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Building strong institutions to combat climate change and its impacts and for the sustainable management, protection and restoration of natural resources

Building strong institutions for addressing climate change and for the sustainable management of natural resources

This background paper was commissioned by the Secretariat in support of a study by the Committee's informal working group on institutional challenges and opportunities related to climate change action and protection of natural resources. The paper was prepared by Afreen Siddiqi, Research Scientist at the Massachusetts Institute of Technology and Adjust Lecturer in Public Policy at the Harvard Kennedy School, both in Cambridge, Massachusetts in the United States. Discussions for this paper were held with Committee members Linda Bilmes, Geraldine Fraser-Moleketi, Louis Meuleman, Soonae Park, Aminata Toure, Lan Xue and Najat Zarrouk, as well as with Alessandra Alfieri, Environmental Economic Accounts Section, Statistics Division, Department of Economic and Social Affairs. The author has drawn on the observations of the interviewees in her analysis. Quotations in the paper are attributed to this group.

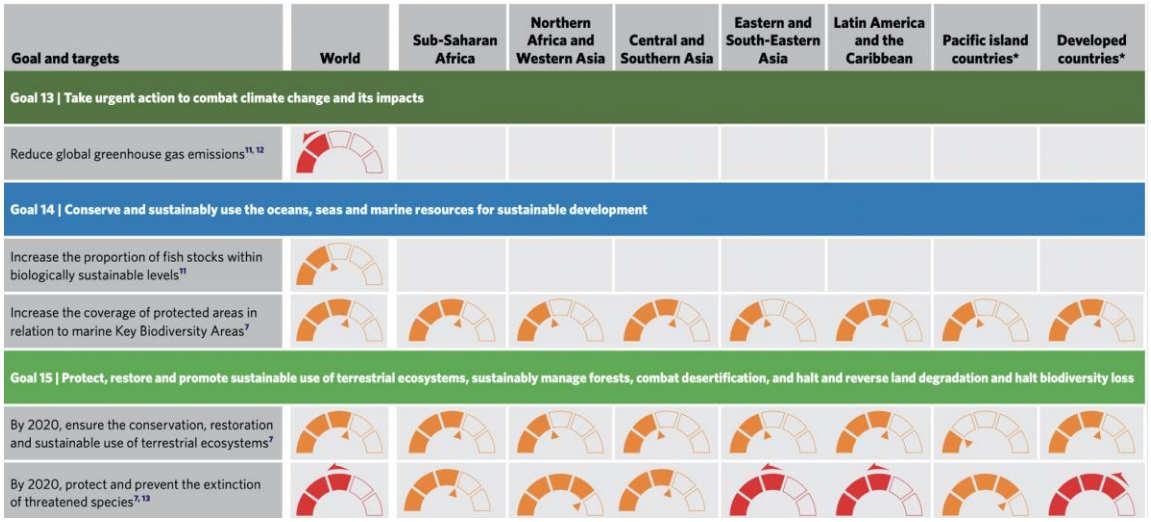
Abstract

Recent assessments showing level of achievement towards targets for action to combat climate change (SDG 13), conservation of oceans and marine resources (SDG 14), and protection and sustainable use of terrestrial ecosystems and halting biodiversity loss (SDG 15) show deterioration or stagnation across all regions of the world. This paper examines challenges in, and opportunities for, efforts that can advance progress. This assessment notes the need for increasing ownership of goals. It is found that 75% of indicators for SDG 13 (climate action) and SDG 16 (strong institutions) are in Tier II (implying that less than 50% of countries are reporting data). Meaningful metrics have yet to be developed that address complexities of estimation of ecosystems. Inadequate funding also remains a major transition barrier. Some of the institutional challenges can be addressed with strategic prioritization of mechanisms for policy coherence, which can allow for knowledge exchange, stimulation of partnerships, and mobilization of new funds. This will require capacity-building in the public-sector and ensuring that systemic arrangements of necessary components for monitoring and action are connected and functioning with adequate speed and strength.

1.0 Introduction

The pace of progress in addressing emissions of greenhouse gases and sustainable use and management of natural resources is not on track for fulfilling the 2030 development agenda.[1] The most recent assessments, showing trends and level of achievement towards targets for action to combat climate change (SDG 13), conservation of oceans and marine resources (SDG 14), and protection and sustainable use of terrestrial ecosystems and halting biodiversity loss (SDG 15) show either a deterioration or stagnation across all regions of the world (Figure 1). The chart presents trend assessment (with colors) and level assessment (with a gauge meter) to measure progress towards the target from a baseline year to the most recent data point.

Figure 1. Progress on selected targets of Sustainable Development Goals 13, 14 and 15



Codes: red – deterioration, orange: limited or no progress, green: substantial progress. The gauge meter shows the current level of development with respect to the distance from a target, using the latest data. Figure source: [1]

Most countries have instituted a variety of approaches for coordination, planning, and reporting for achieving their policy goals and SDG targets. Some of these include integration of the SDGs into national and local development plans; development of implementation roadmaps; and creation of statistical offices and bureaus for collecting and reporting data for indicators of SDGs.[2–4] The strength of public institutions and quality of public administration, however, remains deficient in many countries. In some cases, there is lack of full ownership of SDGs (partly explaining the poor performance in achieving development targets). There are is also lack of necessary integration and coordination, erroneous or incomplete reporting, and absence of necessary systemic arrangements at local, state, and national levels that are needed for achieving the pledged goals.

The most recent assessment of progress on SDGs related to institutions, SDG 16 (promoting peaceful societies and accountable and inclusive institutions) and SDG 17 (strengthening means of implementation and global partnerships) partly indicate these issues.[1] However, it also reveals the need for improvement in measurement of quality and strength of institutions and partnerships. The current indicators, for example, track inputs (such as funds and statistical offices being set up), but not the outputs of these efforts [a]. Thus, on one hand most governments around the world have put in some policies, structures, and mechanisms to coordinate for and make progress towards the SDGs. On the other hand, as shown in Figure 1, progress on SDGs 13, 14, and 15 has been dismal. This is partly because while in some cases structures have been created, but institutional function remains deficient. As one expert observed, "one country noted establishment of twenty environmental committees with people from different stakeholders' groups, and then when asked how often do they meet, [the response was] well they have never met yet."

Starting with this context and focus on SDGs 13, 14, 15, 16 and 17, an assessment of institutional arrangements for, and challenges facing, climate action and sustainable management of natural resources is conducted here. Institutions are defined to include both policies, laws, and norms (rules of social behavior)[5] as well as organizations. This paper draws from technical and annual reports of public and private organizations, peer-reviewed academic literature, as well as discussions with members of the working group in the Committee.

2.0 Shifting the economy-environment paradigm: changing mindsets for a transition

The paradigm of development, continuing since the industrial revolution in the 18th century, heavily centered on expanding production with scant regard to environmental harm. However, as the cumulative environmental harm became publicly evident and scientifically proven, advocacy for controlling pollution gained momentum leading to new institutions in the US and Europe in later parts of the 20th century. The environmental protection agency (EPA) was established in 1970 in the US[8] and "the origin of European environmental policy is conventionally defined as the adoption of the EU's first Environmental Action Programme in 1973".[9] Shifts have also emerged in the private-sector, and the revision of the "statement of purpose of a corporation" by the Business Roundtable (a confederation of 200 major U.S. companies) in 2019 marks a departure from past conceptions. The new statement adopts a move "away from shareholder primacy and includes commitment to all stakeholders". It commits to "dealing fairly and ethically" with suppliers, supporting communities in which businesses work, and protecting "the environment by embracing sustainable practices"[11]. One observer notes, this shift marks "the days when companies could follow Milton Friedman's famous admonition to focus narrowly on optimizing shareholder value have passed".[12] It is too early to know what (if any) actual change would occur following this new stated purpose. However, it is important to note that such a change (at least radical in conception) has taken place in some quarters of the world of business. An additional marker for change is the increase in reporting on sustainability. In 2011, slightly less than 20% of S&P 500 companies reported on sustainability; by 2017 the share had increased to 85% (GAI, 2017).

In the global policy arena, the adoption of SDGs represents an essential step forward in shifting the paradigm of economy and environment relationship. The opening remarks of the European Commission in the Annual Sustainable Growth Strategy 2020 indicate this with the statement: "Economic growth is not an end in itself. An economy must work for the people and the planet. Climate and environmental concerns, technological progress and demographic change are set to transform our societies profoundly. The European Union and its Member States must now respond to these structural shifts with a new growth model that will respect the limitations on our natural resources and ensure job creation and lasting prosperity for the future."[13]

While there are clear signs of change, a due recognition of the foundational role of the natural environment in enabling and sustaining economies has yet to occur across all sectors and spheres of society (citizens, corporations, public administrators) globally. This is partly evident through the continuation of policies that are harmful for the environment and through in-action of legislators in many countries. In some regions, productive (but polluting) activities are seen as a short-term economic necessity. This sustainable development goals have yet to be fully owned.

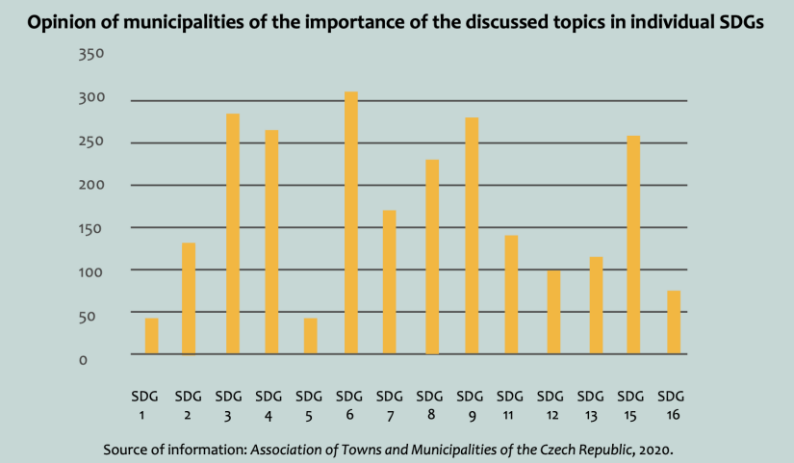
2.1 Including and empowering communities: enabling engaged constituencies

In suggesting a paradigm shift, an important first question is to explore "how do we ensure that we are not talking on behalf of the billions without their involvement?" Without such inclusion and representation, a real paradigm shift cannot be achieved.

UN guidelines for Voluntary National Reviews (VNR) for 2022 focus on the issue of inclusion explicitly, noting "Tied in directly with the section on multi-stakeholder participation […], is national ownership of the SDGs. Awareness raising and dissemination of information about the SDGs throughout all branches and levels of government and among stakeholders is a crucial and ongoing dimension of creating an enabling

environment, and participatory and inclusive processes, a central requirement in the 2030 Agenda, can help to create a sense of ownership."[14] A recent review of VNR efforts, has noted that "the 2016-2019 VNRs showed that around 75 per cent of countries reporting to the HLPF from 2016-19 noted inclusion of non-state actors, 80 per cent highlighted activities to inform the public and diverse stakeholders, and 80 per cent also provided information on multi-stakeholder engagement to nationalize the 2030 Agenda and generate ownership. In 2020, there was an increase in the inclusion of local government in the VNR reports. Another trend was further inclusion of non-state actors in the drafting of the VNRs" [15]. These steps are in the right direction, but more needs to happen. As one expert noted, "There is a lot to do for the leaders of local and regional authorities to integrate the climate change among their vision, their mission, and action. In a lot of examples, they take this to private consultants, so they [consultants] will do it for them. But there is no ownership." [a] Some formal surveys point to a somewhat similar picture (Figure 2).

Figure 2. Survey results on importance of each SDG for municipalities in the Czech Republic show varying priorities for specific SDGs.



Source: [3]

Empowerment of citizens is essential for creating ownership for sustainability goals. And as one expert observed, "the citizens need to be viewed as actors rather than passive beneficiaries." Several instances of positive environmental change that resulted from grass roots efforts of local residents serve to highlight the importance of self-motivated, community action. These include restoration of mangrove forests to revive local livelihoods in Senegal (Box 1) and preservation of wetlands in the Republic of Korea (Box 2).

Box 1. Reviving mangroves and livelihoods – community action in Senegal

Senegal has 185,000 hectares of mangrove estuaries in the regions of Casamance and Sine Saloum, but almost a quarter of mangroves have been lost since the 1970's due to freshwater reduction. This was due to droughts, upstream agricultural practices, firewood collection, and road infrastructure. The loss of mangroves has led to a decline in fish stocks on which local communities have depended for their food and livelihoods.

A mangrove restoration project began with community-led efforts in the mid 1980s. These efforts raised the consciousness of the government over time and became a prominent example of

ecosystem restoration in Senegal. The project, coordinated by the Livelihoods Carbon Fund (LCF) since 2011, has aimed at restoring mangroves to protect arable land from salinization, produce fish resources and wood. Some impact assessments after 10 years show positive effects. Replantation has occurred over 10,000 hectares, with involvement of over 200,000 people. In 2017, it was estimated that the restoration of mangroves has led to an increase in fish stocks of more than 4,200 tons per year. The study also estimated that 15% of previously abandoned rice fields could be restored and that rice fields further offshore could increase their yields by 10% and more." [16] The factors have included a strong local commitment of NGOs combining awareness, organization, monitoring and technical support and a state of mangrove degradation where the local population was affected in economic and social terms.

One calculation estimates the absolute value of the overall impact on 300 villages of €5.68 million for aquatic resources (fish, oysters and shrimp) in 2018. Since 2012, fourteen communities have reported planting new mangroves in degraded areas, including thirteen communities on their own initiative and one with the assistance of the Water and Forests Department, the public authority in charge of public forest management.[16] In return of their investment in the Livelihoods-Senegal project, the companies that are supporting the Livelihoods Carbon Fund receive carbon credits to offset their CO_2 emissions. Investors in the Carbon Livelihoods Fund have provided NGOs with necessary funding for replanting (population awareness, validation of scientific models, intervention logistics, etc.) and will continue to finance monitoring and evaluation until 2029, for a total duration of 20 years.[16]

Photo: Mangroves in Senegal. Photo source: [16]

Box 2. Saving Suncheon Bay: preserving nature and biodiversity in the Republic of Korea

The Suncheon Bay tidal flat (over 28 km²) has the most variety of waterfowl in Korea. About 252 species, including 48 of the world's rare birds inhabit the tidal flats along the 40 km coastline. This shelter for endangered species in Suncheon Bay was created due to efforts of local governments and citizens.

Suncheon Bay was an abandoned land in the early 1990s, and a large project had been planned. Citizens groups came forward to preserve the reed forest and natural state of the Bay. They promoted downstream maintenance of Dongcheon, a river passing through the city center, and a public-private cooperation system was established to protect Suncheon Bay. As a result of their efforts, the planned project was cancelled and a full-scale ecological survey began in 1996 that led to discovery and documentation of several rare bird species. From 2001 to 2010, Suncheon Bay was designated as a wetland protected area and has since been developed as a representative eco-tourism destination in Korea. [17, 18]

In 2006, Suncheon Bay became the first coastal wetland in Korea to be registered under the Ramsar Convention. In 2013, the city of Suncheon created the Suncheon Bay National Garden (1.22 million m²), an 'eco-belt', to prevent the downtown area from expanding to Suncheon Bay. In 2015, over five square kilometers of river estuaries and farmland around Suncheon Bay were additionally designated as a wetland protected area. Suncheon Bay National Garden, designated as the nation's first national garden in 2015, attracts tourists with various festivals such as the Spring Flower Festival, Summer Water Light Festival, Autumn Garden Reed Festival, and Winter Starlight Festival. In July 2021, it was registered as a UNESCO World Heritage Site.[17, 18]

Photo: Suncheon Bay Black Crane. Source: [17]

Federal or state-level policy action that incentivizes community-led action and empowers citizens can be an effective means for accelerating efforts for climate change action and environmental protection. One such example is President Biden's new proposal to launch the Civilian Climate Corps. It aims to create social awareness in environmental issues amongst the younger generation group and aims to create future leaders in the fields of environmental careers. This can strengthen public participation and ultimately advance agendas for solving environmental issues.[19] Governments at all levels should consider options that create incentives for citizen mobilization and action to address sustainability goals.

2.2 Knowledge sharing for creating informed communities

Knowledge sharing across sectors, regions, and time is essential – and affects mind-sets. Institutions for knowledge sharing need to be strengthened that ideally provide multiple channels for exchange. These include exchange from academia to the field (e.g., technology to innovations in models of business and practice), from developed countries to developing countries, and from one generation to the next generation. "Such knowledge sharing could be a key factor in bringing out the best accommodation to climate change". Knowledge is also an important driver in goal formulation and mutually accepted knowledge can lead to shared motivations and action. An extensive body of work has been produced on knowledge generation and knowledge exchange for sustainable development in the past quarter century.[20] However, the trends in lack of global ownership and insufficient action indicate that efforts for knowledge sharing need to expand in magnitude and accelerate in time.

2.3 Shaping social norms for well-being

A shift in mindsets occurs from people's efforts, and knowledge, but also from policy and regulation. Discussing the role of the state in shaping mindsets (and specifically social norms) may seem problematic. But social scientists observe that "it is difficult to understand social norms absent conditions created by governments and political processes. State interventions can change social norms, just as social norms can influence or constrain what actions the state can consider".[21]

Government policies alter choices and behaviors by changing the conditions influencing behaviors, and studies show that behaviors – initially incentivized by policy - can eventually affect values. It is noted that "policies can become more cost effective in the long run if they feed back to influence social norms, so that behaviors become self-reinforcing even in the absence of external regulations or penalties. […]. Recycling provides a simple example. In many places, recycling programs began with much grumbling, under the pressure of increased costs for oversized garbage loads. Today, recycling is second nature for many people, who have come to view it as a normative behavior. This has led to increased recycling even under reduced enforcement." [21] Research suggests that making behaviors more convenient and more visible alters conditions for behavior and produces significant impact on social norms: "when recycling is made convenient, there is little difference in recycling rates between pro-environment and environment- neutral households."[21] Additionally, "behaviors originally practiced for the social reward may become rewarding in themselves, because consumers associate the resulting positive feelings with the behavior itself rather than with the approval of others."[21]

There are, however, many open questions when it comes to using policy incentives for norm shifts. For instance, it is unclear what is the role of prior norms and conditions before a policy intervention. "Government policies are not being visited on a blank slate of citizen values and preferences."[21] Understanding the impact of preexisting norms on likely outcomes of policies designed to alter behaviors is critical. Another essential (and poorly understood factor) is the now globally connected nature of social interactions. Social norms are being initiated and sustained through electronic media networks, communication platforms, as well as face to face interactions. Policy interventions, often targeted at particular geographies, will need to account for these new realties, and this has important implications for the emergence of social norms at local scales.

Overall, efforts for strengthening institutions should explore how social norms can be affected and thus leveraged to create societal shifts towards practices that improve human well-being and health and protect the natural environment.

3.0 Measuring and monitoring for sustainability

Monitoring the trajectory of progress is essential, however, measuring is not always easy. Early efforts included creation of composite indices using a range of indicators measuring state of ecosystems, land use, and environmental pollution. Ecosystems sustain and fulfill human life through "ecosystem services." For instance, "aquatic habitats support populations of fish caught for food; mangroves stabilize shorelines and decrease damage to people and property from storms [….] Ecosystem services can be final (produce benefits directly, such as seafood) or intermediate (underpinning final services; e.g., the generation of habitats that support fish populations)." [6] The condition of ecosystems has a direct bearing on the environment and human health, and any meaningful indicator for sustainability has to incorporate some measures that capture this information. One early example was the Environment Sustainability Index (ESI) that was started in 1999 with collaboration between universities, public agencies, and private-sector groups. This later evolved into the Environmental Performance Index (EPI) that is currently a composite index of 32 indicators of environmental performance.[22]

The measuring and monitoring of indicators for SDGs is a significant advancement in tracking for sustainability. A set of 231 indicators for 17 SDGs have been adopted, and SDG progress reports distill and organize data to showcase status of progress around the world.[1] There are, however, continuing challenges that need to be addressed.

3.1 Challenges in reporting and improving indicators

The indicators for SDG targets are classified into tiers based on their level of methodological development and availability of data at the global level [23]. Indicators in Tier 1 and Tier II are those that are "conceptually clear and have an internationally established methodology and standards". Tier I have data regularly produced by at least 50 per cent of countries, whereas Tier II do not have regular reporting by countries. [23] A review of current tier classification (as of March 2021) shows that there are 97 Tier II indicators (and 4 have two classification Tiers). The number of indicators and fraction of Tier II indicators for SDGs 13-17 are shown in Table 1.

Table 1. Total number and fraction of Tier II indicators for SDGs 13, 14, 15, 16 and 17 as reported in March 2021[23]

SDG	Total indicators	No. of Tier II indicators	Tier II fraction
13 - Climate action	8	6	75%
14 - Life below water	10	5	50%
15 - Life on land	14	3	20%
16 – Peace, justice and strong institutions	24	18	75%
17 - Partnerships for the goals	24	8	33%

Current data shows that SDG 13 (climate action) and SDG 16 (strong institutions) are being poorly reported globally with 75% of indicators in Tier II. Also, one half and one third of indicators in SDG 14 and 17 respectively are in Tier II. This global picture reveals severe deficiencies in reporting (and by extension knowledge) about status of issues in SDGs 13 and 16 in particular, but also for SDG 14, 15 and 17. Thus, improving reporting on existing indicators requires immediate attention and efforts.

Additionally, while the current set of indicators are useful, improvements and revisions of indicators should continue. "Measuring progress requires meaningful indicators" [a], and given the impending 2030 timeline, it is suggested that "countries should be encouraged to experiment with auxiliary SDG indicators, which are meaningful but sometimes lack statistical data or rely on qualitative assessments." [a] Such efforts may yield better monitoring and may also help in "accelerating the maturation of the official SDG indicators. Examples

of such indicators relevant for climate action and sustainable management of natural resources include: The corruption perceptions index of Transparency International, which could be a proxy for target 16.5 ("Substantially reduce corruption and bribery in all its forms"). Corruption is one of the systemic causes of unsustainable natural resources management."

3.2 Moving beyond GDP: using new measures of wealth

Recent data on SDGs shows that there has been little to no progress on the indicator of 'proportion of countries with fully funded national statistical plans' in SDG 17.[1] It serves as a forewarning that measurements and monitoring capacities are not where they need to be. But beyond the challenge of having the capacity to measure, there are fundamental challenges of how to measure for SDGs 13, 14, and 15 given their inherent complexity. As compared to some other SDGs, measurement and reporting challenges are among the greatest for SDGs 13, 14, and 15, no matter how good the statistical offices maybe in a country.

Several new metrics have been proposed for quantifying natural capital and ecosystem services. Natural capital refers "to the living and nonliving components of ecosystems that contribute to the generation of goods and services of value for people."[6] One such metric is the Inclusive Wealth Index (IWI) intended to be a more effective metric than the Gross Domestic Product (GDP) and seeks to ultimately reframe the concept of national wealth. GDP measures 'flow' in an economy (production of goods and services), whereas it is the 'stocks' of wealth (of natural, human, and produced capital) that need to be monitored for assessing sustainability. The IWI is computed using a discounted sum of human, produced, and natural capital stocks that have been priced and converted into monetary units. A bi-annual inclusive wealth assessment report has been produced by the United Nations Environment Program (UNEP) since 2012. The most recent report notes, "GDP misleads when used in social evaluation not because it is [only] a measure of means [to achieve welfare goals], but because it is not the right measure of means."[24] The 2018 Inclusive Wealth Report showed that forty-four out of the 140 sample countries experienced a decline in inclusive wealth per capita since 1998 even though GDP (income) per capita increased in all but a handful of them.[24]

There are challenges in using the IWI. Determining the price for many capital stocks is difficult. For instance, forests provide timber (that have a market price), but they also host diverse species of flora and fauna, provide services for flood control, purify air, store carbon, and regulate climate. It is very challenging to determine a monetary value for all the important services that a forest provides for human well-being. It has been noted that the IWI does not properly account for what ecologists call "critical capital"–such as clean air and water that are difficult to price.

3.3 Accounting for nature: System of Environmental-Economic Accounting (SEEA)

A different, but related, stream of work has been on ecosystem accounting. The United Nations Statistical Commission adopted the SEEA Ecosystem Accounting (SEEA) in March 2021. It consists of "a comprehensive statistical framework for organizing data about habitats and landscapes, measuring the ecosystem services, tracking changes in ecosystem assets, and linking this information to economic and other human activity. Ecosystem accounts, in varying levels of detail, have been used to inform policy development in more than thirty four countries.[25] The SEEA provides a set of standard concepts, definitions, classifications, accounting rules and tables. And this allows for converting economic and environmental information into internationally comparable statistics. It can be used to directly measure 40 indicators for 9 SDGs and provides supplemental information for numerous others.[26] The developers of SEEA position this new system of accounting as a bridge, that eliminates "data siloes".[26] Five countries, Brazil, together with Mexico, China, Indica and South Africa, have so far conducted a recent Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project, funded by the European Union.

In accounting for ecosystem services, some of the environmental variables are computed using information from maps, data, and models. The required expertise and professional background to produce, compile, and 'report' this data, is a barrier for governments that may not have the necessary trained personnel. This widens the capacity gap between and within countries.[27] To lower the barrier for use, web-based tools, such as ARIES, have been developed for aiding in compiling ecosystem accounts.[28] The tool generates ecosystem

accounts for any user-specified terrestrial area in the world (such as a country, administrative region, watershed, etc.), by using freely available global remote-sensing derived data and models, and computes these accounts online, and generates formal reports.

The need for valuing nature for sustainability has long been advocated[29], and recent efforts are paving the way for widely operationalizing such valuation.

A useful set of cases demonstrating the importance of valuing and accounting for ecosystems were compiled of water utilities in the United States.[30] It was noted that public utilities own and protect water sheds. The forests in the water sheds filter and purify the water and reduce operations cost from otherwise what would be incurred if mechanical water treatment plants had to be operated. However, this value provided by the forests is omitted from accounting books, and the total asset value of what utilities own is not duly reflected (Box 3).[30] The report, with a variety of examples, makes the case that despite the uncertainty in exact quantification of ecosystem services, a financial justification can be made for investment in natural infrastructure or nature-based solutions (NBS). Natural infrastructure "incorporate the natural environment that mimic or work in concert with natural processes to provide clean water, clean air, flood, fire and drought risk reduction, and other benefits. Unlike many forms of gray (built) infrastructure, NBS also offer an array of economic, social, and environmental co-benefits".[7]

Box 3. The case for nature's capital – valuing catchments for water supply in Seattle, United States

A study of the City of Seattle in the US, showed that if the Seattle Public Utility (SPU) did not protect and manage the 90,000 acre Cedar Watershed (which it acquired in 1889) for drinking water, the city would have to today "pay an upfront cost of $200 million to build a filtration plant to filter the city's water supply with annual operating and maintenance costs of $3.6 million per year if the forest did not do its job (Batker et al. 2010). Of course, after a century it would likely have been the third or fourth filtration plant to be built." [30]

Two key differences are notable when considering natural infrastructure: First, natural infrastructure can provide benefits over centuries or longer, whereas manmade built infrastructure provides benefits over a few decades at most. Second, the value of natural infrastructure can appreciate in time (partly due to scarcity) but built infrastructure depreciates. Due to this, investments in natural infrastructure can be much more valuable and contribute to sustainability.[30]

The accounting standards in the US make an omission for the value the watershed provides[30]. Only the value of the land is accounted. Thus, if a $200 million filtration plant was built, it would count as an asset, but the forest providing the same service is not included in the books. One real implication of this omission is that the utility cannot raise capital on this asset (i.e. the forest) for its maintenance and restoration[30]. The irony was also noted that if the watershed becomes polluted, then clean-up costs are immediately recognized as an expense and are recorded as a liability. But a pristine watershed has no value (beyond the cost of land).

Photo: Cascade Crest, at 5414 feet, is the highest point in the Cedar River Watershed. Photo source: [31]

While debates on accounting and valuation of natural capital and ecosystems services have continued in the past decade, and a variety of accounting efforts have been undertaken, there has not been wide adoption and incorporation in real decisions".[32] There has been a substantial "accounting push" but much less of a "policy pull". The new standardization efforts led by the UN statistical commission[25], however, may foster wider adoption and use in the decades ahead. In related developments (but of different types of metrics) in the private-sector, measures for quantifying sustainability are gaining attention.

3.4 Challenges and opportunities in environmental accounting

There are inherent uncertainties and complexities in ecological systems, and that creates important limitations for accounting. The accounts are incomplete in terms of the number of condition indicators and services assessed, the currently available data is over a short time series (average length of time covered by its quantitative accounts is about nine years).[33] Another challenge is of different boundaries of how ecosystem processes function and how administrative jurisdictions have been organized. It has been noted that "modeled SEEA results can typically be aggregated at various scales, but limitations may exist when disaggregating statistical data reported by administrative divisions across biophysical boundaries like watersheds, and in assessing supply chains in private-sector accounts.[33] The issue of different spatial boundaries demarcating different jurisdictions (over what are ultimately integrated and interacting resources) exists more generally for public agencies governing different resources. It is particularly pronounced for cases of irrigation-based agricultural production in regions where one agency is administering water and another agriculture.[35]

Some of these challenges can be addressed with new technologies. Aerial and space-based remote sensing has been important for measuring land use, extent of ecosystems and water bodies[36]. The advent of unmanned aerial vehicles (UAVs) and small spacecraft have further reduced costs of data collection[37]. Frequently collected data is being used for monitoring crop growth, air quality, toxic leaks and spills. It is also critical for monitoring fires and assessing damages after natural disasters or severe weather events. In the past decade, an acceleration has occurred in access to space, and this opens new opportunities for earth observation and environmental monitoring.[38] Until the 2010s, there were about 60-100 satellites launched yearly, but in 2021, 1400 satellites have been launched by September of that year.[39] The new (and cheaper) data acquisition technologies are opening up opportunities for developing and developed countries that were not available two decades ago. These advancements should be harnessed to improve accuracy of costs and benefits estimation of policies for climate adaptation and action.[40] A recent study using high-resolution analysis of fair market value of private lands in the contiguous United States provided estimates for conservation cost of up to 8.5 times greater accuracy than earlier proxies that used coarser data sets. It showed that "earlier proxies underestimated conservation costs, especially at the expensive tail of the distribution, and underestimated policy budgets by factors of up to 37.5." [40]

4.0 Institutional arrangements for climate change action and natural resources

Institutional arrangements, channeling information and knowledge, are essential for coherent policies. Policy coherence is achieved through coordination and multi-stakeholder participation, to effectively allocate resources by examining interconnections between policies. Soon after the adoption of SDGs in 2015, the issue of policy linkages was raised[41], partly stemming from prior research on interactions between water, energy, food security[34], land, and climate.[42] Tradeoffs and synergies embedded in policy options that sought to develop one sector while undermining efforts in other sectors were being examined. For example, promoting some types of biofuels in efforts for energy security were shown to undermine efforts for water security and impacted land use and vice versa.[43] The focus on policy coherence, as included in SDG 17, is essential as it "aims, as a minimum, to identify trade-offs and mitigate negative impacts between policies.", and where possible, aims "to foster synergies and produce policies that mutually reinforce each other."[44] It also calls for ensuring coherence between policies at various levels of government; for ensuring that policies in different sectors are mutually supportive and do not work against each other.[44] Three targets SDG 17.13, 17.14, and 17.15, are explicitly categorized for "policy and institutional coherence".[23] The methodology for indicator 17.14.1, consists of computing a composite score quantified along eight dimensions for each

country: "1. Institutionalization of Political Commitment 2. Long-term considerations in decision-making 3. Inter-ministerial and cross-sectoral coordination 4. Participatory processes 5. Policy linkages 6. Alignment across government levels 7. Monitoring and reporting for policy coherence 8. Financing for policy coherence"[44] These are all important considerations. However, this effort is in nascent stages as the methodology has been formalized in 2020, and all three indicators are in Tier II classification. This implies that fifty percent or more countries have yet to report on this data. It is important that efforts for policy coherence should be accelerated and strengthened.

4.1 Addressing fragmentation

Achieving policy coherence will require addressing the fragmentation challenge. Institutional fragmentation is an impediment for climate action and natural resources sustainability. The concept of "bridge organizations' that bring "together state and non-state actors from global to local scales", has been explored. These "aid in managing fragmentation, through exercising four enabling functions: enhancing transparency, participation, knowledge sharing, and coordination."[45] This was applied to examine REDD+ programs for addressing deforestation. The concept of 'bridge organizations' was present in earlier work on 'adaptive governance of socio-ecological systems'.[46] It noted that "management of ecosystem and landscapes is complex to apprehend and implement and, therefore, cannot easily be subject to planning and control by a central organization, such as a national government. However ..[…] enabling legislation, flexible institutions, and recognition of bridging organization, are good candidates for governmental actions, which can be carefully tested and evaluated."[46]

Prior work on knowledge systems for sustainable development explored an analogous idea of 'boundary organizations'[47] that connect (through knowledge exchange) and coordinate action across organizations. The theoretical work provides a useful foundation, and the need is now to test and operationalize these propositions.

4.2. Mobilizing funds through partnerships and valuation of ecosystem services

A pragmatic option, that partly addresses the fragmentation challenge, is to enable new partnerships among stakeholder groups using services provided by shared natural capital. River basins, forests, and other such ecosystems provide value to a number of stakeholder groups. Determining monetary value of these services and using that as a basis to forge new partnerships and mobilize funds can open opportunities for cash-constrained local and state governments. A few examples are discussed here:

4.2.1 Public-private partnerships in river basins

New funding arrangements that partly rely on private-sector contributions, incentivized through demonstrated and quantified benefits of improving ecosystem services in water sheds, are a promising approach. Private-sector enterprises such as hydropower companies and public agencies such as water utilities, operating in the same water shed have partnered to create funds that restore or improve upstream ecological conditions of the watershed, and that in turn increases supply (for more hydro-electric energy generation), reduces costs of operations for water purification, and costs for provision and treatment for public drinking supply. In these arrangements, the partnership with energy companies and other industry has provided vital 'anchor' funds to enable and sustain the efforts over the long-term. Some examples include the 'Cultivate Good Water' initiative in Southern Brazil (Box 4), and a recent intervention in Kenya for conserving the Upper Tana River basin (Box 5).

Box 4. Reducing pollution and recovering energy through public-private partnerships in southern Brazil

Large hydropower infrastructure has trade-offs for communities and the environment. However, several dams will continue operations for decades ahead, and understanding how these systems may anchor public-private partnerships is useful. One such case is of the Itaipú Dam constructed in 1984. It is one of the world's largest hydropower generating facility providing 90% of Paraguay's and 16% of Brazil's electricity. Sediment (loose soil) in rivers blocks the dam and is a major challenge. In the Paraná watershed, sedimentation is driven by soil erosion from deforestation for agriculture. Conservation of forests and natural ecosystems ensure low sediment levels in the reservoir and prevents damage to power generating turbines. In the decades prior to the Itaipú dam construction, large portions of native forest on the Brazilian side of the Paraná river were cleared for corn and soy plantations, livestock production, and expansion of towns. Agricultural runoff containing pesticides and animal excrement started to accumulate and flowed downstream into the reservoir. This contributed to lake eutrophication, that decreases the useful lifespan of the reservoir. Water quality was further negatively impacted by sewage and garbage disposal in or near the watershed, and due to rural roads.

Since the 1970s, the operator of the hydropower facilities conducted watershed restoration programs aimed at reducing sediment to reduce operations costs [48]. However, broader co-benefits were also of interest. The programs engaged with 70 municipalities in Brazil and Paraguay of nearly 1.7 million people. Two initiatives; Cultivating Good Water on the Brazilian side, and Itaipú Preserves on the Paraguayan side, were launched. These efforts were internationally recognized and received UN-Water's Water for Life Award for best practices in water management in 2015.

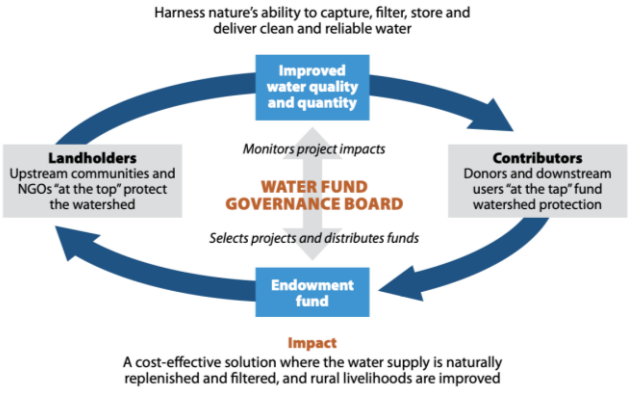
Within the programs, one initiative was on improving disposal of livestock and poultry waste, and recovering energy for cooking, transportation, and electricity. The Ajuricaba Agroenergy Condominium for Family Agriculture was set up with participation of 33 small farms (properties with areas between 10 ha and 20 ha) that annually generated ~16,000 tons of waste. Digestors were installed on each property for decomposing waste and recovering biogas. The biogas can be used directly for cooking, heating water for cleaning operations on farm, and through this project, could also be transported by a pipeline (built over 25 km) to a central facility of a micro-thermal station. Here, the biogas could be used to generate electricity, use thermal energy for grain drying, or could be used in vehicles (after purification of the biogas to biomethane). This project led to 350 kWh/day of electricity generation. In addition to promoting environmental and economic benefits to farmers, the project was promoted as one that would create and stimulate supply chains requiring skilled labor, technical activities, and raise environmental awareness in the local community [49]. New research is now examining how such waste-to-energy recovery systems can be made scalable and financially viable across municipalities[50].

Photo: Itaipu reservoir. Reforestation efforts focused on the strip or buffer surrounding the reservoir. Source: [48]

Box 5. Forging new public-private partnerships - Water Fund for Kenya's Tana River Basin

The Tana River is the source of 95 percent of drinking water supplies for Nairobi's 4 million residents. It also provides water for one of the country's most important agricultural areas, and its water flow enables half of the country's hydropower output. Since the 1970s, forests on steep hillsides and areas of wetlands have been converted to agriculture. This has led to soil erosion as soils are washed down into the river. The 300,00 small farms on steep slopes lose productivity with lost topsoil, and the sediments in the river chokes water treatment and distribution facilities. In some cases, there were complete service disruptions for days or weeks at a time in Nairobi. Up to 60 percent of Nairobi's residents do not have access to a reliable water supply.

To address these challenges the Upper Tana-Nairobi Water Fund was created. "Water funds are founded on the principle that it is cheaper to prevent water problems at the source than it is to address them further downstream. Public and private donors and major water consumers downstream contribute to the Fund to support upstream water and soil conservation measures, resulting in improved water quality and supply"[51]. The Nairobi Water Fund, established through coordination of the Nature Conservancy, built on similar efforts in Latin America, where more than 30 water funds are either underway or in development.



An important element in bringing stakeholders together, and forging the partnerships was modeling and analytical work that quantified the benefits for contributing to a fund and restoring ecosystems of the upper basin. The economic impact of interventions was modelled for Farmers in the sub-watersheds; NCWSC—the major water and sewerage service provider for Nairobi; and KenGen—the leading power generation company in Kenya, with several hydropower dams operating in the watershed. Conservative results demonstrated over 50% reduction in sediment concentration in rivers; up to a 15% increase in annual water yields during the dry season; increased agricultural yields for smallholders and agricultural producers; and increased annual revenue for KenGen as a result of increased power generation and avoided shutdowns and spillages; furthermore there were cost savings for NCWSC stemming from avoided filtration, lowered energy consumption, reduced sludge disposal costs and fewer shutdowns. The fund's business case showed that a $10 million USD investment in water fund-led conservation interventions is likely to return $21.5 million USD in economic benefits over a 30-year timeframe. Current partners and investors for the fund include over 10 business enterprises and public agencies.[51]

Photo (top): Ndakaini Dam in the Thika-Chania sub-watershed provides the main water storage for Nairobi City water supply. Photo (bottom): An illustration showing the arrangement and functioning of the Water Fund. Photos Source: [51]

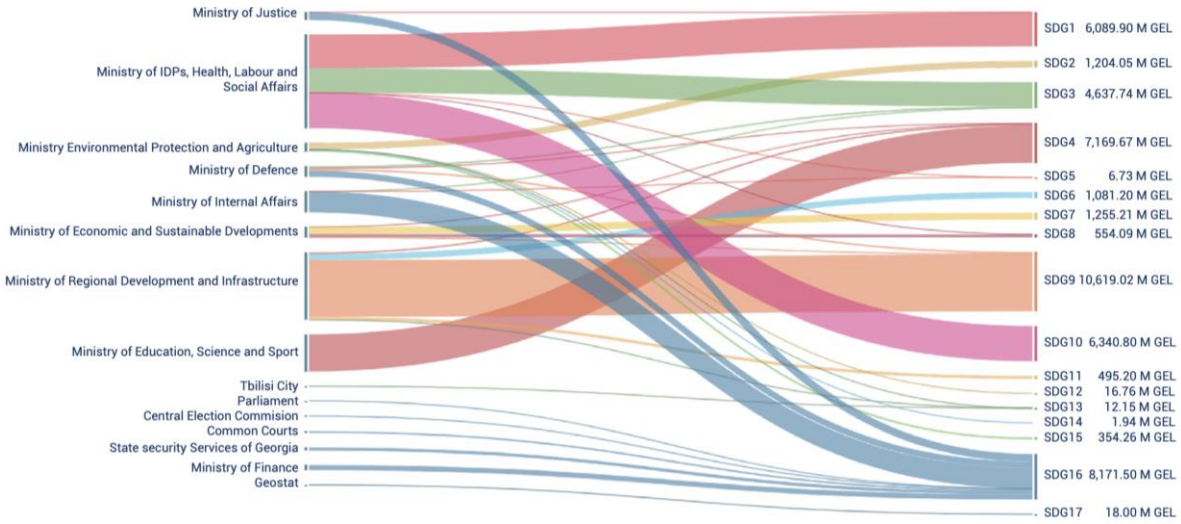
4.2.2 New models for debt-to-nature swaps

Debt restructuring for conservation and climate change adaptation is a potential option for developing countries. Debt-for-nature swaps, first created by WWF in late 1980s, started a new way of thinking about conservation and also initiated opportunities to involve institutions not previously engaged in conservation efforts [53]. The use of such swaps expanded then receded in the 1990s and beyond. More recently, there has been new activities where need for funding climate adaptation in developing countries has renew interest in using this approach. In one recent example [54] the restructuring was done to provide funding to support adaptation to climate change through improved management of coasts, coral reefs and mangroves. The debt restructuring was through a combination of impact investment capital and grants and was expected to allow the national government to free capital streams and direct them toward climate change adaptation and marine conservation activities. The expectation was that it would benefit fisheries and tourism industries, and ultimately livelihoods.[54] In COVID-19, debt service suspension was announced for 73 low-income countries, and some have called for moving beyond suspension to partial cancellation. Some note that, it is "of paramount importance to align debt restructuring efforts with climate, biodiversity, and development goals."[55] Because biodiversity and climate change are intrinsically linked, debt swaps should be designed to maximize dual benefits to biodiversity and climate mitigation, such as preserving carbon sinks by reducing deforestation." For new models, it is important to be mindful to "avoid pitfalls of such swaps in the past, such as inadequate provision of resources, misalignment with the debtor country's policies, and offering too little debt restructuring to sufficiently reduce debt stress" [55]. It has been noted that while debt swaps do not historically have the best track record, common flaws can now be avoided.[56] Overall, these instruments can play an important role in advancing progress on SDGs 13, 14, and 15 in some countries.

4.3 Transparency in resource allocation

The extent of resources allotted for efforts addressing climate change and natural resources are not clearly known. It is therefore difficult to assess the seriousness of commitments to achieving these goals. A review of VNRs shows few cases with clear budgetary allocations for each SDG. Figure 3 shows an example for the exception.

Figure 3. Budget allocations for 17 SDGs 2019-2022 in Georgia



Source: [4]

In most cases, the VNRs and action plans are devoid of substantive discussion of how the achievement of goals is being funded. The summary of High Level Political Forum (HLPF) for VNRs submitted in 2021

points out the difficulties that many countries still face in financing for sustainable development.[15] The question of resources (monetary, human, and technological) remains unresolved, and for many in the developing world, is a fundamental reason for institutional inaction (through policy) and lack of institutional capacity. One expert noted, "When we put the economy and the natural environment on the same level, we must be willing to put the resources into it." Furthermore, not only adequate level of investment is needed, but also its right timing (now and soon), and at right scale (so that local communities experience it) [a]. It has to be so that "communities and people can feel the effect positively of what it means to have the economy and the natural environment on the same footing, they must be able to have access to energy sources, they must have access to opportunities for a new economy that comes about", and "the new economy cannot be a promise that is three, five, ten years down the line. The promise is needed now with some short-term dividends, but with a long-term vision in mind." The visible trends for many in the developing world, are not of improvement of the natural environment, but of rising costs for basic resources such as water and energy. One expert noted that, "the price of this vital commodity [water] is going up and up […] and the production of water has become a profit-search driven activity." Similarly, solar energy remains the most "expensive energy in many developing countries and is not affordable for many."

4.4 Institutional capacity building

In the most recent summary of the HLPF it was recommended that "governance initiatives should include capacity building for parliamentarians to support their ability to monitor and review SDG budgeting and implementation."[15] In some countries, the issue of capacity building is at a foundational level. One expert observed that public practitioners in some countries lack the capacity to formulate institutions (laws), and in an international conference, a public official once related that "we have a big ministry, but we don't have lawmaking capacity. When we have to make a law, we have to hire a consultant to write a law for us". Such public institutions are not positioned to fully evaluate whether outside proposals (such as from international lending banks or development agencies) are suitable for their particular context and cultural conditions. They cannot appropriately "judge if the templates from a bank or from a big consultancy, is the right one." Bridging this capacity gap requires a long-term and sustained commitment and emphasis.

In cases where active efforts are being invested to build capacity, some have pointed to the extensive demands placed on time and energy for public officials in 'training programs' for use of new tools and methods for implementing and monitoring the SDGs. There is a plethora of tools that have been disseminated to the extent that there can be confusion. In one resource, there are over fifty-four tools, databases, and approaches listed [57]. One expert observed, many of "the tools overlap, and in some cases are counterproductive… […] Local and regional authorities are all the time in training or capacity building. So, when are they working for the communities and their citizens?" Public sector agencies need to develop approaches for streamlining and efficiently coordinating capacity building efforts for SDGs.

4.5 Regulatory enforcement for pollution reduction and waste management

In case of natural resources, there is a fair degree of national and sub-national jurisdiction (and power) that can affect the condition of these resources. Mineral resources, water resources, forests, fisheries, and many other stocks of natural capital have been affected and need to be addressed with actions of national and sub-national governments. The international climate action negotiations are continuing slowly. But a low-hanging fruit, related to improving environmental sustainability, is the national enforcement of regulations for extraction of natural resources and environmental pollution. There is a need to strengthen enforcement of existing (and creation of new) regulations that address activities in mining, manufacturing, and related industries.

The issue of waste management has also become critical. Increase in populations and consumption, in many developing countries, has not been in concert with development of systems for management and safe disposal of waste. Consequently, the level of local environmental pollution has increased significantly[58]. Some of these challenges can be addressed with policy interventions discussed earlier regarding changing mindsets and social norms. There are other issues such as illegal dumping of toxic waste by industry that requires capacity building of public officials as well raising awareness of local residents who can help in protection

and enforcement. In many instances, industries have polluted freshwater bodies with toxic waste (such as mercury and other heavy metals) that are harmful for human health. An aware and empowered constituency will serve to push for government action.

4.5.1 Nature-based solutions for lower-costs and higher benefits

For remediating pollution and reducing emissions, the option of nature-based solutions (NBS) instead of built-infrastructure (or gray infrastructure) has been gaining attention.[7, 59] NBS can be cheaper, longer lasting, and provide not only immediate monetary benefits (in terms of lower costs) but also other benefits such as creating natural spaces for biodiversity and other ecosystem services. For example, constructing a wetland area to purify water is cheaper than building a mechanical water treatment plant. The operations and maintenance costs are also more favorable for NBS, and that can be very attractive for developing countries where maintenance costs are often difficult to meet. NBS have been explored for not only addressing pollution, but also addressing environmental risks due to climate change (see Table 2).

Table 2. A list of nature-based and gray (built-infrastructure) solutions. Each can address climate-related risks and also provide other ecosystem services

Climate Risk	Gray Solutions (Engineered)	Nature-based Solutions
Urban stormwater / flood management	• Retrofitted / enhanced urban storm-water drainage systems • Engineered flood protection	• Green roofs • Urban gardens and green spaces • Riparian and wetland vegetation restoration, creation, and management
Coastal flooding, storm surge, sea level rise, and erosion	• Seawalls, dykes, permanent artificial walls, and temporary storm barriers • Improved drainage systems	Conservation, management, restoration, and (in some cases) creation of: • Coral reefs (including using artificial substrate) • Oyster reef • Sea grass • Coastal wetlands, mangroves, and salt marshes • Sand dunes and beaches
Inland flooding	• Alluvial dykes and dams (creation, retrofitting, and maintenance) • Improved pumping, piping, and storage systems	• Upslope vegetation management • Forest restoration • Riparian and wetland restoration/creation and management, living weirs, and check-dams • Floodplain management
Landslides	• Retaining walls • Gabions	• Upslope vegetation management • Reforestation and afforestation (where appropriate)
Water scarcity	• Reservoirs / dams • Concrete catchments • Desalination plants (if coastal) • Aqueducts	• Watershed restoration, including reforestation (where appropriate) • Permeable 'green' areas for groundwater replenishment
Soil erosion and sedimentation	• Retaining walls • Terracing • Dredging programs	• Upslope vegetation restoration and management • Reforestation and afforestation (where appropriate) • Management of littoral vegetation and wetlands

Source: [59]

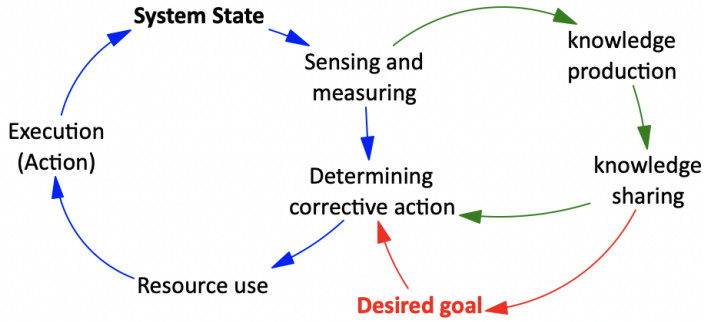
In a recent (but small) survey conducted in the United Sates (US) to investigate drivers of adoption of NBS by some corporations[7], the results showed that "After 'lowering project costs', the companies cite 'managing regulatory requirements and risk' as the second ranked primary driver of NBS adoption". Several of the companies also saw natural disaster risk mitigation as an important driver for NBS implementation. The NBS were cited to be implemented to meet regulations from federal statutes, like the Clean Water Act requirements, local regulations, and municipal regulations (such as storm water fees) in the US. Contaminated sites are regulated through various state and federal regulations including "The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which grants the Federal Government the authority to recover damages from the release of hazardous substances into the environment that results in degradation or harm to the natural environment". [7] New approaches (such as NBS) in concert with regulations can drive adoption of solutions that can improve environmental conditions. The role of policy and rules is salient (and evident) here. New transitions will be enabled through combination of technology and legislation that is established and enforced.

In summary, policy coherence, resource mobilization, capacity building, and enforcement of regulations as discussed above can combine to create necessary advances in achieving targets for SDGS 13, 14, and 15. Equally important, for institutions in different regions, is to align with the culture, history, and tradition of "what works" in that region.[60]

5.0 'Goal-seeking' systems and 'adaptive governance'

Dynamic systems have inter-connected components, linked through information and action, that steer the system's state. The blue circle (shown in Figure 4) represents a fundamental concept in systems theory that 'goal-seeking' behavior arises in systems through an arrangement of sensors (that measure and report information), a comparator that compares the reported measurement with a set target (or goal) and then determines corrective action (as needed). A process of resource use (energy or other resources) has to occur that powers actuators affecting the system state, and this cycle repeats over time.[62] Goal-seeking' systems include components for sensing and measuring, comparing, determining necessary corrective action, using resources, and executing action that affects the system state. This cycle repeats over time and when operating with sufficient speed and strength steers the system state to a desired goal. Additional (slower moving) components of knowledge production, and knowledge sharing, relevant in human societies, connect with this cycle and shape the choice of actions and goals.

Figure 4. Dynamic systems with inter-connected components '



This general abstraction was distilled by scientists and engineers observing regulatory systems in living organisms that successfully maintained internal temperature and chemical balance while operating under changing external conditions. These ideas were later successfully applied in constructing systems for guidance, navigation, stability, and steering in complex machines in automotive, aerospace, computation, and health care sectors [61] . This abstraction (and various elaborations) have been applied for organization and business management, policies for sustainability,[63] and 'adaptive governance'.[46] Researchers working on socio-ecological systems recommended adaptive governance by building "knowledge and understanding of resource and ecosystem dynamics" and mobilizing all sources of knowledge in a society. Then, feeding that knowledge into management that "is characterized by continuous testing, monitoring, and reevaluation to enhance adaptive responses"[46]. Additionally, "flexible institutions and multilevel governance systems" need to be built, as "the adaptive governance framework is operationalized through adaptive co-management", wherein "adaptive co-management relies on the collaboration of a diverse set of stakeholders, operating at different levels through social networks."[46] In some recent work, ideas of adaptive governance have been advanced and applied for case-studies in China.[64]

Here, from the basic abstraction (shown in blue), an explicit addition of knowledge generation and sharing is added to highlight its important role in sustainable development (shown in green in Figure 4). This conception provides a synthesizing framework that elicits examination of systemic questions. For instance, starting with the 'goal', it prompts questions of inclusion and participation (who is setting the goals and how) and knowledge (for goal setting). Questions about necessary action, based on measured state of the system

and its comparison with the goal, can be interrogated. For instance, how is the information obtained, how comprehensive and accurate is it, and how frequently is it collected. The question of how choices for corrective action are evaluated is salient. The issue of resource use (and by extension availability of necessary resources) is highlighted. These include human expertise, monetary funds, and materials. Action (or execution of action plans)– through partnerships- ultimately affect the system. If one or more of the components in this connected system (of sensing, evaluating, and acting) are missing or weak, then 'goal-seeking' behavior will not result. Furthermore, this need to operate at necessary speed for timely information and action. Time to collect information, time to make decisions, and time for action needs to be such that effective steering (rather than stagnation) results. Significant lags in one or more of the links will impede realization of desired change in the system. Knowledge generation and sharing also takes time, and often it takes a much longer time to use this knowledge for shaping and setting future goals. The blue and green circles may operate at different frequencies affecting pace of change. The framework shown in Figure 4 depicts a single level (for simplicity of representation). In a multi-level governance system, separate structures operate at each level, and each level also exchanges necessary information and resources. A critical question, for strengthening institutions, is to consider what and how to enable this exchange.

6.0 Recommendations

1. Prioritize establishment and strengthening of mechanisms for policy coherence

The linkages and mapping across SDGs are well recognized.[41] Food security (SDG 2) is closely tied with water security (SDG6), with preservation of oceans and marine ecosystems (SDG 14), and conservation of forests and terrestrial ecosystems (SDG 15). Similarly, the goal for safe and sustainable cities (SDG 11) is also linked to SDG 14 (particularly in coastal regions). These linkages need to be leveraged through coherent policy. Policy coherence targets (17.13, 17.14 and 17.15) should be given priority attention. If strong policy coherence mechanisms are put in place, the issues of institutional fragmentation, siloed knowledge, and need for efficient spending will get concurrently addressed. Shared natural resources can anchor efforts for coherence, stimulate partnerships and create new funding possibilities.

2. Bring transparency in efforts for climate action and natural resources management by including allocations for SDGs 13, 14 and 15 in Voluntary National Reviews (VNRs)

The UN guidelines suggest to look "at the full range of financing sources (public/private, domestic/international) and non-financing means of implementation, such as capacity development and data needs, technology, and partnerships."[14] However, few VNRs show what monetary (budgetary) allocations are being made nationally for achieving the goals. The resources devoted to these SDGs remain low in many countries (and partly explain the state of stagnation). More reporting and disclosure can serve to bring global and national attention to this issue.

3. Strengthen accountability of state (public) organizations for environmental protection by including state of natural resources in their jurisdiction as part of their performance assessment

The condition of natural resources should be included (in part) to evaluate performance of public agencies. This is now more feasible with new measurement and accounting tools for ecosystems. A disclosure for such performance can create impetus and motivation for improving quality of operations and provide greater accountability of their effectiveness. Some countries are piloting these possibilities.

4. Build capacity in public-sector for environmental accounting, valuation, and consideration of natural infrastructure for public purpose

It is becoming important to train cadres of accountants in public institutions that can work with ecological data in addition to monetary data. Capacity building at all levels (from municipal to national levels) is needed. Partnerships with academic and research institutions should be instituted for training new cadres of

professionals. Nature-based solutions for infrastructure projects, in public agencies are in nascent stages, or absent entirely in some countries. Awareness should be increased for considering these options for public infrastructure, and it is important to build capacity for decision makers in agencies related to infrastructure decisions and development. These solutions, when feasible, can become the means of collaboration across historically separate agencies such as of water, waste management, energy, and agriculture. The European Union has legally required consideration of 'reasonable alternatives' for environmental impact considerations. Similar approaches in other regions can lead to increased knowledge and awareness of possibilities for interventions that may offer superior alternative to built infrastructure in some cases. [59]

5. Strengthen channels of knowledge generation and sharing

Knowledge sharing creates informed citizens who can become active to safeguard their natural resources. Community activities for protecting their ecosystems from pollution (including toxic waste dumping) and extraction (such as from illegal logging or fishing) should be supported through public institutions. Channels for preserving and sharing knowledge across generations and across spatial regions need to be created. Additionally, knowledge generation from all groups should be encouraged and incentivized.

6. Use a portfolio of institutional arrangements for a feasible transition to enhanced sustainability

The complex challenge of addressing climate change requires a portfolio (strategic combination) of mechanisms. There is no single, optimal approach. Depending on the local context and culture, the suitability (and success) of approaches will differ. Therefore, multi-faceted (and partially redundant) mechanisms should be used and tested to see what succeeds. A package of different types of measures (including taxation, standards, rules, and knowledge exchange) may have a better chance of reducing risks and adverse impacts of climate change. The portfolio should ensure that there are systemic arrangements of necessary components for monitoring and action that are connected and functioning with necessary speed and strength. Additionally, it is critical to consider how to phase-out and smoothly transition existing elements. For instance, the issue of stranded assets (where infrastructure has been built, commissioned, and is operating) in developing countries is one such case. For a shift to more sustainable and cleaner production, mechanisms (both through technology and through financing) are needed for a transition that allows for addressing the issue of existing infrastructure that may not conform to new environmental standards. Furthermore, the transition needs to be coordinated with coherence and stability of regulations, rather than through regulatory flux that creates uncertainties.

7.0 Concluding remarks

This study explored challenges and opportunities related to institutions for climate action and natural resources. The examination showed that pace of progress has been deficient; improvements in measuring and monitoring is needed (in particular for institutions and partnerships); and institutional arrangements for policy coherence need to be prioritized. Given the deficiency in measuring and reporting, along with inadequate resources for action, the necessary systemic components are not in place that can enable effective 'goal-seeking'. Systems theorists and practitioners observe that interventions through institutions offer the greatest possibility of achieving systemic change.[65] The greatest challenge (and one with also the highest possibility of returns) is to act through the institutional lever in human societies. But this possibility only exists to the extent that the institutions are strong and effective. The quest for institutional strength is highly salient for progressing towards sustainability.

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