisms for continuity and mainstreaming, FAB risks becoming a one-off success. Dedicated FAB-style calls for CEEC participation are needed to address their underrepresentation despite acute agri-food challenges (e.g. land fragmentation, limited innovation capacity).

2. **Institutionalize thematic working groups and foresight exercises.**
   EU–China working groups on low-carbon agriculture, food traceability, IWFS management, and waste reduction should be established to support knowledge co-creation. These groups should use decision-support tools like FARMSTEPS and FARMSCAPE to guide policy and innovation tailored to diverse agro-ecological settings.

3. **Align food system cooperation with environmental and biodiversity agendas.**
   Food systems should not be siloed from climate and biodiversity goals. China's ecological civilization strategy and the EU's Green Deal can converge through targeted collaboration on nature-based solutions, land use optimization, and biodiversity-friendly farming.

4. **Foster open knowledge-sharing platforms and data transparency.**
   A digital EU–China observatory on food sustainability–featuring dashboards, case studies, and project databases–could improve visibility, enable monitoring, and democratize access to best practices. Continuity in academic events, co-publication, and thematic conferences would reinforce intellectual exchange.

5. **Strengthen cultural and culinary diplomacy.**
   As highlighted in interviews, food is not just trade or policy–it is culture. Culinary diplomacy efforts, cross-cultural campaigns, and gastronomy exchanges can help

dismantle stereotypes and foster mutual understanding. Emphasis should be placed on understanding each other's food grammars and values.

8.2 Strengthening China–CEEC cooperation: from trade to institutional transformation

1. **Move beyond trade to build structural partnerships.**
   While trade remains a key pillar, China–CEEC cooperation must evolve into co-created initiatives. This includes establishing joint labs, field stations, and agri-tech incubators that respond to CEEC needs (e.g., fragmented landholding, rural out migration, biodiversity loss). In Croatia and N. Macedonia, for instance, targeted pilot programs in AI-driven agriculture and cold-chain development have been identified as high-potential areas for co-development with Chinese partners.

2. **Develop joint research frameworks and funding mechanisms.**
   Inspired by Horizon Europe, a China–CEEC research program with multi-year funding calls could target digital farming, agroforestry, circular economy models, and sustainable value chains. Dedicated R&D platforms for Polish dairy and honey exports, integrated with blockchain-based certification, could build on China's e-commerce strengths and CEEC specialty food offerings.

3. **Launch integrated education and mobility schemes.**
   Establishing joint degree programs, bilateral scholarships, and student exchanges focused on rural entrepreneurship, sustainable agri-business, and food governance would strengthen human capital and build future-ready cooperation.

4. **Address rural depopulation and youth disengagement.**
   Drawing on China's Science and Technology Backyard model and CEEC's rural startup hubs, projects should empower youth through leadership labs, AI hackathons, and co-designed value-added production models. Diaspora engagement should be institutionalized to bridge innovation and cultural knowledge. The use of youth-focused agri-tech innovation hubs in Serbia, Romania, and N. Macedonia could catalyze local talent and mitigate migration pressures.

5. **Co-create regional green innovation zones.**
   China and CEEC should establish regional innovation corridors (e.g., in the Balkans or Carpathians), integrating smart agriculture, climate adaptation, and eco-tourism. These zones would serve as replicable showcases of cooperative innovation. China's RES (Resource and Ecologically Sound) model could be adapted to SEE countries, emphasizing long-term cooperation, agroecology, and sustainable input reduction.

6. **Prioritize digital traceability, waste reduction, and food safety.**
   Joint platforms could integrate China's blockchain capabilities with the EU's food labeling standards.

8.3 Cross-cutting and systemic recommendations

1. **Create a tri-regional Observatory on Sustainable Food Systems.**
   This observatory could track project outcomes, monitor cooperation levels, assess alignment with SDGs, and offer a repository for tools, models, and datasets. It would also help evaluate trade-offs in environmental, economic, and social goals.
2. **Promote long-term collaboration models.**
   Recommendations include establishing joint labs, launching cross-regional pilot initiatives, and creating co-funded innovation platforms. These can ensure continuity in research, support institutional trust-building, and foster collaborative innovation. Joint China–CEEC mechanisms modeled on the EU–China Co-Funding Mechanism could ensure sustainable R&D investment beyond ad hoc bilateral projects.
3. **Center cooperation around resilience, not market integration.**
   Thematic exchanges should highlight context-specific practices (e.g., agroforestry in China, organic farming in CEEC) rather than standardizing around industrial models.
4. **Engage youth, civil society, and diaspora communities.**
   Exchange programs, co-design initiatives, and leadership training focused on sustainability and digital tools can build legitimacy and innovation. CEEC and SEE countries, engaging diaspora researchers and professionals in joint China–CEEC agri-programs would enhance credibility and cross-cultural transferability.
5. **Pursue a multi-scalar strategy.**
   Interventions should span farm, landscape, and national levels and be informed by both grassroots insights and strategic planning.
6. **Build cross-cultural understanding through shared food narratives.**
   Cultural humility is essential. More inclusive communication efforts, co-produced media, and grassroots storytelling can mitigate distrust and build mutual respect.
7. **Incorporate emerging challenges in future cooperation.**
   Topics like land grabs, rural equity, food sovereignty, and ecosystem restoration (e.g., Loess Plateau–style projects in CEEC) must feature more prominently in cooperative agendas. Given China's success with the Grain for Green Program, similar ecosystem restoration efforts in the Carpathians or the Balkans could serve as symbolic and practical pillars of trilateral cooperation.

9. Conclusion

This study set out to examine the evolving contours of food system transformation through the lens of China–EU–CEEC cooperation. It sought to answer four core research questions: the role of policy frameworks and technological innovation in enhancing sustainability and resilience; the potential of mutual learning and technology transfer; mechanisms to strengthen trilateral cooperation; and how China–CEEC collaboration can be more strategically leveraged for agricultural modernization.

EU food systems, framed by strategies such as the Farm to Fork and the Common Agricultural Policy (CAP), rely on regulatory incentives, stakeholder consultation, and subsidiarity. However, interview data and secondary analysis reveal persistent gaps in implementation–particularly in CEEC countries - due to uneven administrative capacity, bureaucratic fragmentation, and short-term funding cycles. Nonetheless, the EU provides an advanced model of agroecological experimentation, digital governance in food labeling, and consumer trust mechanisms like Protected Geographical Indication (PGI), which can serve as blueprints for international cooperation. In contrast, China's food system is rooted in state-led planning, centralized coordination, and a robust pilot-to-policy model. Innovations such as the Integrated Water-Fertilizer System (IWFS), blockchain traceability, and the No-Waste Cities initiative demonstrate how large-scale transformation can be orchestrated when supported by aligned political, infrastructural, and technological systems. Notably, China's Science and Technology Backyard model, which embeds researchers within rural communities, mirrors European efforts like EIP-AGRI, but with greater state support and implementation continuity. Despite their divergent institutional logics EU–China food systems cooperation has a strategic relevance. The FAB initiative, co-funded Horizon research, and policy dialogues have offered frameworks for structured engagement. Key areas of synergy include food traceability, digital agriculture, ecosystem services, and sustainable dietary transitions. Yet, interviews point to the need for better communication, continuity in funding, and more inclusive governance mechanisms to overcome geopolitical tensions and public skepticism.

Central and Eastern European Countries (CEEC) occupy a particularly strategic position in this evolving trilateral framework. As "formalizing" systems, they share institutional affinities with China, such as post-socialist legacies, fragmented landholdings, and under-resourced extension services. Countries like Serbia, Croatia, N. Macedonia, and Poland illustrate both the vulnerabilities and the innovation potential of this region. Survey responses and interviews underscored structural constraints–ranging from rural depopulation to outdated technologies–but also revealed optimism about the potential of targeted China–CEEC engagement, especially through pilot projects, capacity building, and cold-chain logistics integration. The analysis confirms that mutual learning and technology transfer between China, the EU, and CEEC must be approached as a two-way street. While much of the discourse has focused on what China can learn from EU standards, China's experience in scaling innovation and linking food policy with poverty alleviation, rural revitalization, and ecological restoration offers crucial insights for the EU - especially in CEEC contexts, where implementation remains weak.

The report also identifies key mechanisms to enhance cooperation, including:

- The institutionalization of trilateral platforms, such as a Tri-Regional Observatory on Sustainable Food Systems,

- Joint research labs and mobility schemes to foster innovation and human capital,

- Regional Green Innovation Zones tailored to CEEC agricultural ecosystems,

- Cross-pilot projects in digital agriculture, smart irrigation, food waste reduction, and traceability integration.

China–CEEC cooperation, in particular, must evolve from symbolic trade expos and infrastructure projects to deeper, institutionalized partnerships. This includes building long-term R&D alliances, leveraging CEEC's scientific and agricultural institutes, and embedding cooperation within local governance structures. As the report notes, models such as China's RES (Resource and Ecologically Sound) agriculture can be adapted to Southeast Europe, while EU tools like performance-based payments and eco-schemes may help structure incentives for local farmers. What emerges from this study is a vision of food system transformation grounded not only in sustainability and innovation, but also in institutional co-evolution. The systemic differences between China and the EU are not merely obstacles - they offer fertile ground for complementary learning and experimentation. The CEEC region, with its institutional hybridity and openness to external investment, can serve both as a bridge and a laboratory for testing these hybrid approaches.

Ultimately, realizing this potential will require a shift from ad hoc, top-down initiatives to participatory, place-based, and long-term strategies. By aligning their respective strengths - China's scaling capacity, the EU's governance tools, and CEEC's regional knowledge–these partners can co-develop a new architecture of cooperation that is resilient, equitable, and future-oriented. The findings and recommendations throughout this report provide a roadmap for moving from parallel efforts to genuine co-production of sustainable food futures.

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