
SCIENCE FOR SUSTAINABILITY: BRIDGING RESEARCH AND INNOVATION TO ACHIEVE THE SDGS

Niño Ismael Sanchez Pastor^{1*}

Adviser, Center for Health Research & Innovation Gullas College of Medicine, Banilad, Mandaue City, Cebu, Philippines¹

*Correspondence Email: uygcnnisp@gmail.com

ABSTRACT

Bridging the gap between research and innovation is essential to achieving the United Nations Sustainable Development Goals (SDGs) by 2030. This study evaluated how sustainability science serves as a structural framework for closing two major systemic barriers: the Research Implementation Gap and the Innovation Valley of Death. A retrospective review was conducted of two previous health events. Interventions were evaluated against the SDGs using Nilsson's 7-Point SDG Interaction Scale.

Both previous health events demonstrated that human survival depends on interdisciplinary data sharing, multi-agency enforcement, adaptive governance, and direct community engagement. These elements align with core principles of sustainability science. The responses revealed positive SDG interactions—such as scientific data-to-policy pipelines reinforcing public health risk reduction (+2)—alongside negative trade-offs, in which strict containment blockades directly undermined local livelihoods (-2). To institutionalize these, the research sector must adopt the San Francisco Declaration on Research Assessment (DORA) to assess research beyond journal factors and citations. Innovation leaders must integrate the Triple Bottom Line (TBL) framework (People, Planet, Profit). Together, DORA and TBL provide the operational foundation for sustainability science, accelerating the development of resilient policies and supporting long-term human survival

KEYWORDS

Sustainability Science, Sustainable Development Goals (SDGs), Nilsson Interaction Scale, San Francisco Declaration on Research Assessment (DORA), Triple Bottom Line (TBL), Interdisciplinary Research, Innovation Valley of Death



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INTRODUCTION

Science for sustainability is best considered either a vocation—a calling to serve the greater good—or an orientation—a particular approach or mindset toward research. Although it is now a rapidly emerging academic field, it requires scientists and researchers to dedicate their knowledge, technology, and findings to solving wicked human problems. These complex, persistent issues, ranging from climate change to systemic inequality, lack simple solutions. More scientists are being called upon to adopt sustainability science, an interdisciplinary field that examines how human, environmental, and engineered systems interact. It addresses complex problems in human communities and the Earth's environment by strengthening the link between knowledge and realworld solutions (UNESCO, 2026). Sustainability science bridges research and innovation to accelerate progress toward the United Nations Sustainable Development Goals (SDGs), a set of global objectives for human survival. UNESCO recommends that policies generated by sustainability science can transform society.

RESEARCH METHOD

This study qualitatively described two historical health crises. The purpose was to assess the longitudinal and retrospective applicability of sustainability science using the science as a lens. It analyzed the 1988 Manila Bay Harmful Algal Bloom (HAB) and the 2020 localized COVID-19 response in the cities of Cebu and Mandaue. This study evaluated crisis interventions against specific SDGs and their sub-targets through a sustainability science lens. The approach enabled a rough assessment of both positive and negative alignment across sectors or tasks during multisystemic health events.

The study then applied a 7-Point SDG Interaction Scale developed by Nilsson (Nilsson, Griggs, Visbeck, & et al, 2016) to the emergency responses. Nilsson's interaction scale classified interactions along a spectrum from indivisible (+3) to canceling (-3):

- +3 Indivisible: Inextricably linked to the achievement of another goal.
- +2 Reinforcing: Directly aids the achievement of another goal.
- +1 Enabling: Creates conditions that enable another goal.
- 0 Consistent: Neutral; no significant positive or negative interaction.
- -1 Constraining: Limits options or imposes trade-offs on another goal.
- -2 Counteracting: Clashes directly with another goal, creating friction.
- -3 Canceling: Makes it impossible to reach another goal

Nilsson's scale identified where multiple SDGs interacted positively or negatively based on responses to the health event. A grounded analysis was conducted to show how sustainability science can bridge research and innovation to accelerate future SDG achievement.

The ideas in this article were generated by the author. Gemini (Google) was used as a supporting tool for textual formatting, clarity enhancement, and draft synthesis. All intellectual concepts, analytical framework applications, case study interpretations, and final content were critically evaluated, verified and cited by the author (ICJME, 2026).

RESULT AND DISCUSSION

Real-World Case Experiences

To show how sustainability science can accelerate progress toward the SDGs, let us examine two complex “wicked” health events that occurred in our region.

Case 1: The Harmful Algal Bloom in Manila Bay, 1988 (Pastor, Gopez, Quizon, & et al, 1989)

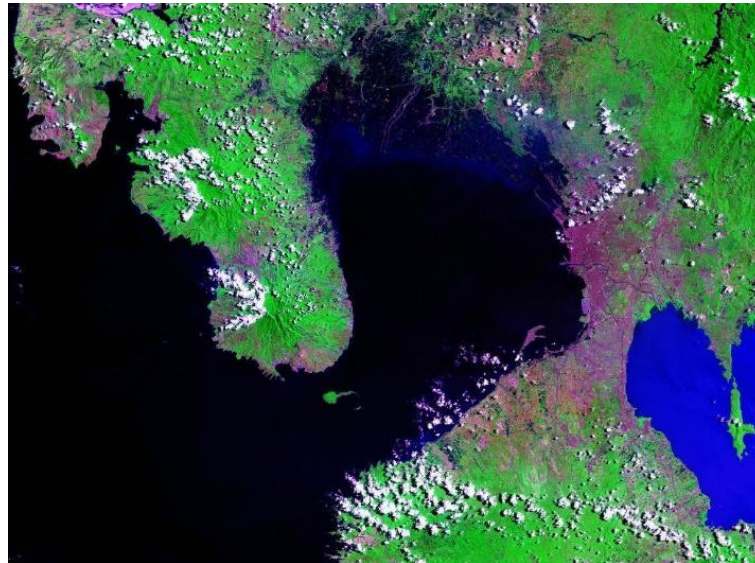


Figure 1. Manila Bay (Contributors, 2026)

While the term 'sustainability science' was not formally coined or institutionalized in 1988, the dynamics of the 1988 Manila Bay Harmful Algal Bloom (HAB) crisis mirrored what we now recognize as a complex, coupled human-natural system shock. Analyzing this historical case through a modern sustainability science lens provides valuable retrospective insights into how proto-sustainability principles organically emerged during multi-systemic emergencies. We apply sustainability science as a retrospective analytical lens to evaluate the 1988 crisis management, illustrating the core tenets of today's sustainability science.

HABs render bivalve shellfish, such as oysters, toxic to humans, causing paralytic shellfish poisoning (PSP). PSP can be fatal. The index case during this HAB was detected on August 19, 1988, and the crisis lasted for over two months. Coping with this HAB required a coordinated response across several sectors, serving as an early real-time application of sustainability science.

Multiple agency enforcement

Preventing the harvest of toxic shellfish is not within the purview of a health practitioner; marine biologists and fisheries officers prevented harvests in contaminated seabeds. But shellfish farms and seabeds cover vast parts of the sea; so, Coast Guard officers and marine police were necessary to prevent the harvest of toxic shellfish from expansive seabeds. At the same time, land-based police officers were needed to prevent the transport of toxic shellfish, while sanitary inspectors were deployed to prevent the market sale.

Monitoring and Surveillance

Fisheries biologists monitored dinoflagellate counts in the water column and cysts on the seafloor, while food chemists initially measured toxin levels in contaminated shellfish collected by fisheries biologists. Epidemiologists monitored PSP cases in nearby health facilities.

Medical treatment and Public Health Intervention

No antidote was known. Patients were managed conservatively in health facilities by health practitioners. The best intervention was a ban on the gathering, harvesting, transporting, selling, and consumption of toxic shellfish. Behavioral control was reinforced by extensive print and broadcast media campaigns that disseminated information about the shellfish ban, as the internet was unavailable in the affected areas at the time.

Policy translation

The Department of Health created a National Red Tide Task Force (NRTTF) with the Bureau of Fisheries and Aquatic Resources as chair. All data from fisheries biologists, food chemists, and epidemiologists were transmitted to the NRTTF. Each week, the NRTTF issued bulletins on toxin levels in shellfish samples and on seafood safe for human consumption in affected areas. Local government officials used the NRTTF bulletins as a basis for declaring official bans as local policies. The monitoring data-to-policy translation successfully linked scientific data to regulatory action.

Social & Economic Conflicts.

As HAB presence persisted, the local community suffered. Seafood restaurants and the Manila Bay fishing industry sustained massive financial losses because uncontaminated, safe seafood were avoided by seafood connoisseurs. To address these issues, the academic community assisted by spreading accurate information about PSP, safe shellfish, and sanitation. Meetings were also held with seafood restaurants, fishing magnates, and local shellfish farmers to help ensure shellfish safety.

Table 1: The 1988 Manila Bay HAB seen through the Sustainability Science Lens and related to the UN SDGs.

1988 Manila Bay HAB	Interacting SDG	Target SDG	Nilsson Scale Rating	Interaction Type
Multi-Agency Enforcement (Sea-to-Land)	SDG 17: Partnerships; SDG 14.4: Sustainable Fishing and Illegal, Unreported and Unregulated Fishing	SDG 3.d: Risk Reduction	3	Indivisible
NRTTF Scientific Data-to-Policy Translation	SDG 14.a: Scientific Knowledge, Research and Technology; SDG 16.6: Effective Institutions	SDG 3.d	2	Reinforcing
Media Campaigns for Behavioral Compliance	SDG 16.10: Information Access	SDG 3.d	1	Enabling
Academic & Industry Stakeholder Dialogue	SDG 17: Partnerships	SDG 8: Economic Growth; SDG 2: Zero Hunger	1	Enabling
Strict Harvesting Bans vs. Fishing Economy	SDG 3: Good Health and Well-being	SDG 8: Economic Growth; SDG 1: No Poverty	-2	Counteracting

Although this health event occurred in 1988, before the term "sustainability science" was widely adopted, the public health response embodied its principles. The 1988

HAB response served as a realistic forerunner that can be productively analyzed using modern sustainability science. The 1988 HAB response was driven by standard public health emergency protocols and crisis management, rather than by sustainability science research itself. But the marine HAB event was closely linked to the fisheries, health, and economic sectors, the local government, and the environment in the successful protection of public health, advocacy for shellfish safety, and the management of marine resources. Sustainability science served in this study as a modern analytical lens to demonstrate its retrospective application to these complex, interdisciplinary health events. The interaction between the 1988 Manila Bay HAB responses and the SDGs, viewed through a sustainability science lens, is presented in Table 1.

Applying Nilsson's SDG Interaction Scale to the 1988 Manila Bay Harmful Algal Bloom (HAB) responses demonstrated how public health crisis management inherently involved a spectrum of multi-sectoral SDGs. Multi-agency enforcement on land and at sea (SDG 17 & SDG 14) was indivisible (+3) from strengthening health risk reduction and disease management (SDG 3.d). The National Red Tide Task Force (NRTTF) established a reinforcing (+2) data-to-policy translation. By translating oceanographic research and toxin surveillance (SDG 14.a) into weekly public health bulletins, the task force, responsible for governance (SDG 16), directly accelerated research-based policy action to protect human health (SDG 3.d). Information dissemination and multi-stakeholder consultations and meetings served as enabling (+1) mechanisms. Print and broadcast media campaigns provided the information needed to impose shellfish consumption bans (SDG 3), while academic-fishing industry communication (SDG 17) sought to restore public trust in the safety of seafood, thereby reducing shocks to local fishing livelihoods (SDG 8) and food security (SDG 2).

Unfortunately, the public health intervention of strict bans on harvesting, transporting, gathering, and selling (SDG 3) counteracted (-2) the local economy (SDG 8) and fishing livelihoods (SDG 1). The persistent ban led to massive financial losses for local fishers and seafood establishments, resulting in unavoidable negative economic impacts during this severe environmental health emergency.

Case 2: Localized COVID-19 Response in Cebu and Mandaue Cities (December 2019 – April 2020).

Six years ago, the world experienced a global pandemic caused by a strain of COVID-19. Ground zero of the COVID-19 pandemic was Wuhan, China, where it was initially detected as a cluster of pneumonia cases in December 2019 (WHO, 2020). The COVID-19 index case in the Philippines was reported on January 30, 2020, in Manila, involving a Chinese tourist from Wuhan, China, who entered the country via Mactan International Airport in the island of Cebu (Casilao, 2020). The first local index case, a physician, was confirmed on March 18, 2020, who resided in Mandaue City, adjacent to Cebu City (Abatayo, 2020).

Rapid spread of the news and public concern quickly circulated via social media, prompting the Cebu City mayor to implement pre-emptive measures, which included the following (Letigio, 2020):

1. A declaration of a state of preparedness (Knapp, 2023) (Letigio, 2020)
2. An emergency operations center was established.
3. Establishment of quarantine areas in 80 barangays, the lowest government unit.
4. Coordination with private and government health facilities, the Bureau of Quarantine and the regional Department of Health
5. Augmentation of personal protective equipment (PPEs) for local frontliners

Ten days later, the regional Department of Health detected a cluster of 18 COVID-19 cases on March 28, 2020 (Erram, 2020).. The city mayor placed the city under general community quarantine (GCQ) on May 31, 2020. The GCQ consisted of the following:

1. Health checkpoints at the city's 11 entry points
2. Liquor ban
3. Closure of non-essential businesses
4. A four-hour workweek for city government employees

The LGU regulated entry to the city's public markets based on the first letters of city residents' family names. Cebu City Mayor suspended classes across all levels in public and private schools. The city restricted domestic travel by land, air, and sea transportation. The government also advised people to stay home, maintain physical distance with another person, wear masks, wear face shields, and wash hands regularly. Public transport vehicles were banned from plying their usual routes.

COVID-19 caused an immense shock to the city's public and private educational, economic, social and environmental systems. During this early stage of the local epidemic, there was no known drug or vaccine, so the crisis literally paralyzed the city, forcing it to prioritize human health and survival. The city was forced to adapt from an initial pre-emptive measure to long-term control. This shift is an extraordinary application of sustainability science.

Multiple Agency Enforcement

A highly coordinated enforcement response involved various security and regulatory bodies, including quarantine officers, police, coast guards, marine police, military personnel, village guards, and village health workers. Enforcement systems were to maintain public order and health security. While this aligns with the development of effective, accountable institutions in times of crisis, the heavy security presence exposed institutional vulnerabilities in non-discriminatory laws and policies. Behavior control for enforced stay-at-home orders, mask mandates, and crowd restrictions during this pandemic relied on partnerships among various enforcement agencies. The control was made possible when multiple enforcement agencies coordinated across traditional public, public-private, and civil society groups to manage a global crisis

Monitoring and Surveillance

People's movement was monitored and regulated at airports, seaports, and 11 entry points of the locality. This coordinated monitoring and surveillance by multiple institutions across multiple sites during the COVID-19 pandemic helped ensure the safety of cities with dense urban slum areas and villages. The Emergency Operations Center received data from every city hall department, government offices, and private institutions, while contact tracing was coordinated with volunteers and later with staff hired by the city. Epidemiologic surveillance shifted to trend analysis, guiding the city days ahead of the actual outbreak.

Medical Treatment & Public Health Intervention

Initial intervention focused on behavioral control: physical distancing, strict handwashing, and the use of face masks, and face shields that were initially made by volunteers. These public health interventions slowed the spread of infectious pathogens, protecting vulnerable populations and preventing health system overload. As COVID-19 cases increased, the city constructed quarantine centers for suspected cases and upgraded local clinical laboratories so that swab samples were no longer flown 700 kilometers away for testing.

Social & Economic Conflict

The strict quarantine blockade to prevent exposure to COVID-19 caused widespread disruptions throughout the city. Non-essential businesses were shut down. The economy adapted to online grocery and contactless delivery. Operations at the city hall and private institutions were limited to fewer than 8 hours a day, disrupting workflows. International and domestic borders were closed. Schools transitioned to remote learning, where student assignments were monitored via the internet and text messaging. Volunteers and non-government organizations provided food and water supplies to students stranded in their dormitories and to villagers in blockaded villages or slum areas.

Policy Translation

All data were collected, processed and released by the city's Emergency Operations Center (EOC). The EOC used data as a basis to continue, partially lift, or open local village blockades. The monitoring data-to-policy translation successfully linked scientific data to the regulation of human behavior: physical distancing, use of face masks and shields, handwashing, and staying home. The interaction between the COVID-19 responses to SDGs are shown in Table 2.

Table 2: The 2020 COVID-19 pandemic seen through the Sustainability Science Lens and related to the UN SDGs.

COVID-19 Responses	Interacting SDG	Target SDG	Nilsson Scale Rating	Interaction Type
Local Lab Upgrades & Quarantine Building	SDG 9: Industry, Innovation and Infrastructure; SDG 3.3: Other Communicable Diseases	SDG 3.d: Risk reduction	+3	Indivisible
Multi-Agency & Volunteer Mobilization	SDG 17.17: Public, Private and Civil Society Partnerships	SDG 3: Good Health and Well-being; SDG 11: Sustainable Cities and Communities	+2	Reinforcing
Data-to-Policy EOC Pipeline	SDG 16: Peace, Justice and Strong Institutions	SDG 3: Good Health and Well-being; SDG 11: Sustainable Cities and Communities	+2	Reinforcing
Digital Adaptation (E-Commerce/Remote Class)	SDG 9: Industry, Innovation and Infrastructure/Technology	SDG 8: Decent Work and Economic Growth; SDG 4: Quality Education	+1	Enabling
Heavy Security Enforcement Presence	SDG 17: Partnerships; SDG 16: Peace, Justice and Strong Institutions/Security	SDG 16.b: Non-discriminatory Laws and Policies	-1	Constraining
Strict Quarantine Blockades & Business Closures	SDG 3: Good Health and Well-being	SDG 8: Decent Work and Economic Growth; SDG 4: Quality Education	-2	Counteracting

Nilsson's SDG Interaction Scale showed that local COVID-19 responses, viewed through a sustainability science lens, revealed complex relationships among the UN Sustainable Development Goals (SDGs). Developing local clinical laboratories (SDG 3.3) and rapidly constructing decentralized quarantine facilities (SDG 9) proved indivisible (+3) from health risk reduction (SDG 3.d), as local sample testing enabled the city to manage the biological shock without relying on distant facilities. An indivisible relation (+3) was also observed when local clinical laboratories could test swab samples and manage the

biological shock locally. Enforcement by several government agencies and volunteer mobilization (SDG 17.17) directly protected public health (SDG 3) and urban safety (SDG 11). The Emergency Operations Center (EOC) translated scientific data into evidence-based regulations. Technological adaptation (+1) bridged technology, work, and education. Transitioning to online grocery delivery, contactless logistics, and online student assignment monitoring helped cushion economic disruption (SDG 8) and maintain educational programs (SDG 4) during strict lockdowns.

Like the 1988 HAB responses, the COVID-19 responses had negative consequences. The presence of several security personnel (SDG 17 & SDG 16) constrained (-1) the factor on nondiscriminatory laws and policies (SDG 16.b), exposing vulnerabilities caused by these control measures. The strict quarantine blockades and business closures (SDG 3) acted as a counteracting (-2) force against economic growth (SDG 8) and quality education (SDG 4), highlighting the friction between immediate health containment and socio-economic well-being.

Core Characteristics & Limitations

The operational successes and tensions of HAB and COVID-19 responses demonstrated how sustainability science can protect human survival. Both events revealed a persistent, similar systemic model that may accelerate progress toward the UN SDGs through sustainability science. Both required interdisciplinary data sharing, adaptive governance, and balancing social and economic impacts. This demonstrates that sustainability science principles are not temporary academic trends but timeless systemic necessities for human survival in interconnected systems. Effective solutions were consistent across years of different health events (dinoflagellates and viral events), showing that sustainability science possesses enduring and fundamental principles of human-ecological control. Based on the two health events, the characteristics of sustainability science can now be extracted.

Core Characteristics of Sustainability Science

Systems thinking

A holistic mindset for investigating the factors and interactions that contributed to human survival during the HAB and COVID-19 events. This showed how stakeholders, researchers, and the entire community work together in different types of teams and, through that understanding, create the best possible processes to accomplish just about anything (SNHU, 2024).

Solution-driven approach

Sustainability science was used to find the most suitable solutions to the public health problem and minimize the social shock caused by HAB AND COVID-19 (Knapp, 2023). This was behavioral control in HAB and the initial phase of the COVID-19 pandemic. This needed systems analysis of proposals from multiple disciplines and technology (Boyd, 2022).

Interdisciplinary approach

Sustainability science involves an interdisciplinary approach to wicked problems. The COVID-19 and HAB responses consisted of collaborations among researchers from different disciplinary, organizational, and cultural boundaries. HABs are an oceanographic problem that involves climate science, economics, and public health management. In like manner, the COVID-19 pandemic was a microbiological problem involving behavioral science, public health, pharmacology, environmental science, and economics.

Direct community and stakeholder engagement

During both the HAB and COVID-19 crises, an engagement strategy involving village-level stakeholders was significant. Various groups, such as government, communities, NGOs, civil society, and investors, had to be identified and recruited to address the crises and protect public health (Hendricks, 2026).

Adaptive learning and behavior

The evolving responses to both HAB and the COVID-19 pandemic demonstrated adaptive learning and behavior. This is how sustainability science enables human societies and individuals to continuously acquire knowledge, modify actions, and adapt to environmental feedback to mitigate the impact of HAB and the COVID-19 pandemic. It emphasizes "learning by doing" to address global environmental challenges where predicting exact outcomes is often difficult or impossible.

Documented Restraints

Reactive decision-making

HABs and the COVID-19 pandemic required long-term, transparent pre-event planning. Both events were sudden, requiring leaders to shift instantly from routine operations to crisis management. Governments often initiate emergency HAB disaster management (Baum, Fisher, Bogueva, & et al, 2026) . Reactive decisions are often prioritized because they appear more dramatic and politically expedient than proactive, long-term, preemptive planning, which limits transparency until the pandemic in the country's area of responsibility has penetrated. This was also due to insufficient and inaccurate scientific data during the initial impact phase. Unfortunately, such reactive decisions disrupted workflows and decreased the quality of health care. Lessons learned from the COVID-19 pandemic response emphasized the need for ... preparedness that extends beyond the health sector and the distribution of resources (Farag, Ozen, Spaulding, & et al, 2026).

Fragmentation of specialized knowledge

Sustainability science is interdisciplinary. However, traditional sciences remain specialized. The public health agenda focuses on public health frameworks, theories, and models, while other sciences concentrate on their specific branches. For example, shellfish farming is an economic activity, so policies for managing HAB primarily focus on economic impacts, with little regard for human health (Baum, Fisher, Bogueva, & et al, 2026). During the COVID-19 pandemic, research efforts remained thematically and geographically fragmented, and the translation of insights into policy and practice was inconsistent (Tornimbene, Redikes, Philip, & et al, 2026).

Global Disparity Over Planetary Resilience

Sustainability science balances the Environment, Society, and Profit. This balance shifts during crisis periods. Government officials often assume an emergency mode to protect the economy, overlooking the risks posed by HABs and the COVID-19 pandemic. These risk factors existed before these health events. HABs, for example, occur due to favorable conditions in the littoral thermocline, nutrient availability, and human population dynamics before a bloom. The COVID-19 pandemic was facilitated by a breach in the animal-to-human ecological barrier (Hao, Wang, Wang , & et al, 2022). These were often neglected during initial emergencies as governments focused on mitigating the economic impact.

Social inequities

Sustainability science advocates for community resiliency. The COVID-19 pandemic had multifaceted effects on environmental conditions, economic systems, and quality of life (Ray, Abeysingha, Deegala, & et al, 2025). A review of how the government managed the COVID-19 pandemic found that it had a significant impact on the social sphere (Alizadeh, Nazamia, Sharifi, & et al, 2023). HABs denied marginal seabed gatherers their daily food sources.

Research Assessment

Current research assessment practices play a decisive role in shaping scientific priorities, funding, and careers. Yet they often rely on narrow metrics (Journal Impact Factor, JIF) that fail to capture collaboration, openness, and societal impact. This can create perverse incentives and strain research systems (OECD, Reforming research assessment for better science, 2026).

Funding

Because sustainability science operates at the complex intersection of science, technology, and innovation, it requires substantial funding to coordinate efforts across distinct scientific fields and social sectors. For example, HAB research (and its funding) has focused more on the economic and health implications of HAB events than on broader human dimensions (McKinley, Kapiotsinis, Mndy, & el al, 2024). The NIH funded large consortia and clinical trials to develop diagnostics, therapeutics, and vaccines. Approximately 8% of the funding was allocated to R01 grants. Clinical trial sites were generally located in areas of high COVID-19 burden (Narahari, Horgan, Chandrabhatla, & et al, 2024). But other hyper-specialized scientists outside medical research were also addressing the COVID-19 pandemic. Civil engineers and architects studied how to construct quarantine centers. Data scientists built predictive models for the pandemic. Social scientists studied vaccine hesitancy.

Closing the Research-Innovation Gap to Accelerate SDG Accomplishment

Research and innovation are essential to achieving the SDGs. They operate in different ways. The United Nations defines innovation as the process of finding, testing, and spreading new solutions to create value (UN, 2023). In contrast, research is defined as creative and systematic work undertaken to increase the stock of knowledge—including knowledge of humankind, culture, and society—and to devise new applications of available knowledge (OECD, Frascaton Manual 2015: Guidelines for Collecting and Reporting Data Research and Experimental Development: The Measurement of Scientific, Technological and Innovation Activities, 2015). Research generates new evidence, theories, and technological concepts; innovation converts research outputs to solve real-world problems, formulate public policies, or fulfill market solutions

Although researchers and innovation leaders refer to the UN SDGs as their benchmarks for their research, studies have shown that the majority of SDG targets cannot be met by 2030 (Reinertz D., 2026), (AFD, 2025). With only about 4 years remaining, there is a need to address the cause of this delay. The delay is caused by two structural barriers between research and innovation:

1. The Research Implementation (or policy) Gap: The failure to translate scientific discoveries into practice because they remain in academic journals and laboratories (Reinertz D. , 2026).
2. The Innovation's Valley of Death: The financial and technical valley that separates scientific research that has successfully exited from its basic grant funding but has not

yet secured venture capital, corporate sponsorship, market-based scaling, (Reinertz D., 2026) or policy creation.

The research implementation gap occurs when scientific discoveries remain confined to academic journals rather than being translated into real-world solutions or policy. This is the major drawback in research implementation. It is caused by a research assessment method that emphasizes publishing and prioritizes quantity and citations. Another drawback is the advancement in information technology, such as Artificial Intelligence (AI). AI is assisting researchers in generating more research output in less time, which can overwhelm public-sector implementation. The gap is also widened by the way modern academic research disciplines are structured, such as specialized vertical knowledge pillars. While public health, marine biology, microbiology, pharmacology, or economics focus narrowly within their disciplinary silos, systemic shocks—such as Harmful Algal Blooms (HABs) and pandemics like COVID-19—do not respect academic boundaries. They occur on a common floor where these pillars are built. On this floor, human behavior, the physical environment, and governance interact dynamically. On this floor, the various UN SDGs also stand. This floor is sustainability science, holding the pillars erect. Implementers should be engaged in translating research to make it useful. This floor can significantly accelerate progress toward the UN SDGs but cannot guarantee full achievement by 2030 unless it is constructed and adopted through research. Table 3 shows the focus areas of DORA and its possible impact on the UN SDGs.

Table 3. DORA focus areas and the UN SDGs

DORA Focus Area	Remarks	Target SDG Impact
Responsible Research Assessment (RRA) (Lima, 2025)	Research outputs are assessed beyond the Journal Impact Factor (JIF) and translated into policy papers and/or community-based solutions.	SDG 9: Industry, Innovation and Infrastructure; SDG 17: Partnerships for the Goals
Open Science Alignment (OSA)	Promotes free and global access to research for researchers, policymakers, and the public sector worldwide.	SDG 4: Quality Education
Holistic & Inclusive Evaluation	Supports the democratization of research assessment, particularly for underrepresented groups and locally relevant research.	SDG 5: Gender Equality; SDG 10: Reduced Inequalities
Cross-Disciplinary Evaluation (CDE)	Provides incentives for multidisciplinary research that addresses interconnected sustainability challenges and the SDGs.	SDG 13: Climate Action; SDG 14: Life Below Water; SDG 15: Life on Land

Constructing this floor requires the academic research sector to adopt and implement the San Francisco Declaration on Research Assessment (DORA) (ASCB P. S., 2025). Launched by the American Society for Cell Biology (ASCB) in 2012, DORA is a global initiative to reform how research is assessed. DORA promotes quality and impact in research through fair and comprehensive research assessment practices, aligning with ASCB's effort to honor excellence in all aspects of scientific achievement, from innovative research to the mentorship and support of the next generation of scientists (ASCB P. S., 2025). It provides resources to support responsible research assessment and plays an important role in shaping research policies. As a result, UNESCO endorsed the shift to DORA (DORA, 2023).

DORA has four focus areas that can accelerate progress toward the SDGs through sustainability science and change how research is assessed. Current research assessment for publication, funding, job applications, and career progression relies on the Journal Impact Factor (JIF). As a result, researchers seek to publish in high-JIF journals. Journals

with a high JIF are usually review journals, multidisciplinary flagship science publications, and specialized medical or life sciences titles, which again shows how their focus and specialized pillars set them apart. DORA can transform research output to enhance SDG progress.

DORA's first focus area is responsible research assessment (RRA). RRA expands the definition of "valuable" research beyond traditional peer-reviewed papers. It incentivizes researchers to produce actionable technological artifacts—such as open-source software, datasets, lab hardware protocols, and patents—which directly feed into innovation. Action-oriented research and development requires strong partnerships between research institutions, local governments, NGOs, and civil society. DORA's RRA supports research assessment that rewards collaborative, interdisciplinary work and participatory research over individual JIF & citation counts.

The second focus area of DORA is open science alignment (OSA). Journals with high JIF can be expensive and accessible only to a limited number of specialty readers. Open science alignment is a set of principles and practices that aim to make scientific research across all fields accessible to everyone, benefiting scientists and societies globally. DORA's OSA enables global access to research outputs which centers on democratizing knowledge, removing economic barriers to learning, and building institutional capacity globally. DORA's OSA ensures that students, educators, and independent researchers worldwide—regardless of financial status or geographic location—have free access to current state-of-the-art scientific developments and learning materials. It provides open access for all, rather than relying on expensive journals or publications limited to specialty readers. Free access permits educators to incorporate current scientific evidence directly into their university curricula and vocational training programs, thereby improving global educational quality.

Prestigious journals marginalize researchers from lower-income institutions. The third focus area of DORA is holistic and comprehensive evaluation. This involves reforming research assessment to evaluate interested scholars based on the content, quality, and concrete impact of their work, rather than relying on the JIF. DORA promotes assessing non-citation contributions, such as mentorship, institutional service, community assistance, and joint leadership, and reduces dependence on metrics that disproportionately disadvantage women researchers (SDG 5). DORA recognizes research addressing local, indigenous, or regional challenges, published in local journals or repositories, and guarantees it is evaluated fairly regardless of citations or the JIF (SDG 10).

DORA's fourth focus area, cross-disciplinary evaluation (CDE) supports the research side of sustainability science. Cross-disciplinary evaluation focuses on how multidisciplinary research translates into a policy, product, idea, or service that benefits multiple stakeholders in the community. DORA explicitly validates co-authorship, interdisciplinary team roles, and joint leadership rather than prioritizing sole-author, single-discipline research. DORA explicitly advocates providing incentives for multi-institutional, cross-sector team science as well as collaborative roles (such as co-investigators and cross-field mentors) (Gagliardi, Chen, Boury, & et al, 2023). It can accelerate the achievement of climate action, for example, that requires combining meteorology, climate science, economics, public policy, engineering, and sociology. The quality-of-Life Below Water demands integration among marine biology, oceanography, geospatial analytics, maritime law, and local community knowledge. Research on Life on Land relies on ecology, forestry, land-use planning, agricultural science, and indigenous stewardship. By removing these research assessment barriers on the research side, DORA directly supports the sustainability science bridge and facilitates crossing the second barrier, the "innovation's valley of death."

The innovation's valley of death (VoD) specifically portrays the financial and technological gap that emerges when institutional R&D outputs exhaust public research grants successfully but fail to attract private venture capital, local governance or corporate investment necessary for production or enforcement (Reinertz D. , 2026). This is the high-risk, underfunded, and highly bureaucratic phase where proven research tries—and usually fails—to transition into a mountable, straightforward, and utilized solution.

Historically, crossing this valley takes a decade. But considering the SDGs, we do not have a decade. We have 4 years. The problem is not a lack of solutions. Research laboratories, universities, and technology incubators have already discovered the science needed to address the UN SDGs. The health event system responses to HAB & the pandemic were initiated through a partnership between the government and the private sector. Funds and technical assistance from multiple agencies contribute to a single goal: the well-being of stakeholders. The question now is how modern government and private systems can cross the valley of death (VoD)? The response is sustainability science.

To build the sustainability science bridge and floor, innovation sponsors, leaders, and managers must adopt the “Triple Bottom Line” (TBL) framework proposed by Elkington. Elkington argued that legacy market systems are built for linear or incremental improvements. Successful research often dies in the Valley of Death because traditional investors evaluate it using short-term, single-bottom-line metrics. Current innovation focuses only on profit. The TBL expands this bottom line beyond profit. Innovation leaders, sponsors, and managers should focus not only on profit but also on the three pillars of TBL: profit, people, and planet. According to Elkington, the TBL approach redefines profit to capture the broader economic value created for society while accounting for the hidden economic costs (externalities) of doing business. The Profit pillar is not rejected or downplayed; rather, it is elevated. It recognizes that economic wellbeing is vital for sustainability yet asserts that real economic profit cannot come at the expense of human well-being (People) or ecological soundness (Planet). Elkington further argues that every commercial activity generates environmental costs—such as carbon emissions, toxic runoff, microplastic contamination, or deforestation—that are traditionally borne by society rather than the company. The Planet pillar requires innovation leaders, sponsors, and managers to identify, measure, and minimize these "externalized" costs. The Planet pillar asserts that long-term business survival is impossible on a degraded planet. It measures success not by how efficiently a company extracts resources, but by how effectively it minimizes ecological harm, operates within Earth's natural capacity, and contributes to environmental balance. The third TBL pillar is People. Elkington describes this as a company measuring its success not just by its earnings, but by its contribution to human well-being. A truly sustainable business creates value for society by treating workers ethically, uplifting communities, and actively adding to a fair, safe, and equitable world. Innovation leaders, sponsors, managers, and policymakers are now encouraged to integrate TBL principles into regulatory frameworks, particularly in areas related to corporate responsibility, environmental conservation, and social equity. social equity (Nica, Charita, & Georgescu, 2025).

The TBL catalyzed research with real-world social impact during the Manila Bay HAB and the COVID-19 pandemic. Innovation leaders protected profit. The environment was closely monitored and controlled. People's health was protected via behavioral control. TBL has been accepted as a framework to promote SDG 8 (Work), 9 (Technology), and 13 (Climate change) by promoting pluralism and inclusiveness for the harmonious development of the economy (profit), the environment (planet), and society (people) (Ansarinassab & Santosh, 2026). Innovation leaders, sponsors & managers have much to gain by accepting the TBL Data from 100 companies from Albania, Bosnia and

Herzegovina, North Macedonia, and Serbia in March 2025, which show that the economic and social dimensions are associated with statistically significant direct gains. Environmental initiatives, by contrast, deliver weaker, not significant effects unless the organization invests in enabling conditions (Debarliev, Drakulevski, & Kitanoviki, 2026). The TBL can be incorporated by innovation leaders, managers or sponsors by operationalizing a circular economy in their businesses (Rexhepi Mahmutaj, Jusufi, Krasniqi, & et al, 2025). Innovation through the TBL pillars can help achieve the SDGs, as shown in Table 4.

Table 4: TBL Pillars and UN SDGs

TBL Pillars	Definition	Core SDG Impact	Pillars' Relation to SDG
People	Social equity and well-being	SDG 1: No Poverty	Stimulates economic security by advocating for fair compensation, social protection, and livelihood support.
		SDG 2: Zero Hunger	Promotes safe and acceptable food systems for vulnerable groups.
		SDG 3: Good Health and Well-being	Supports physical and mental well-being by ensuring safety, disease prevention, and accessible healthcare for all.
		SDG 4: Quality Education	Endorses inclusive learning to eliminate educational barriers and promote lasting capacity building.
		SDG 5: Gender Equality	Recognizes equal rights and opportunities and aims to dismantle gender-based biases in leadership, pay, and evaluation.
		SDG 10: Reduced Inequalities	Promotes social inclusion and fairness by empowering marginalized, localized, and underrepresented populations.
Planet	Environmental protection	SDG 6: Clean Water and Sanitation	Protects watersheds, reduces effluent contamination, and supports the restoration of aquatic ecosystems.
		SDG 7: Affordable and Clean Energy	Reduces reliance on fossil fuels to decrease air pollution and carbon emissions.
		SDG 11: Sustainable Cities and Communities	Reduces urban ecological footprints through green spaces, waste reduction, and clean transportation.
		SDG 12: Responsible Consumption and Production	Limits resource depletion, toxic pollution, and environmental waste.
		SDG 13: Climate Action	Reduces greenhouse gas emissions and integrates climate adaptation into operations and policies.
		SDG 14: Life Below Water	Supports the prevention of marine pollution, overfishing, and coastal ecosystem destruction.
		SDG 15: Life on Land	Protects forests, restores degraded soil, and helps halt biodiversity loss.
Profit	Market resilience and long-term economic sustainability	SDG 8: Decent Work and Economic Growth	Generates long-term economic value through ethical business practices and stable employment.
		SDG 9: Industry, Innovation and Infrastructure	Promotes modern infrastructure and sustainable innovation to strengthen long-term market competitiveness.
Integrated TBL	Holistic support for People, Planet, and Profit	SDG 16: Peace, Justice and Strong Institutions	Establishes the legal, ethical, and institutional foundation needed to balance People, Planet, and Profit.
		SDG 17: Partnerships for the Goals	Unites multi-stakeholder resources, expertise, and collaboration to drive action across all TBL dimensions.

CONCLUSION

This study placed the 1988 Manila Bay HAB Crisis alongside the 2020 Localized COVID-19 Response. The central message is clear. In both historical and contemporary contexts, government emergency responses have a latent capacity to forcibly close the Research Implementation Gap and traverse the Innovation Valley of Death. This study demonstrated that sustainability science is an enduring, systemic need for navigating shocks in complex humanenvironment systems. Retrospective assessments of the 1988 Manila Bay Harmful Algal Bloom (HAB) and the 2020 localized COVID-19 response in Cebu and Mandaue, Philippines, using Nilsson's SDG Interaction Scale. The rating scale revealed enduring patterns of cross-sectoral interdependencies. In both crises, survival and public health protection depended on transdisciplinary data integration, multi-agency enforcement, adaptive governance, and community-level mobilization. While these crisis interventions generated powerful interactions—such as linking real-time scientific surveillance directly to protective policy—they also exposed sharp negative effects on other SDGs, particularly when strict health blockades counteracted local economic livelihoods (SDG 8) and heavy security enforcement constrained non-discriminatory policy implementation (SDG 16.b).

Accelerating progress toward the 2030 United Nations Sustainable Development Goals requires bridging two persistent structural barriers: the research implementation gap and innovation's "Valley of Death." As the two case studies illustrate, overcoming these barriers demands a fundamental structural shift away from isolated, single-discipline knowledge pillars. On the research side, adopting the San Francisco Declaration on Research Assessment (DORA) replaces narrow publication metrics with incentives for collaborative, open, and action-oriented solutions. On the innovation side, embedding Elkington's Triple Bottom Line (TBL) framework encourages sponsors, leaders, and policymakers to evaluate progress beyond short-term financial returns, balancing profit with human well-being and planetary health. By unifying DORA-aligned research assessment with TBL-driven innovation, sustainability science provides the operational foundation for translating scientific evidence into transformative, resilient policy, ensuring global societal progress and human survival.

Our duty as researchers and innovation leaders is to change these adaptive behaviors from reactive crisis management into a proactive development framework.

Conflict of Interest

The author reports no financial, professional, or personal conflicts of interest that influence or bias the content of this manuscript.

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