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Taking an Integrated Approach to the SDGs: A Survey and Synthesis

BACKGROUND PAPER FOR SESSION TT5: LEVERAGING SOLUTIONS – SMART POLICIES, PLANS AND ACTIONS

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Contents

Tables:

Figures:

1: Introduction

The Sustainable Development Goals (SDGs) were designed to be "integrated and indivisible, balanc[ing] the three dimensions of sustainable development" (United Nations General Assembly, 2015). If a piecemeal approach is taken to SDG planning and implementation, there is a risk that progress made in one goal area offsets progress in another. An integrated approach could also prove more cost-effective by concentrating time and resources on a set of reinforcing as opposed to a single isolated objective(s). Integration may also help to pare the SDGs 169-targets down to a more manageable set of priorities for policymakers struggling with an overly expansive list of options. An integrated approach to the SDGs is therefore critical to making efforts to implement the new global agenda holistic, cost-effective and manageable.

While integration is much needed, it is not entirely new. Integration has been part and parcel of the discourse on sustainable development since the concept was conceived three decades ago (World Commission on Environment and Development, 1987). But, for many of the reasons noted above, the 2030 Agenda has brought an added sense of urgency to integration. This heightened urgency was fully on display even before the SDGs were adopted when the Annex document to the Open Working Group (OWG) Proposal for SDGs contained a list of interlinkages among the thematic focus areas (OWG, 2014a; OWG, 2014b). It has only grown since then with the 2030 Agenda noting that the goals are integrated (UNGA, 2015) and the creation of Working Group under the Inter-Agency and Expert Group on SDGs (IAEG-SDGs) with a mandate to identify interlinkages (UNSD, 2016).

This added attention is spurring more research and has given rise to a number of tools that aim to make integration actionable. These include tools that employ network analysis to illustrate interlinkages across a wide range of goal and target areas to water-food-energy nexus, urban systems, and co-benefits approaches that look at integration across a narrower set of issues. But, while these tools and approaches offer useful support for decision making, concrete examples of the actual practice of integration remain few and far between. This is evident in early efforts to work on the SDGs that exhibit a familiar tendency to delegate responsibilities down traditional administrative silos and departments.

Part of the explanation for the lack of practical applications—beyond siloed administrative structures—is that there have been few attempts to discuss how the larger network analysis (that illustrates interlinkages across a wide range of goal and target areas) and the narrower water-food-energy nexus, urban systems and co-benefits approaches relate to each other. For each of the above approaches this paper contributes to the discussion by identifying: 1) which SDGs it focuses upon; 2) what are its key features; and 3) what are the main opportunities and challenges to using said approach as a basis for decisions in applied contexts. The paper will conclude with a review of the possible combinations and complementarities between these approaches. That synthesis can help operationalize an integrated approach to support the implementation of the SDGs moving forward.

2: Integration in the SDGs: Literature Review and IGES Initiatives

The 17 SDGs offers a prime opportunity to introduce an integrated approach that capitalizes on synergies and avoid trade-offs. Some studies have begun to demonstrate this potential across a wide range of goals and targets. Niestroy (2016), for instance, provided a framework for clustering goals and targets across related themes. Elder, et al. (2016) have taken a more functionalist perspective that underlines that many of the goals are means of implementation (MOI) for achieving other goals. Nilsson, et al. (2016a; also Nilsson, et al. 2016b) highlight the *strength* of interactions and have developed a scale ranging from +3 to -3 (higher score means stronger reinforcing link between two targets) to demonstrate varied weightings. The International Council for Science (ICSU) meanwhile employed the same scale as Nilsson, et al but with a deeper review of interactions at the goal and target levels (ICSU, 2017). The Millennium Institute's Integrated Model for Sustainable Development Goals Strategies (iSDG) begins to model interactions at the national level, offering country development scenarios as well as synergies assessment (Millennium Institute, 2017a; Millennium Institute, 2017b).

A second branch of literature tends to focus on interactions within or across a particular goal or policy area. One of the main areas that has received attention in this regard is SDG 6—the water goal. A recent study from The UN Economic and Social Commission for Asia and the Pacific (ESCAP, 2017), for example, took a nexus-type approach to assess the interlinkages of the water-related Goal 6 with other goals. Shivakoti, et al. (2015) and Bengtsson and Shivakoti (2015) meanwhile found Goal 6 to be at the centre of SDG integration, recommending an integrated perspective be applied to assess synergies and trade-offs. Other relevant branches of literature work from a single or a set of closely related goals, including the water-food-energy nexus, urban systems, and co-benefits approaches described in greater detail later in the paper.

Looking across this literature, different organisations and individuals have demonstrated that the SDGs as whole can help cluster similar issues; demonstrate means and ends; gauge the strength of interrelationships; and be modelled at the national level. Further, several other studies have worked from a single or set of clearly related SDGs to underline linkages, cleavages, and branch points working outward from a particular set of policy areas. Even within this diverse view, the studies further appear to be converging on a common theme: that is, how to make the SDGs and the tools that they offer more tractable for decisions makers. However, in part due to the diversity and newness of this work, there is room to make existing studies more policy relevant. Further, there is ample scope to examine the relationship between and within broader SDG-wide and narrower issue specific studies. In sum, there is a growing need to help integrate the literature on SDG integration.

2.1 Network Analysis and Visualisation of SDG Interlinkages

The Institute for Global Environmental Strategies (IGES) initiated a project entitled "Sustainable Development Goals, Targets and Indicators" to help address some of the knowledge gaps in understanding SDG interactions. The main purpose of this project was to demonstrate an integrated approach with interlinkages across a large cross-section of SDG so that they can be used as a practical tool for national SDG integration and policy coherence.

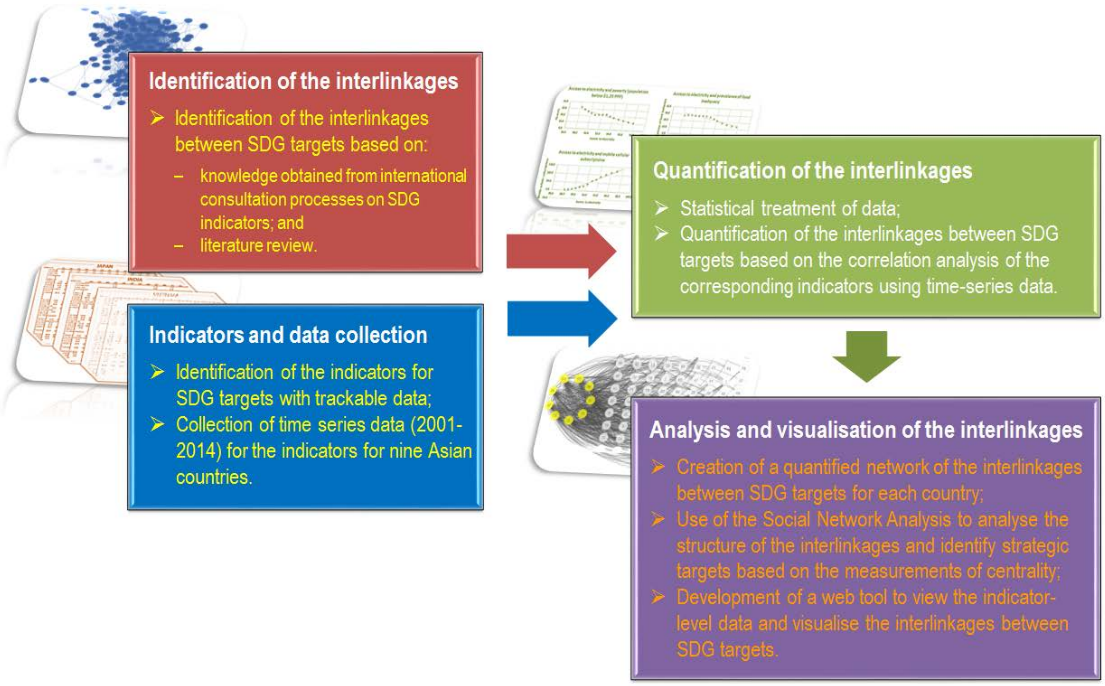


Figure 1: Analytical framework for SDG interlinkages analysis

Source: Zhou and Moinuddin (2017).

At the core of the Identification of the linkages between each pair of the 169 SDG targets was an extensive review and synthesis of scientific literature and relevant documents from major international policy processes working on SDGs and indicators. A network of SDG interlinkages assumed to present the causal links between the targets was constructed. In total, 51 indicators with trackable data for nine countries were identified and mapped with 108 targets (out of 169 targets due mainly to lack of data). The identified linkages were then quantified based on the indicator-level time-series data corresponding to associated targets for the nine select countries.

Using Social Network Analysis (SNA) techniques, the general structure of the SDG interlinkages network and the distinguishing features of country-specific quantified SDG networks were analysed across an array of *centrality* measures. These included degree centrality (measuring how wide the connections between one target with other targets), eigenvector centrality (measuring both the width of connections with others and whether being connected with influential targets), betweenness centrality (measuring the bridging roles between unconnected targets) and closeness centrality (measuring the distance separating from others), etc. Key strategic targets that play various central roles in the network were then identified for individual countries by ranking indicators against the above centrality measures. Country-specific dashboard matrices indicating potential synergies and trade-offs between SDG targets were also created.

Based on the identification, quantification and analysis of SDG interlinkages between targets, the following became clear. The structure of the SDG interlinkages network features dense and complicated interactions between SDG targets, implying that an integrated approach is needed in many countries. The ranking results of SDG targets against various centrality measures (see **Table 1** as an example) indicate a few key targets in the network are most influential due to their consistently high scores on the previously discussed dimensions of centrality (Target 2.3 (double agriculture productivity), Target 2.4 (build sustainable food production systems), Target 6.1 (universal access to safe drinking water), Target 6.2 (universal access to sanitation and hygiene), Target 7.1 (universal access to energy) and Target 9.1 (develop resilient infrastructure)). A dashboard matrix indicating potential reinforcing (positive links indicated by green) and conflicting (negative links indicated by red) linkages between 108 targets for individual countries (see examples for Bangladesh and Japan in **Figure 3** and **Figure 4**) suggest the importance of respecting national circumstances and tailoring the means of implementation for achieving the SDGs. Finally, a web tool on SDG Interlinkages and Data Visualisation, accessible for free on-line at **http://sdginterlinkages.iges.jp/**, was developed to enable policymakers and other users to visualise the interlinkages between SDG targets and explore indicator-level data for the nine select countries.

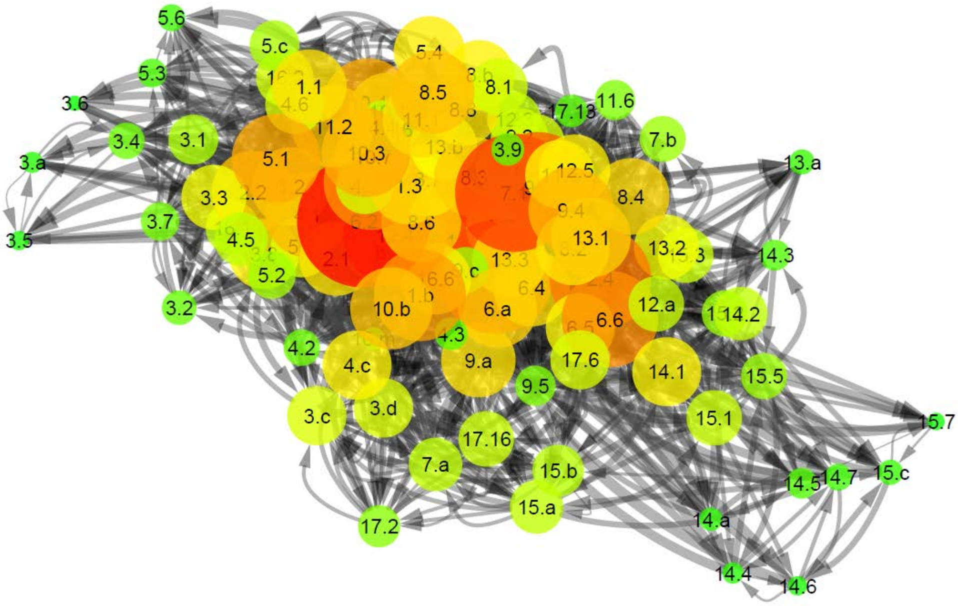


Figure 2: A complicated network of SDG interlinkages between SDG targets

Rank	In-degree	Out-degree	Degree	Closeness	Eigenvector	Betweenness
1	6.2	6.2	6.2	15.7	2.3	6.2
2	2.3	9.1	7.1	15.c	7.1	12.4
3	6.1	7.1	6.1	14.a	6.1	2.3
4	7.1	6.1	2.3	14.5	10.2	6.6
5	10.2	12.4	9.1	14.6	10.4	2.4
6	6.6	2.4	12.4	14.4	6.2	7.1
7	10.3	2.3	2.4	14.7	10.3	6.1
8	10.4	4.1	6.6	14.3	9.1	9.1
9	8.5	6.a	10.2	5.3	8.5	16.6
10	10.b	7.3	1.b	9.5	10.7	1.b

Table 1: Preliminary results on top 10 central targets ranked by various centrality measures

Source: Zhou and Moinuddin (2017).

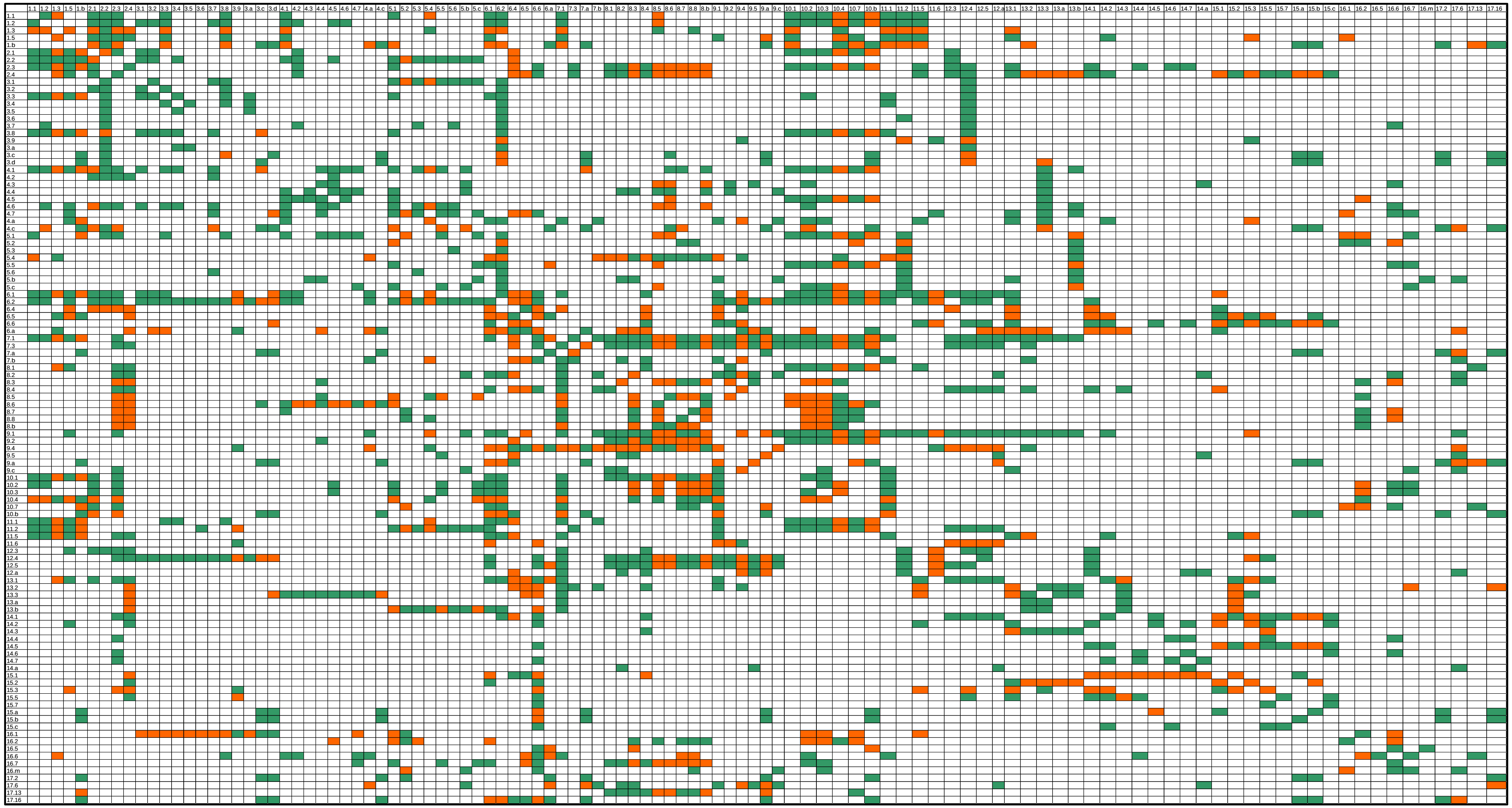


Figure 3: Dashboard for Bangladesh indicating potential reinforcing (in green) and conflicting (in red) linkages between 108 targets

Source: Zhou and Moinuddin (2017).

Notes: This is a square matrix of 108 by 108 targets. Entries without colour indicate there are no potential links between the pair of targets.

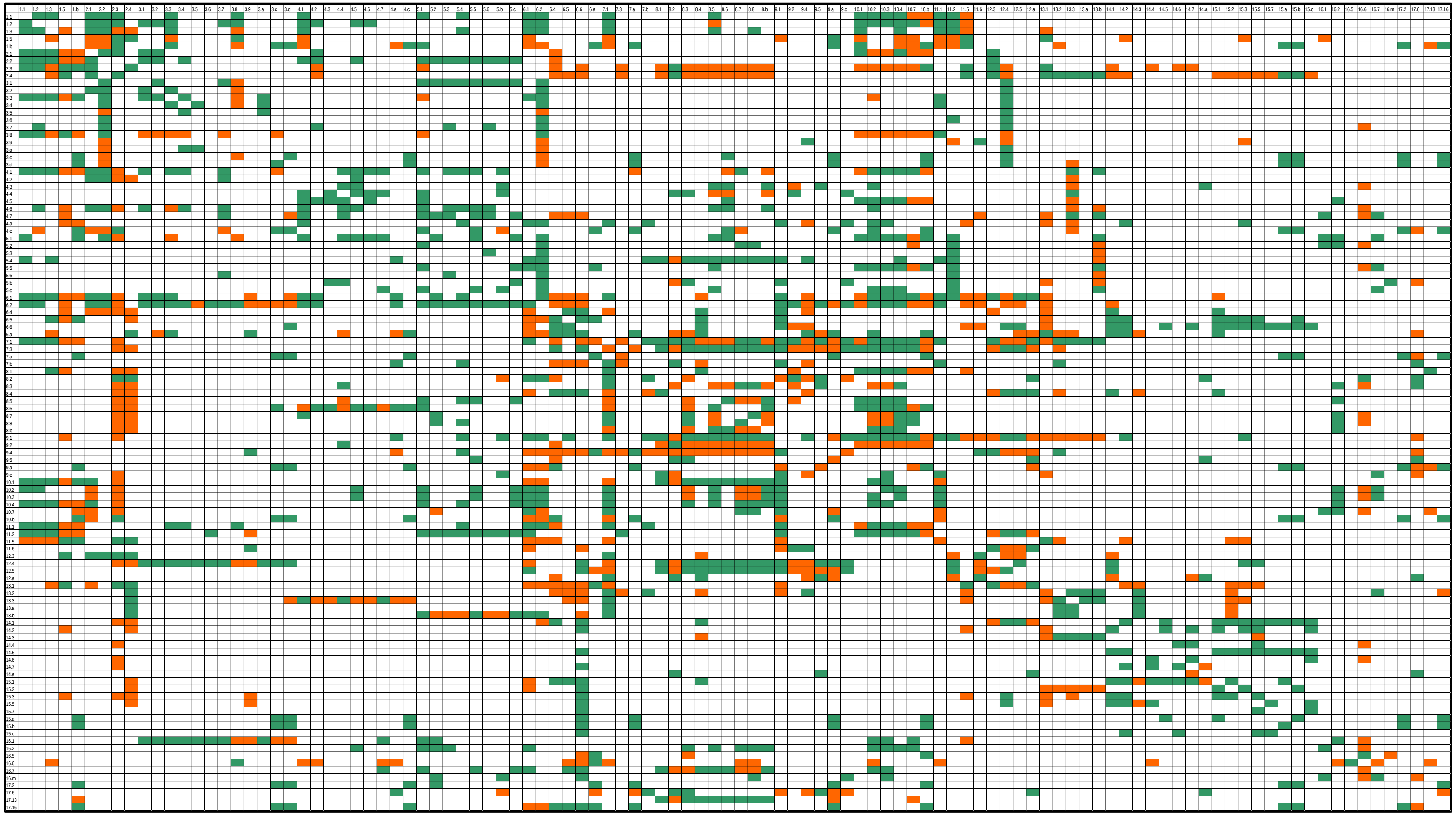


Figure 4: Dashboard for Japan indicating potential reinforcing (in green) and conflicting (in red) linkages between 108 targets

Notes: This is a square matrix of 108 by 108 targets. Entries without colour indicate there are no potential links between the pair of targets.

2.2 Food-Water-Energy Nexus

Throughout the world, about 785 million people go without clean safe water (WHO and UNICEF, 2012), nearly 795 million people remain undernourished (FAO, IFAD and WFP 2015) and 1.2 billion people lack access to electricity (IEA, 2016). The importance of food, water and energy to improving upon these numbers is readily apparent in SDG-2, SDG-6 and SDG-7 and their respective targets. However, the interrelationships between food, water and energy requires working on SDG-2, SDG-6 and SDG-7 not in an isolated but integrated manner. Figure 5, for instance, illustrates some of the key synergies and trade-offs between energy targets in SDGs 2 on food and SDG 6 on water. The food-water-energy nexus (FWEN) offers as a conceptual framework that can help identify cross-sectoral solutions needed to capture these and other synergies. The section will demonstrate both the promise of FWEN in India (to contribute to subsidy shifting policies from power to water use efficiency (WUE)) and several institutional reforms needed to consistently draw upon the FWEN as a basis for policy decisions.

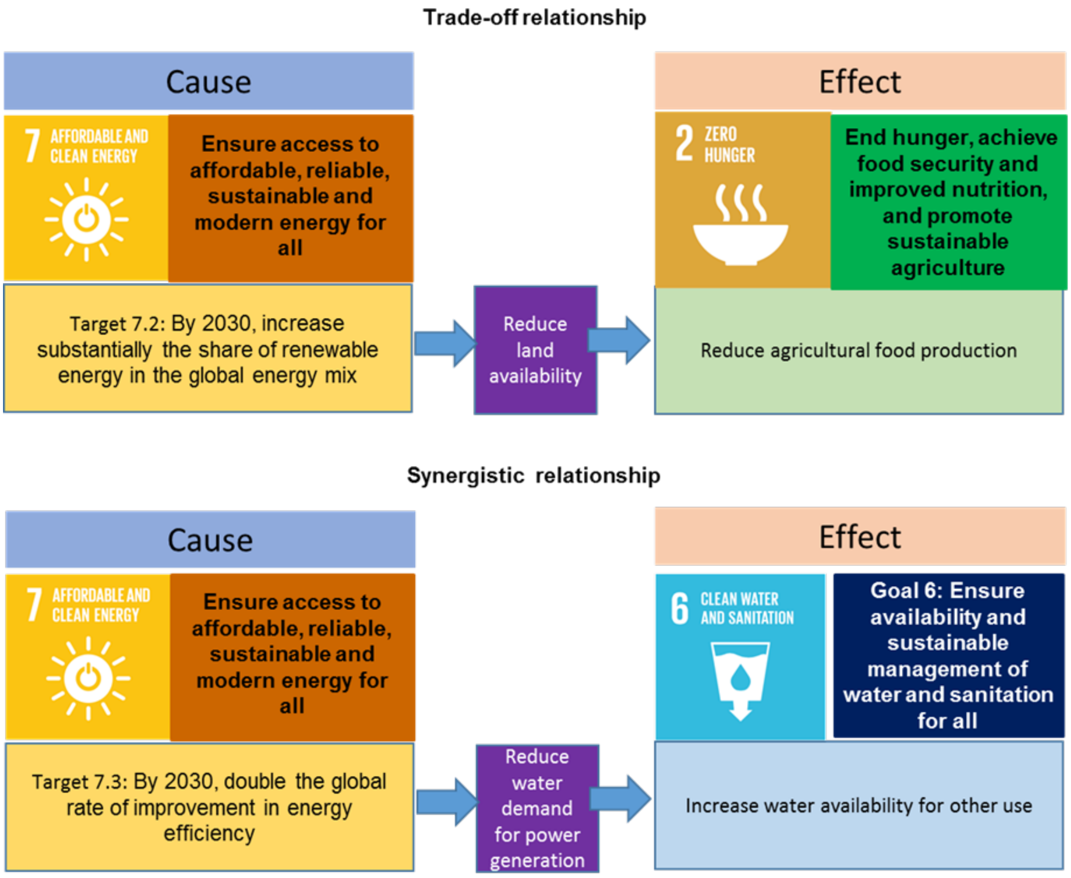


Figure 5: Trade-off and synergistic relationship of corresponding target of SDG-7 with SDG-2 and SDG-6

Sustaining the rapid development of Asia fast-growing economies requires steady and reliable supplies of energy for industries as well as increasing access to modern energy services and electricity. As a result, industrializing countries such as India must reconcile sharply escalating demand for modern energy with the realization that coal based electricity generation is likely to dominate the electricity supply mix for the foreseeable future (Mitra and Bhattacharya, 2012). Coal based power generation is often associated with high water use. In consequence, an increase in water demand may heighten pressure on freshwater resource stocks and cause water user conflicts. Such a tension is evident in energy model estimates commonly used in FWEN research to show available surface water resources will not be sufficient to support additional water demand beyond 2040, without a gradual transition to more water efficient systems (Figure 6). In fact, some cases of conflict between power generation and other sectors over water have already been reported in India (The Times of India 2011, UNEP Finance Initiative, 2010).

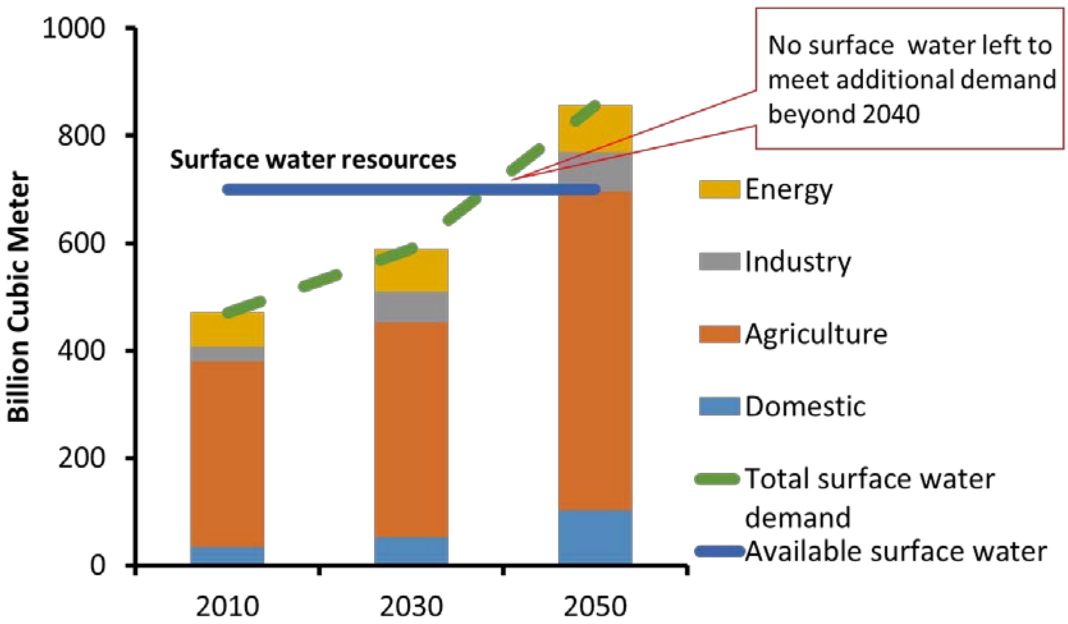


Figure 6: Long-term water supply demand gap scenario of India

This raises the question that the FWEN can help answer: what would kind of policies could lead to a gradual transition to more water efficient systems and avoid water use conflicts? That solution lies in recognizing that governments in many countries provide major subsidies for the electricity used to pump irrigation water. The artificially lowered pricing leads to inefficient and unsustainable energy and water use, which, in turn, jeopardises water and energy security. In developing countries, removing this subsidy from agriculture is politically sensitive, because it is directly linked with farmers' livelihoods and national food security. A policy that shifts the subsidy amount from power supply to water use efficiency (WUE) could become a win-win solution for both governments and farmers. To illustrate, Indian farmers currently receive USD5 billion in subsidies that translate into low electricity tariffs for pumping irrigation water. Estimates have shown that 20% WUE efficiency in India would save 102 billion m3 of water and 82,000 GWh of energy, as well as reducing CO2 emissions by 72 million tons. Shifting this amount to target WUE improvement could potentially lead to a 20% increase in WUE. Such a financial re-allocation could therefore generate multiple socioeconomic and environmental benefits, contributing to SDG-2, SDG-6, SDG-7 and other SDGs by saving energy and water, increasing crop yields and farmer incomes, and mitigating greenhouse gases (GHGs) and other environmental harms.

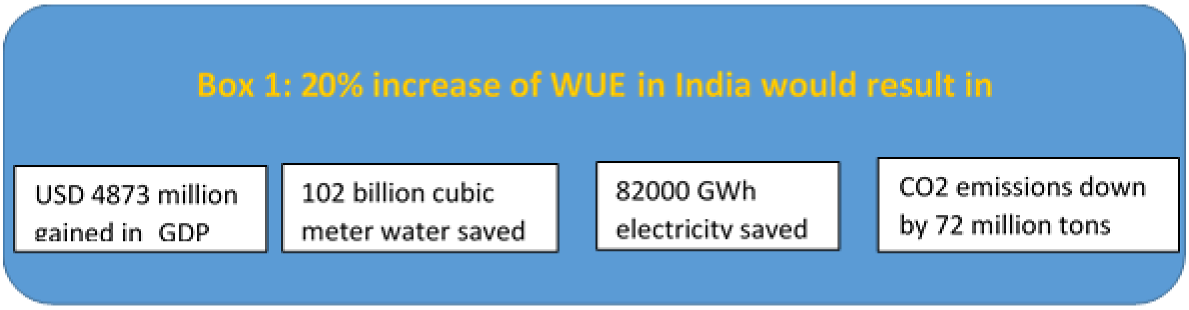


Figure 7: 20% increase of WUE in India would result in

Source: Mitra et al. 2017

The next key question is what would enable solutions such as the subsidy shifting to become a consistent contributor to policy? IGES conducted a stakeholder survey in select developing countries in Asia to understand necessary requirements to enable the adoption of the FWEF nexus. The survey underlined that consistently drawing upon FWEN as a basis for solutions necessitates embedding an integrated approach to problem solving in governance architectures and financing arrangements that have similar set of integrated design principles at their core. In fact, approximately 80 percent of the respondents highlighted the following suggestions: 1) improvement of institutional coordination; 2) need to establish coordinating body; 3) sectoral plans should go through a cross sectoral discussion and approval process; 4) financial allocation should be well coordinated, and 5) awareness raising and capacity building of policy and decision makers.

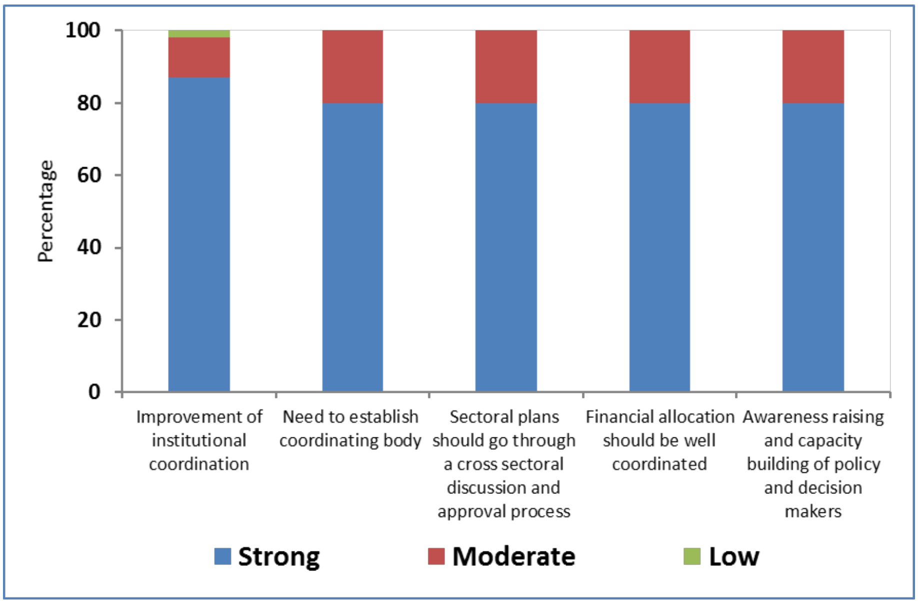


Figure 8: Stakeholder perception on necessary requirements to allow an adoption of the FWEF nexus in country context

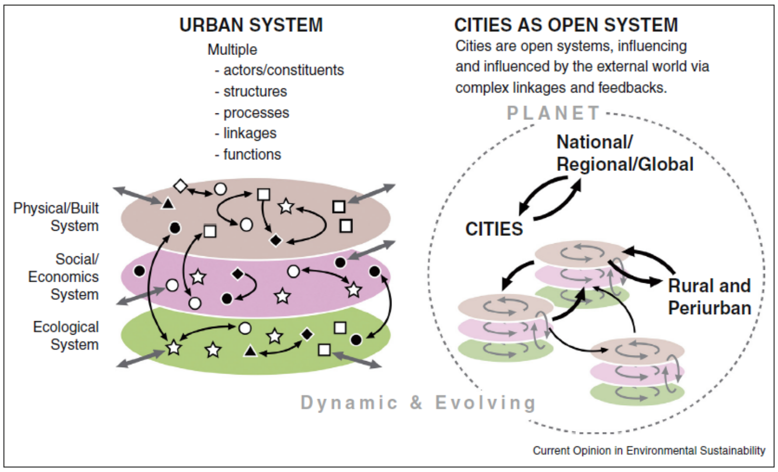
(Source: IGES Survey, 2017).

2.3 Urban Systems

In 2016, more than half of the world's population lived in urban settlements. By the time the 2030 Development Agenda concludes, urban areas are projected to house 60 per cent of people globally and one third of the world's population will live in cities with at least half a million inhabitants (United Nations, 2016). Moreover, even as many of Asia and Africa are predicted to see populations and land areas expand, developed countries are anticipated to adapt to a shrinking population by encouraging population to live in city centres (i.e. compact cities.) Even with these compact cities, however, the concentration of intense economic activities within densely populated areas could drive up demands for natural resources, raising questions on whether resources and waste from even well-planned urban areas can be truly sustainable. Hence, it is with good reason that there is both a headline SDG for cities (SDG 11) and over half of the 169 SDG targets are directly relevant for subnational levels (United Cities and Local Governments, 2016)

It is nonetheless important to recognize that demand for resources in supplying services typical to city governments increases not only competition but also interdependences, leading to further material and immaterial flows within and between urban units. These within and cross-city interdependencies are complemented by growing interactions between the urban, the surrounding area (periurban) and rural areas. The pressures within cities is thus strongly affected by changes outside of their boundaries.

Since these dynamics play out both within and beyond urban boundaries, cities are also susceptible to feedbacks that can lead to disruptive changes or virtuous cycles. Cities must therefore constantly adapt and evolve to withstand possible shocks and capitalize on clusters of benefits. Finally, since urban sustainability depends on minimizing disruptive feedbacks, one city alone cannot truly be sustainable if others are not. An integrated system of changes to prioritize actions that capture synergies and maximize benefits across a network of urban problems is needed.



The typical role of cities

1) Provide adequate infrastructure (eg. mobility, waste, water)
2) Contribute to economic growth and development (eg. trade, job, education)
3) Enhance quality of life_ (eg. open space, safe community)
4) Ensure equity (eg. gender, public assistance)
5) Achieve environmental sustainability (eg. natural resources)

Figure 9: Urban systems structure and linkages

Source: (Bai et al 2016)

Much of the urban research focuses on identifying cause and effect within individual sectors using specific disciplines. A holistic and interdisciplinary approach, on the contrary, tries to identify linkages and interactions between different components of a system. The virtue of this holistic approach is it can help shed light not only the different actors but the dynamic interactions between physical, economic, and social processes that collectively can generate vicious (or virtuous) feedbacks. IGES conducted an interdisciplinary study with government officials and experts from traffic engineering, emissions modelling, and urban governance that illustrates how these constellation factors contributed to a common goal in Bandung, Indonesia: a pilot eco-driving program.

The eco-driving program was first defined as a scenario with high potential to reduce transport oriented air pollutants and GHG emissions after an assessment by a group of emissions modelling experts from the Asian Institute for Technology together with the Institute of Teknologi Bandung. Next, a group of practitioners and experts for transport related research (i.e. Clean Air Asia) collaborated with the local city government to design a small pilot project that would combine capacity building training followed by data assessment on its potential benefits. Lastly, the Institute of Teknologi Bandung, through a series of interviews and a workshop, concluded that eco-driving training had proved effective but awareness raising activities on economic and health benefits, and stringent regulations would be necessary to promote further eco-driving behavior.

Eco-driving involves training and incentivizing vehicle operators to drive in a way that reduces fuel consumption and minimizes accidents. This can involve encouraging operation at constant speeds (to limit quick deceleration and accelerations), controlling idling, and selecting optimal low-traffic routes. The study revealed these improved driving habits could deliver several immediately identifiable benefits at different levels, including better health (SDG3) and cleaner air quality (SDG11) at the local level; less fuel consumption (SDG 12) at the local and national level; and climate change mitigation (SDG13) at the global level. A second set of possible more indirect second- and third-order effects such as safer roads (SDG11) that would encourage people to walk and take public transportation that could, in turn, lessen socioeconomic inequalities (SDG 10). Figure X helps to map out this system of benefits of some of the contingencies involved in realizing them.

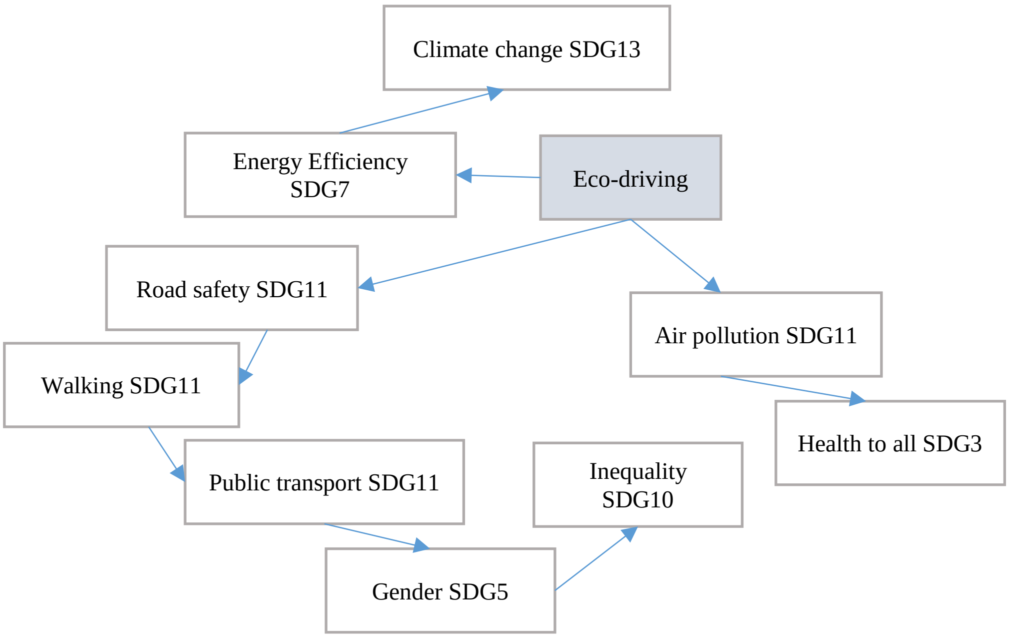


Figure 10: The connection between SDG targets in terms of eco-driving

What are the biggest challenges to employing this approach for decision making? Three come quickly to mind. First, this research was based on a small scale one year pilot program. Without government regulations institutionalizing the program, there was little incentive for drivers to adopt new driving habits beyond the short-term pilot. Second, while clear evidence of the program's multiple benefits could potentially persuade policymakers to establish these necessary regulatory support, it was difficult to introduce a systematic data collection and analysis into institutions participating in the pilot. Third, the success of eco-driving in Bandung depends heavily on what happens outside Bandung. Bandung's economy relies heavily on tourism and textiles manufacturing. These sectors depend on the constant flow of products and people in and out of their "living space" or "places for production." Thus without regulations and good data collection in Jakarta, Bogor, and across the growing urban agglomeration known as Jabotek, there were likely to be unwanted leakage and possible negative feedbacks.

Many of the above constraints point to the need for improved urban governance. This necessitates "hierarchical" multilevel governance (the traditional link between state, sub-regional and local actors) that uses formal rules to address the "whole system"; and governance which concentrates on tackling the link between different problem-oriented units (e.g. water, climate, transport, biodiversity) simultaneously. From the perspective of the whole system, coordination in policy making among the Ministry of Environment and Forestry, the Environmental Agency of West Java Province, the city's Environment Agency and Communication Agency, Local Police and academic experts is desired for eco-driving to achieve its maximum intended effects. In terms of the link between different units, if a wider variety of experts were invited into the program further tangible results might be able to be defined. For example, input from health experts could allow for explicit calculations on air pollution reduction and health benefits. Transport experts could make the connection with pedestrian safety and public transportation networks offer insights into possible avenues for better mobility, making the tourist oriented city further attractive.

2.4 Co-Benefits

Out of all of the integrated approaches, the one with the longest history involves co-benefits. Co-benefits—broadly defined as all of the benefits that come from actions that mitigate climate change and deliver other development gains—originated at the end of the 1980s and early 1990s when discussions were intensifying over the costs and benefits of investing in climate actions (Ayres & Walter, 1991; IPCC, 1995; Pearce, 2000). Since that period, the term and its applications have evolved in line with developments in international and national policymaking. Because many of those developments involve strengthening the linkage between air pollution and climate policies, the emphasis in this section will similarly be placed on co-benefits arising from the synergies between these two policy areas—though wider applications will also be mentioned.

In highlighting the linkages between climate and air pollution, the concept of co-benefits fits well with the integrated approaches recommended under the SDGs. Recent studies have shown, for instance, that air pollution is mentioned in three targets and two indicators under the 17 SDGs. Meanwhile, climate change has its own goal in the form of SDG 13 (which is arguably linked to nearly all of the other SDGs). There is, however, no language in the SDGs that explicitly makes the linkage between climate change and air pollution; identifying and leveraging these linkages will be largely up to policymakers as they interpret the SDGs in their own context (Elder & Zusman, 2016).

Though the notion of co-benefits initially received attention in the 1980s chiefly from natural scientists, it gained much greater attention in research as economists began to apply a relatively standard set of tools to quantify and monetize possible benefits from actions with multiple goals (Nemet, Holloway, & Meier, 2010; Pearce, 2000). Initially this research focused chiefly on the United States and Europe, reflecting both the understanding that developed countries would lead in mitigating GHGs and had the data needed to look at the additional air quality benefits from doing so. However, by the early 2000s and definitely over the past decade, the focus has shifted from developed to developing countries (Mayrhofer & Gupta, 2016).

There were a few reasons behind this shift. One was that research demonstrated that additional benefits from mitigating climate change tended to be several magnitudes of order greater in developing as opposed to developed countries; this largely reflected generally poorer state of air quality in rapidly industrializing countries and higher pollution densities (and exposure to air pollution) in countries where this work was done (Ayres & Walter, 1991; IPCC, 1995). In addition, beginning with the Clean Development Mechanism (CDM) and continuing to Nationally Appropriate Mitigation Actions (NAMAs) and Nationally Determined Commitments (NDCs), developing countries have more actively participated in international climate negotiations with voluntary climate mitigation projects and policies (Takemoto, Wada, & Hirofumi, 2012; Zusman, 2008). The development benefits of these actions (and therefore the co-benefits) are understandably critical for countries needing to ensure investments have immediate impacts on their populations. A related stimulus for growing interest in developing countries have been concerns over air pollution crises that have grown in parallel with research showing that some forms of air pollution (now called short-lived climate pollutants (SLCPs) contribute to near-term warming in climate systems (UNEP/ WMO, 2011).

With research and policy both advancing interest in co-benefits, a relatively standard approach to looking at the air quality and climate benefits has emerged. That approach is a logical extension of the economic and energy modelling that has deep roots in climate policy research. The approach typically involves looking at a policy area where there are clearly emissions of multiple types of pollutants and greenhouse gases (GHGs)—energy, transport, and waste management policy are the most frequently cited candidates (Walsh, 2008; Zusman, Srinivasan, & Dhakal, 2012). The next step involves developing one or more alternative policy (or project scenarios) for the policy area in question. This is then followed by estimating the baseline emissions for multiple pollutants and GHGs for that policy area in the absence of that alternative scenario; this is then compared to the emissions with that scenario. A comparison between the "with and without" policy provides an estimate of possible emission reductions. To convert the emissions estimates into monetary figure that is more likely to resonate with policymakers, an additional set of models can be used to estimate possible changes in emission concentrations, ambient air quality, and health endpoints (such as averted premature deaths and illness) that can be monetized. In fact, it is the application of this kind of approach in more vast and varied contexts that have been behind the sharp increase in published literature on the theme.

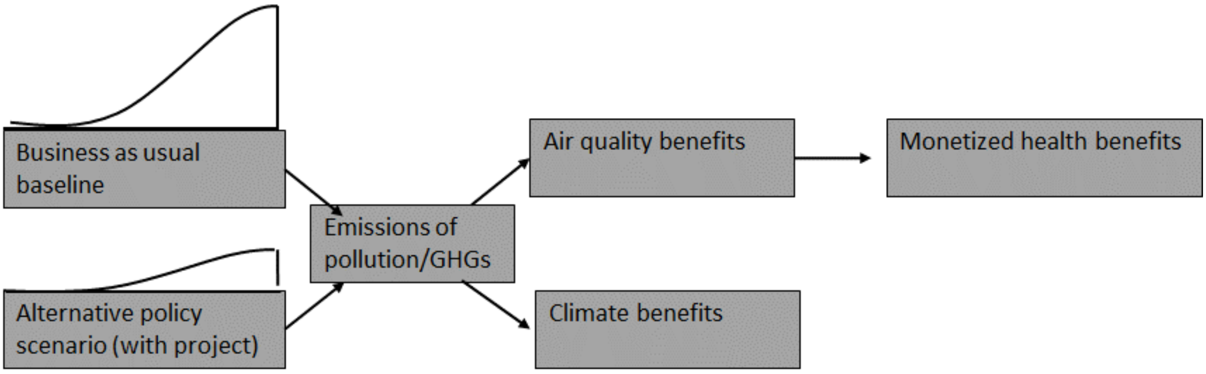


Figure 11: The Steps to Quantify Co-benefits

Despite increased interest in policy and research on co-benefits, there nonetheless remains significant gaps between the two that require highlighting when discussing integrated approaches. One of the gaps involves the sometimes implicit assumption in the quantitative research on co-benefits that quantifying benefits can lead to policies capable of realizing those benefits. A vast collection of social science research has highlighted that policymakers are not necessarily benefit maximizers. Rather, policymakers frequently base decisions on a more select set of indices that may or may not include overall benefits. They may also aim to satisfice: this refers to the predilection to achieve but not go beyond certain benchmarks while minimizing costs and time. Other challenges to application of a co-benefits approach range from the practical limits on data that can affect the robustness of estimates to institutional arrangements that reinforce a tendency to think about one impact at a time.

Even with these constraints, there are several steps that can be taken to support the consideration of co-benefits and contribute to integrated approaches under the SDGs. One such step forward would be to look more closely at where co-benefits sits in a broader systems thinking (Puppim de Oliveira et al., 2017). Part of the challenge with research of co-benefits is that it tends to concentrate chiefly on quantifying benefits rather than placing those benefits into a broader set of changes to policies, institutions, and resource flows needed to achieve them. In this connection, some of the research on integrated approaches may offer some useful insights into how co-benefits can contribute to systems thinking and vice versa.

3: Summary and Conclusion

The previous two section described vast and varied integrated approaches to the SDGs. These approaches are indeed different in many respects. The most obvious point of contrast is their scope and scale. The network analysis tends to focus on integration at the national level across potentially all of the SDGs. Meanwhile, the food-water-energy nexus and co-benefits tend to look at particular SDGs at the national or local level, and the urban systems concentrate on cities (in interaction with other cities and surrounding peri-urban and rural areas). Another area where the approaches vary are in their analytical methods and presentation of results. The network analysis uses correlations in time series data and social network analysis to map interactions and generate national dashboards; the food water energy nexus draws from energy models to identify policy solutions and make recommendations; the urban systems work is based on interdisciplinary systems thinking to put in motion virtuous interactions and minimize disruptive feedbacks; and the co-benefits approach relies upon energy, air pollution, and economic models to estimate cost and benefits of different options. A third area where these approaches diverge involves possible feedbacks and virtuous/vicious cycles; these are highlighted most prominently in the work on urban systems, though are implied in some of the other approaches to integration.

Approach	Main SDGs	Key Features
Network Analysis	Potentially All	• Draws on review and synthesis of scientific literature and relevant documents international policy processes • Quantification based on the indicator-level for time-series data corresponding to associated targets for the nine select countries • *Centrality* measures (degree, eigenvector, betweenness and closeness centrality) determine ranking and linkages • Food, energy, water and infrastructure appear to top priorities • Policy coherence and integrated governance needed for implementation

Water Food Energy Nexus	2, 6, 7	• Conceptual framework that can help identify cross-sectoral solutions needed to capture synergies • Energy demand heighten pressure on freshwater resource stocks; cause water user conflicts • Gradual transition to more water efficient systems needed • Use energy modelling to highlight this tension as well as possible solutions in the form of WU subsidy • Crafting integrated policies requires integrated governance architectures and financing arrangements
Urban Systems	11 out to as many of half the targets including 7	• Highlights interactions within, across, and beyond cities • Underlines not only actors but resource flows matter for urban systems • Requires multidisciplinary approach to see interactions • Underlines possibility for virtuous and vicious feedbacks that lead to disruptive or beneficial changes • Notes the need for systematic compilation of data to operationalize • Requires government actions that institutionalize programs • Multi-level governance important to withstanding shocks and capitalizing on streams of change
Co-benefits	3, 11, 13 (possibly 7)	• Growing interest tracking bottom-up climate actions • Uses cost-benefit analysis with some monetization of health benefits • Still rather limited to economic modelling with less interaction with other disciplines • Need greater consideration of policymakers limited interest in maximizing benefits • Need greater consideration for governance that can motivate achieving multiple benefits on multiple levels

Table 2: Key features of integrated approaches

While the differences between these approaches are evident, at least four similarities also warrant attention. First, all of the approaches feature different forms of integration that can potentially make work on the SDGs more holistic, cost-effective, and manageable. This largely comports with the motivation for ensuring the SDGs are implemented in an integrated manner. Second, though all of these approaches are increasingly relevant for the SDGs, whether they are relevant for policymakers remains an open question. Policy relevance remains a common sticking point. Making these approaches will likely require increased interactions with policymakers to help them own and mainstream context-appropriate integrated approaches. Third, the four different approaches aim to become policy relevant by illustrating relationships and contingencies in way that will move decisions closer to an ideal of evidence-based policy making. That is, they will become closer to selecting solutions based on a rigorous and robust empirical analysis of all observable impacts. Finally, all the approaches underline the importance of new forms of multi-level governance (and to a lesser extent financing) to achieve their desired ends. An estimate of multiple benefits or a diagram of streams of synergies will only induce limited action without the governance architectures are not properly aligned to following through on its prescriptions. Institutional fragmentation and policy incoherence will undermine even the most careful and compelling analyses.

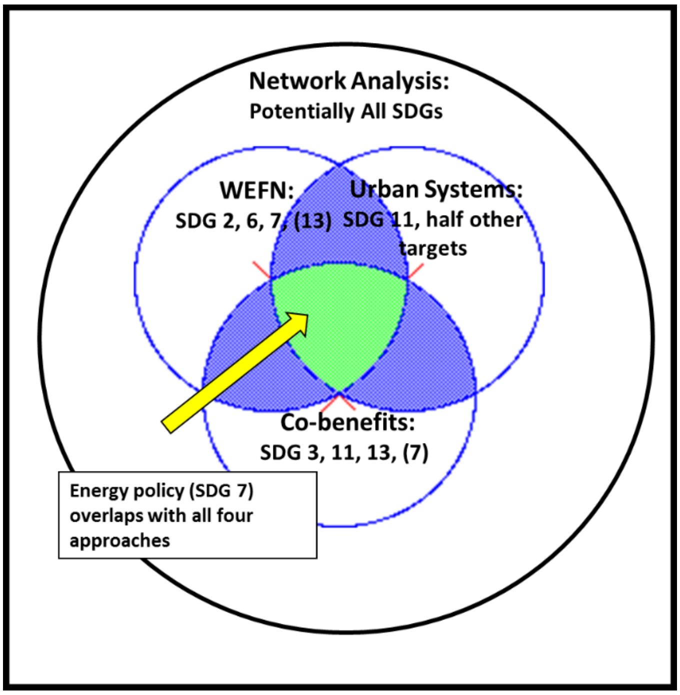


Figure 12: Mapping Different Integrated Approaches

As illustrated in Figure 13, these different approaches also relate in one other less obvious complementary way. Seeing this complementary involves recognizing that the three narrower approaches are nested within the broader network analysis framework. It also requires noticing that the three narrower approaches (and by default the broader network analysis) intersect and converge around a shared interest in energy policy (eco-driving is largely about saving energy). This is perhaps unsurprising given the findings that access to energy is central concern in the network analysis. However, it also suggests that for policymakers who do not know where to start on the SDGs, working to ensure access to sustainable access to energy may be an appropriate entry point. This further implies that, given the importance of governance, a growing body of literature on energy governance might help those working on integration work better together.

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