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Delivering sustainable climate action: reframing the sustainable development goals

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Globally, climate change represents the most significant threat to the environment and socio-economic development, endangering lives and livelihoods. Within the UN's current 17 Sustainable Development Goals (SDGs), climate action is explicitly covered under Goal 13, "to take urgent action to combat climate change and its impacts". This perspective considers how to re-frame the SDGs and their successor towards mainstreaming climate action within the targets and indicators of all the development goals.

Sustainable development aims to protect the natural environment, people and society in the present and future. The term sustainable development first emerged in the 1980s within the context of environmental protection, specifically mentioned in the 'World Charter for Nature' during the 37th United Nations General Assembly in 1982[1]. The principle emphasized a comprehensive consideration of the factors affecting the environment along with the fundamentals of their protection. A major development was the Brundtland Report, published in 1987 by the World Commission on Environment and Development (WCED), which defined sustainable development and explained how it could be achieved[2]. From the 1980s to the 2000s, the concept of sustainable development evolved to also encompass social development, with the 1992 Rio de Janeiro Earth summit representing a landmark moment[2–5]. In 2000, the United Nations (UN) introduced eight Millennium Development Goals (MDGs) focussing on global challenges related to poverty, education, gender equality, maternal and child health, disease, and environmental sustainability, which were set to be achieved by 2015[6]. The success of the MDGs is debatable, as benefits were not accrued equally across the globe, but their adoption was widely recognised as the "most successful anti-poverty movement in history" with an estimated one billion people raised out of poverty[7]. After a decade of implementing MDGs, a new set of Sustainable Development Goals (SDGs) were proposed, with the aim of peace and prosperity for people, and protection of the earth (environment and nature), now and in the future[8]. Seventeen SDGs were adopted during the 2015 General Assembly, comprising 169 targets (including 248 indicators) with a 2030 deadline[9].

Climate change is the greatest contemporary threat to the environment, human wellbeing and livelihoods. The impacts of climate change include increasing temperatures, rising sea levels, shifts in weather patterns, and increases in frequency and magnitude of extreme weather events including heatwaves, droughts, floods and storms[10,11]. From the pre-industrial era to the present day, the global average surface temperature has increased by more than 1.0 °C, and projections suggested further rises throughout the 21st century, with a 1.5 °C temperature increase initially expected to be reached or exceeded between 2030 and 2050[12]. However, the recent WMO report confirmed that the global average surface temperature reached 1.45 °C (±0.12 °C) above the pre-industrial baseline in 2023, indicating that this threshold is being approached much sooner than originally predicted[13]. As global temperatures rise, climate-related risks to human health, livelihoods, food security, water supply and economic growth also increase, with potentially catastrophic impacts.

Climate change directly and indirectly threatens sustainable development through multiple interlinked pathways. These threats influence the SDG targets, and hence limit their attainability. Within the 17 SDGs, climate change is explicitly covered and addressed under Goal 13 "Climate Action". However, 'climate' is mentioned only four times within the remaining 16 SDGs. Since the SDGs were written and ratified, the relevance of climate change has moved up the public and political agenda due to its increasingly visible effects[14]. Despite this, the discordant timeframes of long-term climate targets (for example, IPCC 1.5 °C target[12]) and shorter-term sustainability goals hinder climate resilient development.

In this paper, we explore potential synergies and trade-offs between climate action and the other 16 SDGs. This paper highlights how the SDGs should be reframed to make mitigation of and adaptation to climate change central to all SDGs (Fig. 1). Through a unique combination of expert elicitation and a comprehensive literature review, we offer actionable guidance for policymakers and stakeholders aiming to integrate climate objectives

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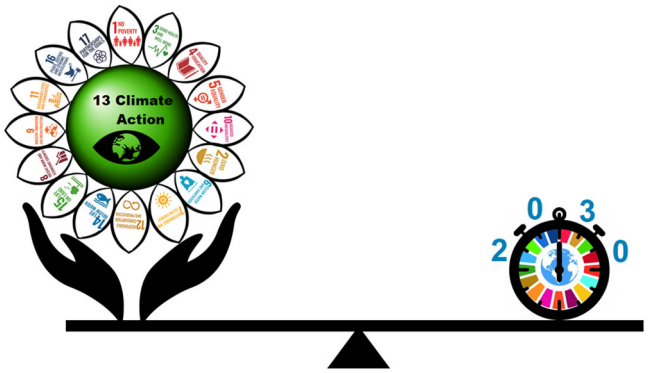

Fig. 1 | Reframing Sustainable Development Goals with a Climate-Centric Approach

within broader development strategies. This will aid the development of an integrated, systemically-conceived roadmap, fostering simultaneous and effective progress in both climate-resilient development and sustainability agendas.

Sustainable Development Goals, limitations and climate change

The 17 SDGs aim to end poverty, build social-economic-health protection and enhance education and job opportunities, while tackling climate change and providing environmental protection[9]. The SDGs were developed through consultation with countries, international institutions and civil society. UN member states collectively agreed and formulated the global goals, but individual countries are responsible for reviewing and implementing progress towards SDG targets. Several obstacles that hinder the achievability of these goals have been identified, including:

i) Climate change: The UN 'Special Edition of the Sustainable Development Goals Progress Report' highlights that climate change poses a threat to the progress across SDGs linked to poverty, inequality, health, environment, prosperity, and peace and justice[15–17]. Climate change also jeopardizes the existing achievements of the SDGs and their precursors.

ii) Global co-ordination and commitments: The SDGs are part of an international agenda that requires global efforts and commitments[9], however international coordination and binding accountability are difficult to achieve in a highly heterogeneous and competitive world, especially as countries/institutions are not legally obliged to act on them[18–20]. The lack of international participation and barriers to adoption of global policies due to competing local priorities are obstacles in achieving sustainable goals.

iii) Data/models: Progress towards the SDGs is impeded by the lack of adequate data, models and tools to address complex policy challenges. The challenges primarily revolve around effective data management and the dissemination of knowledge from existing tools and datasets, particularly in lower-income countries[21,22].

iv) SDG Interdependencies: Each SDG is inherently complex and inevitably interdependent with other goals[23], which further increases the whole system complexity. While the lack of progress on one SDG can hinder progress on others, the converse opportunity also exists. In other words, multiple economic, social, and environmental benefits can be achieved by adopting systems thinking and well-coordinated actions that synergistically align with multiple SDGs[24,25]. Supporting this notion, Le Blanc[23] demonstrated the interlinkages among thematic areas of the SDGs through social network analysis, viewing them "as a network of targets".

This paper describes how the impacts of climate change are the biggest challenge to achieving the SDGs, and thus argues for climate action to be embedded in each. A review by Nerini, Sovacool[15] suggests that governance processes and structures for mitigating climate change and other sustainability challenges need to be better strategically aligned to achieve the SDG targets. Kelman[26], argues that climate change can be usefully placed and linked within other sustainable development activities to avoid the separation of climate adaptation and mitigation activities. The IPCC explores the interactions of climate change and responses with SDGs, including sustainable development impacts at 1.5 °C and 2.0 °C global warming[12]. The report clearly highlights that the impact of 2.0 °C global warming will be far more severe than 1.5 °C, especially with respect to agriculture, coastal dependent livelihoods, children, older populations and the poor.

The evidence base unequivocally illustrates the necessity of addressing the synergies and tensions between two complex agendas to formulate an integrated solution for climate resilient and global sustainable development. To this end, we discuss the trade-offs and synergies between climate change and specific SDGs in detail in the following sections. As indicated above, several authors address the issue of climate change in relation to the SDGs, yet they do this by exploring possible impacts on targets and indicators—action within the SDG Agenda, rather than reframing the SDGs and their targets and indicators. Soergel et al.[27], for example, explore the impact of climate change on 56 indicators, or their proxies. Here, we also offer solutions and recommendations to reduce these trade-offs, reframing sustainable goals in a way that overcomes and unites fragmented decision-makers and actions.

In the following sections, the SDGs are analysed under the themes of: (a) Human and Social Sustainability, (b) Environmental and Resource Sustainability, and (c) Governance.

Human and Social Sustainability

Globally, 85% of all people living in poverty, defined as those earning less than $1.90 per day, are in rural regions and dependent upon agriculture[28]. However, the concept of poverty encompasses more than just income levels, incorporating essential factors such as access to healthcare, education, and social inclusion. Agricultural advancement is frequently recognized as providing the most significant potential for fostering poverty alleviation[29,30]. Climate change is intricately intertwined with the 'No Poverty' targets, including 1.1 (eradicate extreme poverty), 1.3 (social protection system), 1.4 (equal rights to economic resources) and 1.5 (build the resilience of the poor and vulnerable) in multifaceted ways[31,32].

While global poverty has plummeted from 42.7% in 1980 to 9.3% in 2017[33], this reduction has largely been underpinned by unsustainable economic practices that drive climate change. While many global poor have benefitted from economic development, climate change will disproportionately affect people living in poverty[34]. This will likely increase poverty in the medium-and long-term thus hindering achievement of SDG1 targets, unless adaptation policies are heavily targeted to protect the people in climate-vulnerable contexts[35,36]. This example demonstrates the tensions between short-term poverty goals and longer-term climate goals. This tension needs to be addressed whilst ensuring that mitigating or reducing climate change is not at the expense of development, or vice versa. We advocate for low-carbon economic development goals through reframing the 'No Poverty' targets to embrace climate-resilience solutions.

Promoting Good health and well-being (SDG3) directly contributes to the reduction of poverty and inequality[37]. The attainment of good health and well-being relies on a safe and enabling environment, fostered by effective climate change mitigation and sustainable development efforts[37]. There is substantial evidence that underscores the strong synergies between health and well-being and climate change (goals)[38–40], for example direct health impacts from climate related disasters (Goals 3.6, 3.8, 3.9); transmission patterns for communicable diseases/risk of global pandemics (Goals 3.3, 3.4); and extreme heat and excess deaths (cardiovascular and respiratory disease) (Goal 3.8). Climate change also impacts on mental health (Goal 3.4) and provision of health infrastructure and systems (Goals 3.8, 3.c, 3.d). These impacts amplify existing inequalities and can have an individual and societal impact through interpersonal violence, conflict and forced

migration[41]. Moreover, pandemics such as COVID-19 and zoonotic disease outbreaks are expected to become more frequent as climate change advances[42]. Numerous factors that escalate the risks of pandemics also intensify climate change impacts and vice versa, such as deforestation, habitat destruction, increased population density and globalisation. A habitable climate and resilient ecosystems are critical determinants of human development, influencing individual and social behaviour. Reframing the SDGs to reflect these interdependencies provides a unique opportunity to promote public health through an integrated policy approach that spans diverse sectors, builds inter-sectoral collaboration, and has a clear focus on prevention as well as ensuring universal health coverage. The simultaneous translation of long-term climate mitigation and adaptation strategies to short-term health goals will reduce fragmented actions and help vulnerable and climate-vulnerable regions.

Another key target of Human and Social Sustainability is quality of education (SDG4) which closely interconnects to poverty (SDG1), good health and wellbeing (GDG3), equality and women's empowerment (SDG5 and SDG10)[43]. Studies show that climate-related disasters and extreme weather events impact children's physical and mental health as well as their well-being by interrupting food security, poverty reduction, and sustained production and development[44–46], which in turn undermines education targets[47,48]. Education and climate change goals are complementary, as education empowers societies to cope with climate challenges[49] and addresses them through attitudinal and behaviour changes. SDG4 actions are currently too universalistic, and do not encourage collective actions to address climate change[50]. For example, climate change mitigation requires education, awareness, motivation, and capacity building as goals in SDG13.3, but SDG4 does not adequately highlight the need for climate education. Revisiting the role of education in collective climate action requires mainstreaming climate adaptation and mitigation strategies within education systems from primary school level upwards to improve social, ecological and economic systems, enabling positive environmental outcomes that will contribute to climate goals. To do this, climate-focused educational goals and methodologies should be developed to empower local (i.e. communities, societies, councils and NGOs) and global actors (i.e. international institutes and governing bodies).

Climate change and its associated hazards, can exacerbate existing gender inequalities, often leading to disproportionately adverse repercussions for women and girls. Notably, environmental and resource pressures exacerbate gender inequalities and power imbalances, particularly in communities grappling with resource scarcity and stress[51]. Climatic shocks (e.g. floods) can escalate the risk of violence, especially against women and other vulnerable groups (Goals 5.2, 5.3)[52,53]. On a more positive note, clear and broad links exist between the climate crisis and the empowerment of women. For instance, nations with greater female representation in governing bodies tend to exhibit lower climate footprints[54]. There is a need to integrate gender equality within climate goals at both local and global levels. In reframing the SDGs, women must be accorded pivotal roles and ownership as both local and global leaders in formulation and execution of sustainable climate and development approaches. Inequality can negatively impact upon mental and physical health and associated life expectancy, obesity, teenage births, and higher rates of crime, and anti-social behaviour[55,56]. All these issues are influenced to some degree by climate change via its influences on health, social behaviour and economic growth.

Environmental and Resource Sustainability

Environmental and resource sustainability are aligned with SDGs 2, 6, 7, 12, 13, 14 and 15, which are multiply interconnected. As an illustration, the specific targets of SDG2 (Zero Hunger) span the environmental dimensions (agricultural productivity, sustainable and resilient production systems, and climate change adaptation), the domain of public health (ending hunger and malnutrition) and socioeconomic factors (farmer incomes and markets)[44,57]. To achieve the SDG2 targets, a focus on ensuring that ecosystem-based management, sustainable agriculture and crop production is responsive to climate change-related impacts is essential. Studies of the potential trade-offs between ecosystems, agriculture/food production and climate change[16,44,58,59] demonstrate the need for deeply embedding climate actions in SDG2 targets. The UN Food and Agriculture Organization[60] underscores the need to increase global food production by 70%, with developing nations required to double their efforts to feed their population by 2050[60]. Yet, climate impacts will potentially lead to a 2% reduction in agricultural production per decade throughout this century[61]. This demonstrates how climate change can lead to food insecurity, driving up poverty and inequality. Reliable climate resilience tools must therefore be embedded within SDG2 to inform policy and programming decisions for farmers and vulnerable communities, as well as better climate forecasting and food security considerations. A strategic shift, founded on effective coordination and knowledge exchange between farmers, policy forums, and climate institutions, with conclusions tested for resilience to local and global changes is also necessary[25]. These reforms should be underpinned by climate-aware financing mechanisms for crop and related agriculture, both upfront and over the life-cycle of the roadmap.

Climate change likewise poses significant challenges to clean water and sanitation goals (SDG6)[62]. Climate change affects water ecosystems and the availability and quality of water resources[63], thereby influencing SDG6 targets. The IPCC report warns that a warmer climate will increase the frequency and intensity of precipitation during wet periods, potentially intensifying flooding, while certain regions may encounter drought conditions[64]. Allied research has shown how climate change threatens the attainment of SDG6 and global water security targets. For instance: a) rising sea levels might lead to surface and groundwater degradation in coastal freshwater aquifers; b) elevated water temperature will increase the spread of harmful algae in rivers, compromising water quality; and, c) melting and retreating glaciers could impact drinking water supplies. These disruptions in water supply and sanitation will inevitably escalate costs within the SDG target pathways. Affordable and integrated measures are imperative, entailing technological enhancements and data refinements, to avert these negative economic side-effects. SDG6 needs to adopt an implementation pathway that includes integrated water-climate solutions, an integrated regulatory framework, risk management and cost models.

Healthy oceans and freshwater ecosystems underpin sustainable development[9], and their links to food, energy, water and transport make them a vital trade platform. Oceans and seas mitigate global warming by absorbing about 30% of global carbon dioxide (CO_2) emissions[65]. Nonetheless, climate impacts (especially temperature rise) and CO_2 enrichment directly affect ocean chemistry (i.e. pH and calcium carbonate saturation state), which affect marine biota through diverse mechanisms[66–68]. Moreover, subsequent variations in ocean circulation and salinity associated with climate change affect sea water chemistry[66]. Despite the substantial synergies and trade-offs between climate change mitigation actions and the protection of sea and marine life, climate action is not currently integrated in SDG14 thereby hindering progress. Oceans and seas should be viewed as a climate change solution with SDG14 promoting solutions for sea-based renewable energy, transportation, food and trade, through effective policy interventions including management and climate-sensitive modelling tools.

Climate change further creates stresses on land use, exacerbating existing risks to terrestrial ecosystems and biodiversity, primarily through intensified rainfall, flooding, increased drought frequency and severity, heat stress and sea-level rise[69,70]. Like the oceans, the terrestrial biosphere aids climate mitigation by absorbing about 20% of fossil-fuel CO_2 emissions[71]. Given these synergies and tensions, effective land-based climate change mitigation and adaptation policies much be formulated to safeguard nature and biodiversity conservation. A systems approach is imperative to facilitate this, though political agendas and community interests can impede cohesive action. There is need to better understand how global climate goals influence terrestrial ecosystems and, consequently, livelihoods. Involving local actors (who have core contextual knowledge and understand local impacts) in strategies and policies at the global level when reframing the SDGs will reduce fragmented actions and encourage sustainable development. However, involvement must extend beyond the shaping of policies and strategies

to being integral to delivery of actions[72] – in the same way that local actors should help develop the local narrative for the places in which they live and work, they should be both empowered and trusted to deliver that narrative[73]. Here, we are dealing with a 'call to arms' specifically to address the impacts of, and to limit further, climate change as part of the local narrative. Put another way, climate change actions should never be 'additional' or 'generic' but should be woven into the fabric of places and the people who live and work in them.

Renewable and clean energy production is essential for the success of the Paris Agreement[74]. However, climate change related impacts resulting from temperature, precipitation changes, sea level rise and extreme hydrometeorological events directly influence the generation, distribution, and consumption of energy[75,76]. Climate change mitigation efforts within the energy system will have broader implications, such as: (a) land use change for biomass to replace fossil fuel (SDG15); (b) water for cooling (SDG6); and, (c) waste and environmental pollution: batteries, solar cells (SDG12). Studies have identified tensions and conflicts between climate change and energy systems[75,77], yet these trade-offs remain unaddressed within SDG7. Technological innovation and system design both promote clean energy and can make it affordable and accessible for all. Moreover, challenges like resource scarcity, research finance, effective deployment and local policies and governance need to be integrated into the delivery of SDG 7.

Clean energy significantly contributes to sustainable consumption and production (SDG12), where Goals 7 and 12 are strongly interconnected, such as the extraction of critical raw minerals required for the global transition to net zero. These activities also present new sustainability challenges, with the most adverse impacts manifesting in low-resource settings. Notably, SDG12 mandates sustainable consumption and production systems to curtail environmental impacts and resource scarcity, yet it fails to highlight unsustainable patterns of production and consumption. Climate-related disasters and environmental variations directly impact production and consumption activities, notably escalating production costs and consumption demands, while food security, poverty alleviation, energy, medicine, infrastructure, welfare and services all depend on productive activities[17,78–81].

An integrated Sustainable Development approach that promotes collaborative and localised bottom-up decision-making, financial support and incentives remains critical for attaining the climate action goal and interconnected SDGs, such as SDG 12.

Governance

Governance ensures accountability for decent work and economic growth (SDG8), industry, innovation, and infrastructure (SDG9), sustainable cities and communities (SDG11), peace, justice, and strong institutions (SDG16), and partnerships to deliver the Goals (SDG17).

Sustained and inclusive economic growth (SDG8) can drive progress, generate decent jobs for all, and enhance living standards[9]. At the same time, growth heavily relies on a stable climate system. Recent decades have witnessed a consistent rise in climate-related damage (i.e., on environment impact, infrastructure degradation, etc), which negatively impact growth. This underscores the inherent interdependency of the SDGs. There is clear evidence that climate change related impacts (i.e. temperature rise) adversely impacts production and consumption (Goals 8.2, 8.4), innovation (Goal 8.3), crime and inequality (Goals 8.5, 8.7, and 8.8) and trade (Indicator 8.a), which have both direct and indirect effects on sustainable economic activities and decent work[82,83]. We advocate for embedding climate resilience policies into economic systems, focusing on four major sectors: agriculture, energy, infrastructure and transport. Economic tools can incentivise beneficial trade-offs between SDG8 and climate change, while accurately include the climate impact in economic costs to ensure climate-friendly economic development in the short and long-term. More broadly, short-term economic goals should be integrated with long-term climate actions within a synergistic framework that aligns the success of the Paris Agreement with climate-resilient economic growth[84]. To achieve this, combined climate-economic decision tools are required and the input data with which to use the tools. The tension between the current economic approaches and the worsening climate situation also brings into consideration whether fundamentally new economic approaches are required to solve the climate crisis. For example, the concept of 'doughnut economics' and more broadly circular economics argues for economics that simultaneously meet the needs of humanity and also the planetary system[85,86]. It has been argued that GDP is a poor indicator of development and promotes unsustainable growth; alternatives such as the Genuine Progress Indicator (GPI), Human Development Index (HDI), and Gross National Happiness (GNH) have been promoted[87,88], alongside a more general discourse around degrowth[88]. However, to date, these approaches have not been widely adopted.

To achieve sustainable economic growth and tackle future challenges, industries must adapt, and infrastructure must be upgraded to deliver socio-economic development alongside goods and services. Technological justice should be emphasized to ensure widespread use of the latest green technologies. Climate change has profound implications for sustainable industrialisation (9.2, 9.3, and 9.5) and the quality and resilience of infrastructure (9.1 and 9.4) goals. Climate variabilities such as temperature rise, intense precipitation, and other extreme weather events affect infrastructure, leading to notably higher maintenance and repair costs. Climate-related disasters and extreme weather cause infrastructure (i.e. roads, bridges, buildings, dams etc.) designed for a particular climate range to fail far earlier[89,90]. Moreover, climate change will impact future development plans in areas where poverty is prevalent and infrastructures are insufficient (Indicator 9.a)[91]. Industrial and infrastructure development consumes large quantities of energy that (unless sourced renewably) will contribute to carbon/greenhouse gas emissions. In turn, these developments would compromise the Paris Agreement goals of reducing global temperature.

We believe that improving innovation systems alone will not be enough, development sectors require affordable and equitable access to renewable energy and a climate-resilient environment. Achieving SDG9 will mean managing development-climate trade-offs by prioritising innovative technological transitions, coupled with increasing green investment and renewable financing at both government and industry levels. An integrated financial and management system involving global and local institutions is needed to promote green and renewable industrial growth and innovation in an equitable and inclusive way. Failing to achieve SDG9 targets due to these climate challenges will hinder job creation and the establishment of stable and prosperous cities and communities (SDG11). An example of the difficult trade-offs to be considered is within the tourism industry, which accounts for 8% of global greenhouse gases. Adverse climate is threatening tourism in various regions by disrupting travel and harming its potential for growth[92].

Realizing sustainable cities and communities hinges on addressing all three dimensions of sustainability: social, economic and environmental[93]. Designing and implementing systemic changes (whether physical creation, operational protocol adjustments, or policy/governance advancements) necessitates acknowledging that well-managed cities hold immense potential for low-carbon living at every stage of the design and implementation process[73]. Numerous studies highlight the role of climate variability on communities and urban development[93–97]. Most notably, climate change-driven extreme weather events impacts on basic services, infrastructure, housing, human livelihoods and health[98]. Against this background, the vision of sustainable cities and communities will be lost unless they are encouraged to enhance resilience through an effective climate action framework, incorporating green infrastructure[99] and community-based educational tools within SDG11. A systems approach to building sustainable cities necessitates integrated solutions[100], integrating urban-climate action planning with socio-economic, technological, and political priorities.

Peace, Justice and Strong Institutions (SDG 16) significantly contribute to socio-economic development and the establishment of sustainable cities and communities. Climate change threatens to undermine SDG 16 because it will escalate tensions and competition over land and water supplies as communities face increasing insecurity[101–103]. In turn, this is likely to trigger new waves of climate change forced migration, both domestically and

internationally, which could adversely affect national security, justice, and—through the rise of populist "outsider" candidates—democratic consolidation[104–107]. In this context, it is important to note that the COVID-19 pandemic has gone hand-in-hand with a global economic crises and credit crises, which have eroded the resilience of individuals and communities, and reduced the resources available to governments to respond to climate-related issues. This is problematic, as it is critical to boost investment in strategies that offset the direct impact of climate change while concurrently building more resilient institutions in both rural and urban areas.

Sustainability goals can only be achieved when we work together across all sectors[84], through effective and meaningful partnership (SDG17). This is particularly true of climate action: addressing climate goals requires financial resources (Goals 17.1–17.5), widespread adoption of new technologies and innovations (Goals 17.6–17.8), capacity building (Goal 17.9), trade policies (Goals 17.10–17.12) and policy and institutional cohesion (Goals 17.13–17.19)[108]. Hence, there is a pressing need to bring together local and global climate institutions, and governing bodies under one umbrella when reframing development goals. By strengthening partnerships, the co-benefits of sustainable climate and development goals will be more easily delivered. This requires an acknowledgement that climate change is a multidimensional problem in which activities designed for SDG outcomes also contribute to climate change, and vice versa.

Centring on developing and emerging nations, SDG17 should embrace a socio-innovation approach, emphasizing eco-innovation solutions, harnessing bottom-up approaches in localising the SDGs and grassroots educational programs/tools for both consumers and producers that support climate resilience consumption and production systems. Beyond promoting an integrated financial system that promotes climate resilient production and consumption, the active involvement of local actors (i.e. small producers) in the educational promotion of eco-innovation solutions is critically important in overcoming environmental barriers to achieving sustainable goals.

These identified synergies and trade-offs must be collectively addressed in the Development Goals. Considering the pervasive interdependencies discussed above, SDGs, targets and indicators should be forward-looking, but context-dependent, taking into account potential climate change impacts via robustly created future scenarios[84]. Adopting the potential solutions proposed here will help in the design and implementation of climate-focused sustainable actions and ensure effective social, political and economic progress towards the SDGs. The following section provides recommendations for cross-cutting pathways that can achieve this.

Implications/recommendations for future sustainable development goals and way forward

Since climate change is the greatest threat to sustainable development[109,110], effective progress towards the SDGs requires an understanding of the multiple interdependencies between the 17 individual SDGs when addressing the trade-offs and exploiting the synergies between their ambitions and climate action. Conversely, limited progress on reaching the SDGs will make climate goals more difficult to achieve. The recent UN Climate Change & SDGs Conference[110], reiterated the need to unlock climate actions in the SDGs by ensuring simultaneous progress in climate-resilient development and the sustainability agenda. To this end, we recommend that the SDGs be systematically reframed to embed climate action in the targets and indicators in a way that emphasise the interdependencies between goals (Fig. 1). This will enable the exploitation of cross-cutting pathways that recognise the synergies between the SDGs and climate action. Social, political and economic reforms, coupled with effective coordination, will all be required. It is important that our proposed climate-centric approach to other sustainability goals does not lead to duplication of existing policy structures, which would lead to inefficiencies through competing bureaucracies.

We therefore propose the following steps:

1. Climate objectives and SDGs need to be integrated The SDGs aim to embed positive practices to improve people's lives, but climate change is negatively impacting on progress to achieve the 2030 goals. Coupling the climate objectives of the Paris Agreement to the SDGs within the same pathway and timeframe will enable stakeholders to work towards positive environmental outcomes, whilst achieving long-term climate sustainability and development targets. The recommended approach to systematically designing climate-resilient practices under each SDG, by amending their targets and indicators, is that advanced by Rogers et al. [111], in which each system of interest represented by the targets and indicators is mapped in relation to all other human and natural systems to identify the points of dependency and interdependency. This mapping can then be used to identify all the stakeholders who should combine to become part of the solution, the nature and extent of the impacts that changes to include climate action would result (thereby enabling the redesign to deliver most effect), and the relevant forms of governance that might provide a barrier to change (so that they can be amended).

   Align Long-term and Short-term Goals: Along with the long-term goals, clearly defined short-term targets and actions must be embedded within the SDGs and associated time-bound roadmap. Setting both long/short-term goals will provide a tangible structure by which social and economic development can adopt climate-resilient actions. Crucially, this would unify the timeframes for achievement of sustainable development and climate goals, ensuring that climate action is not achieved at the expense of development, or vice versa. In addition, the integration of the long-term and short-term goals will make transparent the necessary shape of development activities such as agriculture, manufacturing, transport and energy infrastructure services, which would otherwise be disrupted if climate action and the sustainability agenda are not unified. This 'joined up thinking' would transform fragmented actions into productive synergies, with benefits at all levels.
2. Inclusion of local actors in developing sustainability goals and solutions Both the SDGs and climate change require global action, but this is enacted through multiple local actions and national actions. Policy developed to meet the climate goals at the international level (good for Global Development Goals) can negatively impact local livelihoods by influencing, for example agriculture, energy, and natural resources. Sustainability is determined locally[111], through local priorities set by actors who understand the conditions, and so they must be treated as trusted advisors. This means valuing their contributions and giving them ownership within advisory panels focussed on reframing the SDGs to become more climate-centric. Doing this will enable global actors to understand how local actions affect the climate and development and vice versa, and that it is only by the integration of multiple local actions that sustainable and climate-resilient goals can be achieved. This coordination between local and global will also help to fill the data and knowledge gaps, which is essential to reframe the development goals. Moreover, local actors should then be empowered, and trusted, to take local actions.
3. Provision of adequate financial resources to facilitate an inclusive climate resilient sustainability agenda Financial pressures and global economic insecurity are the greatest risks to climate-resilient sustainable goals. Bridging upfront financing and whole life-cycle funding is needed to support development in vulnerable regions. Global and local institutions need to co-create a unified financial system to support climate-resilient sustainable goals, enabling resource generation, monitoring and pathway evaluation under one umbrella. This approach can be made complementary with other national-scale design frameworks to improve national economic policies that support advancement across multiple SDGs[112].
4. Establish a Climate and Sustainable Development (CSD) focused advisory body: A dedicated international CSD Panel for multi-sectoral and intergovernmental coordination and knowledge exchange should be created to bring together people from government forums, climate institutes, civil societies, policy, research and industry, fed by similar national panels, which in turn are fed by locally-convened panels[111].

Table 1 | SDG themes along with expert contributions

SDG Themes	Related SDGs	Area of Expertise
Theme 1: Human and Social Sustainability		
	1 (*Poverty*)	Economists, social policy experts
	3 (*Health and well-being*)	Public health specialists, epidemiologists
	4 (*Education*)	Educational researchers, sociologists
	5 (*Gender Equality*)	Gender studies experts, human rights advocates
	10 (*Reduced Inequalities*)	Sociologists, economists
Theme 2: Environment and Resources Sustainability		
	2 (*Zero Hunger*)	Agricultural scientists, food security experts, nutritionists
	6 (*Clean Water and Sanitation*)	Environmental engineers/scientists, hydrologists
	7 (*Affordable and Clean Energy*)	Energy policy analysts, engineers
	12 (*Responsible Consumption and Production*)	Sustainability experts, economists
	14 (*Life Below Water*)	Marine biologists, oceanographers; climate experts
	15 (*Life on Land*)	Ecologists, Forestry Scientists, Geoscientists, Environmental Chemists; climate scientists
Theme 3: Governance Sustainability		
	8 (*Decent Work and Economic Growth*)	Business and Management experts, Environmental Economists
	9 (*Industry, Innovation, and Infrastructure*)	Infrastructure Planners and experts, Industrial experts
	11 (*Sustainable Cities and Communities*)	Urban Economists, transport experts, Sociologists,
	16 (*Peace, Justice, and Strong Institutions*)	Political scientists, legal scholars
	17 (*Partnerships for the Goals*)	International relations experts, development economists

This set of panels should collect data information and knowledge on the tensions and synergies between climate action and the current SDGs that truly represents the local, regional, national and international perspectives of institutions, governments and society. Their primary task would be to prepare a transparent, accessible and evidence-based roadmap before 2030 to advise the UN General Committee on the next climate-focused SDGs. This panel structure would be inclusive, therefore authoritative and trusted, and able to advise on methodologies that would articulate likely positive and negative outcomes of actions[84], hence de-risking decisions to act and so emboldening the pursuit of climate-focused goals. The Commission on Sustainable Development, which preceded the High-Level Political Forum on Sustainable Development (HLPF)[113], laid a strong foundation for sustainable development efforts. Therefore, we propose that the Commission would be a suitable place to embed the CSD advisory body. This approach would build on the existing structure, enhancing the focus on climate-specific goals, ensuring coordination with the UN system, and avoiding the creation of redundant bodies.

Given the highlighted challenges, systems thinking is essential when planning the roadmap leading to revisions to the SDGs, and systemically designed climate-resilient practices must be embedded in the SDGs to facilitate new synergies and manage trade-offs. The integration of the above guiding principles (steps 1–4) into the revised SDGs will allow for the systematic design, financing and oversight of climate-resilient practices. This perspective does not provide detailed mechanisms on how to achieve this, but we believe it provides the overarching actions required to integrate climate action successfully with the other development goals. The failure to resolve tensions between development goals and climate action will make it impossible to achieve inclusive sustainable development.

Methods/Approach

We brought together a highly cross-disciplinary cohort to address this interdisciplinary challenge by convening 16 disciplinary experts through a series of webinars to examine the SDGs (Table 1). Critically, the approach adopted in the webinars was one of collaborative working beyond disciplinary boundaries, since each delegate had an adequate knowledge of the other disciplines represented, such that detailed debates and analysis were carried out in the spirit of transdisciplinarity. The webinar series adopted three broad themes: (1) *Human and social (SDGs 1, 3, 4, 5, 10)*, (2) *Environment and Resources* (SDGs 2, 6, 7, 12, 14, 15), and (3) *Governance* (SDGs 8, 9, 11, 16, 17). These webinars aimed to identify and understand: (a) Evidence of trade-offs between climate change and other SDGs, (b) How SDGs can be framed in the light of climate change to achieve climate-resilient sustainability goals. We adopted an expert elicitation approach, utilising the information and knowledge from the inputs to these panels to fill in the systematic information gaps in these areas. This paper distils the evidence collected, with all speakers collectively shaping the text. Significant participation from an audience of senior academics, early-career researchers and students provided subsidiary information.

Our expert analysis identified that nearly all SDG targets and indicators are interdependent with climate change actions. Examples of these dependencies are elaborated and documented using expert review, where evidence was built through existing peer-reviewed studies and grey literature.

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Conceptualisation: A.S. and F.D.P.; Formal analysis: A.S.; Investigation: A.S.; Resources and Supervision: F.D.P.; Writing—original draft: A.S.; Writing – review and editing: F.D.P., J.R., C.L. H.B., S.E.B., N.O.B., J.R.B., N.C., H.F., S.K., K.N., F.N., L.R., C.D.F.R., K.R., and I.T.; Validation: F.D.P., J.R., C.L. H.B., S.E.B., N.O.B., J.R.B., N.C., H.F., S.K., K.N., F.N., L.R., C.D.F.R., K.R., and I.T.

Competing interests

The authors declare no competing interests.

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