Bridging Disciplines for Sustainability: Achieving the SDGs Through Collaborative Synergy

Swasti Srivastava*

Assistant Professor, School of Life Sciences and Biotechnology, CSJM University, Kanpur

***Corresponding Author**

DOI: https://doi.org/10.51244/IJRSI.2026.1311000026

Received: 31 October 2026; Accepted: 05 November 2026; Published: 20 November 2026

ABSTRACT

The 2030 Agenda for Sustainable Development demands a shift away from traditional, siloed academic approaches toward integrated, cross-sectoral frameworks. This chapter examines how multidisciplinary collaboration in higher education can accelerate systemic progress toward interconnected Sustainable Development Goals (SDGs). Grounded in complex adaptive systems theory, institutional governance models, and university case studies, the study evaluates the dynamics of cross-field research. Findings indicate that isolated disciplines are inadequate for addressing complex, systemic challenges like climate disruption, resource depletion, and socio-economic inequity. Conversely, fusing natural sciences, engineering, social sciences, and humanities yields scalable, high-impact solutions. Nevertheless, structural barriers—including departmental silos, rigid tenure metrics, and fragmented funding—hinder deep collaboration. To resolve these friction points, we propose institutional reforms: revising faculty incentives to credit joint achievements, funding autonomous interdisciplinary hubs, updating graduate curricula with co-mentorship models, and building strategic public-private-civic partnerships that position higher education as a essential engine for global sustainability.

Keywords: academic governance, higher education, multidisciplinary collaboration, policy implications, SDG.

INTRODUCTION

1.1 Contextual background

The adoption of the 2030 Agenda for Sustainable Development by the United Nations in 2015 established a comprehensive framework designed to foster global peace, prosperity, and ecological balance (Carpentier & Braun, 2020). Central to this agenda are the 17 SDGs, which span interconnected economic, social, and environmental dimensions ranging from climate action (SDG 13) and clean energy (SDG 7) to quality education (SDG 4) and reduced inequalities (SDG 10) (Carpentier & Braun, 2020; Sorooshian, 2024; Yuan, 2021). These goals operate as a system of interdependent targets, where progress in one domain frequently hinges upon or impacts outcomes in another.

Higher education institutions (HEIs) occupy a vital position in this ecosystem as primary generators of knowledge, innovation, and leadership development (Ankareddy et al., 2025; Schaap et al., 2025). However, traditional academic structures have historically been organized around isolated, highly specialized disciplines. While departmental specialization has historically driven domain-specific advancements, it is fundamentally ill-equipped to address modern sustainability challenges (Jerab & Mabrouk, 2023; Rammert, 2025). Complex global issues cannot be understood or resolved through a single lens; they require collaborative strategies that bridge the natural sciences, social sciences, engineering, and humanistic disciplines.

1.2 Research gap

Despite growing recognition of the need for cross-field engagement, a significant gap remains between the theoretical endorsement of multidisciplinary collaboration and its practical implementation within higher education governance (Kim & Coonan, 2023; Nagelhout & Carradini, 2026). Existing literature frequently

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

highlights the broad benefits of sustainability education or focuses on specific technological innovations in isolation (Ankareddy et al., 2025; Ansari, 2025; Wardat & AlAli, 2025). However, limited critical analysis exists on the structural and institutional mechanisms required to operationalize multidisciplinary research effectively.

Furthermore, traditional academic governance structures characterized by rigid departmental budgeting, discipline-bound tenure and promotion criteria, and segregated grant allocation models continue to actively disincentivize collaborative work (Gudissa et al., 2025). There is a distinct lack of comprehensive frameworks that connect macro-level SDG targets with actionable administrative strategies, research evaluation reforms, and institutional policy implementations inside universities (Podgórska & Zdonek, 2024; Zhu et al., 2024).

Multidisciplinary collaboration emerges as a necessary approach to bridge these gaps. By integrating knowledge, tools, and methodologies from disparate fields, researchers and policy professionals can develop balanced, real-world solutions. Higher education institutions play a pivotal role as catalysts for this transformation, acting as hubs for research, innovation, and policy alignment. This chapter explores how multidisciplinary collaboration serves as an engine for achieving the SDGs, identifies structural barriers within higher education governance, and offers actionable strategies for fostering collaborative research ecosystems.

1.3 Objectives

The chapter aims to bridge the gaps by examining how higher education institutions can transition from fragmented academic silos into dynamic, multidisciplinary ecosystems capable of driving the SDGs. Specifically, the primary objectives of this study are to:

1. Evaluate the theoretical basis: Analyze how Complex Adaptive Systems (CAS) theory and cross-disciplinary models (multidisciplinarity, interdisciplinarity, and transdisciplinarity) apply to systemic SDG implementation.

2. Identify Institutional Barriers: Critically examine the structural, financial, and evaluation-based impediments that prevent faculty and researchers from engaging in cross-departmental collaboration.

3. Analyze Impact Models: Demonstrate the practical application and benefits of multidisciplinary research through real-world case studies focused on urban climate adaptation and circular economy innovations.

4. Propose Governance and Policy Solutions: Formulate actionable, structural policy recommendations for higher education leaders to reform institutional incentives, build collaborative research infrastructure, and align academic outputs with global sustainability targets.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 The nexus of complex adaptive systems and sustainability

Sustainability problems are inherently "wicked problems," challenges characterized by high complexity, uncertainty, dynamic interactions, and conflicting stakeholder values (Weaver et al., 2023). Grounded in CAS theory, global challenges like climate change (SDG 13) and reduced inequalities (SDG 10) involve interconnected components where a change in one domain inevitably creates ripple effects in another (Abujder et al., 2024; Magliocca, 2023).

A complex adaptive system (CAS) comprises interacting components whose collective behavior produces emergent patterns at the system level (Abbott & Hadžikadić, 2017; Carmody-Bubb, 2023). Examples include ecosystems, cities, and food or healthcare systems. These systems adapt to change, and their behavior cannot be predicted by studying parts alone(Abbott & Hadžikadić, 2017; Carmody-Bubb, 2023) . Understanding this relationship helps us develop sustainability strategies that can adapt to uncertainty and changing conditions. Sustainability demands balancing interconnected dimensions to avoid unintended consequences. Another scenario that can be considered pertains to implementing renewable energy infrastructure (SDG 7), which requires not only technological expertise from engineering disciplines but also socio-economic evaluations to

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

protect local livelihoods (SDG 8) and legal frameworks to ensure environmental justice (SDG 16). Viewing sustainability through the lens of CAS highlights the necessity of cross-disciplinary frameworks that can accommodate dynamic interactions across biological, physical, and socio-political systems.

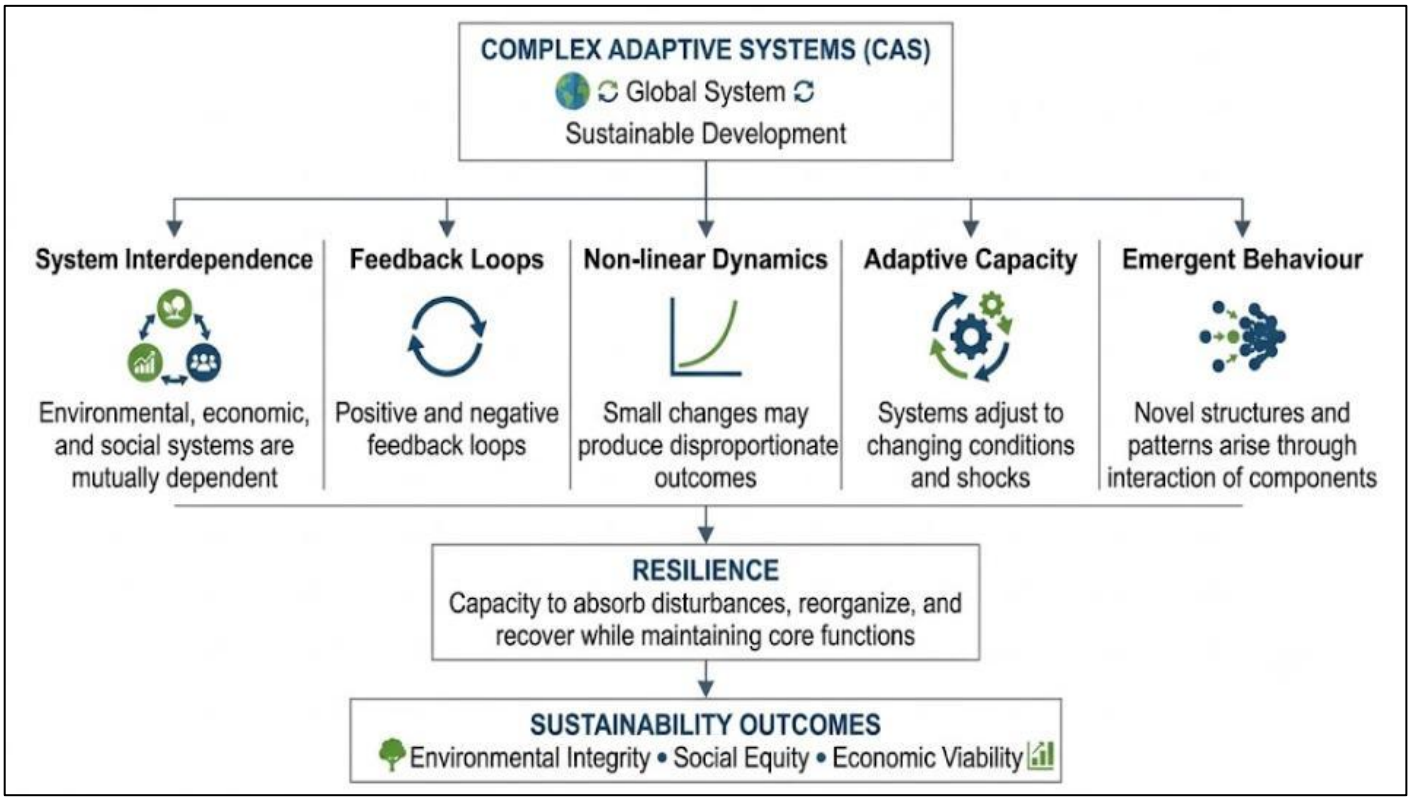


Figure 1: Complex Adaptive Systems and Sustainability Nexus

A nexus represents the interconnections among systems that influence one another, such as the water-energy, food-water-energy, climate-health, and technology-society-environment nexuses (Mutanga et al., 2024; Zahedi et al., 2024; Islam, 2025). Managing these domains in isolation is less effective than understanding their dynamic interactions. Complex adaptive systems underpin sustainability through feedback loops- positive feedback amplifies change, while negative feedback stabilizes systems (Abbott & Hadžikadić, 2017; Carmody-Bubb, 2023). Figure 1 illustrates sustainability as a dynamic process shaped by six principles: interconnectedness, non-linearity, feedback, adaptation, resilience, and emergence. Sustainable systems must remain resilient, capable of absorbing disturbances like climate change, resource depletion, pollution, and economic shocks while continuing to function. For instance, resilient agriculture integrates crop diversity, efficient irrigation, soil conservation, and local knowledge. Emergent properties arise from interactions among components, producing outcomes not predictable from individual parts such as collective consumer behavior driving plastic waste or energy demand. Hence, sustainability requires understanding collective dynamics and fostering collaboration across disciplines.

Thus, complex adaptive systems with sustainability lead to understanding how interconnected human, environmental, economic, and technological systems change over time and designing solutions that are resilient, adaptive, resource-efficient, and capable of responding to unexpected changes.

2.2 Spectrum of cross-disciplinary approaches

The "spectrum of cross-disciplinary approaches" involves a wide range of ways in which different academic disciplines, technologies, sectors, and stakeholders can work together to achieve sustainable development (Köhler et al., 2019a; Mansoor & Williams, 2024). Sustainable development cannot be addressed by one discipline alone because environmental, economic, technological, social, and health-related problems are interconnected (Islam, 2025; Izah et al., 2025). To effectively analyze collaboration, it is essential to delineate the spectrum of cross-disciplinary engagement:

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

- Multidisciplinarity: Scholars from different disciplines work sequentially or in parallel from their respective disciplinary perspectives to address a common problem without integrating their underlying frameworks (Cao et al., 2025; Shanableh et al., 2022). As for industrial wastewater treatment, chemists study pollutants, biologists study microbial degradation, environmental scientists assess ecological effects, and engineers design treatment systems. The findings are then combined to address the overall problem.

- Interdisciplinarity: Researchers actively integrate concepts, methodologies, and data from multiple fields to create a unified conceptual framework, as in the development of biomaterials for wastewater treatment (Shanableh et al., 2022). They may combine experts from biotechnology, nanotechnology, chemistry, environmental science, materials science, and engineering. Thus, the knowledge from different fields is integrated rather than simply placed side by side.

- Transdisciplinarity: Collaboration extends beyond academic institutions to include non-academic stakeholders such as policymakers, industry leaders, and local communities co-designing solutions to real-world problems (Mazzocchi, 2019; Shanableh et al., 2022). Scientific knowledge is combined with practical and local knowledge. A sustainable wastewater project demands collaboration among academia, industry, communities, and policymakers to create solutions that are technically sound, economically feasible, socially accepted, and environmentally sustainable. Building strong multidisciplinary networks within higher education lays the groundwork for achieving transdisciplinary transformation.

- Technology-driven approach: Emerging technologies such as nanotechnology, biotechnology, AI, IoT, GIS, and green chemistry integrate with traditional disciplines to address sustainability challenges. These innovations enable pollutant removal, bioremediation, and real-time environmental monitoring while promoting circular economy principles by transforming waste into valuable resources.

Table 1. Contribution of multiple disciplines to sustainable development (Mittal & Bansal, 2024; Vaverková et al., 2025)

Discipline	Contribution
Biology	Ecosystems and biodiversity
Chemistry	Pollutants and material transformations
Biotechnology	Bioremediation and bio-based technologies
Nanotechnology	Advanced materials and sensors
Environmental science	Environmental impacts
Engineering	Sustainable technologies
Economics	Cost and resource allocation
Sociology	Human behaviour and social acceptance
Data science/AI	Prediction and system modelling
Policy studies	Governance and regulation

Beyond the fields shown in Table 1, other disciplines also enrich sustainable development. Psychology contributes insights into behavioral change and environmental attitudes; law ensures compliance and justice in sustainability governance. Education fosters awareness and capacity building, and design thinking integrates creativity with human-centered innovation. Figure 2 depicts how collaboration between technical and human/social domains enables holistic solutions to complex sustainability challenges. The technical domain

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

comprising engineering, data science, and environmental science provide analytical and technological insights, while the human/social domain spanning economics, sociology, and policy & ethics offers contextual understanding and governance perspectives (Pennington et al., 2020; Selin & Selin, 2023). The collaborative framework connecting these domains fosters systemic innovations and integrated policy responses aligned with global sustainability.

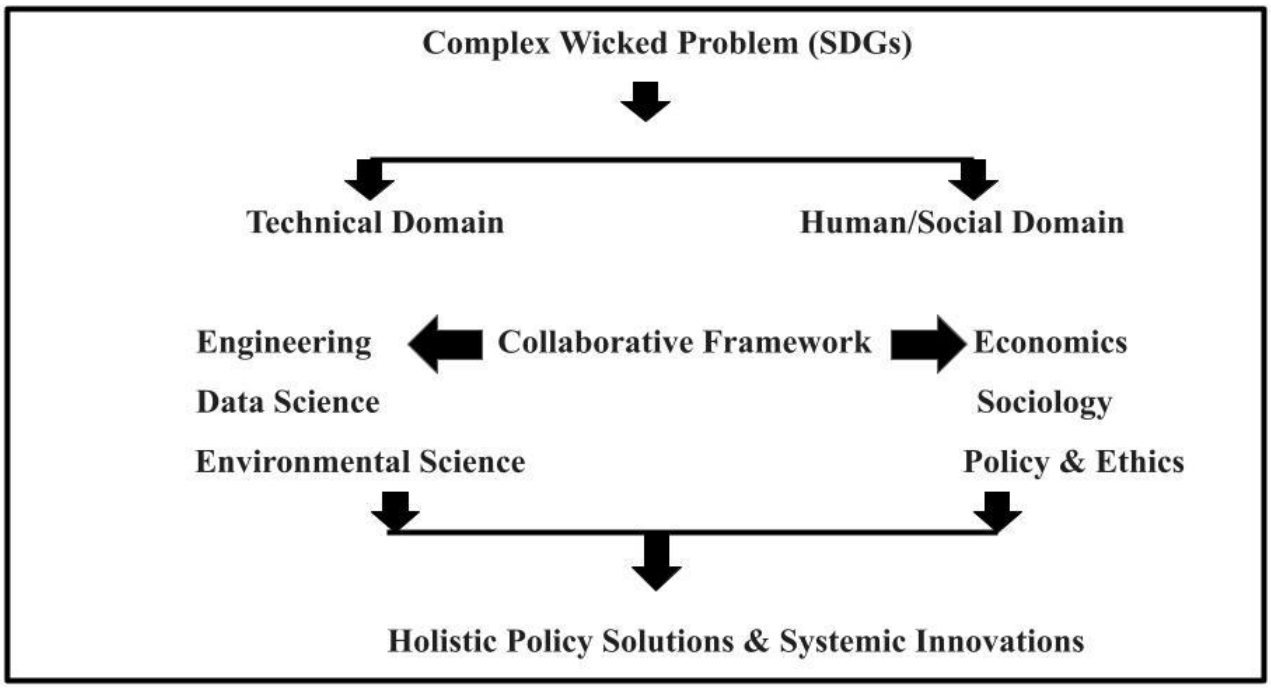


Figure 2: Interdisciplinary Framework for Addressing Complex Wicked Problems (SDGs)

Introducing new wastewater-treatment technologies demands integrating biotechnology, materials science, engineering, chemistry, and economics to ensure feasibility and acceptance. As collaboration deepens, disciplinary knowledge merges, engaging society and stakeholders. Sustainable development thus relies on cross-disciplinary integration and collective action rather than isolated academic solutions.

METHODOLOGY AND DISCUSSION FRAMEWORK

This qualitative study utilizes a thematic analysis and conceptual synthesis framework to examine institutional mechanisms for sustainability. The inquiry evaluates primary literature, policy frameworks from international organizations (e.g., UNESCO, UN-DESA), and institutional case studies of higher education initiatives around the world. The analytical framework evaluates collaborative capacity across three key dimensions.

a) Structural & institutional architecture
b) Incentive & evaluation systems
c) Pedagogical Integration

3.1. Structural & institutional architecture: Examining organizational hierarchies, departmental boundaries, and resource allocation

The organizational structures may be supportive or hindering collaboration, innovation, and long-term sustainability. The organizational hierarchy involves levels of authority and decision-making within an institution.

Navigating Hierarchies and Silos

Rigid administrative hierarchies and specialized departmental silos create significant barriers to interdisciplinary work (McCulloch & Dunn, 2018; Scott & Gong, 2021; Jones et al., 2024). Traditional departmental structures

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

slow interdisciplinary projects by creating administrative barriers. Sustainable institutions must shift toward integrated models with shared research centers and collaborative governance. Interdisciplinary funding pools, open-access facilities, and supportive policies such as joint projects, seed grants, and shared supervision enable efficient, cross-field innovation and resource optimization.

Communication Architecture and Participatory Decision-Making

Information flow in rigid organizations follows a slow, top-down path through administrative channels (Stanikzai & Mittal, 2025). A collaborative communication architecture, supported by shared digital platforms and research networks, facilitates direct exchanges among academic, industry, government, and community stakeholders. Shifting decision-making authority to distributed, cross-disciplinary panels streamlines project approvals, optimizes resource allocation, and aligns institutional priorities with real-world research goals.

Organizational Flexibility for Rapid Adaptation

Addressing emerging environmental challenges requires structural agility. Flexible institutions quickly form interdisciplinary teams, deploy shared resources, and refine strategies based on real-world testing. By decentralizing decision-making, streamlining approvals, and aligning incentives with collaborative outcomes, universities transform institutional architecture into an active engine for sustainable innovation. A strong architecture reduces departmental silos, facilitates resource sharing, encourages interdisciplinary collaboration, decentralizes appropriate decision-making, and creates incentives for sustainable innovation (Lah, 2025).

3.2. Incentive & evaluation systems: Analyzing promotion mechanisms, peer-review structures, and grant funding streams.

Incentive and evaluation systems recognize, reward, assess, and financially support the work of its faculty, researchers, departments, and organizations. In the context of cross-disciplinary approaches and sustainable development, these systems are extremely important because they determine what researchers are encouraged to do and what kinds of work are considered valuable (Braßler et al., 2026). A university may encourage interdisciplinary sustainability research in its policies, but if its promotion, peer review, and funding systems reward only conventional disciplinary achievements, researchers may continue to work within departmental boundaries.

Redesigning Promotion & Incentive Systems

Traditional promotion systems heavily weight single-discipline publication counts and individual achievements (Trueblood et al., 2025). To foster cross-disciplinary work, institutions must broaden criteria to encompass joint publications, multidisciplinary patents, technology transfer, and collaborative research programs. Additionally, tangible incentives such as reduced teaching loads, travel grants, shared facility access, and institutional recognition are essential to offset the additional labor interdisciplinary collaboration requires.

Evolving Peer Review & Grant Funding

Discipline-specific peer review introduces bias when evaluating multi-faceted proposals. Evaluating interdisciplinary projects requires panel structures with experts from all involved domains (e.g., biotechnology, engineering, economics) using dedicated interdisciplinary criteria (Deutsch et al., 2025). Concurrently, funding bodies must shift from rigid disciplinary silos to multi-stream models, offering dedicated sustainability grants, seed funding for emerging ideas, translational research grants, and joint industry-academia funding calls.

Balancing Individual vs. Team Contributions

Evaluating researchers solely on first-author papers hinders large-scale initiatives. Modern evaluation models contrast individual output with team achievement, assessing a researcher's specific role in leadership, methodology, or technical execution within major collaborative projects.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Measuring Societal Impact & Preventing Perverse Incentives

Counting only papers and citations overlooks real-world outcomes like cleaner water, waste reduction, improved public health, and sustainable technologies. Evaluating researchers on real-world societal and environmental impacts rather than just citations drives meaningful, cross-disciplinary innovation and aligns academic priorities with tangible results.

3.3. Pedagogical Integration: Assessing cross-departmental curricula and collaborative research opportunities for students.

Pedagogical integration refers to the deliberate integration of knowledge, skills, teaching methods, learning experiences, and research activities from different academic disciplines into a coherent educational framework (S. Singh, 2026). Sustainable development requires cross-disciplinary problem-solving to address complex issues like climate change, water pollution, and food security. As visualized in Figure 3, strong pedagogical integration achieved through joint courses, shared labs, co-supervision, and team-based learning builds the critical thinking and collaborative skills students need to deliver innovative sustainability solutions.

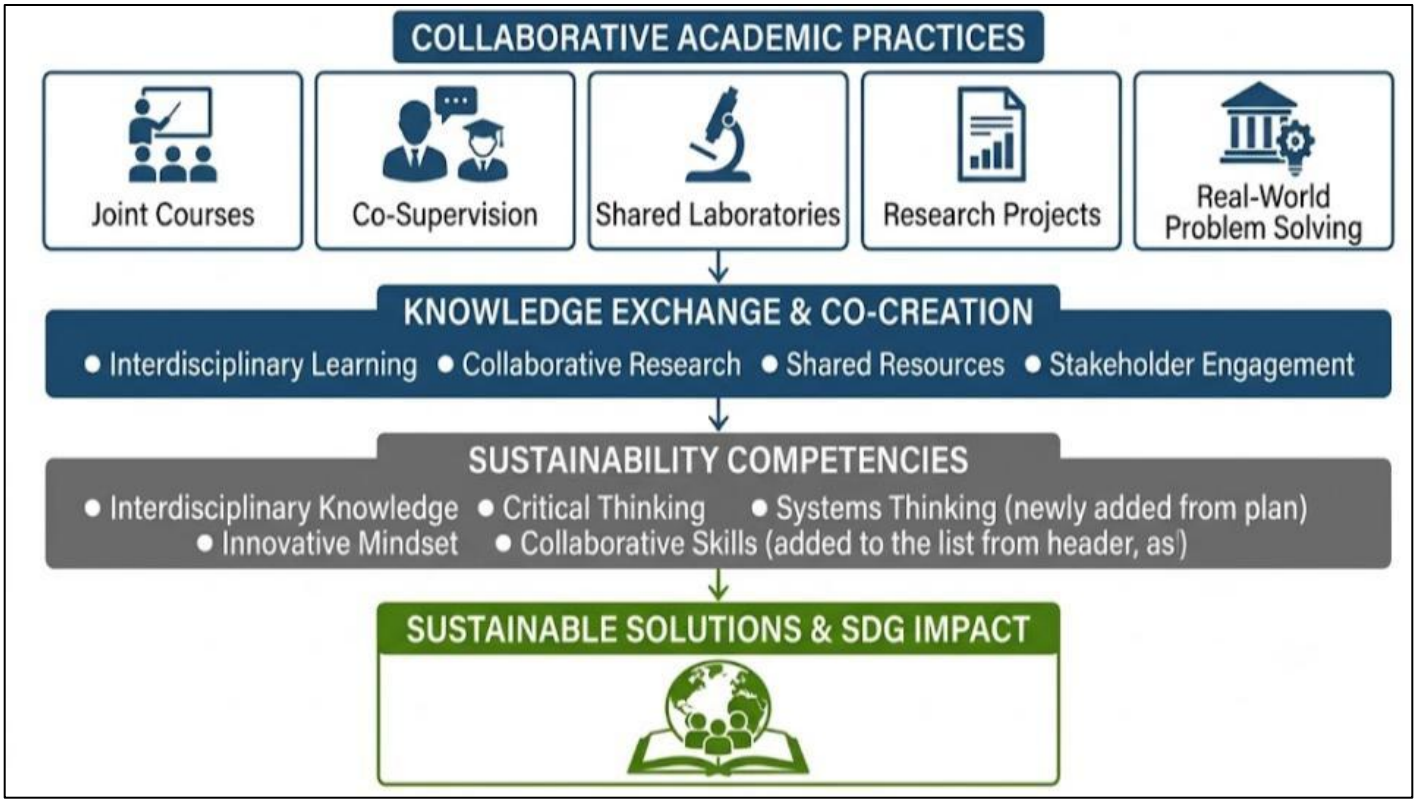


Figure 3: Pedagogical Integration for Interdisciplinary Sustainability Learning

Cross-departmental curricula & collaborative student research

Traditional education isolates disciplines into rigid silos. Pedagogical integration replaces this model with cross-departmental curricula that address complex problems such as climate change, water pollution, and food security from multiple angles (Ramírez-Montoya et al., 2026). For example, sustainable biotechnology courses integrate science, engineering, economics, and policy to tackle environmental challenges. Beyond the classroom, multi-disciplinary student teams collaborate on practical research projects like waste-to-energy conversion, bioplastic production, and water purification.

Interdisciplinary mentoring, shared infrastructure & skill development

Institutions can foster collaborative learning through joint faculty supervision and shared central infrastructure, like nanotechnology labs and bioinformatics hubs. This multi-departmental ecosystem gives students practical

access to diverse tools, building vital transferable skills in cross-disciplinary communication, project management, ethics, and sustainability assessment.

Authentic Assessment & Societal Integration

Conventional exams fail to measure multi-faceted learning. Effective evaluation models prioritize team projects, case studies, field research, posters, reflective reports, and innovation challenges that judge both individual contribution and group performance. Furthermore, pedagogical integration bridges academia with societal needs by partnering with local industries, municipalities, and NGOs (Sadykova et al., 2025). Engaging with authentic issues like municipal waste or industrial wastewater treatment prepares students to become collaborative, adaptive problem-solvers.

Pedagogical Alignment with SDG

Pedagogical alignment with the SDG emphasizes integrating sustainability principles into every dimension of higher education (Ramírez-Montoya et al., 2026). Institutional governance ensures that policies, faculty appointments, and departmental structures reflect sustainability priorities (Liu et al., 2026). Research innovation promotes interdisciplinary collaboration through multi-faculty projects and shared laboratories. Table 2 illustrates how institutional governance, research innovation, curriculum design, and community engagement collectively advance sustainability education. It highlights that governance reforms, interdisciplinary research, experiential learning, and civic partnerships together embed the Sustainable Development Goals into academic practice, fostering holistic and action-oriented learning.

Table 2 Pedagogical Dimensions Supporting SDG

Dimension	Primary Focus Area	Target SDGs Addressed
Institutional Governance	Departmental structures, joint faculty appointments	SDG 17 (Partnerships)
Research Innovation	Multi-faculty grant models, collaborative labs	SDG 9 (Industry, Innovation, Infrastructure)
Education & Curriculum	Interdisciplinary degrees, experiential learning	SDG 4 (Quality Education)
Community Impact	Public-private-civic partnerships	SDG 11 (Sustainable Cities & Communities)

A strong pedagogical integration system therefore creates interdisciplinary curricula, joint courses, co-supervision, collaborative research projects, shared laboratories, team-based learning, and real-world problem-solving opportunities. It prepares students not merely to become specialists in one field but to become collaborative problem-solvers capable of addressing complex sustainability challenges.

ANALYSIS AND DISCUSSION

4.1 Structural Barriers to Multidisciplinary Research

Despite widespread recognition that complex societal and sustainability challenges require collaboration across disciplines, academic institutions are still largely organized around disciplinary boundaries (Braßler et al., 2026; Lah, 2025). Academic structures, budgets, and promotion systems remain centered on specialized disciplines, creating friction for interdisciplinary research. As illustrated in Figure 3, structural barriers exist across individual, institutional, and system levels. Urging researchers to collaborate fails unless governance, funding, and evaluation frameworks simultaneously evolve to actively support cross-disciplinary work.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

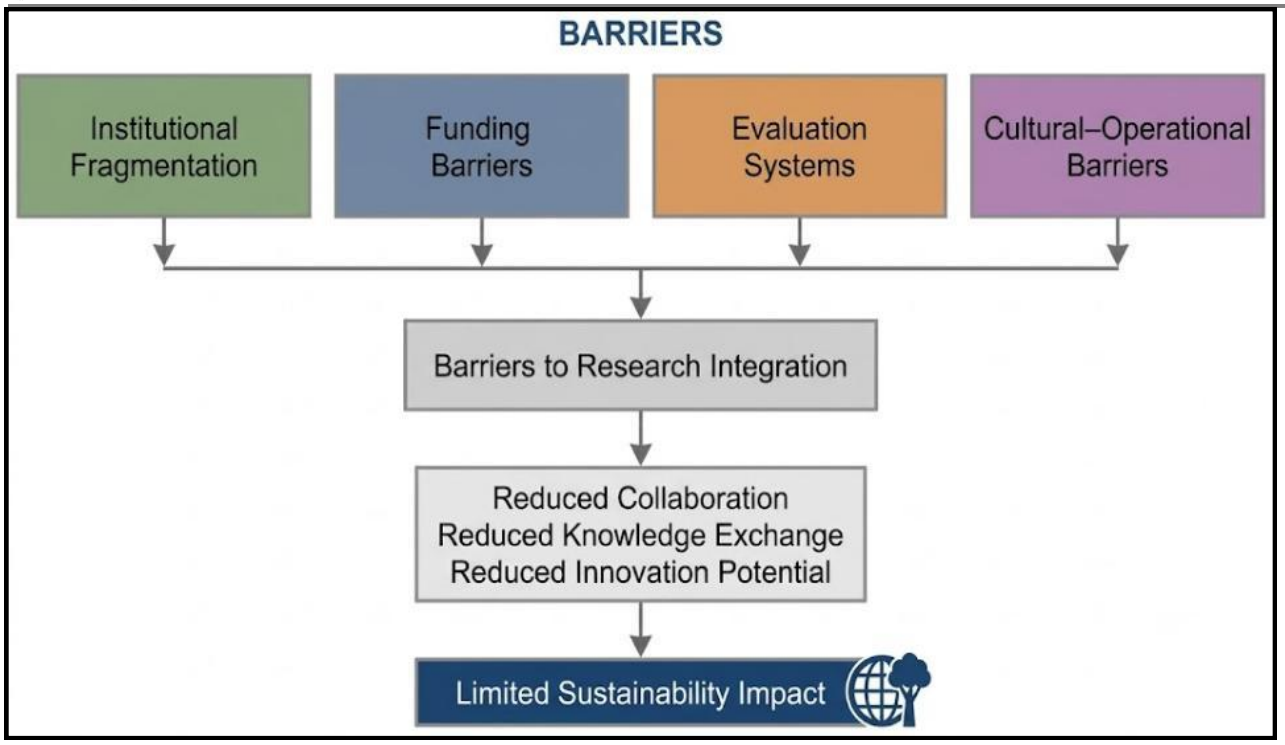


Figure 3: A Systems Perspective on Structural Barriers to Multidisciplinary Research

Departmental and Governance Barriers

Universities are traditionally organized into departments such as biotechnology, chemistry, engineering, and social sciences. While this structure promotes specialization, it restricts interaction across disciplines (Liu et al., 2026). Multidisciplinary projects often encounter administrative complications, viz., unclear ownership, budget control, and supervision responsibilities when spanning multiple departments. Shared governance mechanisms and interdisciplinary centers can mitigate these issues by clarifying roles and fostering joint accountability.

Resource and Funding Fragmentation

Departmental funding, segregated facilities, and narrowly categorized grants create rigid boundaries that restrict resource sharing and force interdisciplinary projects into traditional disciplinary molds. Establishing interdisciplinary funding pools and shared facilities can reduce these inefficiencies (Park et al., 2026).

Evaluation and Career Advancement

Academic promotion systems emphasize individual achievements like publications, citations, and single-discipline grants. Collaborative research, where contributions are distributed across teams, receives limited recognition (Kemp, 2013). This discourages participation in complex projects. Institutions can address this by revising evaluation criteria to value collaborative outputs and team-based innovation.

Peer Review and Publication Challenges

Multidisciplinary proposals are frequently reviewed by single-discipline experts who may not appreciate integrative approaches. Similarly, publication outlets remain discipline-specific, making it difficult for cross-domain studies to find suitable journals (Deutsch et al., 2025). Creating diverse review panels and supporting interdisciplinary journals can enhance visibility and acceptance of integrative research.

Communication and Methodological Barriers

Different disciplines use distinct terminologies, frameworks, and validation methods, leading to conceptual friction. Experimental scientists, engineers, economists, and social scientists often differ in how they define

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

evidence and success (Mariotti, 2022). Interdisciplinary workshops and training can help develop shared conceptual frameworks and methodological compatibility.

Workload, Time, and Cultural Constraints

Multidisciplinary collaboration demands extensive coordination meetings, shared data management, and joint writing, adding to faculty workload (LaFrance et al., 2019). Without institutional recognition of collaboration time, researchers may deprioritize such efforts. Moreover, academic culture often equates excellence with disciplinary depth, creating psychological resistance to cross-field work. Leadership-driven incentives and recognition programs can help shift this mindset.

Intellectual Property and Student Barriers

Collaborative projects raise questions about ownership of publications, patents, and datasets. Transparent policies on authorship and IP rights are essential to prevent disputes. Students also face rigid curricula that limit cross-departmental learning. Joint courses, co-supervision, and shared laboratories can cultivate interdisciplinary competence among future researchers (LaFrance et al., 2019).

Data and Infrastructure Silos

Research data are often stored in isolated departmental systems using incompatible formats. This hinders integration and reuse. Developing shared digital infrastructure and interoperable databases can strengthen collaborative capacity.

Strategies for Overcoming Barriers

Overcoming institutional barriers through shared funding, joint governance, and interdisciplinary centers enables high-impact SDG outcomes. As highlighted in Table 3, multidisciplinary involvement serves as the foundation, but long-term sustainability impact relies on integrating knowledge, structured governance, and practical implementation to transform academic frameworks into real-world solutions.

Table 3. Synergy-to-Sustainability Framework for Multidisciplinary Action in Higher Education Institutions (Annelin & Boström, 2024)

Stage	**Institutional Function**	**Integration Mechanism**	**Expected Contribution**
Sustainability challenge definition	Establish system boundaries, relevant SDGs, affected populations and principal pressures	Systems and SDG-nexus mapping	Prevents narrow disciplinary framing
Knowledge and capability mapping	Identify scientific, technical, social, economic, policy and contextual expertise	Cross-disciplinary capability mapping	Aligns participation with the actual problem
Collaboration architecture	Define leadership, roles, resources, data arrangements and responsibilities	Boundary-spanning governance	Reduces administrative and coordination barriers
Integrated problem framing	Combine complementary disciplinary interpretations	Interdisciplinary synthesis	Reveals causal connections, vulnerabilities and trade-offs

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Co-design and implementation	Translate integrated knowledge into workable interventions	Researcher-stakeholder collaboration	Links academic knowledge with implementation
Multidimensional evaluation	Assess environmental, health, economic, social, institutional and SDG-interaction outcomes	Integrated sustainability indicators	Avoids single-dimensional definitions of success
Learning, adaptation and scaling	Use evidence to modify, replicate, discontinue or expand interventions	Feedback and organizational learning	Builds durable institutional capacity

4.2 Synergistic Case Studies: The SDG Impact

Case Study 1: Climate Adaptation and Public Health (SDGs 3, 11, and 13)

An initiative uniting climate scientists, urban planners, and public health experts exemplifies how cross-disciplinary collaboration can address complex sustainability challenges. By integrating microclimate projections, green-infrastructure design, and health-impact evaluation, the team developed predictive models for urban heat islands. The resulting policy tool enabled municipal leaders to reduce urban temperatures and heat stress hospitalizations, demonstrating the synergy between climate adaptation and public health (Goniewicz et al., 2025; Jia & Turcu, 2025; Lobo et al., 2023)**.**

Interconnectedness of Sustainable Development Goals

Climate adaptation and public health illustrate the interdependence of SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) (Seelajaroen & Jitmaneeroj, 2025). Climate change affects not only ecosystems but also human health, infrastructure, water availability, food security, and social equity (Goniewicz et al., 2025; Lobo et al., 2023). Building climate-resilient cities therefore requires simultaneous protection of human health, strengthening of urban systems, and adaptation to environmental change.

Climate Risks and Urban Vulnerability

Rising environmental stresses like extreme heat, pollution, and shifting disease patterns heavily impact vulnerable urban populations. Climate adaptation advances SDG 3 by mitigating health risks, requiring health systems to strengthen resilience through early-warning networks, heat-health plans, disease surveillance, and robust infrastructure.

Urban Resilience and Infrastructure Design

Under SDG 11, sustainable urban planning integrates green roofs, urban forests, cool surfaces, improved drainage, flood-resistant structures, and climate-resilient housing (Jia & Turcu, 2025). These interventions enhance environmental quality while improving public health outcomes. Urban adaptation strategies must also ensure inclusivity. Installing green infrastructure only in affluent areas may improve local conditions but fail to achieve equitable sustainability.

Transdisciplinary Climate-Health Framework

Addressing climate-health challenges requires a transdisciplinary framework that integrates public health, environmental sciences, urban planning, data analytics, social sciences, and governance (Goniewicz et al., 2025; Lobo et al., 2023). By combining these scientific, social, and policy dimensions, institutions can accurately assess risks, build resilient infrastructure, and implement effective, coordinated health-climate solutions.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Equity, Water Security, and Governance

Climate risks disproportionately impact vulnerable populations, requiring social equity in adaptation strategies (Mutanga et al., 2024). Advanced tools like real-time water quality sensors help prevent disease outbreaks. To maximize impact, multi-sector partnerships among universities, governments, and industries must collaborate, evaluating success across SDG metrics to advance health, urban resilience, and sustainability simultaneously.

Evaluating Integrated Outcomes Across SDG Dimensions

To assess the real impact of climate-health and sustainability interventions, evaluation must move beyond single-sector metrics toward integrated indicators that reflect the synergy among SDG 3 (Health), SDG 11 (Urban Sustainability), and SDG 13 (Climate Action). Measuring success through a multidimensional lens ensures that improvements in one domain, such as reduced heat-stress hospitalizations, are linked to parallel gains in urban resilience and climate adaptation.

Integrated indicators as summarized in Table 4 capture cross-cutting outcomes such as reduced disease burden, enhanced green infrastructure, improved air and water quality, and strengthened institutional capacity for climate-responsive governance. They also highlight co-benefits, including social equity, resource efficiency, and participatory decision-making (Workman et al., 2026; Wright et al., 2025). By aligning evaluation frameworks across health, environment, and urban systems, policymakers can identify interventions that deliver simultaneous progress toward multiple SDGs, ensuring that sustainability efforts remain holistic, adaptive, and inclusive.

Table 4: Integrated indicators across SDG dimensions for intervention evaluation

SDG Dimension	Focus Area	Key Performance Indicators
Health Indicators (SDG 3: Good Health & Well-Being)	Public health impacts, disease burden, and community health resilience	Heat-related illness Hospital admissions Mortality Vector-borne disease incidence Respiratory disease
Urban Indicators (SDG 11: Sustainable Cities & Communities)	Environmental quality, urban infrastructure resilience, and livability	Green-space availability Urban temperature Drainage capacity Access to resilient infrastructure Air quality
Climate Indicators (SDG 13: Climate Action)	Mitigation, risk reduction, preparedness, and adaptive capability	Greenhouse-gas emissions Climate-risk exposure Adaptation capacity Energy efficiency Disaster preparedness

Simultaneously achieving SDG 3, SDG 11, and SDG 13 requires moving beyond isolated sectoral planning. Interconnected climate, health, and urban challenges demand integrated, cross-disciplinary, and participatory approaches to build resilient cities and equitable health outcomes.

Case Study 2: Circular Economy Innovations (SDGs 8, 12, and 17)

A joint project between materials engineering, business management, and environmental law yielded biodegradable packaging solutions paired with commercialization models. Engineers designed sustainable materials, business researchers mapped supply-chain logistics, and legal experts navigated regulatory approvals. This combined effort accelerated the commercial viability of green packaging alternatives far faster than a purely technical research endeavor could achieve.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Transitioning from a traditional linear economy ("Take-Make-Use-Dispose") to a regenerative circular economy ("Reduce-Reuse-Repair-Recover-Recycle-Regenerate") fundamentalizes resource conservation (Daga et al., 2025). Rather than treating waste management as an end-of-pipe mitigation strategy, circular innovation systematically preserves product and material value across their life cycles. This systemic evolution requires integrating economic, technological, environmental, and institutional dimensions.

The Interconnected Nexus of SDG 8, SDG 12, and SDG 17

Sustainable development relies on the mutual reinforcement of production systems, economic growth, and cross-sectoral collaboration. Figure 4 illustrates the dynamic interplay among SDG 8, SDG 12, and SDG 17, emphasizing how responsible consumption, decent work, and global partnerships collectively drive sustainable production and inclusive growth. SDG 12 drives sustainable design and resource recovery, SDG 8 turns these waste streams into economic growth and green jobs, and SDG 17 connects key stakeholders to scale these innovations across industries and communities.

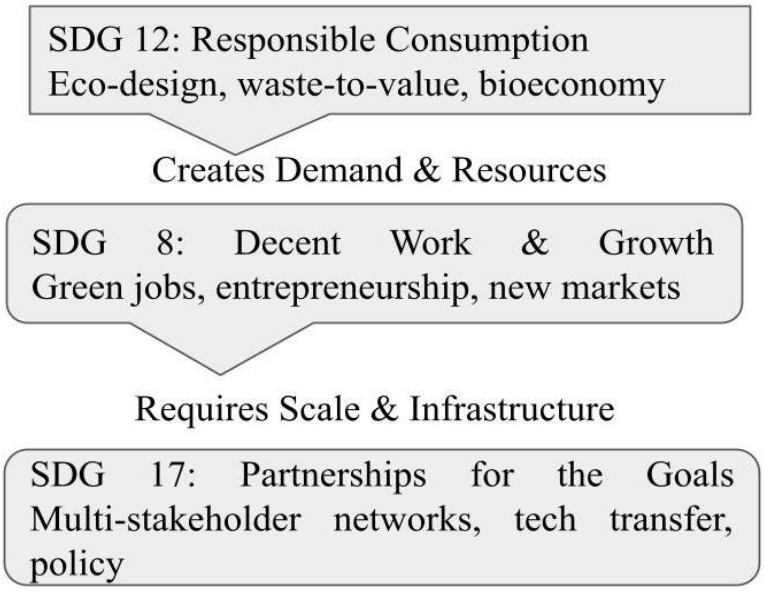


Figure 4: SDG 8, SDG 12, and SDG 17 nexus

Operationalizing Circularity: Bioeconomy and Industrial Symbiosis

Circular frameworks achieve commercial and ecological viability by turning organic waste like agricultural residues, keratin, and food discards into bioplastics, materials, and biofuels. Through industrial symbiosis and intentional life cycle design, one industry's waste becomes another's raw material, shifting the focus from post-consumer waste management to closed-loop resource recovery (Barathi et al., 2026).

Digital technologies

Digital technologies accelerate circularity by creating intelligent systems that monitor and optimize resource use. AI enhances waste sorting and predictive maintenance; IoT and digital twins enable real-time tracking and simulation of material flows; and blockchain ensures transparent, verified supply-chain traceability for sustainable resource management (Dhingra et al., 2026; Handoyo & Sueb, 2026).

Multi-stakeholder ecosystems

Translating circular concepts into market-ready applications requires cross-sector collaboration among governments, academia, industry, and civil society. These multi-stakeholder ecosystems enable resource pooling, shared governance, and knowledge exchange (Malysheva, 2022). As detailed in Table 5, diverse partners collectively drive policy, innovation, and community engagement to advance sustainable development across environmental, economic, and social dimensions.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Table 5: The stakeholders and their contribution to sustainability

Stakeholder Group	Primary Operational Contribution
Universities & Research	Fundamental R&D, waste characterization, techno-economic analysis, life-cycle assessments (LCA)
Industry & Start-ups	Scale-up manufacturing, commercialization, product-as-a-service delivery, take-back infrastructure
Government & Policy	Regulatory frameworks, tax incentives, green public procurement, landfill diversion mandates.
Investors & Financials	Venture capital, green bonds, seed funding for emerging circular technology scale-ups.
Communities & NGOs	Raw material supply collection, consumer adoption, social impact verification, public awareness

Multidimensional Metrics and System Implementation

Evaluating circular economy outcomes requires holistic environmental, economic, and social metrics that look beyond simple waste volumes. Although high initial costs, fragmented supply chains, and regulatory hurdles pose significant challenges, aligning responsible production (SDG 12), economic growth (SDG 8), and multi-stakeholder partnerships (SDG 17) creates a self-sustaining cycle for long-term circular success (Truant et al., 2024).

5. Future Strategies for Interdisciplinary Sustainability

Achieving the SDG requires shifting from isolated disciplinary knowledge toward integrated systems (Köhler et al., 2019; Panda & Dash, 2025). The following strategic priorities provide a roadmap for structural, educational, and governance reform.

- **Reforming Academic Governance & Incentives:** Universities and funding bodies must update promotion, tenure, and appraisal models to credit collaborative research, multi-author contributions, joint patents, and real-world policy translation.

- **Structuring Cross-Departmental Infrastructure:** Institutions should establish dedicated Interdisciplinary Research Centers (IRCs) and shared core laboratories operating outside traditional departmental hierarchies. Supported by independent budgets and seed grant programs, these centers equalize resource access for complex inquiries.

- **Integrating Modular Curricula & Co-Mentorship:** Higher education must embed interdisciplinary problem-based learning into graduate and doctoral frameworks. Joint student supervision across fields such as biotechnology, engineering, and economics prepares future researchers to address complex challenges like climate resilience and water security.

- **Fostering Multi-Stakeholder Alliances (SDG 17):** Governance frameworks should build participatory partnerships with industry, local governments, and civil society. Engaging non-academic stakeholders in defining research questions ensures solutions move directly from the laboratory into commercial and community implementation.

- **Embedding Systems Thinking & Adaptive Policy:** Policy design and institutional governance must account for feedback loops, non-linear developments, and non-academic outcomes. Continuous monitoring and adaptive management ensure interventions account for economic, social, and environmental trade-offs.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue XI November 2026

Figure 5 illustrates a process-flow model of a three-stage strategic framework transitioning from foundational academic governance to pedagogical integration and broader strategic stakeholders. It highlights key operational pillars at each phase, including collaborative metrics, co-mentorship models, and multi-sector alliances to drive systemic educational policy of the future.

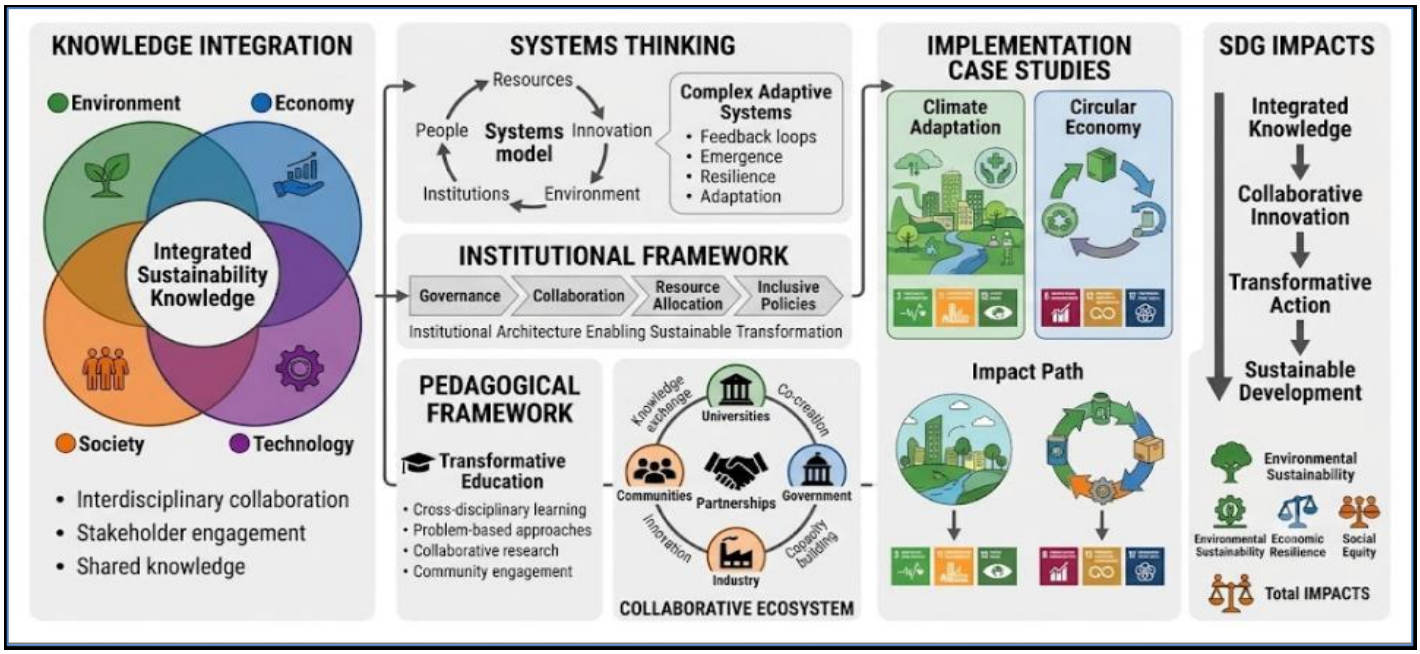


Figure 5: Strategic Framework for Educational Integration and Stakeholder Collaboration

CONCLUSION

Sustainable development is fundamentally a collaborative and systemic endeavor. While deep domain specialization remains essential, it is insufficient on its own for solving challenges whose causes and consequences cross disciplinary, institutional, and geographic boundaries. Addressing interconnected global problems demonstrated by the alignment of climate adaptation with public health (SDGs 3, 11, 13) and circular bioeconomy innovations (SDGs 8, 12, 17) requires a fundamental structural shift.

Cross-disciplinary collaboration cannot depend solely on individual goodwill; it requires systemic institutional transformation. Departmental silos, rigid administrative hierarchies, and narrow metric-counting must be replaced by flexible organizational architectures, holistic incentive structures, and cross-departmental educational frameworks. Higher education institutions must evolve from isolated repositories of specialized knowledge into dynamic, collaborative ecosystems. By aligning scientific excellence with structural flexibility, adaptive governance, multi-stakeholder partnerships, and responsible innovation, academic and policy systems can move past fragmented responses toward resilient, inclusive, and transformative pathways for achieving the Sustainable Development Goals.



Graphical abstract: Interdisciplinary Pathways to Sustainability: Research, Innovation, and Real-World Impact

REFERENCES

1. Abbott, R., & Hadžikadić, M. (2017). Complex Adaptive Systems, Systems Thinking, and Agent-Based Modeling. In M. Hadžikadić & S. Avdaković (Eds.), Advanced Technologies, Systems, and Applications (Vol. 3, pp. 1–8). Springer International Publishing. https://doi.org/10.1007/978-3-319-47295-9_1
2. Abujder, W., Neto, A., Junior, P., Palma Calabokis, O., & Ballesteros-Ballesteros, V. (2024). The Theory of Complexity and Sustainable Urban Development: A Systematic Literature Review. Sustainability, 17. https://doi.org/10.3390/su17010003
3. Ankareddy, S., Dorfleitner, G., Zhang, L., & Ok, Y. S. (2025). Embedding sustainability in higher education institutions: A review of practices and challenges. Cleaner Environmental Systems, 17, 100279. https://doi.org/10.1016/j.cesys.2025.100279
4. Annelin, A., & Boström, G.-O. (2024). Interdisciplinary perspectives on sustainability in higher education: A sustainability competence support model. Frontiers in Sustainability, 5. https://doi.org/10.3389/frsus.2024.1416498
5. Ansari, M. S. A. (2025). Sustainability through innovation and creativity in educational landscape: A systematic literature review analysis. Sustainable Futures, 10, 101433. https://doi.org/10.1016/j.sftr.2025.101433
6. Barathi, A., Kundu, D., Pooja, K., Surya, M., Jacob, S., Samanta, P., Kumar, V., & Kuila, A. (2026). Toward sustainable industry: Integrating industrial symbiosis, biorefineries, and circular economy for SDG alignment. Sustainable Energy & Fuels, 10(8), 1816–1844. https://doi.org/10.1039/d6se00037a
7. Braßler, M., Schultze, M., & Krys, S. (2026). Beyond disciplinary boundaries: Exploring cross-understanding in interdisciplinary teams in the field of sustainable development. Sustainability: Science, Practice and Policy, 22(1), 2674557. https://doi.org/10.1080/15487733.2026.2674557
8. Cao, Z., Zhang, L., & Huang, Y. (2025). How do researchers collaborate across disciplines? Patterns of interdisciplinary collaboration based on disciplinary and contributory perspectives. Journal of Information Science, 01655515251373082. https://doi.org/10.1177/01655515251373082
9. Carmody-Bubb, M. (2023). What Is a Complex Adaptive System? In M. Carmody-Bubb (Ed.), Cognition and Decision Making in Complex Adaptive Systems: The Human Factor in Organizational Performance (pp. 7–11). Springer International Publishing. https://doi.org/10.1007/978-3-031-31929-7_2
10. Carpentier, C. L., & Braun, H. (2020). Agenda 2030 for Sustainable Development: A powerful global framework. Journal of the International Council for Small Business, 1(1), 14–23. https://doi.org/10.1080/26437015.2020.1714356
11. Daga, S., Yadav, K., Singh, P., & Mishra, V. (2025). Beyond the Take-Make-Dispose Model—Unlocking the Power of Circular Economy for an Environmentally Resilient Future. In P. Singh, S. Daga, K. Yadav, & V. Mishra (Eds.), Circular Economy and Environmental Resilience: Solutions for a Sustainable Tomorrow, Volume 1 (pp. 1–11). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-93091-1_1
12. Deutsch, L., Pohl, C., Bresch, D. N., & Hoffmann, S. (2025). Creating favorable conditions for inter- and transdisciplinary integration – An analytical framework and empirical insights. Global Environmental Change, 91, 102963. https://doi.org/10.1016/j.gloenvcha.2024.102963
13. Dhingra, D., Mishra, R., Chhabra, S., & Abichandani, Y. (2026). Digital Technologies and the Future of Circular Economy: AI, Blockchain, and IoT in Sustainable Global Trade. In A. Kumar, P. Batta, P. S. Rathore, T. A. Kumar, & J. R. J. Ramírez (Eds.), Blockchain Innovations for a Sustainable Circular Economy (pp. 257–278). Springer Nature Switzerland. https://doi.org/10.1007/978-3-032-02428-2_11
14. Goniewicz, K., Burkle, F. M., & Khorram-Manesh, A. (2025). Transforming global public health: Climate collaboration, political challenges, and systemic change. Journal of Infection and Public Health, 18(1), 102615. https://doi.org/10.1016/j.jiph.2024.102615
15. Gudissa, Z. A., Pittino, D., Bayiley, Y. T., & Eslami, M. (2025). Strategy-making at higher education institutions: Faculty member's academic engagement with industry and strategy participation. Cogent Education, 12(1), 2588541. https://doi.org/10.1080/2331186X.2025.2588541
16. Handoyo, S., & Sueb, M. (2026). Integrating Digital Technologies Into the Circular Economy: A Systematic Literature Review of Trends, Challenges, and Opportunities. Circular Economy and Sustainability, 6(2), 111. https://doi.org/10.1007/s43615-026-00876-5

17. Islam, H. (2025). Nexus of economic, social, and environmental factors on sustainable development goals: The moderating role of technological advancement and green innovation. Innovation and Green Development, 4(1), 100183. https://doi.org/10.1016/j.igd.2024.100183
18. Izah, S. C., Ogwu, M. C., & Salimon, S. S. (2025). Principles of Sustainable Development and Environmental Management. In M. C. Ogwu & S. Chibueze Izah (Eds.), Evaluating Environmental Processes and Technologies (pp. 29–63). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-85327-2_2
19. Jerab, D., & Mabrouk, T. (2023). The Evolving Landscape of Organizational Structures: A Contemporary Analysis (SSRN Scholarly Paper No. 4584643). Social Science Research Network. https://doi.org/10.2139/ssrn.4584643
20. Jia, Y., & Turcu, C. (2025). Climate, Health, and Urban Green Infrastructure: The Evidence Base and Implications for Urban Policy and Spatial Planning. International Journal of Environmental Research and Public Health, 22(12), 1842. https://doi.org/10.3390/ijerph22121842
21. Jones, A. A., Uhd, J., Kabore, C. D., & Cornett, K. A. (2024). Breaking Down Silos in the Workplace: A Framework to Foster Collaboration. Journal of Public Health Management and Practice : JPHMP, 30(6), E306–E311. https://doi.org/10.1097/PHH.0000000000002007
22. Kemp, A. (2013). Collaboration vs. Individualism: What Is Better for the Rising Academic? The Qualitative Report, 18(50), 1–8. https://doi.org/10.46743/2160-3715/2013.1429
23. Kim, E., & Coonan, T. (2023). Advancing Sustainability Education through a Cross-Disciplinary Online Course: Sustainability and Human Rights in the Business World. Sustainability, 15(6), 4759. https://doi.org/10.3390/su15064759
24. Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., … Wells, P. (2019a). An agenda for sustainability transitions research: State of the art and future directions. Environmental Innovation and Societal Transitions, 31, 1–32. https://doi.org/10.1016/j.eist.2019.01.004
25. Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., … Wells, P. (2019b). An agenda for sustainability transitions research: State of the art and future directions. Environmental Innovation and Societal Transitions, 31, 1–32. https://doi.org/10.1016/j.eist.2019.01.004
26. LaFrance, D. L., Weiss, M. J., Kazemi, E., Gerenser, J., & Dobres, J. (2019). Multidisciplinary Teaming: Enhancing Collaboration through Increased Understanding. Behavior Analysis in Practice, 12(3), 709–726. https://doi.org/10.1007/s40617-019-00331-y
27. Lah, O. (2025). Breaking the silos: Integrated approaches to foster sustainable development and climate action. Sustainable Earth Reviews, 8(1), 1. https://doi.org/10.1186/s42055-024-00102-w
28. Liu, J., Li, C., & Liu, L. (2026). University Governance for Sustainability: Overcoming Structural Fragmentation to Enable Institutional Transformation. Sustainability, 18(15), 8019. https://doi.org/10.3390/su18158019
29. Lobo, J., Aggarwal, R. M., Alberti, M., Allen-Dumas, M., Bettencourt, L. M. A., Boone, C., Brelsford, C., Broto, V. C., Eakin, H., Bagchi-Sen, S., Meerow, S., D'Cruz, C., Revi, A., Roberts, D. C., Smith, M. E., York, A., Lin, T., Bai, X., Solecki, W., … Gauthier, N. (2023). Integration of urban science and urban climate adaptation research: Opportunities to advance climate action. Npj Urban Sustainability, 3(1), 32. https://doi.org/10.1038/s42949-023-00113-0
30. Magliocca, N. R. (2023). Intersecting security, equity, and sustainability for transformation in the Anthropocene. Anthropocene, 43, 100396. https://doi.org/10.1016/j.ancene.2023.100396
31. Malysheva, E. A. (2022). Stakeholders and Their Role in the Context of Sustainable Development. In S. I. Ashmarina & V. V. Mantulenko (Eds.), Proceedings of the International Conference Engineering Innovations and Sustainable Development (pp. 663–668). Springer International Publishing. https://doi.org/10.1007/978-3-030-90843-0_75
32. Mansoor, Z., & Williams, M. J. (2024). Systems approaches to public service delivery: Methods and frameworks. Journal of Public Policy, 44(2), 258–283. https://doi.org/10.1017/S0143814X23000405
33. Mariotti, S. (2022). The economics–engineering nexus: Response to the commentaries. Journal of Industrial and Business Economics, 49(1), 1–29. https://doi.org/10.1007/s40812-021-00203-z

34. Mazzocchi, F. (2019). Scientific research across and beyond disciplines. EMBO Reports, 20(6), EMBR201947682. https://doi.org/10.15252/embr.201947682
35. McCulloch, K. L., & Dunn, M. J. (2018). Breaking Down Walls Through Collaboration. American Journal of Infection Control, 46(6), S116. https://doi.org/10.1016/j.ajic.2018.04.197
36. Mittal, P., & Bansal, R. (2024). Role of Cross-Disciplinary Collaborations for Holistic Approach to Sustainability. In P. Mittal & R. Bansal (Eds.), Community Engagement for Sustainable Practices in Higher Education: From Awareness to Action (pp. 143–160). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-63981-4_9
37. Mutanga, S. S., Mantlana, B. K., Mudavanhu, S., Muthige, M. S., Skhosana, F. V., Lumsden, T., Naidoo, S., Thambiran, T., & John, J. (2024). Implementation of water energy food-health nexus in a climate constrained world: A review for South Africa. Frontiers in Environmental Science, 12. https://doi.org/10.3389/fenvs.2024.1307972
38. Nagelhout, E., & Carradini, S. (2026). Bridging disciplinary divides: Insights and recommendations for fostering interdisciplinary research. Higher Education Research & Development, 45(6), 1785–1800. https://doi.org/10.1080/07294360.2026.2634270
39. Panda, S., & Dash, B. M. (2025). The Sustainable Development Goals: Implementation Challenges and Integrating Policies. The International Journal of Community and Social Development, 7(2), 316–326. https://doi.org/10.1177/25166026251345297
40. Park, M., Maity, S. K., Wuchty, S., & Wang, D. (2026). Interdisciplinary papers supported by disciplinary grants garner deep and broad scientific impact. PNAS Nexus, 5(3), pgag057. https://doi.org/10.1093/pnasnexus/pgag057
41. Pennington, D., Ebert-Uphoff, I., Freed, N., Martin, J., & Pierce, S. A. (2020). Bridging sustainability science, earth science, and data science through interdisciplinary education. Sustainability Science, 15(2), 647–661. https://doi.org/10.1007/s11625-019-00735-3
42. Podgórska, M., & Zdonek, I. (2024). Interdisciplinary collaboration in higher education towards sustainable development. Sustainable Development, 32(3), 2085–2103. https://doi.org/10.1002/sd.2765
43. Ramírez-Montoya, M. S., Rodriguez-Arroyo, J. A., Tenorio-Sepulveda, G. C., & Patino, A. (2026). A multiple case study of interdisciplinary training for sustainable development goals. Discover Sustainability, 7(1), 1047. https://doi.org/10.1007/s43621-026-03478-1
44. Rammert, A. (2025). Transforming mobility governance: Challenges faced in Germany. Discover Sustainability, 6(1), 576. https://doi.org/10.1007/s43621-025-01489-y
45. Sadykova, A., Berikkhanova, A., Atabekova, B., Sholpankulova, G., & Abdykhalykova, Z. (2025). Social partnerships among academia, industry, and government in education: A bibliometric analysis. Frontiers in Education, 10. https://doi.org/10.3389/feduc.2025.1516358
46. Schaap, L., Nijland, F., Cents-Boonstra, M., & Vanlommel, K. (2025). A Framework Supporting the Innovative Capacity of Higher Education Institutions: An Integrative Literature Review. Sustainability, 17(14), 6517. https://doi.org/10.3390/su17146517
47. Scott, I., & Gong, T. (2021). Coordinating government silos: Challenges and opportunities. Global Public Policy and Governance, 1(1), 20–38. https://doi.org/10.1007/s43508-021-00004-z
48. Seelajaroen, R., & Jitmaneeroj, B. (2025). Interdependencies among SDGs: Evidence-based insights for sustainable development indicators and policy. Environmental and Sustainability Indicators, 27, 100762. https://doi.org/10.1016/j.indic.2025.100762
49. Selin, H., & Selin, N. E. (2023). The human–technical–environmental systems framework for sustainability analysis. Sustainability Science, 18(2), 791–808. https://doi.org/10.1007/s11625-022-01177-0
50. Shanableh, A., Aderibigbe, S., Omar, M., & Shabib, A. (2022). Challenges and Opportunities of Multi-Disciplinary, Inter-Disciplinary and Trans-Disciplinary Research. In A. Badran, E. Baydoun, & J. R. Hillman (Eds.), Higher Education in the Arab World: Research and Development (pp. 311–325). Springer International Publishing. https://doi.org/10.1007/978-3-030-80122-9_18
51. Singh, S. (2026). What's learning got to do with sustainability-oriented cross-sector partnerships? A systematic literature review. Management Review Quarterly. https://doi.org/10.1007/s11301-026-00598-w

52. Sorooshian, S. (2024). The sustainable development goals of the United Nations: A comparative midterm research review. Journal of Cleaner Production, 453, 142272. https://doi.org/10.1016/j.jclepro.2024.142272
53. Stanikzai, M. E., & Mittal, E. (2025). Strategic alignment of organizational structure based on decisions for sustainable organizational performance: A bibliometric-systematic literature review. Cogent Business & Management, 12(1), 2560650. https://doi.org/10.1080/23311975.2025.2560650
54. Truant, E., Borlatto, E., Crocco, E., & Sahore, N. (2024). Environmental, social and governance issues in supply chains. A systematic review for strategic performance. Journal of Cleaner Production, 434, 140024. https://doi.org/10.1016/j.jclepro.2023.140024
55. Trueblood, J. S., Allison, D. B., Field, S. M., Fishbach, A., Gaillard, S. D. M., Gigerenzer, G., Holmes, W. R., Lewandowsky, S., Matzke, D., Murphy, M. C., Musslick, S., Popov, V., Roskies, A. L., ter Schure, J., & Teodorescu, A. R. (2025). The misalignment of incentives in academic publishing and implications for journal reform. Proceedings of the National Academy of Sciences, 122(5), e2401231121. https://doi.org/10.1073/pnas.2401231121
56. Vaverková, M. D., Polak, J., Kurcjusz, M., Jena, M. K., Murali, A. P., Nair, S. S., Aktaş, H., Hadinata, M. E., Ghezelayagh, P., Andik, S. D. S., Rahmana, A., & Franc-Dąbrowska, J. (2025). Enhancing Sustainable Development Through Interdisciplinary Collaboration: Insights From Diverse Fields. Sustainable Development, 33(3), 3427–3454. https://doi.org/10.1002/sd.3302
57. Wardat, Y., & AlAli, R. (2025). Sustainability in Higher Education: Challenges, Innovations, and Research Prospects. Educational Process International Journal, 16(1). https://doi.org/10.22521/edupij.2025.16.292
58. Weaver, D., Moyle, B. D., McLennan, C., & Casali, L. (2023). Taming the wicked problem of climate change with "virtuous challenges": An integrated management heuristic. Journal of Environmental Management, 347, 119136. https://doi.org/10.1016/j.jenvman.2023.119136
59. Workman, A., Cullen, S., Gunasiri, H., Moo, E., Mulvenna, V., Savage, R., MacDonald, F., & Bowen, K. J. (2026). The health co-benefits and costs of climate adaptation interventions: A rapid scoping review and implications for policy and practice. The Journal of Climate Change and Health, 29, 100666. https://doi.org/10.1016/j.joclim.2026.100666
60. Wright, C. Y., Naidoo, N., Anand, N., Kapwata, T., & Webster, C. (2025). "SCALE-up" – a new framework to assess the effectiveness of climate change adaptation interventions for human health and health systems. BMC Public Health, 25(1), 2247. https://doi.org/10.1186/s12889-025-23358-z
61. Yuan, M. (2021). Geographical information science for the United Nations' 2030 agenda for sustainable development. International Journal of Geographical Information Science, 35(1), 1–8. https://doi.org/10.1080/13658816.2020.1766244
62. Zahedi, R., Yousefi, H., Aslani, A., & Ahmadi, R. (2024). Water, energy, food and environment nexus (WEFEN): Sustainable transition, gaps and Covering approaches. Energy Strategy Reviews, 54, 101496. https://doi.org/10.1016/j.esr.2024.101496
63. Zhu, B., Wang, T., Liu, G., & Zhou, C. (2024). Revealing dynamic goals for university's sustainable development with a coupling exploration of SDGs. Scientific Reports, 14, 22799. https://doi.org/10.1038/s41598-024-73702-3