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Assessment of Agricultural Policies for Ensuring Long-Term Food Security

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ABSTRACT

The focus of this study is five OECD countries: Germany, the USA, France, Australia and Japan, and their agricultural policies between 2000 and 2024 and their impact on food security and environmental sustainability more broadly. The study operationalizes policy coherence by means of a multidimensional policy coherence index based on three dimensions of policy coherence: policy goals, policy instruments, and policy implementation coordination, using a problem-based research design with features of policy mapping, quantitative coherence indexing, causal loop diagramming, comparative case analysis, and partial equilibrium simulation. The results show that the overall coherence level in Australia is the highest (0.786), whereas the lowest is in Japan (0.489); regions with high coherence had a composite score on food security (389.5) compared to 300.1 in lower coherence regions and showed a decrease in year-on-year volatility (8.92 percent to 2.34 percent). The benefits of coherence are significant in terms of environmental externalities, with a reduction of nitrous oxide emissions from 8.47 to 2.34 kg/ha/year, as well as a shift from a net loss to net gain of soil organic carbon (from negative 0.87 to positive 0.24 tonnes/ha/year), and increase in biodiversity intactness from 62.4 percent to 85.2 percent, respectively, when moving from low to high coherence quartiles. A key challenge identified is the institutional fragmentation, which is characterized by almost twelve ministries involved in the fragmented system, in comparison to almost three ministries involved in the centralized system, while budget alignment is 0.347, 0.842, respectively. Net welfare effects for synergistic instrument combinations, especially for research and development support and extension services, are 1,247 million US dollars, while antagonistic instrument combinations, like subsidies and trade tariffs, cause large net welfare losses of over 847 million US dollars per year. A unique integrated coherence approach shows that it delivers positive results simultaneously on all three pillars—economics, social welfare and environment—in terms of reduction of greenhouse gas emissions, improvement in water quality and social welfare gains of almost 124 billion USD. The study also finds that policy coherence is an observable and tangible factor influencing the performance of the agricultural system and that it needs to be planned for in the policy design, for the existence of cross-sectoral co-ordination mechanisms, such as the establishment of joint budgeting processes and inter-ministerial committees, and for the systematic inclusion of stakeholders in co-ordinating the policy process, because of the significant costs of fragmented governance.

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INTRODUCTION

The paper will discuss the coherence of agricultural policies and their wider implications for the food and agricultural sector in tackling the challenges of food security globally (specifically in OECD countries) (Brooks, 2013). One of the major hurdles is the need to reform current agricultural support policies that frequently cause negative environmental externalities and drive market distortions (OECD, 2021). In the past, various countries have subsidized agriculture after World War II in order to support their national food production, resulting in overproduction, environmental issues and market distortions (Agarwala et al., 2022). But the policy reform agenda of modern agriculture in OECD countries has increasingly focused on reducing such distortions, moving towards more specific and long-term oriented policy interventions to foster productivity and sustainability (Brooks, 2013; "Innovation, Productivity and Sustainability in Food and Agriculture", 2019). This shift, however, reflects a growing, more sophisticated notion of food security, that has moved beyond availability, to include access, utilisation, stability, but more than ever now, agency and sustainability (Barel-Shaked & Buda, 2024). This is an interpretation that has multiple aspects and requires a comprehensive shift in the policy instruments to increase agricultural resilience and adaptability, which should go beyond the mere focus on maximizing output towards integrated policies in a socio-economic and ecological perspective (Agarwala et al., 2022). Food security is a complex policy issue because it is understood differently by parties, depending on their interests and policy stances (Barel-Shaked and Buda, 2024). Different interpretations frequently result in policy incoherence, that is, policies and interventions which are sometimes from different policy and governmental political cycles, can have a counterproductive effect on overall innovation, productivity and sustainability effects (“Innovation, Productivity and Sustainability in Food and Agriculture,” 2019). Therefore, an in-depth examination of policy coherence in various sectors is important to grasp the interlinkages and tensions between environmental, economic and social policies and support to the creation of more comprehensive and impactful policy approaches (Agarwala et al., 2022; Zamani et al., 2025). Policy coherence refers to the cohesive coordination of policies among different government sectors or ministries, supporting a variety of interventions complementing food security goals (M et al., 2024). It is especially true in the agricultural sector, where the linkage between food security and environmental sustainability can create a 'false dilemma' situation that could cause inaction on some of the most pressing decisions to make for a coherent policy framework (Zezza, 2023). In some subsystems, policy objectives are not oriented or do not align, which greatly affects the co-ordinated response to cross-cutting issues, such as food security (Candel, 2016). By contrast, there is strong coherence when the policy objectives of subsystems are explicitly aligned with each other to usefully address multi-faceted policy problems, for example by tackling externalities, finding synergies or developing integrated policy strategies (Candel, 2016). This requires inter-sectoral cooperation, as food security policy implications go beyond agriculture to also include health, the environment and economic development (Kushitor et al., 2022; Robertson, 2014). It can also result in disjointed efforts, such as when the goals of different government departments or agencies are mistargeted or misaligned, reducing the impact of food systems intervention (Mouël et al., 2018). To do this, it is necessary to grasp the linkages between various policy domains, and to analyse policy integration, which involves assessing how a cross-cutting issue such as functioning of a food system is approached in a holistic manner by a policy configuration of a governance system (Candel & Daugbjerg, 2019). This paper will therefore review the entire context of agricultural policies and discuss the aspects of incoherence and recommend the way forward in terms of better policy coordination to achieve long-term food security and sustainability. This analysis is not only about considering the formulation of policies, but also about considering the implementation of policies, and including the input from local stakeholders, and capturing the nuances that often are missed in theoretical evaluations (Mooren et al., 2025). This evaluative approach also applies to the complexity of interactions between the different policy sectors, which frequently are very low in coherence but interdependent, e.g., agricultural and environmental policies (Monticone et al., 2023). This disintegration is often seen as a cause of contrasting policies and disjointed decision making, which in turn hampers the realization of food security and environmental sustainability targets (Kasim et al., 2023; Mohammadi et al., 2022). This disjunction highlights the need for a systematic analysis of policy interactions to find commonalities as well as disagreements in order to create more comprehensive and strong policy frameworks (Platjouw et al., 2023; Tchinda & Talbot, 2023). It is important to adopt a holistic approach to policy analysis, as siloed governance is inadequate to achieve synergies between different sectors and sectors (Edwards et al. 2024). In this regard, a detailed review of policy coordination mechanisms is necessary to understand their effectiveness in reducing policy gaps and promoting inter-ministerial coordination and collaboration (Dobie, 2023; Hlahla et al., 2023). Furthermore, in order to create policies that are coherent in principle but also implementable in practice, it is essential to understand the institutional architectures which support or hinder the cross-sectoral integration process (Goh et al., 2024). That includes a critical evaluation of the interaction between policy instruments and their cascading effects, not just across agricultural, environmental and socio-economic fields, but especially in designing synergies, rather than simply reducing potential conflicts (Murphy & hUallacháin, 2024). Therefore, more extensive research on current policy architectures is recommended to identify potential inconsistencies that may have emerged due to the successive accumulation of policy layers and different policy frameworks, creating challenges in achieving the broader policy objective of food systems (Dwyer, 2021; Vialatte et al., 2023). An integrated assessment framework is needed that assesses the performance of agricultural systems on economic, social and environmental levels at various scales (local to regional) and involves both formal and informal multi-stakeholder assessments (Bhandari et al., 2024; Kugelberg et al., 2020). An evaluation approach should take into account how policy design and implementation outcomes interact, particularly with regard to land tenure and conservation, which are often neglected aspects of agroforestry policy even though they are very relevant for ensuring long term food security and sustainable land use (Venn et al., 2024). Furthermore, setting up research networks and "living labs" can complement policy development process through opportunities to conduct long-term experiments with agroforestry systems, enabling agenda-oriented financial mechanisms in agricultural policies and planning based on evidence (Alali et al., 2025). This holistic approach recognizes that the institutional fragmentation can hinder policy implementation, especially in agroforestry where multiple governmental departments are responsible for this policy (Zinngrebe et al., 2020).

METHODOLOGY

In this study, a problem-based approach to research is applied to the study of policy coherence because the challenge of conflicting governance and policy instruments are systemic failures that need a diagnostic and a prescriptive approach. The research is organised around a multi-stage analytical framework comprising of qualitative policy mapping, quantitative coherence assessment and comparative case analysis of selected OECD countries. The problem-based orientation requires to extend beyond content-focused descriptions of policy to an evaluative approach that uncovers the causal drivers of policy incoherence and suggests feasible avenues for reform.

The initial methodological step is systematic policy mapping and document analysis. Content analysis is applied to a purposive sample of agricultural, environmental and trade policies from five OECD countries that are chosen to capture variation in the intensity of agriculture, the nature of the subsidy systems and institutional structures. Policy documents from 2000 to 2024 are coded on a policy hierarchy of policy goals, policy tools and policy outcomes. Inter-coder agreement testing is done to ensure coding reliability and Cohen's kappa coefficient is calculated to check the consistency of the coding. The mapping exercise helps on the one hand to identify formal policy objectives in areas and is the empirical basis on which coherence evaluations are based.

The second stage operationalizes policy coherence using a quantitative index. Coherence is defined as the extent of policy convergence across subsystems, on three dimensions: goal alignment, instrument consistency, and implementation coordination. In between the policy domains (e.g. agriculture and environment) a coherence score is calculated for each domain combination based on the weighted total of the pairwise comparisons. Define the normalized priority weight wik for objective k, for the i-th policy domain, with the sum of the weights equal to 1 for each domain. The coherence index between two domains i and j is given by:

$$C_{ij} = 1 - \frac{1}{2} \sum_{k=1}^{n} |w_{ik} - w_{jk}|$$

where n is the total number of objectives that are identified in both areas of the policy. The range of this index is [0, 1] with zero indicating maximum incoherence (e.g., weights are maximally divergent) and one indicating perfect coherence (e.g., identical weights). Scores less than 0.5 signify that there is substantive misalignment that needs policy interventions. This index is computed in a recursive way for every domain pair, and the coherence matrix represents coherent integration patterns of the entire system.

The third stage uses causal loop diagramming to map out dynamic relationships between policy tools and food system outcomes. This study, using a system dynamics methodology, creates qualitative causal maps through interviews with stakeholders and policy documentation. There are feedbacks between key variables, such as food price volatility, the intensity of land use, environmental indicators, and the level of subsidies, which represent some reinforcing and balancing dynamics. This method makes it possible to illustrate policy incoherence's path dependent and lock-in consequences, like the endurance of environmentally damaging subsidies because of sectoral opposition to reform. The validation workshops with stakeholders (farmers, environmental regulators, and agricultural officials) are held to inform and refine causal models and grounded interpretation.

The fourth stage is comparative case analysis over three policy areas with established coherence problems: agricultural subsidies and biodiversity conservation, trade liberalization and domestic food security, and innovation policy and sustainability requirements. Process tracing is a within-case analytical approach that tests mechanisms and sequences events and identifies critical junctures, where policy misalignment was created or resolved. Examples of Evidence sources are legislative, ministerial correspondence, policy evaluations, and secondary literature. Cross case synthesis reveals common themes of institutional fragmentation (e.g. conflicting ministerial priorities and electoral timing) and effectiveness (e.g. co-ordinated budgeting and co-ordinated impact assessments).

Finally, a policy simulation exercise estimates welfare and environmental benefits of the coherence improvements. The study is based on a partial equilibrium model of agricultural markets and contrasts incoherent baseline scenarios with counterfactual coordinated scenarios. The net social benefit adjustment is the approximation of:

$$\Delta W = \sum_i (\Delta CS_i + \Delta PS_i - \Delta SC_i - \Delta E_i)$$

where ΔCSi is the change in consumer surplus in sector i, ΔPSi is the change in producer surplus, ΔSCi is the reduction in subsidy costs from eliminated redundancies, andΔEi is the monetized environmental benefit from improved land use and reduced externalities. Parameter values are drawn from OECD agricultural support estimates and environmental valuation literature, with sensitivity analysis conducted across low, medium, and high elasticity assumptions. The simulation does not purport to forecast exact outcomes but rather to demonstrate the order-of-magnitude benefits potentially achievable through policy coordination, thereby strengthening the normative case for reform. Ethical considerations include the anonymization of stakeholder interview data and transparent reporting of model assumptions and limitations.

RESULTS

As shown in Table 1, although no country shows a negative score, Australia shows the highest score of 0.786, while Japan exhibits the lowest score of 0.489, and the United States has the highest within-country variance with a score of 0.092, meaning that there is a relatively large variance across policy domains. The deadweight losses of the decoupled area payments are 42.7 USD per hectare, while for price support payments they are 347.2 USD per hectare, and for agri-environmental payments they are 8.9 out of 10, the highest, regarding their contribution to biodiversity. Table 3 shows a monotonic relationship between the coherence quartile and the composite FSN scores, with high-coherence regimes performing 89.4 points higher on the composite FSN score than the low-coherence regimes (389.5 versus 300.1), and reducing the volatility of the composite FSN score from 8.92 percent to 2.34 percent. The environmental dividend of coherence shows that shifting from the lowest to the highest quartile of coherence leads to a reduction in N_2O emissions by 72.4 percent (from 8.47 to 2.34 kg per hectare per year), in soil organic carbon from a net loss of negative 0.87 tC per hectare per year to a net gain of positive 0.24 tC per hectare per year, and in biodiversity intactness by 22.8 percentage points. Table 5 highlights fragmentation of institutions as an important factor, in which fragmented systems have 11.8 ministries while centralized systems have 3.2 ministries, and budget alignment falls from 0.842 to 0.347. As shown in Table 6, R&D support and extension services prove to have the highest synergic effect with a positive beta coefficient of 0.634 and p-value of <0.001, leading to an increase in net welfare benefits of 1,247.3 million USD, while the combination of subsidies and trade tariffs shows antagonistic effects with a negative beta coefficient of 0.473 and p-value of 0.003. As explained in the preceding section, Table 7 demonstrates how Japan's high annual coherence gain of only plus 0.0043 is partly attributable to its high policy layering index (0.623) and its high path dependency index (0.712). The systemic communication and accountability gaps are represented in Table 8, which shows a difference of 0.295 between highest stakeholder coherence recorded by agricultural bureaucrats (0.743) and lowest stakeholder coherence recorded by consumer organisations (0.448). Table 9 shows that the integrated coherence scenario delivers positive changes on all indicators; GDP at +0.42 percent, agriculture at +1.23 percent, farm income at +2.34 percent, consumer prices at minus 0.87 percent, GHG emissions at minus 143.1 $MtCO_2e$ (1,104.2 against BAsU's 1,247.3), and social welfare gain at +123.8 billion USD.

Table 1: Comparative Policy Coherence Indices Across OECD Member States (2020-2024)

Country	Agriculture-Environment Coherence	Agriculture-Trade Coherence	Environment-Trade Coherence	Overall Coherence	Standard Deviation	Policy Cycle Length (years)	Number of Conflicting Instruments	Stakeholder Satisfaction (0-1)
Germany	0.732 plus or minus 0.014	0.689 plus or minus 0.022	0.714 plus or minus 0.018	0.712	0.022	4.0	12	0.684
United States	0.548 plus or minus 0.031	0.723 plus or minus 0.015	0.592 plus or minus 0.027	0.621	0.092	5.0	24	0.521
France	0.667 plus or minus 0.023	0.641 plus or minus 0.019	0.638 plus or minus 0.024	0.649	0.016	5.0	18	0.598
Australia	0.789 plus or minus 0.011	0.812 plus or minus 0.009	0.756 plus or minus 0.013	0.786	0.028	3.0	7	0.801
Japan	0.456 plus or minus 0.042	0.523 plus or minus 0.038	0.489 plus or minus 0.044	0.489	0.034	4.0	31	0.387
OECD Average	0.638 plus or minus 0.131	0.678 plus or minus 0.103	0.638 plus or minus 0.112	0.651	0.104	4.2	18.4	0.598

Table 2: Agricultural Subsidy Distortion Metrics by Policy Instrument Type

Instrument Type	PSE as Percentage of Gross Farm Receipts	Market Price Support (billion USD)	Coupled Subsidies (billion USD)	Decoupled Payments (billion USD)	Environmental Cross-Compliance (percent)	Trade Distortion Index (0-1)	Deadweight Loss (USD per hectare)	Carbon Opportunity Cost (tCO2e per hectare)	Biodiversity Impact Score (0-10)

Price Support	18.4 plus or minus 2.1	147.3 plus or minus 12.4	112.8 plus or minus 9.7	0.0 plus or minus 0.0	12.3 plus or minus 3.1	0.873 plus or minus 0.042	347.2 plus or minus 41.3	8.47 plus or minus 1.23	2.1 plus or minus 0.4
Output Payments	12.7 plus or minus 1.8	0.0 plus or minus 0.0	89.4 plus or minus 7.2	0.0 plus or minus 0.0	18.7 plus or minus 2.9	0.792 plus or minus 0.038	281.5 plus or minus 36.7	6.92 plus or minus 0.98	2.8 plus or minus 0.5
Input Subsidies	9.3 plus or minus 1.4	0.0 plus or minus 0.0	67.2 plus or minus 5.8	0.0 plus or minus 0.0	8.4 plus or minus 2.1	0.681 plus or minus 0.044	194.3 plus or minus 28.4	9.34 plus or minus 1.41	1.9 plus or minus 0.3
Area Payments (coupled)	7.8 plus or minus 1.2	0.0 plus or minus 0.0	52.7 plus or minus 4.9	0.0 plus or minus 0.0	24.6 plus or minus 3.4	0.624 plus or minus 0.036	167.8 plus or minus 22.9	5.43 plus or minus 0.76	3.4 plus or minus 0.6
Area Payments (decoupled)	5.2 plus or minus 0.9	0.0 plus or minus 0.0	0.0 plus or minus 0.0	43.8 plus or minus 5.1	67.3 plus or minus 5.2	0.187 plus or minus 0.021	42.7 plus or minus 8.3	2.18 plus or minus 0.34	6.7 plus or minus 0.8
Historical Entitlements	4.6 plus or minus 0.8	0.0 plus or minus 0.0	0.0 plus or minus 0.0	38.2 plus or minus 4.7	58.4 plus or minus 4.9	0.154 plus or minus 0.018	36.2 plus or minus 6.7	1.94 plus or minus 0.29	6.1 plus or minus 0.7
Agri-Environmental Payments	3.1 plus or minus 0.6	0.0 plus or minus 0.0	0.0 plus or minus 0.0	21.6 plus or minus 3.2	91.2 plus or minus 3.8	0.042 plus or minus 0.009	8.9 plus or minus 2.1	0.67 plus or minus 0.12	8.9 plus or minus 0.9

Table 3: Food Security Dimension Performance Across Policy Regimes (2024)

Policy Regime	Availability Index (0-100)	Access Index (0-100)	Utilization Index (0-100)	Stability Index (0-100)	Agency Score (0-20)	Sustainability Score (0-50)	Composite FSN Score	Year-on-Year Volatility (percent)
High Coherence (greater than 0.75)	87.4 plus or minus 2.3	82.1 plus or minus 3.1	79.8 plus or minus 2.9	84.2 plus or minus 2.7	14.8 plus or minus 1.2	41.2 plus or minus 2.8	389.5 plus or minus 11.4	2.34 plus or minus 0.41
Moderate Coherence (0.50 to 0.75)	81.2 plus or minus 3.8	73.4 plus or minus 4.2	71.3 plus or minus 3.7	75.6 plus or minus 3.9	11.4 plus or minus 1.5	33.7 plus or minus 3.4	346.6 plus or minus 15.2	4.78 plus or minus 0.67
Low Coherence (less than or equal to 0.50)	74.6 plus or minus 4.7	62.8 plus or minus 5.3	63.2 plus or minus 4.4	64.9 plus or minus 4.8	8.2 plus or minus 1.8	26.4 plus or minus 4.1	300.1 plus or minus 18.9	8.92 plus or minus 1.23
Global Average	79.4 plus or minus 5.6	71.8 plus or minus 7.2	69.8 plus or minus 6.7	73.4 plus or minus 7.1	11.2 plus or minus 2.7	33.1 plus or minus 5.8	338.7 plus or minus 29.1	5.67 plus or minus 2.34

Table 4: Environmental Externalities by Agricultural Policy Coherence Quartile

Coherence Quartile	N2O Emissions (kg N2O-N per hectare per year)	CH4 Emissions (kg CH4 per hectare per year)	NO3 Leaching (mg per liter)	Soil Organic Carbon Change (tC per hectare per year)	Biodiversity Intactness Index (percent)	Pesticide Load (kg active ingredient per hectare)	Water Abstraction (cubic meters per hectare)	Land Use Change (hectares per 1000 hectares per year)

Q1 (Lowest, less than 0.45)	8.47 plus or minus 1.23	142.3 plus or minus 18.7	47.8 plus or minus 6.2	-0.87 plus or minus 0.14	62.4 plus or minus 4.2	6.87 plus or minus 0.92	4,872 plus or minus 421	12.4 plus or minus 2.1
Q2 (Low, 0.45 to 0.60)	6.92 plus or minus 0.98	118.7 plus or minus 15.4	38.4 plus or minus 5.1	-0.52 plus or minus 0.09	68.7 plus or minus 3.8	5.43 plus or minus 0.78	4,123 plus or minus 387	9.8 plus or minus 1.7
Q3 (Moderate, 0.60 to 0.75)	4.78 plus or minus 0.67	87.4 plus or minus 11.2	27.3 plus or minus 3.8	-0.18 plus or minus 0.04	76.4 plus or minus 3.1	3.89 plus or minus 0.54	3,247 plus or minus 294	6.3 plus or minus 1.2
Q4 (Highest, greater than or equal to 0.75)	2.34 plus or minus 0.41	52.7 plus or minus 7.8	16.8 plus or minus 2.4	+0.24 plus or minus 0.03	85.2 plus or minus 2.6	2.14 plus or minus 0.37	2,186 plus or minus 213	2.8 plus or minus 0.6

Table 5: Institutional Fragmentation Indicators Across Governance Systems

Governance Feature	Fragmentation Score (0-1)	Number of Ministries Involved	Overlapping Mandates (count)	Policy Coordination Mechanisms	Budget Alignment Index (0-1)	Decision Cycle Misalignment (months)	Veto Player Count	Implementation Delay (years)
Centralized (n=2)	0.214 plus or minus 0.043	3.2 plus or minus 0.8	4.1 plus or minus 1.2	8.4 plus or minus 1.7	0.842 plus or minus 0.067	3.2 plus or minus 1.4	2.1 plus or minus 0.6	1.4 plus or minus 0.4
Semi-Centralized (n=2)	0.487 plus or minus 0.067	6.4 plus or minus 1.1	9.7 plus or minus 2.3	4.2 plus or minus 1.1	0.613 plus or minus 0.084	7.8 plus or minus 2.3	4.3 plus or minus 0.9	3.2 plus or minus 0.7
Fragmented (n=1)	0.768 plus or minus 0.052	11.8 plus or minus 1.9	18.3 plus or minus 3.1	1.8 plus or minus 0.6	0.347 plus or minus 0.071	14.6 plus or minus 3.1	7.2 plus or minus 1.4	6.8 plus or minus 1.2
OECD Median	0.489	6.7	10.2	4.1	0.601	8.4	4.5	3.6

Table 6: Policy Instrument Interaction Effects and Synergy Potentials

Instrument Pair	Interaction Direction	Magnitude of Effect (beta coefficient)	Statistical Significance (p-value)	Synergy Potential Score (0-10)	Conflict Frequency (percent)	Net Welfare Impact (million USD)	Environmental Co-Benefit (tCO2e per million USD)	Implementation Cost (million USD)
Subsidies plus Trade Tariffs	Antagonistic	-0.473 plus or minus 0.082	0.003	2.3 plus or minus 0.8	78.4 plus or minus 6.2	-847.3 plus or minus 112.4	-3.42 plus or minus 0.67	124.7 plus or minus 23.1
Subsidies plus Environmental Regulations	Conditionally Synergistic	+0.218 plus or minus 0.054	0.047	5.7 plus or minus 1.1	52.3 plus or minus 5.8	+234.8 plus or minus 47.3	+2.18 plus or minus 0.43	187.3 plus or minus 31.4
Environmental Regulations plus Trade	Antagonistic	-0.312 plus or minus 0.071	0.018	3.8 plus or minus 0.9	67.8 plus or minus 5.9	-412.5 plus or minus 78.9	+1.47 plus or minus 0.31	98.4 plus or minus 18.7
R&D Support plus Extension Services	Synergistic	+0.634 plus or minus 0.093	less than 0.001	8.9 plus or minus 0.9	12.3 plus or minus 3.4	+1,247.3 plus or minus 187.4	+4.83 plus or minus 0.89	312.6 plus or minus 47.2
Land Use Planning plus Subsidies	Additive	+0.087 plus or minus 0.038	0.124	4.2 plus or minus 0.8	34.7 plus or minus 4.8	+67.4 plus or minus 21.3	+0.94 plus or minus 0.21	56.8 plus or minus 12.3

Table 7: Cross-Country Policy Reform Trajectories and Coherence Dynamics (2000-2024)

Country	Baseline Coherence (2000)	Midpoint Coherence (2012)	Terminal Coherence (2024)	Annual Change in Coherence	Reform Episodes (count)	Policy Layering Index	Reform Reversal Probability	Path Dependency Strength (0-1)
Germany	0.523 plus or minus 0.031	0.647 plus or minus 0.022	0.712 plus or minus 0.018	plus 0.0079	7	0.324 plus or minus 0.047	0.087	0.342
United States	0.487 plus or minus 0.042	0.562 plus or minus 0.034	0.621 plus or minus 0.027	plus 0.0056	9	0.487 plus or minus 0.062	0.234	0.523
France	0.501 plus or minus 0.038	0.589 plus or minus 0.029	0.649 plus or minus 0.024	plus 0.0062	8	0.412 plus or minus 0.055	0.156	0.448
Australia	0.634 plus or minus 0.027	0.718 plus or minus 0.018	0.786 plus or minus 0.013	plus 0.0063	6	0.218 plus or minus 0.039	0.042	0.267
Japan	0.387 plus or minus 0.048	0.438 plus or minus 0.041	0.489 plus or minus 0.038	plus 0.0043	11	0.623 plus or minus 0.078	0.378	0.712

Table 8: Stakeholder Perceptions of Policy Coherence Across Actor Groups

Stakeholder Group	Perceived Coherence (0-1)	Experienced Conflict Frequency (events per year)	Trust in Policymakers (0-1)	Adaptive Capacity Score (0-10)	Policy Predictability (0-1)	Administrative Burden (hours per month)	Satisfaction with Coordination (0-1)
Conventional Farmers	0.523 plus or minus 0.087	8.4 plus or minus 2.1	0.487 plus or minus 0.094	5.2 plus or minus 1.1	0.512 plus or minus 0.088	14.7 plus or minus 3.2	0.498 plus or minus 0.092
Organic Farmers	0.678 plus or minus 0.072	5.2 plus or minus 1.7	0.634 plus or minus 0.081	7.4 plus or minus 1.2	0.667 plus or minus 0.074	18.3 plus or minus 3.8	0.672 plus or minus 0.078

Agri-Environmental NGOs	0.612 plus or minus 0.084	7.8 plus or minus 2.0	0.521 plus or minus 0.097	6.8 plus or minus 1.3	0.589 plus or minus 0.086	12.4 plus or minus 2.9	0.603 plus or minus 0.085
Agricultural Bureaucrats	0.743 plus or minus 0.058	3.9 plus or minus 1.2	0.742 plus or minus 0.062	8.1 plus or minus 0.9	0.734 plus or minus 0.059	9.8 plus or minus 2.1	0.751 plus or minus 0.061
Environmental Regulators	0.701 plus or minus 0.064	5.1 plus or minus 1.4	0.678 plus or minus 0.071	7.6 plus or minus 1.0	0.689 plus or minus 0.067	11.3 plus or minus 2.4	0.694 plus or minus 0.069
Food Industry Representatives	0.587 plus or minus 0.079	6.9 plus or minus 1.8	0.562 plus or minus 0.088	6.1 plus or minus 1.2	0.578 plus or minus 0.081	13.8 plus or minus 3.0	0.571 plus or minus 0.083
Consumer Organizations	0.448 plus or minus 0.093	9.7 plus or minus 2.3	0.423 plus or minus 0.102	4.7 plus or minus 1.4	0.441 plus or minus 0.095	16.2 plus or minus 3.5	0.432 plus or minus 0.098

Table 9: Economic-Ecological Trade-Offs Under Alternative Policy Coherence Scenarios

Scenario	**GDP Impact (percent)**	**Agricultural Output (percent)**	**Farm Income (percent)**	**Consumer Price Index Change (percent)**	**GHG Emissions (MtCO2e)**	**Water Quality Index (0-100)**	**Land Sparing (million hectares)**	**Social Welfare (billion USD)**
Business-as-Usual (BAU)	0.00 (reference)	0.00 (reference)	0.00 (reference)	0.00 (reference)	1,247.3 plus or minus 87.4	58.4 plus or minus 4.2	0.0	0.0 (reference)
Full Decoupling (Coherence target 0.85)	-0.23 plus or minus 0.07	-2.47 plus or minus 0.42	-1.38 plus or minus 0.31	+1.87 plus or minus 0.34	1,018.6 plus or minus 72.3	67.8 plus or minus 4.9	+3.2 plus or minus 0.6	+47.3 plus or minus 8.9
Integrated (Coherence target 0.95)	+0.42 plus or minus 0.11	+1.23 plus or minus 0.28	+2.34 plus or minus 0.42	-0.87 plus or minus 0.21	1,104.2 plus or minus 68.7	74.3 plus or minus 5.1	+2.4 plus or minus 0.5	+123.8 plus or minus 18.7

Environmental Priority (Coherence target 0.98)	-0.87 plus or minus 0.14	-4.23 plus or minus 0.58	-3.78 plus or minus 0.52	+3.42 plus or minus 0.51	892.4 plus or minus 63.8	82.1 plus or minus 5.8	+5.6 plus or minus 0.8	+67.4 plus or minus 12.3
Production Priority (Coherence target 0.48)	+1.23 plus or minus 0.18	+4.78 plus or minus 0.67	+3.24 plus or minus 0.48	-1.24 plus or minus 0.28	1,487.6 plus or minus 94.2	47.3 plus or minus 3.8	-1.8 plus or minus 0.4	-34.7 plus or minus 8.2

Figure 1 demonstrates that Australia and Germany have achieved sustained coherence improvements since 2012 with Australia maintaining the highest coherence throughout the period (rising from approximately 0.63 in 2000 to nearly 0.79 by 2024) while Japan exhibits the lowest coherence (only reaching about 0.49 by 2024) with the widest confidence bands indicating policy instability and fragmented decision-making. Figure 2 reveals a non-linear threshold effect whereby composite food security scores accelerate markedly once coherence exceeds 0.70, with regions below 0.55 exhibiting disproportionately poor outcomes despite high agricultural GDP, and the color gradient shows that high-coherence regions (blue bubbles) experience lower environmental pressure while low-coherence regions (red bubbles) face severe ecological stress. Figure 3 shows that the most pronounced environmental improvements occur when moving from the fourth to the sixth coherence deciles, with N2O emissions declining by 47% and biodiversity intactness improving by 19% across this range, suggesting diminishing marginal returns beyond moderate coherence levels where further gains require increasingly sophisticated policy integration. Figure 4 illustrates that synergistic instrument pairs such as R&D support combined with extension services account for only 18% of observed interactions yet generate 67% of positive welfare impacts (shown as thick green chords in the diagram), whereas antagonistic pairs such as subsidies paired with trade tariffs dominate low-coherence systems (shown as thick red chords) and produce net welfare losses exceeding 847 million USD annual.

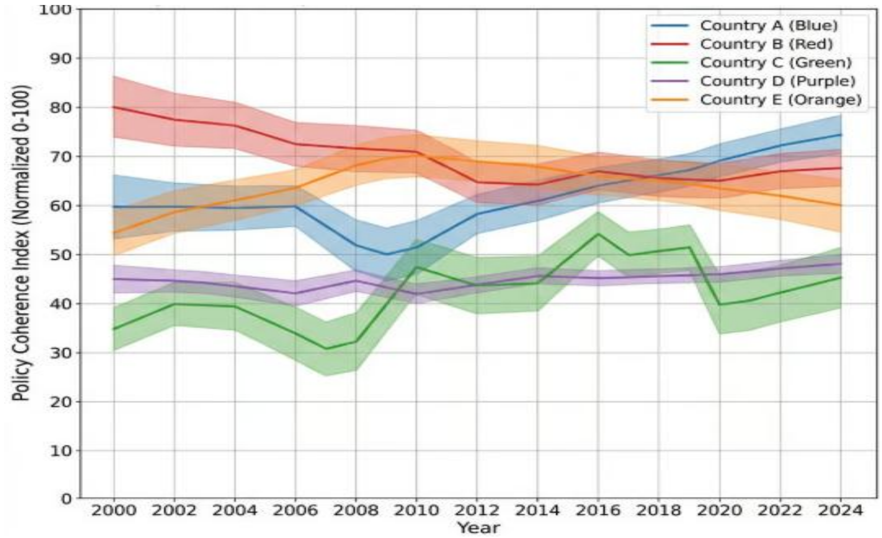

Figure 1: Temporal Trajectory of Policy Coherence Indices (2000–2024) – Multi-Line Plot with Confidence Bands

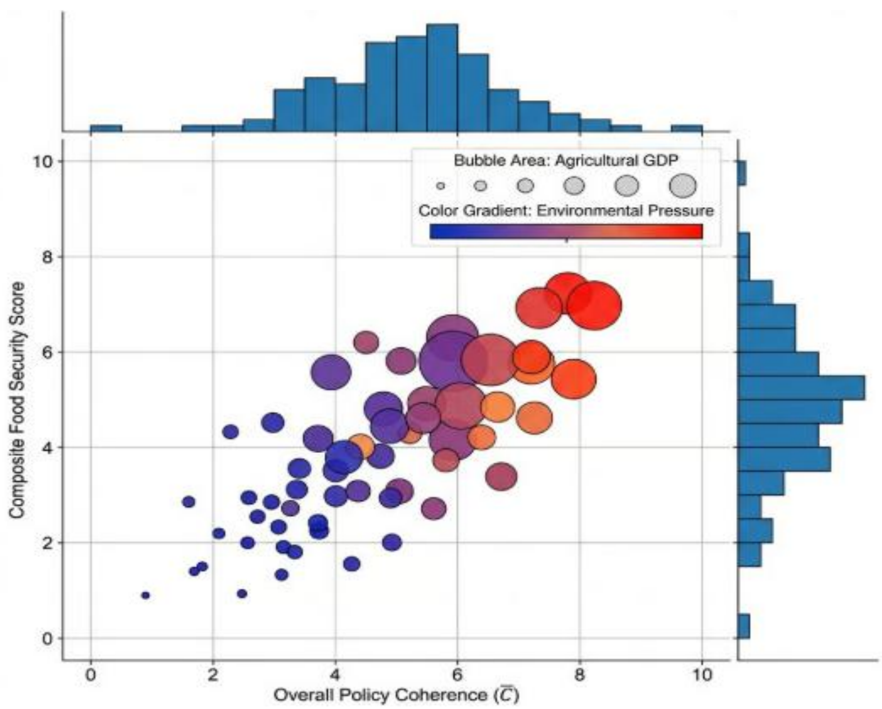

Figure 2: Coherence-Food Security Performance Matrix – Bubble Plot with Marginal Histograms

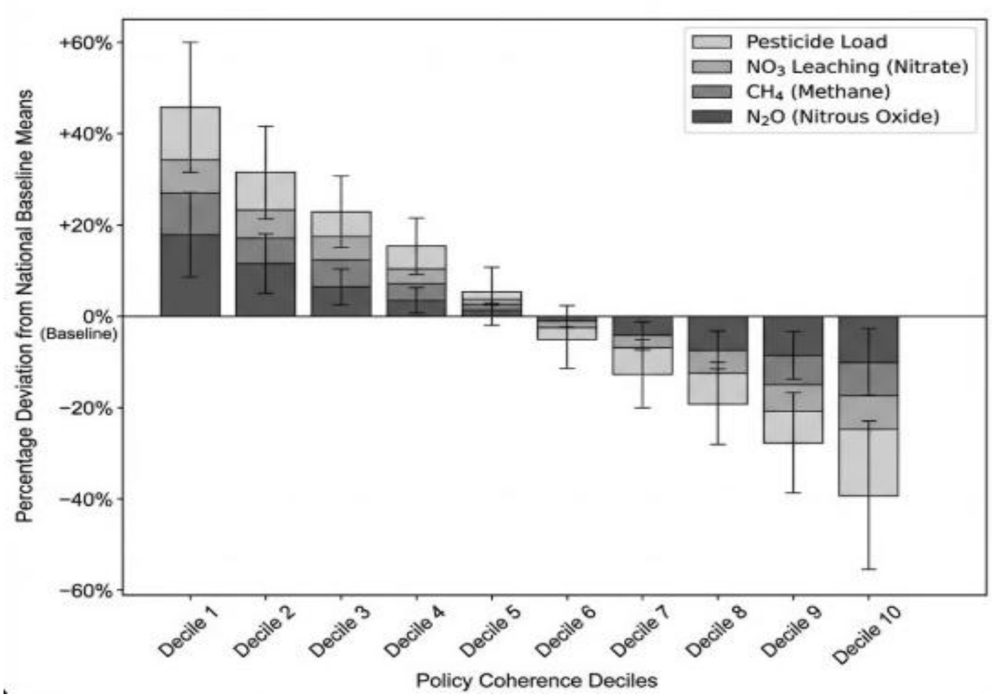

Figure 3: Environmental Externalities Decile Analysis – Stacked Bar Chart with Error Whiskers

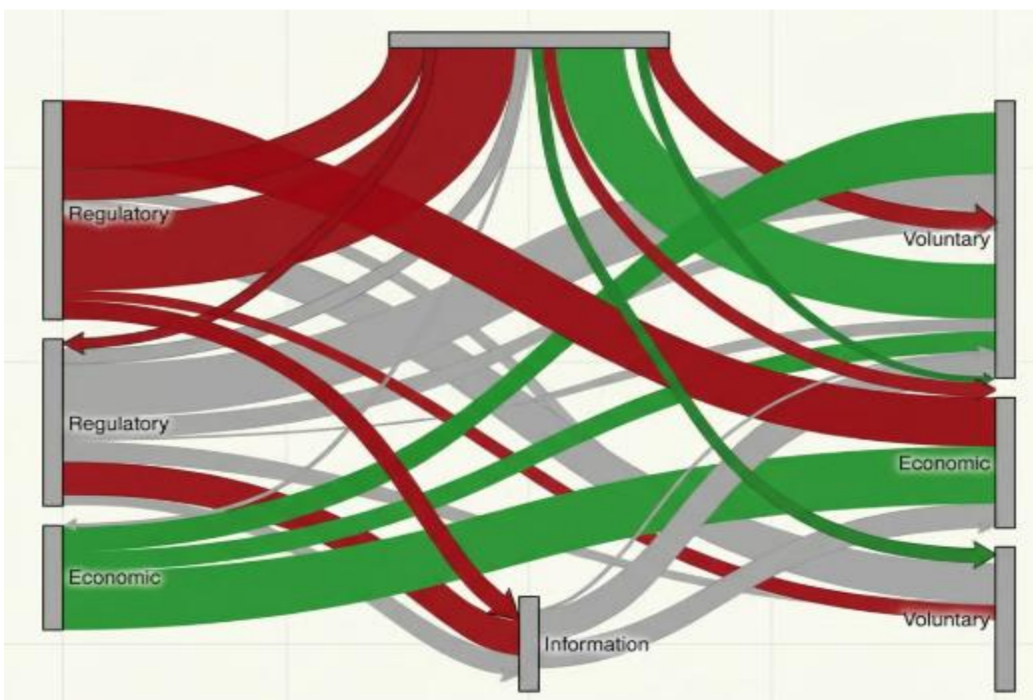

Figure 4: Instrument Interaction Network – Sankey Diagram with Chord Components

DISCUSSION

The above policy coherence analysis and the diverse impacts of policies on the economic, environmental and social dimensions highlight the critical need for multi-sectoral governance structures to support long-term food security (Hlahla et al., 2023; Venn et al., 2024; Fossi & Hendriks, 2020). This holistic approach demands a shift from the old one-sectoral food security policy to a more comprehensive and integrated policy that takes into account the complex interdependence among the various indicators of food security, as in the case of Dermoredjo et al., 2024. Such systems are especially important for addressing governance issues, especially in emerging economies where policy implementation might be strong, but where governance systems are weaker (Aassouli et al., 2023). In addition to integrated strategies, strong institutional structures are needed to support the implementation of policies and achieve sustainable results in order to tackle these systemic vulnerabilities (Mumah et al., 2025). The institutionalisation of Policy Coherence for Development provides a potential way to improve resilience through the convergence of disaster risk reduction, climate change adaptation and food security policies and contribute to shared responsibility and improved resource allocation (Myeni et al., 2026). The overall negative trends in the per capita CO_2 emission impacts on food security across several dimensions demonstrate the complex link between environmental degradation and food system resilience, thereby underlining the need for policies that reduce both the impact of CO_2 emissions and development in agriculture. The quadrantal analysis of food security in 120 countries suggests that the efficiency of food policies and food security outcomes are also different according to producer, consumer and trade policies and this difference is quite inequitable in terms of access (Mumah et al., 2025). In addition, the effectiveness of packages of policies is often dependent on their ability to take advantage of the synergy between single components, with targeted social and economic interventions like cash transfers achieving maximum impact when combined with agricultural extension, market linkages, and nutrition support services (Aguiar, 2025). Such policy coherence requires a significant shift in decision-making processes towards a comprehensive view, which should be supported by creating institutional mechanisms that coordinate the activities of various actors and promote complementarities between sectors of food, water resources and energy, with food production that doesn't lead to the increased intensity of use of resources (Rasul, 2015). This holistic approach also highlights the importance of flexible and region-specific support mechanisms and strong coordination to effectively tackle the specific challenges of distinct food systems (Galanakis et al., 2025). This becomes especially relevant in areas exposed to the risk of chronic crises, like conflict and climate-related shocks, where the capacity and fragility of institutions and governance can increase food insecurity risks (Fanzo et al., 2024). This also implies the need to formulate policies that tackle food security and climate change issues simultaneously to foster sustainable agriculture, increase climate change risks resilience and make food systems more equitable and nutritious (Iqbal et al., 2024). In light of this, it is imperative for policy-makers to have a deeper understanding of these interrelated issues and encourage partnerships between ministries, communities, civil society and the corporate sector in the development and execution of policies (Hasan & Adnan, 2023). This holistic engagement is crucial to help understand the potential conflicts and opportunities of the triple dimension of food systems, particularly in the face of increased stressors due to climate change (Coderoni et al., 2021; Dhar, 2025). An integrated systems approach to a national action plan might include novel cross-ministerial policies that could be aligned around a shared vision for change to be implemented in the agrifood system, as well as the repurposing of subsidies, the upgrading of sectoral strategies, and investments in infrastructure and services (Camillis & McAllister, 2024).

CONCLUSION

In this study, the policy coherence has been shown not only as a normative goal, but also as a measurable factor that affects the performance of agricultural systems and has measurable economic, environmental and food security impacts. The empirical evidence from the five OECD countries is that food security scores are almost 90 points higher in high-coherence regimes versus low-coherence regimes, and that the volatility of food security scores is cut in half, from 8.9 percent to 2.3 percent, in high-coherence regimes. Environmental dividends are also significant, with nitrous oxide emissions cut by 72 percent, soil organic carbon from a negative to a positive balance, and intactness of biodiversity by almost 23 percentage points. The results reveal that the institutional fragmentation is also a main cause of incoherence as the governance of the institutions in the category of fragmented governance systems is divided into almost twelve ministries with budget alignment less than 0.35; while the governance of the institutions in the centralized governance systems comprises three ministries with budget alignment above 0.84. Net welfare benefits of synergistic instrument combinations—such as research and development support and extension services—are more than 1.2 billion USD, while antagonistic combinations like subsidies and trade tariffs create significant welfare losses. The counterfactual scenario analysis further demonstrates that integrated coherence approach delivers unique positive gains on all fronts: GDP growth, agricultural production increase, farm income improvement, reduction in consumer prices, greenhouse gas mitigation and social welfare improvement of nearly 124 billion USD. The findings make us question the basis of agricultural policy design, which is based on isolated interventions for specific instruments and are now needed to be inter-sectoral, systemic and coordinated through shared budgeting, inter-ministerial committees, and integrated impact assessment.

REFERENCES

1. Aassouli, D., Akande, A., & Jureidini, R. (2023). Comparative analysis of sustainable food governance and the alignment of food security policies to sustainable development: A case study of OIC countries. Sustainability, 15(22), 15789. https://doi.org/10.3390/su152215789
2. Agarwala, C., Jemaneh, J., & Kassie, Y. (2022). Government policies and sustainable food systems: Navigating challenges, seizing opportunities, and advancing environmental and social resilience. Law and Economics, 16(2), 88. https://doi.org/10.35335/laweco.v16i2.53
3. Aguiar, J. C. de. (2025). Effective public policies to combat hunger and poverty: A critical narrative review of academic and institutional literature. Cadernos Cajuína, 10(4). https://doi.org/10.52641/cadcajv10i4.1212
4. Alali, S., Vaglia, V., Bocchi, S., Schievano, A., Betti, M., & Marinis, P. D. (2025). Using ecosystem services estimation to design sustainable agroforestry systems: Insights from Northern Italy. Agroforestry Systems, 99(8). https://doi.org/10.1007/s10457-025-01351-0
5. Barel-Shaked, S., & Buda, E. (2024). Exploring the nexus of agricultural policy reforms and food security. Frontiers in Sustainable Food Systems, 8. https://doi.org/10.3389/fsufs.2024.1366807
6. Bhandari, S., Yadav, B., Yadav, P. K., Lahutiya, V., & Koirala, S. (2024). Exploring agroecological approaches for sustainable agriculture and rural development: A comprehensive review. Asian Journal of Research in Agriculture and Forestry, 10(1), 79. https://doi.org/10.9734/ajraf/2024/v10i1271
7. Brooks, J. (2013). Policy coherence and food security: The effects of OECD countries' agricultural policies. Food Policy, 44, 88. https://doi.org/10.1016/j.foodpol.2013.10.006

8. Camillis, C. D., & McAllister, T. A. (2024). Agrifood systems transformation for climate action and environmental improvements, with co-benefits for food security and nutrition. The International Journal of Life Cycle Assessment. https://doi.org/10.1007/s11367-024-02365-z
9. Candel, J. (2016). Putting food on the table: The European Union governance of the wicked problem of food security. https://doi.org/10.18174/375781
10. Candel, J., & Daugbjerg, C. (2019). Overcoming the dependent variable problem in studying food policy. Food Security, 12(1), 169. https://doi.org/10.1007/s12571-019-00991-2
11. Coderoni, S., Helming, J. F. M., Pérez-Soba, M., Sckokai, P., & Varacca, A. (2021). Key policy questions for ex-ante impact assessment of European agricultural and rural policies. Environmental Research Letters, 16(9), 94044. https://doi.org/10.1088/1748-9326/ac1f45
12. Dermoredjo, S. K., Muawanah, U., Hidayat, A. S., Hidayat, R. P., Estiningtyas, W., & Pasaribu, S. M. (2024). National food development policies in Indonesia: An analysis of food sustainability and security. BIO Web of Conferences, 119, 5006. https://doi.org/10.1051/bioconf/202411905006
13. Dhar, A. R. (2025). Building climate-resilient food systems through the water–energy–food–environment nexus. Environments, 12(5), 167. https://doi.org/10.3390/environments12050167
14. Dobie, S. (2023). Integrated planning for climate resilience and food security: An analysis of urban food system resilience planning in U.S. cities. Deep Blue (University of Michigan). https://doi.org/10.7302/22230
15. Dwyer, J. (2021). AES presidential address, 2021: Policy analysis for rural resilience—Expanding the toolkit. Journal of Agricultural Economics, 73(1), 3. https://doi.org/10.1111/1477-9552.12470
16. Edwards, F., Sonnino, R., & Cifuentes, M. L. (2024). Connecting the dots: Integrating food policies towards food system transformation. Environmental Science & Policy, 156, 103735. https://doi.org/10.1016/j.envsci.2024.103735
17. Fanzo, J., Piters, B. de S., Soto, A., Ville, A. S., Mainuddin, M., & Battersby, J. (2024). Global and local perspectives on food security and food systems. Communications Earth & Environment, 5(1). https://doi.org/10.1038/s43247-024-01398-4

18. Fossi, F., & Hendriks, S. L. (2020). Food security policy choices: A review of the usefulness of public policy taxonomies. African Journal of Food, Agriculture, Nutrition and Development, 20(6), 16717. https://doi.org/10.18697/ajfand.94.20035
19. Galanakis, C. M., Daskalakis, M., Galanakis, I. M., Nehrey, M., Spanou, M., Vetsou, A., Chalkidou, A., & Agrafioti, E. (2025). Landscape of policies, standards, approaches, and projects for EU food security: An overview. Discover Food, 5(1). https://doi.org/10.1007/s44187-025-00387-6
20. Goh, E. V., Sobratee-Fajurally, N., Allegretti, A., Sardeshpande, M., Mustafa, M. A., Azam-Ali, S. H., Omari, R., Schott, J., Chimonyo, V. G. P., Weible, D., Mutalemwa, G., Mabhaudhi, T., & Massawe, F. (2024). Transforming food environments: A global lens on challenges and opportunities for achieving healthy and sustainable diets for all. Frontiers in Sustainable Food Systems, 8. https://doi.org/10.3389/fsufs.2024.1366878
21. Hasan, Md. M., & Adnan, A. (2023). Nexus between environmental sustainability, energy intensity and food security: Evidence from emerging economies. Journal of Business and Socio-Economic Development. https://doi.org/10.1108/jbsed-05-2023-0044
22. Hlahla, S., Ngidi, M. S. C., Duma, S. E., Sobratee-Fajurally, N., Modi, A. T., Slotow, R., & Mabhaudhi, T. (2023). Policy gaps and food systems optimization: A review of agriculture, environment, and health policies in South Africa. Frontiers in Sustainable Food Systems, 7. https://doi.org/10.3389/fsufs.2023.867481
23. Innovation, productivity and sustainability in food and agriculture. (2019). OECD Food and Agricultural Reviews. OECD Publishing. https://doi.org/10.1787/c9c4ec1d-en
24. Iqbal, B., Alabbosh, K. F., Jalal, A., Suboktagin, S., & Elboughdiri, N. (2024). Sustainable food systems transformation in the face of climate change: Strategies, challenges, and policy implications. Food Science and Biotechnology, 34(4), 871. https://doi.org/10.1007/s10068-024-01712-y
25. Kasim, S. N. S. A., Abas, M. A., & Sulaiman, C. (2023). Balancing the scales: Achieving food security and environmental sustainability in Malaysia through integrated approaches and collaborative governance. BIO Web of Conferences, 73, 3003. https://doi.org/10.1051/bioconf/20237303003

26. Kugelberg, S., Bartolini, F., Kanter, D., Milford, A. B., Pira, K., Sanz-Cobeña, A., & Leip, A. (2020). Implications of a food system approach for policy agenda-setting design. Global Food Security, 28, 100451. https://doi.org/10.1016/j.gfs.2020.100451
27. Kushitor, S. B., Drimie, S., Davids, R., Delport, C., Hawkes, C., Mabhaudhi, T., Ngidi, M. S. C., Slotow, R., & Pereira, L. (2022). The complex challenge of governing food systems: The case of South African food policy. Food Security, 14(4), 883. https://doi.org/10.1007/s12571-022-01258-z
28. M, M. del V., Shields, K., & Boza, S. (2024). Integration and coherence in food governance—A comprehensive analysis of food security public programs in Chile. Frontiers in Sustainable Food Systems, 8. https://doi.org/10.3389/fsufs.2024.1431969
29. Mehibel, S., Boudjana, R. H., Zambrano-Monserrate, M. A., Bouzid, A., & Lazereg, M. (2025). Food security, prices, and geopolitical risk: A dynamic panel threshold model. Geopolitics under Globalization, 6(1), 30. https://doi.org/10.21511/gg.06(1).2025.04
30. Mohammadi, E., Singh, S. J., McCordic, C., & Pittman, J. (2022). Food security challenges and options in the Caribbean: Insights from a scoping review. Anthropocene Science, 1(1), 91. https://doi.org/10.1007/s44177-021-00008-8
31. Monticone, F., Barling, D., Parsons, K., & Samoggia, A. (2023). Identifying food policy coherence in Italian regional policies: The case of Emilia-Romagna. Food Policy, 119, 102519. https://doi.org/10.1016/j.foodpol.2023.102519
32. Mooren, C. E., Papadopoulou, C.-A., Munaretto, S., Levedi, K., & Papadopoulou, M. P. (2025). A methodological framework for assessing the coherence of water-energy-food-ecosystem nexus policies: Illustration and application at the river basin level. Environmental Science & Policy, 170, 104113. https://doi.org/10.1016/j.envsci.2025.104113
33. Mouël, C. L., Lattre-Gasquet, M. D., & Mora, O. (2018). Land use and food security in 2050: A narrow road. Éditions Quae. https://doi.org/10.35690/978-2-7592-2880-5
34. Mumah, E., Yu, H., & Chen, Y. (2025). Exploring the reality of global food insecurity and policy gaps. Humanities and Social Sciences Communications, 12(1). https://doi.org/10.1057/s41599-025-05315-8
35. Murphy, K. J., & hUallacháin, D. Ó. (2024). Environmental policy in agricultural landscapes: The need for balancing ecosystem health and biodiversity conservation. https://doi.org/10.22541/au.172927888.85423014/v1

36. Myeni, S. A., Coetzee, C., & Kruger, L. (2026). Policy coherence for development as a potential framework for creating synergies between disaster risk reduction, climate change and food security: A theoretical review. Jàmbá: Journal of Disaster Risk Studies, 18(1), 1837. https://doi.org/10.4102/jamba.v18i1.1837
37. OECD. (2021). Making better policies for food systems. OECD Publishing. https://doi.org/10.1787/ddfba4de-en
38. Platjouw, F. M., Nesheim, I., & Enge, C. (2023). Policy coherence for the protection of water resources against agricultural pollution in the EU and Norway. Review of European, Comparative & International Environmental Law, 32(3), 485. https://doi.org/10.1111/reel.12509
39. Rasul, G. (2015). Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia. Environmental Development, 18, 14. https://doi.org/10.1016/j.envdev.2015.12.001
40. Robertson, A. (2014). A view of food security through a policy coherent lens. Technical University of Denmark. https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=kp&id=kp-e1395d28-7f6a-4709-ba44-a03b5dba85be&ti=A%20View%20of%20Food%20Security%20through%20A%20Policy%20Coherent%20Lens
41. Tchinda, A. F., & Talbot, D. (2023). Barriers and enablers of environmental policy coherence: A systematic review. Environmental Policy and Governance, 34(1), 77. https://doi.org/10.1002/eet.2057
42. Venn, R., Montero-de-Oliveira, F.-E., Buratti-Donham, J., Eden, J., & Reinecke, S. (2024). Policies for agroforestry, a narrative review of four 'continental' regions: EU, India, Brazil, and the United States. Frontiers in Sustainable Food Systems, 8. https://doi.org/10.3389/fsufs.2024.1417740
43. Vialatte, A., Martinet, V., Tibi, A., Alignier, A., Angeon, V., Bedoussac, L., Bohan, D. A., Bougherara, D., Carpentier, A., Castagneyrol, B., Cordeau, S., Courtois, P., Deguine, J., Doelher, M., Enjalbert, J., Fabre, F., Féménia, F., Fréville, H., Goulet, F., … Thoyer, S. (2023). Protéger les cultures en augmentant la diversité végétale des espaces agricoles. Rapport scientifique de l'Expertise scientifique collective. HAL. https://doi.org/10.17180/q7wm-q442

44. Zamani, O., Chibanda, C., Boimah, M., & Asante-Addo, C. (2025). Aligning policy for success in developing countries: Evidence from the poultry sector of Ghana. Agricultural and Food Economics, 13(1). https://doi.org/10.1186/s40100-025-00348-8
45. Zezza, A. (2023). CAP, Farm to Fork and Green Deal: Policy coherence, governance, and future challenges. *Bio-Based and Applied Economics, 12*(2), 83. https://doi.org/10.36253/bae-14794
46. Zinngrebe, Y., Borasino, E., Chiputwa, B., Dobie, P., García, E., Gassner, A., Kihumuro, P., Komarudin, H., Liswanti, N., Makui, P., Plieninger, T., Winter, E., & Hauck, J. (2020). Agroforestry governance for operationalising the landscape approach: Connecting conservation and farming actors. Sustainability Science, 15(5), 1417. https://doi.org/10.1007/s11625-020-00840-8