Important interactions among the Sustainable Development Goals under review at the High-Level Political Forum 2017

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CONTENTS

Acknowledgements .................................................................................. 2
Executive summary .................................................................................. 3
1. Introduction ....................................................................................... 7
2. Approaches to analysing interactions .................................................. 8
   2.1 Interactions assessment ................................................................. 9
3. Important interactions across the SDG targets .................................... 12
   Goal 1. End poverty in all its forms everywhere .................................. 12
   Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture ............... 15
   Goal 3. Ensure healthy lives and promote well-being for all at all ages .......... 19
   Goal 5. Achieve gender equality and empower all women and girls ............. 23
   Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation ...... 27
   Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development ............ 31
4. Discussion .......................................................................................... 34
   4.1 State of knowledge and general agreement about interactions ............. 34
   4.2 Comments on context dependency .............................................. 35
   4.3 Addressing interactions in government: institutional challenges for integrated policy-making ......................... 35
5. Conclusions ....................................................................................... 37
References .............................................................................................. 38

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EXECUTIVE SUMMARY

The 2030 Agenda emphasizes interlinkages and interactions among the 17 Sustainable Development Goals (SDGs), and the importance of implementing them as an “indivisible whole”. At the same time, development analysts, policy-makers and practitioners know that there might be both reinforcing relationships and trade-offs as the goals and targets are being implemented. This paper identifies important interactions between the targets under a selection of six goals and other targets across the SDGs. It identifies some institutional implications and challenges thrown up by these interactions. The six goals, 1, 2, 3, 5, 9 and 14, are the goals in focus at the High-Level Political Forum in 2017.

Looking at Goal 1, on eradicating poverty, ensuring equal rights to economic resources and access to services (target 1.4) is known with some certainty to be indivisible from other SDGs. Poverty eradication needs to be understood as aiming for the well-being, welfare and freedom of each individual. Whether development strategies such as export-driven manufacturing, value-adding activities in the food sector or natural resource extraction contribute to poverty eradication depends on there being adequate and effective institutional frameworks to enable equitable access to the resulting opportunities and benefits. At the same time, such frameworks need to be able to accommodate shocks that can come from a variety of sources, and can threaten gains made in poverty eradication.

Under Goal 2, on ending hunger, achieving food security and good nutrition, food security is fundamentally dependent on increasing production, improving quality and ensuring access and utilization to all people. At the same time, agricultural production is currently a major source of environmental impacts, including climate change. There are also strong linkages between nutritious and healthy diets and health outcomes. Ending malnutrition in children is clearly connected to ending preventable child deaths and improving cognitive and physical development. At the national level, positive interactions can be leveraged by coordinating action on agriculture, health, gender, and water and sanitation. Improving utilization of food is enhanced by improvements in education and health policies, and measures to enhance income growth amongst the poor. Investments in sanitation and clean water will also improve nutritional outcomes, in strong interaction with health and gender goals. Institutional programmes at national level to integrate food security with gender and health priorities have shown great potential. The split of responsibilities between agencies governing agriculture, health, education and social programmes can lead to suboptimal development results, but can be overcome. One route is to work with high-quality diets through using public procurement for schools and hospitals.

With regard to Goal 3, on health and well-being, healthy lives depend critically on other SDG areas, including nutritious food, sanitation, clean water and air, and education. There is relatively strong scientific agreement on the multiple interactions between health targets and other targets in the 2030 Agenda. At the national level, however, environmental and health issues almost invariably fall under different ministries and agencies. Ministries of health are central players in governing these interactions. Technical core capacities can be strengthened across countries through international efforts. Institutional capacities should also be developed to coordinate health research processes, findings, and structures, and with the overarching goal of enhancing the health system’s ability to perform its functions. Achieving Goal 3 will rely on the build-up of much stronger linkages between communities and agencies in those various interrelated areas, to enable a more holistic approach to health governance, including in terms of strengthening the capacity to respond to emerging challenges.

In the area of Goal 5, on gender equality and empowering women, the universally positive interactions with other goals suggest that actions for improved gender equality is an important lever for the 2030 Agenda overall. Strengthening interactions with gender equality can be pursued through several different types of institutional arrangements. There are many examples of na-
tional programmes and policies that have been used to improve gender equality and reinforce positive change in other goals at the same time. It may also be necessary to ensure that interventions in other sectors are being designed in ways that do not inadvertently limit utilization by girls and women. National parliaments have a particularly important role in relation to gender equality. Gender mainstreaming (applying a gender lens on all policy domains) can be institutionalized in policy and planning procedures, for example in national development plans and strategies and through gender-responsive budgeting. Gender-disaggregated national statistics to measure development outcomes on, for example, health, nutrition, education, crime and income, are an important component of the institutional framework of mainstreaming.

With respect to Goal 9, on *infrastructure and industrialization*, there is strong agreement that enhancing science, technology and innovation leads to productivity increases, albeit with many dependencies related to governance and scaling capacities. Development of infrastructure contributes to ensuring access to economic resources and services. Promoting inclusive industrialization reinforces economic growth by improving economic productivity, itself a key source of income growth over the long term. Infrastructure also has strong positive impacts on education and health. On the other hand, conventional patterns of industrialization and infrastructure development are associated with well-known trade-offs with a range of environmental issues. Regarding institutional responses, the environmental governance of industrial activity and infrastructure investment is a strongly institutionalized policy domain. An entire ecosystem of institutions for sustainable financing is now being built up or adapted at national and international levels to finance the structural changes that are needed in infrastructure and industrial production systems. Efforts are needed from the public sector to orient innovation towards environmentally sustainable products, processes and services.

Finally, for Goal 14 on *oceans, seas and marine resources*, there is increasing agreement that the regulation of harvesting and ending of overfishing are inseparable from achievement of sustainable and resilient food production – in which traditional and local institutions for regulation can play an important role. The sustainable management of marine and coastal ecosystems builds the resilience of the poor and vulnerable, while addressing ocean acidification goes hand-in-hand with climate mitigation. The governance of the ocean has not been high on political agendas at either national or international levels, and it is difficult to discern to what extent current governance arrangements are oriented to interact with institutions that govern other SDGs. To enable and ensure productive and sustainable economic use of oceans, institutional strengthening is required at different levels. With effective and inclusive institutions, oceans can yield increasing economic benefits, not least for small island developing states (SIDS) to reinforce economic growth, trade, and employment through sustainable use of marine resources.

Coping with the interactions among these goals and targets is a formidable institutional challenge at both national and international levels. Most countries govern their public policy sectors, such as health, energy, agriculture and education, through sectoral ministries and agencies. There are very good reasons for this, such as the need for specialized competencies and clear accountability relationships. However, the trade-offs are well known – since the lack of joint agendas and coordination often leads to inefficient or even contradictory policy actions. The 2030 Agenda, which puts great emphasis on policy coherence and even gives it its own target, 17.14, is a mirror of the aspirations that already exist at the national level to work across policy sectors and coordinate them better.

Working through cross-sectoral governance systems and across linked knowledge fields requires advanced capacities within the government machinery. Policies that aim to support positive goal interactions may have longer payback times and require longer planning horizons than single-goal approaches. Integration of policy areas in administrative practice also requires communication systems and consultations across sectors. These can take different forms, and while building relevant institutions is important, there are challenges in making them effective vehi-
cles of collaboration and delivery, in particular due to institutional barriers, which include both formal and informal incentives within government bureaucracies and narrowly framed policy objectives in sectoral agencies.

Given the many commonalities between countries, national SDGs implementation could be greatly advanced by an internationally coordinated effort to create an open knowledge platform, containing systematic and robust analysis of the SDGs and their interactions, and how they might play out in different contexts. To ensure that this knowledge base becomes cumulative and comparable across knowledge fields, it should build on a common conceptual framework, perhaps developed under the auspices of the United Nations.
1. INTRODUCTION

The adoption of the 2030 Agenda for Sustainable Development (UN General Assembly 2015) marked the shift to a new paradigm for global development policy and cooperation, distinguished not only by the universality principle (addressing all people in all countries; see (UNDG 2016) and a firm commitment to “leave no-one behind”, but also by its strong articulation of the importance of linkages, interdependencies and interactions among development goals – across sectors and jurisdictions. The 2030 Agenda is often referred to as an integrated, “indivisible” whole. It clearly expresses recognition that human development and prosperity are dependent on the earth’s life support systems (International Resource Panel 2015), and that humanity is bound together and mutually dependent across country boundaries. Neither development nor environmental goals can be reached in isolation from other goals or from other countries’ efforts.

Integration and coherence have for some time been leading concerns for international and national agencies around the world. International organizations such as the Organisation for Economic Co-operation and Development (OECD 2016a), the UN Department of Economic and Social Affairs (UNDESA) and the UN Environment Programme (UNEP 2016) have all launched efforts and processes to better understand, manage and leverage the interactions and linkages among development policy areas. Many institutes and ad hoc expert groups have also contributed (e.g. (International Resource Panel 2015; Coopman et al. 2016), as has the European Commission (Giovannini et al. 2015). However, there is at present no structured evidence base or framework for unpacking interactions, and for understanding whether and when goals and targets are indeed “indivisible”, or actually need to be traded off against each other. And while the integration discourse is blossoming in official documents, real-world policy-making still largely comprises negotiations around competing goals and interests.

The purpose of this paper is to help establish a baseline understanding of important interactions within the 2030 Agenda and its set of 17 Sustainable Development Goals (SDGs) and to launch a discussion on the implications of these interactions for integrated approaches to implementation of the 2030 Agenda. It focuses on the six SDGs selected for review at the 2017 High-Level Political Forum. These address ending poverty, ending hunger, healthy lives, gender equality, infrastructure and industrialization, and oceans (Goals 1, 2, 3, 5, 9 and 14). The paper looks at a selection of salient targets under each of the six goals, and important interactions with other targets, based on a reading of the mainstream literature.

The paper addresses the following overarching questions:

- What are the most important interactions between the targets of Goals 1, 2, 3, 5, 9 and 14 and other SDGs?
- How much agreement is there around this knowledge?
- Where would joint action and international responses be likely to bring clear net benefits?
- What are the institutional implications of addressing these linkages among SDGs?

Section 2 describes the conceptual approach used in the analysis and places it in the context of existing literature and efforts to analyse interactions.

Section 3 discusses the six selected goals one by one. Target interactions with targets under other goals are identified. Each interaction is given a score from +3 to -3, to reflect how far it helps or hinders progress towards the targets, and the nature of the interaction is briefly outlined. The level of confidence and degree of consensus regarding the findings on the interactions is indicated with a brief comment, where possible. However, it must be noted that these comments are based on subjective judgement and a necessarily limited reading of the literature. In most cases it has not
been possible to discover how robust the consensus is. The state of knowledge is to some degree dependent on indicator systems and the quality of indicators.1

Section 4 includes a discussion of the results, and offers some observations on institutional issues. Section 5 presents conclusions and suggested priorities and ways forward in developing the knowledge base to support integrated approaches.

2. APPROACHES TO ANALYSING INTERACTIONS

Several different approaches for analysing interactions between SDGs have been tested and published. One approach has been to simply identify them. Le Blanc (2015) used network analysis techniques to establish the existence of linkages, basing his findings on the linkages expressed in the wording of the SDGs. In a further elaboration, Vladimorova and Le Blanc (2016) explored more linkages based on a review of documents in the UN system, focusing on the case of education. A body of international policy and academic literature on the water-energy-food nexus has also highlighted the existence of linkages among, in particular, the topics covered by Goals 2, 6, and 7 (e.g. Hoff 2011).

To support real-world policy and planning, simply identifying a link is insufficient. In the SDG policy debate, therefore, much of the discourse has been around the existence of “trade-offs” and “synergies” (e.g. International Resource Panel 2015; van Vuuren and Kok 2012): whether an interaction is broadly beneficial or adverse. Similarly, literature on institutional interactions and policy coherence has often applied such a binary view (with variations in terminology; see e.g. Oberthür and Gehring 2006).

Some, however, have tried to establish a more nuanced way of viewing interactions. Weitz et al. (2014) used a three-point typology of interactions in their analysis of the water-energy-food nexus in the SDGs: interdependence; imposing conditions or constraints; and reinforcing. Similarly, a Stakeholder Forum study (Coopman et al. 2016) applied an approach for interlinkages with three categories: supporting, enabling and relying, with some subcategories. Also, some international agencies have published increasingly advanced takes on interactions in official reports (e.g. UNESCO 2016; United Nations 2016).

As the conceptual basis for a science-based assessment of interactions, Nilsson et al. (2016) and ICSU (Griggs et al. 2017) presented a seven-point typology, which is applied in the analyses in Section 3: ranging from cancelling (-3), counteracting (-2) and constraining (-1) on the negative side to neutral (0), and enabling (+1), reinforcing (+2) and indivisible (+3) on the positive side (see figure 1).

Policy assessments of interactions are thus progressing and becoming more complex. For the SDGs in particular, characterizing interactions is complicated by the fact that the majority of interactions need to be assessed at the level of the 169 targets, not just the 17 goals. The goals in themselves are highly multidimensional and contain different factors that will interact differentially with other areas.

Due to the wide scope of the SDGs and their targets, the selection of interactions identified in analyses such as that presented here still involves a degree of subjectivity. It is simply not possible to provide a robust, comprehensive assessment of all the important interactions in one single policy paper. Firstly, there are too many of them; selecting a sample of three salient targets from each of the six goals, and only looking at interactions among them, would mean looking at $3^6 = 729$

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1 Data availability on each target indicator is not commented upon in this paper. On this topic, the Inter-Agency and Expert Group on SDG indicators has classified indicators into three tiers: Tier 1: conceptually clear, established methodology and standards, data regularly produced (83); Tier 2: as Tier 1 but data not regularly produced (59); and Tier 3: lacking established methodology and standards (83), plus 5 in multiple tiers. (IAEG-SDGs 2016)
interactions. There can also be more than one interaction between two targets. And looking at interactions with all targets within the remaining 11 SDGs would imply assessing many thousands.

Secondly, every interaction, such as the impact of education on maternal health, is typically the subject of extensive literature, in both academia and development policy and practice. They often represent an entire research area in and of themselves, and characterizing each one fully requires substantial information, much of which will be context-specific. Furthermore, interactions are also the subject of political debate, with multiple views among experts and stakeholders – as can be seen, for example, in the relationship between inequality and productivity growth. Thus, while there may be a common understanding of important interactions in many areas that are generically applicable, in order to guide action and responses at the national level with robust, salient and legitimate knowledge, context-specific and systematic interaction assessments are needed. This requires properly resourced policy research projects as well as policy dialogues. Thus, this paper does not set out to be a definitive, systematic assessment of interactions; it should be read more as a “proof of concept” for such assessments.

2.1 Interactions assessment

As noted above, the assessment uses the typology of interactions presented by Nilsson et al. (2016) and the International Council for Science (Griggs et al. 2017) to characterize interactions among the SDGs (see Figure 1). Interactions can be assessed and scored at the level of the targets themselves (Q: “If we make some degree of progress on target A, how does this affect our ability to make progress on target B?”); for example, getting more modern energy services to rural villages (target 7.1) will reinforce the reduction of deaths and illnesses from indoor air pollution (target 3.9). They can also be assessed at the level of interventions to reach the target (Q: “If we implement policy X to make progress on/achieve target A, how does this policy affect our ability to make progress on target B?”); for example, implementing a tax on energy use to raise public revenues (target 17.1) will reinforce efforts to increase energy efficiency (target 7.3). In this paper, the focus is on the targets themselves, although in some examples there are discussions about interventions.

Important interactions were identified partly through the knowledge base assembled by ICSU, which in 2016 and 2017 organized a knowledge-building effort for some SDGs, and partly through reviews of scientific and grey literature in the six goal areas, including in library databases such as ScienceDirect (www.sciencedirect.com). Strategic samples were then cross-checked with key official synthesis reports such as the Global Sustainable Development Report (United Nations 2016) on infrastructure and UNESCO (2016) on gender equality, to identify and fill any critical gaps.

Each goal area is given an individual assessment table in Chapter 3. Each row concerns a single set of interactions, starting with the highest scoring and ending with the lowest scoring. The columns include the score assigned to the interaction, the relevant target(s) under the goal, the targets they interact with, a brief description of the interaction, a summary of its applicability and key dependencies, and comments on the current state of knowledge and agreement about the interaction.

The key dependencies take different forms, specifically:

**Place-specific context** Interactions may have different character depending on geographical location and what the national context and resource base looks like, not only in terms of natural resources but also levels of infrastructure, institutions, cultures, income and education. Indeed, the underlying interpretation of the target may also look very different depending on national circumstances (Weitz et al. 2015).
Technology Interactions may have different character depending on what technology is used to produce food, energy or water for example. In those cases where the interaction is highly dependent on technology (e.g. for areas such as agricultural production, energy supply and transport in cities), there is also frequently an opportunity for action, as we can improve the interaction by deploying better technologies.

Governance Interactions may have different character depending on what policies and institutional measures are applied. For example, much of the sustainability debate regarding renewable energy (target 7.2) has concerned a negative interaction between biofuels expansion and local livelihoods or food security (Robledo-Abad et al. 2016). It has been observed, however, that this negative relationship can largely be attributed to aspects related to governance as opposed to biofuels production in itself.

Assessing the role of the place-specific resource base, technology and governance is useful not only to understand the underlying dynamics of the interaction, but also points towards potential implications regarding opportunities to move the interaction “up the scale” and even shift it from a negative one to a positive one.

There are various ways of presenting and visualizing the results of such interaction assessments. This paper presents results goal-by-goal and then introduces interactions at target level from the most positive ones, represented by dark green in the table (and a +3 score) to the most negative ones, represented by dark red (and a -3 score). Directionality – whether the influence is one-way or two-way – is indicated in the table with a small arrow.
### GOAL INTERACTION SCORING

<table>
<thead>
<tr>
<th>Interaction Type</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIVISIBLE</td>
<td>+3</td>
<td>The strongest form of positive interaction in which one objective is inextricably linked to the achievement of another. For example, achieving “End all forms of discrimination against all women and girls everywhere” (5.1) would in itself lead to the achievement of “Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life” (5.5).</td>
</tr>
<tr>
<td>REINFORCING</td>
<td>+2</td>
<td>One objective directly creates conditions that lead to the achievement of another objective. For example, strengthening resilience and adaptive capacity to climate-related hazards (13.1) will directly reduce losses caused by disasters (11.5). Providing access to electricity reinforces water-pumping and irrigation systems. The SDG targets and goals provide numerous possibilities for synergies.</td>
</tr>
<tr>
<td>ENABLING</td>
<td>+1</td>
<td>The pursuit of one objective enables the achievement of another objective. For example, providing electricity access in rural homes facilitates the pursuit of education for all, as it allows the rural poor who have to work after school to do homework at night with the aid of electric lighting. Outdoor electric lighting also increases safety in the streets, enabling more women to attend evening courses or school at night.</td>
</tr>
<tr>
<td>CONSISTENT</td>
<td>0</td>
<td>A neutral relationship where one objective does not significantly interact with another or where interactions are deemed to be neither positive nor negative.</td>
</tr>
<tr>
<td>CONSTRAINING</td>
<td>-1</td>
<td>A mild form of negative interaction when the pursuit of one objective sets a condition or a constraint on the achievement of another. For example, efficiency objectives for agricultural water use set conditions for how access to irrigation can be provided. And the climate change mitigation objective limits the options as to how to pursue energy access objectives. In the 2030 Agenda, many targets impose constraints on others. These are important since they can help ensure that development strategies are sustainable over time, help achieve targets with minimum mitigation or rehabilitation costs for other objectives and help ensure that they respect boundaries of the natural resource base. Of course, ensuring that conditionalities are taken into account requires that these have been appropriately mapped.</td>
</tr>
<tr>
<td>COUNTERACTING</td>
<td>-2</td>
<td>The pursuit of one objective counteracts another objective. For example, pursuing policies to boost consumption in order to promote economic growth may counteract the objectives to reduce waste and greenhouse gas emissions. Increasing human habitation in flood-prone areas or agriculture into drought-prone areas may increase important social objectives.</td>
</tr>
<tr>
<td>CANCELLING</td>
<td>-3</td>
<td>The most negative interaction is where progress in one goal makes it impossible to reach another goal and possibly leads to a deteriorating state of the second. A choice has to be made between the two. For example, national security objectives make it impossible to have fully transparent and democratically accountable decision-making in government. Another example is the full protection of nature reserves versus public access for recreational purposes, or access by pastoralists who traditionally traverse the reserve during their seasonal migrations. Here, a balance needs to be struck based on both political judgement and scientific assessment.</td>
</tr>
</tbody>
</table>

**Figure 1: Goal interaction scoring on a seven-point scale**

3. IMPORTANT INTERACTIONS ACROSS THE SDG TARGETS

Goal 1. End poverty in all its forms everywhere

Goal 1 implies an understanding of poverty that goes far beyond income. In recent decades, the concept of poverty has evolved to become multi-causal and multidimensional, which is reflected in the targets under Goal 1, which refer to, for example, “all its dimensions” (target 1.2), social protection (target 1.3), rights and control over to resources and access to services (target 1.4) and resilience building (target 1.5).

It can thus be argued that poverty is in many ways indivisible from other goals. Such an argument is underpinned by the works of development economists and philosophers such as Sen (1993) and Dasgupta (2001) and was embodied in the Millennium Development Goals (MDGs). These theories of poverty and development typically elaborate a set of basic dimensions (freedoms, capabilities, entitlements), including basic access to health services, education, shelter, nutrition, water, energy and sanitation as well as to human rights and liberties, empowerment, social inclusion, human security, dignified livelihoods, and opportunities to participate in trade and production activities.

To take just one example, progress on public health is indivisible from poverty reduction insofar as at low levels of income, rising incomes inevitably lead to health gains, as basic needs (including nutrition, health care, shelter and others) are fulfilled. At higher levels of income, however, the interaction becomes more ambiguous in relation to, for example, nutrition and non-communicable disease (see Goal 3 on health).

Observing the principle of leaving no-one behind, it is important to keep in mind that interactions with poverty cannot be understood as simply interactions with the goal of aggregate economic well-being. The ultimate objective is instead the well-being, welfare and freedom of each individual (Gewirth 1978). This distinction is important, and may change the character of some of the interactions. For example, development strategies such as export-driven manufacturing, industrialization, value-adding activities in the food sector and natural resource extraction invariably reinforce aggregate economic well-being, but they only contribute to poverty alleviation when there are adequate institutional frameworks that enable the poor to take advantage of opportunities and benefits from development.

At the international level, protectionist policies in wealthier countries – coming in response to popular anxiety about the impacts of globalization on domestic jobs and industries – may limit opportunities for export-led poverty reduction in lower-income countries. How far international trade can help reduce poverty is also highly dependent on which sectors are being developed. Furthermore, trade agreements usually aim to facilitate trade in both directions, and recent decades have shown that many domestic infant businesses and industries in, for example, Africa have often been out-competed by more efficient large-scale suppliers from emerging economies (Zafar 2007).

Poverty alleviation is perhaps the strongest SDG in terms of institutionalization, being the key objective and raison d’être of most multilateral development organizations, bilateral development cooperation agencies and national development strategies in lower-income countries. Institutions to combat poverty at both national and international levels have been built up and become strong as part of the entire post-World War II international political order.

In these institutions, there is a strong discourse linking poverty reduction with international trade and access to global markets. At the same time, given current international political developments, poverty-oriented development efforts may need to give more attention to nurturing both domestic and intra-regional market institutions, in addition to engaging with export markets for
### Goal 1: End poverty in all its forms everywhere

**EXAMPLES OF POSITIVE INTERACTIONS**

<table>
<thead>
<tr>
<th>Interaction score</th>
<th>Interacting target(s)</th>
<th>Important interaction&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Key dependencies&lt;sup&gt;b&lt;/sup&gt;</th>
<th>State of knowledge / level of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Rights to resources and access to services (1.4)</td>
<td>&lt; Indivisible from developing infrastructure (9.1)</td>
<td>Infrastructures for basic access, but also for connectivity (United Nations 2016)</td>
<td>Strong agreement and knowledge base</td>
</tr>
<tr>
<td>+3</td>
<td>Building resilience of the poor (1.5)</td>
<td>&lt; Indivisible from sustainably managing marine and coastal ecosystems (14.3)</td>
<td>Generally applicable in coastal areas where communities depend on marine resources for livelihoods</td>
<td>Gaps in scientific knowledge about functioning of marine ecosystems</td>
</tr>
<tr>
<td>+2</td>
<td>Access to rights and economic resources (1.4)</td>
<td>&lt; Indivisible from ending discrimination against women (5.1)</td>
<td>Generally applicable</td>
<td>As targets are formulated, they are indivisible by definition</td>
</tr>
<tr>
<td>+2</td>
<td>Reduction of poverty (1.2) and building resilience of the poor (1.5)</td>
<td>&lt; Reinforced by agricultural productivity and small farm income (2.3)</td>
<td>Keeping rural livelihood opportunities rather than pursuing greater productivity by larger farm units or by reducing labour input</td>
<td>Increasing agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Reduction of poverty (1.2)</td>
<td>&lt; Reinforced by inclusive industrialization (9.2)</td>
<td>Focusing on sectors where poor communities can engage and get employment and training</td>
<td>Increasing agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Reduction of poverty (1.2) and building resilience of the poor (1.5)</td>
<td>&lt; Reinforced by access to modern energy services (7.1)</td>
<td>Generally applicable, but lack of access to energy is predominantly found in rural sub-Saharan Africa and South Asia</td>
<td>Strong agreement and robust knowledge base, but knowledge gaps remain regarding viable scaling models for energy</td>
</tr>
<tr>
<td>+2</td>
<td>Building resilience of the poor (1.5)</td>
<td>&lt; Reinforced by reducing deaths and illness from chemicals and pollution (3.9)</td>
<td>In polluted urban areas and regions where cooking is carried out with traditional cookstoves</td>
<td>Strong agreement and robust knowledge base</td>
</tr>
<tr>
<td>+1</td>
<td>Building resilience of the poor (1.5)</td>
<td>&lt; Enabled by strengthening adaptive capacity to climate-related hazards and natural disasters (13.1)</td>
<td>Generally applicable</td>
<td>Strong agreement</td>
</tr>
</tbody>
</table>

<sup>a</sup> Arrows indicate direction of influence

<sup>b</sup> Geographical, technological, governance and other factors that determine the interaction in a given context
higher value-added products and services. Examples of such efforts in recent years include the African Union’s action plan for boosting intra-African trade, where the economic transformation is driven from within the region itself. This involves creating a more cohesive institutional trade system among countries as well as improving infrastructures (Valensisi and Karingi 2016).

Another important institutional area for poverty reduction is national efforts such as conditional cash-transfer programmes (see Example 1), which offer opportunities to leverage the positive interactions with health care, education, and gender equality. Such institutional programmes oriented towards expanding entitlements and capabilities will go hand in hand with poverty reduction. Given the universal aspiration of eradicating poverty in all its forms, ensuring the rule of law and equal access to justice for all, promoting effective, accountable and transparent institutions, and ensuring inclusive, participatory and representative decision making at all levels will be important elements of the institutional setting.

### EXAMPLE 1: Multidimensional poverty eradication – conditional and connected cash transfers

Conditional cash transfers have received growing attention around the world, across many Latin American, sub-Saharan African and Southeast Asian countries, and in both lower- and middle-income contexts. Programmes like the Brazilian Bolsa Família (family allowance; http://www.gob.mx/prospera) have linked cash assistance to poor households to things like school attendance (Goal 4) or postnatal health care visits (Goal 3). Gender equality dimensions (Goal 5) can be strengthened by directing assistance to the female household head, such as in the Mexican PROSPERA (formerly Oportunidades) programme (see http://www.gob.mx/prospera). Programmes can also be linked to investments in public works and infrastructure (Goal 9). These programmes thus leverage directly on interactions among development goals at the household level. Evaluations of them have been mainly positive. (United Nations 2016, Annex 1)

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2 The reliance on markets for poverty reduction has been criticized also on political grounds as it tends to orient attention to solely the income dimension of poverty. In quantitative measurements of poverty, the income dimension is also strongly institutionalized.
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

The achievement of Goal 2 requires major increases in agricultural production and productivity. For example, the UN Food and Agriculture Organization (FAO) estimates that food production must increase by 70% by 2050 (FAO 2009). But improvements are also needed on the demand and distribution side. For example, food waste (which has its own target under Goal 12) is today estimated at between 30 and 50% of all food produced at different stages of the supply chain (Searchinger et al. 2014). This represents an immense economic, social and environmental opportunity, but also a major challenge due to the multiple actors involved in complex global food supply chains.

Productivity increases have so far been able to keep up with demand and have made food cheaper and more abundant than ever at a general level. This has generated, and has the potential to continue to generate, great benefits in terms of food security and providing adequate nutrition for all. However, the benefits have often been distributed unevenly. To exploit these productivity gains, the food sector has become increasingly reliant on global supply chains. In both developing and higher-income countries, domestic producers often struggle to compete with imports. Since many low-income countries depend on the agricultural sector and are dominated by smallholder farming with relatively low productivity, this is a particularly critical concern.

Agricultural production is also a major source of environmental impact, contributing substantially to greenhouse gas emissions, but also affecting terrestrial ecosystems and biodiversity, and causing coastal pollution and eutrophication (Foley et al. 2011). However, it also provides landscapes and cultural environments that are deeply valued. On the social side, Goal 2 embodies social, economic and environmental dimensions of sustainable development in a balanced way; ending hunger and improving nutrition (social dimension) are addressed through targets 2.1 and 2.2, productivity improvement and revenue increase (economic dimension) through target 2.3, and sustainability of agriculture (environment dimension) through targets 2.4 and 2.5 (Mollier et al. 2017).

Nutritious and healthy diets are embodied in target 2.1 and 2.2, and are intimately linked to health outcomes. Today, the number-one risk factor behind the global burden of disease is diet. This has several important ramifications at all levels of national income, and leads to economic losses. It has been estimated that undernutrition in Africa and Asia has an economic cost equal to 11% of GDP (see also Goal 3 below; GPAFS 2016).

At the national level, positive interactions can be leveraged by coordinating action on agriculture, health, gender, and water and sanitation. Utilization of food is enhanced by improvements in education and health policies, and measures to boost incomes among the poor. Investments in sanitation and clean water also improve nutritional outcomes, in strong interaction with health and gender goals.

Institutionally, integration between food and other SDGs is relatively well established at the international level; both the FAO and the Consortium of International Agricultural Research Centers (CGIAR) have mandates connected to many other development areas, and to poverty. Significant work is ongoing on closing the yield gap and enhancing productivity, and these will continue to be critical areas of action. In this regard, there is great potential to strengthen the positive interactions with Goal 2 by having policies geared to drive large-scale farming focusing on global crops complemented with support to smallholder farm applications and locally adapted crops.

Institutional programmes at the national level to integrate food security with gender and health priorities have shown great potential. Land titling for women in Vietnam reinforced efforts to increase crop yields. And a programme in India that linked 30 million smallholders to dairy infrastructure and markets reinforced improvements in poverty reduction and nutrition, in particular for children (Leach 2015).
**Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture**

**EXAMPLES OF POSITIVE INTERACTIONS**

<table>
<thead>
<tr>
<th>Interaction score</th>
<th>Interacting target(s)</th>
<th>Important interactiona</th>
<th>Key dependenciesb</th>
<th>State of knowledge / level of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Ensure sustainable food production (2.4)</td>
<td>&lt; Indivisible from reducing marine pollution, in particular nutrient pollution (14.1) and overfishing (14.4)</td>
<td>In coastal zones, and technology dependent, but see potential counteraction below</td>
<td>As targets are formulated, they are indivisible by definition</td>
</tr>
<tr>
<td>+3</td>
<td>End child malnutrition in children (2.2)</td>
<td>&gt; Indivisible from ending preventable child deaths (3.2)</td>
<td>Malnutrition leading to children dying is strongly associated with least-developed and fragile states, conflict zones, etc.</td>
<td>Strong agreement and knowledge base, including on how to manage it</td>
</tr>
<tr>
<td>+3</td>
<td>Access to food (2.1)</td>
<td>&gt; Ensuring nutritious diets is indivisible from reduction in burden of non-communicable disease (3.4)</td>
<td>Generally applicable but in very different ways: undernutrition in some countries, obesity in most countries, and unhealthy diets almost everywhere</td>
<td>Strong agreement and increasing knowledge base, but much research needed on mechanisms</td>
</tr>
<tr>
<td>+2</td>
<td>End malnutrition in children (2.2)</td>
<td>&lt; Reinforced by universal access to sanitation and hygiene (6.2), as diarrhoea kills nearly 1 million children under five each year</td>
<td>Burden of diarrhoea strongly linked to developing countries. Prevented by clean water, improved sanitation, and hand hygiene</td>
<td>Strong agreement and knowledge base</td>
</tr>
<tr>
<td>+2</td>
<td>Double agricultural productivity and small farm income (2.3)</td>
<td>&gt; Reinforces the reduction of poverty (1.2) and building resilience of the poor (1.5)</td>
<td>Keeping rural livelihood opportunities rather than pursuing greater productivity by larger farm units or by reducing labour input</td>
<td>Increasing agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Double agricultural productivity and small farm income (2.3)</td>
<td>&lt; Reinforced by access of small scale enterprises to financial services (9.2) and by infrastructure developments (9.1)</td>
<td>Credit and market access are critical barriers</td>
<td>Strong agreement and growing knowledge base</td>
</tr>
<tr>
<td>+1</td>
<td>End malnutrition in children (2.2)</td>
<td>&lt; Malnutrition is not only undernutrition. Mitigating obesity is promoted by quality and sustainable infrastructure (9.1) that enables healthier, more active lifestyles</td>
<td>Obesity is a highly complex development problem as countries move from low to middle and high income. But also in low-income countries, the issue is of growing concern</td>
<td>Neither drivers of child obesity and relationships with infrastructure nor ways to mitigate and prevent obesity are well researched or established</td>
</tr>
</tbody>
</table>
## EXAMPLES OF NEGATIVE INTERACTIONS

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Interaction Description</th>
<th>Knowledge Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double agricultural productivity and small farm income (2.3)</td>
<td>&gt; Constrains protection of terrestrial ecosystems (Goal 15)</td>
<td>Interaction significantly dependent on resource constraints and on what technologies are used, including agrochemicals. In some cases, productivity enhancements might counteract biodiversity if monoculture systems are prioritized.</td>
<td>A contradictory and complicated knowledge base, highly contextual. Whether organic and ecosystems-based approaches are more or less productive in the long term is not entirely clear.</td>
</tr>
<tr>
<td>Double agricultural productivity and small farm income (2.3)</td>
<td>&gt; May counteract ending epidemics and other communicable diseases (3.3)</td>
<td>Negative interaction depending on practices around use of antibiotics in animal husbandry.</td>
<td>Antibiotic-resistant bacteria affecting humans is a well-established problem area. Potential although unproven link to animal antibiotic use, (CDC 2013).</td>
</tr>
<tr>
<td>Double agricultural productivity and small farm income (2.3)</td>
<td>&gt; In some cases increases marine nutrient pollution due to greater application of fertilizer, resulting in leakage (14.1)</td>
<td>This interaction depends strongly on geography (coastal zones) and vulnerability of the ocean ecosystem, as well as technology (precision in applying agrochemicals).</td>
<td>Strong agreement but varying knowledge base depending on region.</td>
</tr>
<tr>
<td>Access to food (2.1)</td>
<td>&gt; May counteract climate change mitigation (13.2)</td>
<td>If dairy- and meat-based diets are pursued by an increasing global population, greenhouse gas emissions will rise significantly.</td>
<td>Strong agreement but controversial politically.</td>
</tr>
<tr>
<td>Access to food (2.1)</td>
<td>&gt; May counteract sustainable water withdrawal (6.4) and reduction of chemical release (12.4)</td>
<td>If global consumption of cereals and sugars is replaced with a more healthy vegetable-rich diet, the use of inputs including agrochemicals may rise, but strongly dependent on regional context, governance and technology.</td>
<td>Growing knowledge base.</td>
</tr>
</tbody>
</table>

* Arrows indicate direction of influence

* Geographical, technological, governance and other factors that determine the interaction in a given context
The quest to end hunger connects the mandates of food and agricultural institutions with those for science, technology and innovation (in Goal 9). Innovation systems in the agricultural sector have been mostly funded by the private sector and often geared towards higher yields, agrochemical tolerance, and the durability of produce in large-scale systems. The potential to develop crops and agro-processing that better meets consumer needs or environmental characteristics has been much less in focus. To maintain and improve crop yields, particularly in the face of climate change, innovation is needed to promote drought and heat resistance in crops, and to improve their water and nitrogen uptake efficiency, nutrient intensity and pest resistance. Several national and regional institutions across the developing world work increasingly on innovation in agriculture, orienting themselves to apply the latest biotechnology to traditional crops that are suitable for small-scale farmers and regional markets (Juma 2011; Virgin and Morris 2016).

Due to the burgeoning of global supply chains, food security is nowadays a multilevel institutional challenge. For commodity crops it requires internationally coordinated responses, as the collective impact of countries acting independently can be detrimental to achieving food security. When countries have responded to food price fluctuations with interventions such as trade restrictions, price controls and buffer-stock policies, this has been seen to amplify market fluctuations (Gouel 2014).

The split of responsibilities between agencies governing agriculture, health, education and social programmes can be overcome by pursuing multi-goal interventions. One route is to work for higher-quality diets through using public procurement for schools and hospitals. Such integrated approaches can leverage both education and health results from dietary improvements as well as shaping longer-term popular norms about diets and lifestyle, and incentivizing food businesses to innovate (GPAFS 2016).

### EXAMPLE 2: Interactions between agricultural productivity, land degradation, poverty reduction and climate change

China attempted to promote agricultural productivity through curbing soil erosion in the Loess Plateau project (1994–2005). This proved to stimulate a whole range of positive interactions between development priorities. Halting activities leading to degradation, and improving agricultural structures such as terraces, increased yields and helped lift more than 2.5 million people out of poverty. In the process, climate change was curbed through enhanced storing of soil carbon and reinforced growth of trees and grassland. Average grain yields increased by 60% over 10 years. Additional interactions included reduced silting in the Yellow River and a reduction in airborne dust carried to Beijing. This is an example of effective leveraging of interactions that transitions a society away from a “nexus syndrome” of degraded ecosystems, low prospects of employment and livelihoods, and vulnerability to climate change. (NCE 2014)
Goal 3. Ensure healthy lives and promote well-being for all at all ages

Goal 3 deals with another very multifaceted concept, health. In 1948, the World Health Organization (WHO) defined health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. Healthy lives depend critically on other SDG areas, including nutritious food, clean water and sanitation, and education. It is connected with economic sustainability and employment, as poor health directly impacts the economy – at both national and individual levels (with often disastrous consequences at household level among vulnerable groups; Jamison et al. 2013). There is relatively strong scientific agreement on the multiple interactions between health targets and other targets in the 2030 Agenda. However, national circumstances related for example to the degrees to which targets are being met are very different.

Within the social dimensions of development, health and education appear to be particularly strongly reinforcing. Education improves health and reduces fertility rates. And conversely, health and nutrition reinforce education (UNESCO 2016). The link between non-communicable disease and food is ever clearer, with problematic developments in low-quality diets in both higher- and lower-income countries. In many places obesity and diseases related to low-quality diets are growing exponentially (GPAFS 2016).

Interactions between environment and health are no less significant, with causality going in both directions, and often via intermediate factors. Temperature increases as a result of climate change results in accelerated spread of vector-borne diseases (such as malaria, schistosomiasis and dengue). Air pollution from transport and from burning of fuels for energy services cause an estimated 7 million premature deaths per year (WHO 2016). Natural disasters that occur as a result of climate change and deforestation lead to ill health and deaths, for example through contamination of water (WHO and WMO 2012).

There are few examples of trade-offs between health targets and other SDGs. In some contexts, economic growth can interact adversely with health. Inequities in the distribution of wealth can exclude groups from health services but also in themselves be a cause of mental health problems. At low levels of income, there is a clear reinforcement between health and economic growth. At higher levels, new health issues emerge. Affluent Western lifestyles (as could be implied in Goal 8) can counteract the reduction of a range of non-communicable diseases (including some forms of allergies, cancer, cardiovascular disease, obesity, and psychiatric conditions such as depression and dementia). As more and more countries, and groups within countries, reach higher levels of income, it is important to mitigate this welfare effect where trends are highly worrying (NCD-RisC 2016). Efforts to promote and implement more healthy versions of affluent lifestyles, for both prevention and treatment, are crucial at both national and international levels.

A relatively recent literature connects health with cities and infrastructure. This is not only a question of pollution (see Example 3, below); urban development and urban form are determinants of the health and well-being of residents, including through their impacts on stress and anxiety. New research shows that better design of cities and neighborhoods significantly reinforces people’s health and well-being. As the city-related targets are formulated in Goal 11, they will not pose a constraint in this respect. However, urban development, as it is often practised today, carries with it potential negative interactions with health and well-being.

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3 In Nigeria, for example, it was shown that doing four more years of school reduced fertility rates by one birth per young girl. In India, female literacy rates were 5% higher for those with better access to water. And in Kenya, girls who received deworming treatment were 25% more likely to pass the primary school exam.
**Goal 3: Ensure healthy lives and promote well-being for all at all ages**

### EXAMPLES OF POSITIVE INTERACTIONS

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<tbody>
<tr>
<td>+3</td>
<td>Reduce maternal mortality (3.1) and access to sexual and reproductive health care services (3.7)</td>
<td>&lt;&gt; Indivisible from sexual and reproductive health rights (5.6)</td>
<td>Generally applicable, but implementation strategies must take into account cultural and political context</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+3</td>
<td>End epidemics (3.3) and preventable child deaths (3.2)</td>
<td>&lt;&gt; Indivisible from access to safe water (6.1) and sanitation and hygiene (6.2)</td>
<td>Generally applicable</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+3</td>
<td>Reduce mortality from non-communicable disease, promote mental health (3.4)</td>
<td>&lt;&gt; Indivisible from eating more nutritious foods (2.1; 2.2) with malnutrition the number one risk driving global burden of disease</td>
<td>Generally applicable, including issues of obesity and low-quality diets</td>
<td>Strong agreement and increasing political interest</td>
</tr>
<tr>
<td>+3</td>
<td>Reduce deaths and injuries from road traffic accidents (3.6)</td>
<td>&lt;&gt; Indivisible from safe, affordable, accessible transport systems (11.2)</td>
<td>A global issue, but accident numbers (per 100,000) worst in Asian and African cities</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Reduce death and illness from chemicals and pollution (3.4)</td>
<td>&lt;&gt; Reinforced by modern energy access (7.1) and to renewable sources of energy (7.2) via reduction in indoor and outdoor air pollution (WHO 2016)</td>
<td>Interaction strongest outdoors in urban areas of rapidly growing economies, and indoor in rural sub-Saharan Africa and South Asia</td>
<td>Strong agreement and strong knowledge base, with air pollution monitoring in real time</td>
</tr>
<tr>
<td>+2</td>
<td>Prevent deaths of newborns and children under five (3.2)</td>
<td>&lt;&gt; Reinforced by dealing with malnutrition (2.3)</td>
<td>Generally applicable</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>End the epidemics of HIV/AIDS, tuberculosis, etc. (3.3)</td>
<td>&gt; Reinforcing the reduction of poverty (1.2) and building resilience of the poor (1.5)</td>
<td>Generally applicable</td>
<td>Strong agreement</td>
</tr>
<tr>
<td><strong>Prevent substance abuse, drugs, alcohol (3.5)</strong></td>
<td><strong>Reinforces building resilience of the poor and vulnerable to shocks (1.5)</strong></td>
<td><strong>Relevant in all contexts</strong></td>
<td><strong>Strong agreement</strong></td>
<td></td>
</tr>
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</table>

Access to maternal health (3.1) and sexual and reproductive health care services (3.7)  
< > Enables and enabled by women’s full participation in economic and political life (5.5) and ending discrimination against women (5.1)  
**Generally applicable**  
**Strong agreement**

Reduce deaths and injuries from road traffic accidents (3.6)  
< Enabled by better infrastructure for transport (9.1)  
**Generally applicable**  
**Strong agreement**

### EXAMPLES OF NEGATIVE INTERACTIONS

- **End epidemics (3.3)**  
  < Constrained by aspiration to lifestyles in harmony with nature (12.8)  
  Potential constraint in certain Western communities that turn away from modernity, including modern vaccines  
  Unclear knowledge base but probably a relatively weak interaction

- **End epidemics (3.3)**  
  > May counteract protection of water-related ecosystems (6.6)  
  Potential counteraction due to unmetabolized pharmaceuticals released into wastewater streams  
  Unclear and complex relationships in an emerging research area (Kümmerer 2009)

- **Reduce mortality from non-communicable disease, promote mental health (3.4)**  
  < Counteracted in many dimensions by increasing levels of welfare and economic growth (8.1) not least via food consumption (2.1)  
  A phenomenon that most rich countries are struggling with, but not necessarily inevitable. The relationship between food consumption and health is highly context-dependent and governance-dependent  
  Unclear and complex relationships in an emerging research area

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*Arrows indicate direction of influence*

*Geographical, technological, governance and other factors that determine the interaction in a given context*
The institutional framework for health governance has been relatively strong for decades, with notable achievements by, for example, the WHO in mitigating and sometimes eradicating infectious diseases. While global health governance has focused strongly on infectious diseases, WHO has also increasingly engaged with other sectors, for example through the World Meteorological Organization and the United Nations Environment Programme (UNEP), on issues in the nexus between health, climate change and air pollution.

At national levels, however, environmental and health issues almost invariably fall under different ministries and agencies. In addition, very few civil society organizations or academic institutions span both. Ministries of health are central players in governing these interactions at national levels. Technical core capacities can be strengthened across countries through international efforts, a long-term but important investment. Institutional capacities should also be developed with respect to national health research systems, to coordinate health research processes, findings and structures, with the overarching goal of enhancing the health system’s ability to perform its functions.

Achieving Goal 3 will require building up much stronger linkages between these communities and agencies to enable a more holistic approach to health governance. The worldwide One Health initiative (www.onehealthinitiative.com) is interesting in this regard, seeking to expand interdisciplinary collaboration and communication and taking an integrated perspective on the linkages between human, animal and ecosystem health. Initiatives at subnational levels are needed, in particular to raise awareness and to strengthen institutional capacity – at district level – to enable the design and implementation of integrated health programmes (covering, e.g., education, nutrition, local environmental management and health) that have the support of communities and local organizations.

**EXAMPLE 3: Interactions between health, economy, urban transport and energy in India**

In November 2016, the Indian government declared an “emergency situation” for New Delhi due to air pollution, leading to shutdowns of schools, construction sites and power stations (Safi 2016). Transport, burning of solid fuels and waste, and ambient dust contribute the most. This pollution leads to severely elevated health risks from respiratory and cardiovascular illness (WHO 2016). Globally, outdoor air pollution accounts for 3 million deaths per year. There is also an established causal link to prenatal mortality (Malley et al. 2017). Costs to society include direct productivity losses from, for example, sick leave and medical costs that have been estimated to 1% of total GDP globally. Taking into account statistical values of lives lost often moves the welfare cost to up towards 5–10% of GDP in particularly polluted places. (OECD 2016b)

**EXAMPLE 4: Interactions between health and climate change impacts in cities**

Heat stress from rising temperatures is a growing phenomenon, particularly in cities, where the urban “heat island” effect aggravates the problem. Lack of vegetation, dense infrastructure, concrete that absorbs heat and buildings blocking wind mean that city temperatures are up to 3°C warmer in the day and up to 12°C in the night than surrounding countryside. (UNU-IIGH, 2016) Heat stress leads to rises in mortality and respiratory disease. The problem has led to significant numbers of deaths in both Europe and India. Beyond the direct consequences of temperature rise, the health impacts are also linked to the environment. For example, heat speeds up chemical reactions for the formation of ground-level ozone, which inflames and damages airways and aggravates lung diseases such as asthma, emphysema and chronic bronchitis. It also increases populations of disease vectors such as mosquitoes. (Tan and Siri 2016)
Goal 5. Achieve gender equality and empower all women and girls

Gender inequalities are already human rights and social problems, but they also represent barriers to development as well as causing inefficiency in the economy. For example, one major positive interaction is the expanded labour supply that results from women entering the workforce – a key source of productivity growth and by extension economic growth. Discrimination against women in the economy constrains economic activity and decent work (Goal 8).

Gender equality naturally cuts across all other SDGs, and can contribute significantly to many of them (Leach 2015). The World Economic Forum (2015) examines correlations across many dimensions of growth and demonstrates strong interactions with gender equality. Broadly speaking, closing gender inequalities in many areas (earnings, health, control of income, bargaining power, access to land etc.) is instrumental to achieving food security (ADB 2013). Evidence suggests that more equal participation of women will unleash improved productivity in agriculture (Ward et al. 2010).

The relationship between gender equality and the environment encompasses many dimensions. Taking a global resource perspective, it is noteworthy how access to sexual and reproductive health leads to lower fertility rates, smaller families and, in the aggregate, lower population growth and pressure on resources and the environment (in the simple IPAT identity: environmental impact = population x affluence x technology; Hartmann et al. 2015).4

Overall the literature does not seem to point to any significant negative interactions between the gender equality targets and other SDGs. The overwhelmingly positive interactions with other goals suggests that actions to improve gender equality can be important levers for the 2030 Agenda overall. Getting to serious grips with gender matters in development interventions will enhance development outcomes across the economy and the sectors of health, education, food, sanitation, and even possibly environmental protection.

Strengthening interactions with gender equality can be pursued through several different types of institutional arrangements. There are many examples of programmes and policies at national levels that have been used to improve gender equality and have reinforced positive change in other goals at the same time. In Brazil, for example, the Bolsa Família programme tied state financial aid to women in poor households conditioned on school attendance and vaccinations. Such integrated programmes empower women as decision-makers in families while at the same time reinforcing educational and health goals (de Brauw et al. 2014).

Gender norms and regulations can be enacted at different levels of government; for example, laws on gender equality or national strategies for advancement of women (Menon et al. 2016). National parliaments have a particularly important role in relation to gender equality. They can enact binding legislation against discrimination and they can, along with government and with political parties, set an example by promoting female politicians to achieve equal political representation. To this effect, gender quotas can be enacted at different levels of government and public affairs.5

Gender mainstreaming (applying a gender lens across policy domains) can be institutionalized in policy and planning procedures such as national development plans and strategies and through gender-responsive budgeting. Sex-disaggregated national statistics to measure development outcomes in, for example health, nutrition, education, crime and income, are an important component of the institutional framework of mainstreaming (UNDP 2014).

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4 This stance, while factually clear and simple, is politically complicated as it puts the spotlight on poor countries, which typically have lower per capita and overall environmental impact than rich ones.

**Goal 5: Achieve gender equality and empower all women and girls**

**EXAMPLES OF POSITIVE INTERACTIONS**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Ending discrimination against women (5.1)</td>
<td>&lt;&gt; Indivisible from ensuring empowerment and political inclusion (10.1) and equal opportunities (10.3)</td>
<td>Generically applicable but discrimination takes very different forms in different contexts. In some societies, it is in the law and in formal institutions, in others it has more informal expressions that can be difficult to detect</td>
<td>Strong agreement but unclear knowledge base</td>
</tr>
<tr>
<td>+3</td>
<td>Access to sexual and reproductive health and rights (5.6)</td>
<td>&gt; Indivisible from reducing maternal mortality (3.3)</td>
<td>Generally applicable and strongest reinforcement where current access is lowest</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Access to sexual and reproductive health and rights (5.6)</td>
<td>&gt; Reinforces ending communicable diseases such as HIV / AIDS (3.3)</td>
<td>Generally applicable and strongest reinforcement where current access is lowest</td>
<td>Strong agreement, e.g. <a href="http://www.who.int/reproductivehealth/topics/linkages/en/">http://www.who.int/reproductivehealth/topics/linkages/en/</a></td>
</tr>
<tr>
<td>+2</td>
<td>Women’s full participation in economic and political life (5.5)</td>
<td>&gt; Reinforces productivity increases in the economy (8.2) and decent job creation (8.3) (Ramos 2014)(Ramos 2014)</td>
<td>Generally applicable and strong effect across all types of economies</td>
<td>Strong agreement; inefficiency of not having women participating is clearly in line with mainstream economic thinking</td>
</tr>
<tr>
<td>+2</td>
<td>Ending discrimination against women (5.1)</td>
<td>&gt; Discrimination prevents women from engaging in trade and from forming small enterprises and providing decent work (8.3 and 8.5)</td>
<td>Generally applicable and strongest where discrimination is highest</td>
<td>Agreement but variable knowledge base and likely difficult to find causality</td>
</tr>
<tr>
<td>+2</td>
<td>Ending discrimination against women (5.1)</td>
<td>&gt; Discrimination blocks access to education at all levels (4.1; 4.2; 4.3; 4.4)</td>
<td>Actions work best when gender equality of educational opportunities are extended to secondary and tertiary education; and where the quality of education received by girls is sufficiently high (Ward et al. 2010)</td>
<td>Strong agreement, but discrimination is a multifaceted problem where research knowledge only now emerging</td>
</tr>
<tr>
<td>+2</td>
<td>Women’s full participation in economic and political life (5.5)</td>
<td>&gt; Reinforces agricultural productivity in smallholder farms (2.3)</td>
<td>That achieving gender equality could increase agricultural profits and yields is generally true but connection is strongest in economies dominated by agriculture</td>
<td>Strong knowledge base</td>
</tr>
<tr>
<td>Indicator</td>
<td>Inequality</td>
<td>Interaction</td>
<td>Context</td>
<td>Agreement</td>
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</tr>
<tr>
<td>Ending discrimination against women (5.1)</td>
<td>&gt; Women's empowerment and control reinforces the nutritional health of their children (2.1)</td>
<td>Applicable in food-insecure communities and countries</td>
<td>Strong agreement</td>
<td></td>
</tr>
<tr>
<td>Women's full participation in economic and political life (5.5)</td>
<td>&lt; Employment of women reinforced by industrialization (9.1) and trade liberalization (17.11; 17.12) as many industries hire women, who are perceived to be more productive than men.</td>
<td>This positive association is strongest in labour-abundant economies in transition, but there is a risk of reversal when industries upgrade (Braunstein and Houston 2015)</td>
<td>Limited knowledge base and probably difficult to find causality</td>
<td></td>
</tr>
<tr>
<td>Women's full participation in economic and political life (5.5)</td>
<td>&lt; &gt; Small but significant relationship between rising female political and workforce participation and lower levels of corruption (16.5; 16.6)</td>
<td>Generally applicable</td>
<td>Emerging and not yet robust knowledge base</td>
<td></td>
</tr>
<tr>
<td>Women's full participation in economic and political life (5.5)</td>
<td>&lt; Enabled by access of small-scale enterprise to financial services (9.3)</td>
<td>Generally applicable</td>
<td>General agreement, but limited knowledge base</td>
<td></td>
</tr>
<tr>
<td>Women's full participation in economic and political life (5.5)</td>
<td>&gt; Greater political representation of women is associated with provision of a different mix of infrastructure (9.1 and 9.4)</td>
<td>Depends significantly on geographical and cultural context</td>
<td>Unclear knowledge base</td>
<td></td>
</tr>
<tr>
<td>Women's full participation in economic and political life (5.5)</td>
<td>&lt; Better maternal health (3.1) enables women to participate in the labour force</td>
<td>Mostly a factor in low-income countries, but generally applicable</td>
<td>Strong agreement</td>
<td></td>
</tr>
<tr>
<td>Ending discrimination against women (5.1)</td>
<td>&lt; &gt; Enables better health for women through reduced exposure to indoor air pollution due to traditional cookstoves (3.9; Casillas and Kammen 2010)</td>
<td>Women disproportionally impacted by this air pollution from cooking in particular in South Asia and sub-Saharan Africa</td>
<td>Strong agreement</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Arrows indicate direction of influence

\(^b\) Geographical, technological, governance and other factors that determine the interaction in a given context
EXAMPLE 5: Interactions between women participating in political life and infrastructure investment

Women’s empowerment and inclusion in economic and political decision-making can influence public choices related to infrastructure investment. For example, in cases where a woman is head of a village council, the type of public goods that are provided is distinctly different from cases where a man is head. However, choices and preferences are locally determined. Studies have shown that in West Bengal women are more concerned about, and spend more money on, drinking water and roads than on other public goods while in Rajasthan women are more concerned than men about drinking water but less about roads. (Ward et al. 2010)

EXAMPLE 6: Public procurement to support women and food security

India’s Targeted Public Distribution System and Brazil’s Fome Zero (Zero hunger) programme used a policy approach where public procurement specifically targeted small-scale farmers (often women) who face barriers to accessing markets. This means better quality food for schools and hospitals, and helps to diversity diets with fresh produce, and also leads to producers obtaining fair prices. In Brazil, sustained declines in hunger, especially in female-headed households, have been observed. This approach is now being replicated in several countries in sub-Saharan Africa (Fukuda-Parr 2015).
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Many of the interactions with SDG 9 on the economic and social side are subjects of very substantial bodies of research literature, including from decades of economic studies and experiences in both national and multilateral institutions such as development banks. There is broad agreement that industrialization, innovation and infrastructure investment are all important enablers of economic growth. Industrialization is critical to improving productivity in the economy, and productivity improvement is the key long-term source of growth (Atkinson 2013). However, when it comes to poverty reduction, Aggarwal and Kumar (2015) show in their study of India that this relationship depends on the poor having opportunities to participate in and benefit from economic activity. As a result, past decades of growth, while lifting many out of poverty, have still left significant populations behind, stuck in deep poverty. Studies suggest that manufacturing industry and value-added activities that generate employment for the poor are effective at reducing poverty (Hull 2009). In the agricultural sector, productivity increases driven by research and innovation are understood to have strong poverty-reduction effects (Thirtle et al. 2003). However, high-tech industrialization strategies may not be ideal for low-income countries – which may find it difficult to compete with more industrialized economies – and may not be inclusive of large groups in society.

Resilient infrastructure encompasses a diverse set of assets. The Global Sustainable Development Report 2016 (United Nations 2016, chap. 2) usefully identifies three ways in which infrastructure supports development (and poverty alleviation in particular): providing basic access (electricity, water, sanitation, communications); enabling structural change (new types of job and industries); and providing connectivity between people and markets (transport infrastructure, and information and communications technology). Currently, bottlenecks in all these are stifling economic activity and poverty alleviation in lower-income economies. It has been suggested that infrastructure deficits reduce economic growth by 2 percentage points per year and reducing firm productivity by as much as 40% in Africa (Ramachandran et al. 2009). Developing regional transport systems in developing regions, in particular, will reinforce intra-regional trade and regional integration and cooperation. Furthermore, increased access to infrastructure services generally improves the possibilities for the poor to be involved in economic activity.

Evaluations have shown that transport and ICT infrastructure does reduce poverty in some areas, through enabling labour mobility, information flows, and non-farm economic activity in rural areas (Calderon and Servén 2014). Furthermore, on the social side, infrastructure reinforces social dimensions of development, including having strong positive impacts on education and health. For example, transport infrastructure enables the establishment of schools and hospitals and reduces travel times to them (Brenneman and Kerf 2002). Energy infrastructure makes it easier for children and adults to study at night, allows schools to use better equipment, and reduces the need to expend labour on collecting traditional fuels.

Industrialization and infrastructure are associated with well-known trade-offs with a range of environmental objectives, as has been articulated in decades of national and international environmental legislation and regulations. Conversely, environmental objectives have traditionally been seen as constraints on industrialization. Science, technology and innovation are both a source of environmental pressures and in large part the solution to them (Giovannini et al. 2015). Deployment of improved technologies and innovation can help support a shift away from a negative to a positive interaction (NCE 2014).

Regarding institutional responses, the environmental governance of industrial activity and infrastructure investment has been a strongly institutionalized policy domain since the 1960s and 1970s, and both regulation and institutions are well developed. Environmental protection agen-
### Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

#### Examples of Positive Interactions

<table>
<thead>
<tr>
<th>Interaction Score</th>
<th>Interacting Target(s)</th>
<th>Important Interaction</th>
<th>Key Dependencies</th>
<th>State of Knowledge / Level of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Enhance science, technology, innovation (9.5)</td>
<td>&gt; Indivisible from productivity increases (8.2) – as in the long term innovation is a key source of productivity growth</td>
<td>Many dependencies related to technology and governance, in particular scaling capacities</td>
<td>Strong agreement at a generic level but a very complex area of research</td>
</tr>
<tr>
<td>+3</td>
<td>Develop infrastructure (9.1)</td>
<td>&lt;-&gt; Indivisible from ensuring rights to economic resources, access to services etc (1.4)</td>
<td>Stronger relationship in areas where the most basic infrastructure is entirely lacking, as opposed to areas where access is the issue</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+3</td>
<td>Promote inclusive industrialization (9.2)</td>
<td>&gt; Reinforces economic growth (8.1) through improving productivity in the economy</td>
<td>Generally applicable</td>
<td>Strong agreement that productivity growth is the key source of income growth in the long term</td>
</tr>
<tr>
<td>+2</td>
<td>Develop infrastructure (9.1)</td>
<td>&gt; Better transport infrastructure reinforces access to food (2.1) and farmers’ access to markets (2.3)</td>
<td>Mostly a concern in countries with infrastructure deficit</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Promote inclusive industrialization (9.2)</td>
<td>&gt; Reinforces reduction of poverty (1.2)</td>
<td>Industrialization needs to occur in sectors where poor communities can contribute and get employment</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Develop infrastructure (9.1)</td>
<td>&gt; Reinforces education (4.1) through reducing travel time to schools, establishment of schools, possibility to study at night etc.</td>
<td>Particularly robust interaction for transport, electricity, telecommunications infrastructure</td>
<td>Strong agreement</td>
</tr>
<tr>
<td>+2</td>
<td>Develop infrastructure (9.1)</td>
<td>&gt; Reinforces access to health care services by reducing cost and time of travel (Brenneman and Kerf 2002)</td>
<td>In particular transport and telecommunications infrastructure</td>
<td>Strong and robust relationship</td>
</tr>
<tr>
<td>+1</td>
<td>Enhance science, technology, innovation (9.5)</td>
<td>&lt; Enabled by quality technical, vocational and tertiary education (4.3)</td>
<td>The interaction is dependent on technology and innovation-oriented educational strategies</td>
<td>Weak agreement on relationship between university capacity and innovation capacity</td>
</tr>
<tr>
<td>+1</td>
<td>Boost industrialization and industry’s share of GDP (9.2)</td>
<td>&gt; Enables ocean and fisheries management (14.4 and 14.6) by reducing emphasis on primary resource extraction in the economy</td>
<td>Dependent on value-adding activities as part of industrialization strategy. However, see also potential counteraction below</td>
<td>Unclear knowledge base</td>
</tr>
</tbody>
</table>
Enhance science, technology and innovation (9.5)  
> Enables agricultural productivity and incomes of small-scale food producers (2.3)  
Bioscience innovation policy and technology support should be oriented towards small holder crops and agroprocessing (Virgin and Morris 2016)  
Increasing agreement based on growing knowledge base

Enhance science, technology and innovation (9.5)  
> Enables the development of scientific management plans for oceans and marine resources (14.4)  
Generally applicable interaction which depends on stronger science-based institutions in the governance system  
Scientific agreement, but political interest in maintaining fisheries / fleets often overrides science in decision-making

Develop infrastructure for transport (9.1)  
> Public infrastructure enables participation of women in the workforce and in political life (5.5) (United Nations 2016)  
Generally applicable  
Unclear knowledge base

**EXAMPLES OF NEGATIVE INTERACTIONS**

Boost industrialization and industry’s share of GDP (9.2)  
< Industrial activities may be constrained by the prevention of marine pollution from land-based activities (14.1) and conservation of coastal areas (14.5)  
A concern universally where there are coastal areas in need of conservation. Zoning of industrial permits and implementing regulation of pollution  
Unclear knowledge base, as systems and drivers within them very complex

Enhance science, technology and innovation (9.5)  
> Technological progress may benefit mostly skilled workers and constrain inclusion of new groups into the formal economy, such as women (5.5) (Andrews et al. 2016) (Andrews et al. 2016)  
Programmes for training and education of women to enable their entry into the skilled workforce  
Unclear knowledge base

Boost industrialization and industry’s share of GDP (9.2)  
> Can counteract climate action measures (13.2) and sustainability of terrestrial ecosystems (15.1)  
Industrial impacts on the environment are by definition very strongly dependent on which technologies are used, and whether proper environmental incentives and regulations are deployed  
Strong agreement and knowledge base, also about cost-effective mitigation actions

Boost industrialization and industry’s share of GDP (9.2)  
> Can counteract ocean and fisheries management (14.4 and 14.6) by “technologization” of fisheries, which has historically led to overfishing  
Counteraction occurs where strong institutions for managing stocks are missing, such as in international waters  
Strong agreement and knowledge base

* Arrows indicate direction of influence

* Geographical, technological, governance and other factors that determine the interaction in a given context
cies and environmental policy instruments, including taxes and regulations, are widespread and mainstream in most countries.

In the next stage of development towards the 2030 goals, structural change in infrastructure and industrial production systems will require significant investment from both private and public sectors. For example, mitigation of climate change and air pollution is widely agreed to depend on a transition away from fossil fuel infrastructure, which will require massive investment in and rebuilding of transport, electricity and urban systems. For this, an entire ecosystem of institutions for sustainable financing is now being built up or adapted at national and international scales – including green state investment banks (Global Commission on the Economy and Climate 2016).

Far less has been done from the public side to orient innovation towards environmentally sustainable products, processes and services. In recent years, science, technology and innovation (STI) agencies have been established in many countries. Complementing this, institutions for public investment are needed, beyond research, development and demonstration (RD&D). In addition to establishing institutions for risk assessment (such as for biotechnology) and creating an enabling environment for innovation, it has been suggested that “mission-oriented innovation” approaches can help direct innovation systems towards specific societal challenges and incentivize actors in different sectors to coordinate efforts to solve them – much like the SDGs. Such frameworks require the state to play an active role, not only to fix market and system failures, but also for being forward-looking and creating and shaping new markets (Mazzucato 2014).

EXAMPLE 7: Interactions between infrastructure development, urban life, climate change and social inclusion

The world is expected to invest around US$90 trillion in infrastructure over the next 15 years, more than is in place in our entire current stock today. Urban infrastructure represents the lion’s share of this massive undertaking, and new investments may substantially “lock in” future CO₂ emissions, as roughly 30% of future CO₂ emissions “committed” annually occur due to new urban buildings and transport systems (Erickson and Tempest 2015). Furthermore, getting these investments right will shape how resilient or vulnerable cities are to climate change. At the same time, making cities more compact connected and low-carbon – for example through providing affordable public transport, and investments to facilitate cycling and walking – have been shown to promote social inclusion, enable more equal access to different parts of the city, and increase employment opportunities for marginalized groups. (Global Commission on the Economy and Climate 2016).
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

More than any of the other goals in focus in this paper, Goal 14 deals with what is predominantly a truly international public good. The foods, services and other benefits we derive from the seas and oceans are under serious stress due, for example, to over-exploitation of fisheries, marine pollution, and climate change. This immediately threatens decent employment, poverty alleviation and livelihoods in coastal areas around the world (but also negatively impacts lives far beyond coastal communities). Goal 14 thus relate to virtually all other goals. Ocean-based economic activities are estimated to generate global income of around US$3–5 trillion per annum (FAO 2014). While designating parts of marine and coastal areas for protection might constrain options for growth and employment policies in some cases, it will help to generate jobs and growth opportunities in others. Sustainable economic development of marine-based activities such as fishing, aquaculture and tourism can contribute to poverty alleviation especially in island states and coastal regions of less developed and developing countries. For example, capture fisheries often play a major role in the national economies of small island developing states (SIDS; Schmidt et al. 2017).

Since oceans are a public good, when examining interactions between Goal 14 and other goals, and how to cope with them, it is crucial to keep in mind both timescales and the variety of human enterprise and activity that affects them. The depletion of ocean resources has many diverse causes at different scales, from local up to global, and differentiated effects, often impacting poor and vulnerable groups the most.

Oceans being to a large extent outside the jurisdiction of national governments, there is an institutional gap in how we address, value and maintain the services and functions that we derive from them. The governance of the oceans has not been high on political agendas at either national or international levels (Noone et al. 2013), and it is difficult to discern whether and how it engages with institutions that cover other areas of the SDGs, although interactions are substantial with, for example, the climate change convention and the World Trade Organization (Oberthür and Stokke 2011). To enable and ensure productive and sustainable economic use of oceans, institutions need to be strengthened at different levels.

As oceans are an international public good, joint international action could have very strong benefits. For example, multilateral institutions to support coordination and data sharing regarding ocean and marine resources, including fish stocks, could be pursued. The UN Technology Facilitation Mechanism launched last year could promote and disseminate innovations for resource-efficient and sustainable marine practices, including fishing and aquaculture.

At the national and regional levels, it could be effective to set up institutions and processes for implementing ecosystem approaches, for example marine spatial planning to establish zoning for development and for conservation. At the same time, local institutions need to be leveraged and strengthened for monitoring and implementation, taking into account local practices and traditions. With effective and inclusive institutions, oceans can yield increasing economic benefits, not least for SIDS, through sustainable use of marine resources to reinforce economic growth, trade and employment.
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

**EXAMPLES OF POSITIVE INTERACTIONS**

<table>
<thead>
<tr>
<th>Interaction score</th>
<th>Interacting target(s)</th>
<th>Important interaction&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Key dependencies&lt;sup&gt;b&lt;/sup&gt;</th>
<th>State of knowledge base / level of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Regulate harvesting, end overfishing etc. (14.4)</td>
<td>&lt;:&gt; Indivisible from sustainable and resilient food production (2.4)</td>
<td>Traditional and local institutions for harvest regulation play an important role</td>
<td>Increasing agreement, and growing knowledge base on both fish stocks and systems for managing local resources</td>
</tr>
<tr>
<td>+3</td>
<td>Sustainably manage marine and coastal ecosystems (14.2)</td>
<td>&gt; Indivisible from building resilience of poor and vulnerable (1.5)</td>
<td>Generally applicable</td>
<td>Agreement, although uncertainty in knowledge about functioning of marine systems, including seabeds.</td>
</tr>
<tr>
<td>+3</td>
<td>Address ocean acidification (14.3)</td>
<td>&lt;: Indivisible from climate mitigation (13.2) as ocean acidification, a major threat, is a direct consequence of greenhouse gas concentrations in the atmosphere</td>
<td>Generally applicable</td>
<td>Strong agreement in principle, although uncertainty in knowledge about ocean-atmosphere interactions</td>
</tr>
<tr>
<td>+2</td>
<td>Regulate harvesting, end overfishing etc. (14.4)</td>
<td>&gt; Reinforces food security and access to food for vulnerable groups (2.1). Food security depends on status of stocks</td>
<td>Short-term trade-offs might occur in terms of local livelihoods, but absolutely critical positive interaction in the long term Depends on differentiated policies and in particular regulation of industrial scale fishing fleets on international waters</td>
<td>Agreement and scientific gaps on carrying capacities of different fish stocks</td>
</tr>
<tr>
<td>+2</td>
<td>Economic benefits from the sustainable use of marine resources (14.7)</td>
<td>&gt; Reinforces the creation of decent jobs and small enterprises in e.g. tourism industry (8.5 and 8.9)</td>
<td>Generally applicable in coastal areas</td>
<td>Agreement but gaps in knowledge base regarding marine ecosystems services and economic development. Lack of assessment of the economic potential of sustainable marine-related growth strategies in most countries</td>
</tr>
</tbody>
</table>
**EXAMPLES OF NEGATIVE INTERACTIONS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Consequences</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>Prevention of marine pollution (14.1), protection of coastal ecosystems (14.2) and conservation (14.5)</td>
<td>Constrain the development and promotion of industrial activity, in particular in coastal areas (9.2)</td>
<td>Affects mostly coastal areas, although upstream catchment areas must be considered. Zoning in permitting and planning that gives industry clear guidelines can minimize this constraint. Agreement but gaps in knowledge on sources of marine pollution, including litter.</td>
</tr>
<tr>
<td>-1</td>
<td>Prevention of marine pollution (14.1), protection of coastal ecosystems (14.2) and conservation (14.5)</td>
<td>Constrain increasing agricultural productivity (2.3) through enhanced fertilizer use</td>
<td>Depends on natural conditions, run-off, etc. (regional context), but mitigation opportunities also in application of fertilizer according to modern precision standards. Agreement but weak knowledge base in many geographical areas.</td>
</tr>
<tr>
<td>-1</td>
<td>Regulate harvesting and end overfishing (14.4)</td>
<td>Constrains the achievement of full and productive employment for all (8.5) in the short term (but enabling it in the long term)!</td>
<td>The significance of this constraint depends on the productive capacity of the ocean, which in turn depends on ecosystem health and effective governance structures. Agreement but scientific gaps in carrying capacities of different fish stocks. Even when science is relatively clear, it is not used in determining sustainable catch.</td>
</tr>
<tr>
<td>-2</td>
<td>Protection of coastal ecosystems (14.2) and conservation (14.5)</td>
<td>Can be counteracted or constrained by urbanization (Goal 11)</td>
<td>Coastal and waterfront housing are observed in many countries, leading to coastal sprawl and placing pressures on coastal ecosystems (e.g. habitat degradation and destruction, pollution), but interaction depends very strongly on geographical context. Strong agreement.</td>
</tr>
</tbody>
</table>

* Arrows indicate direction of influence

b Geographical, technological, governance and other factors that determine the interaction in a given context
EXAMPLE 8: Interactions between marine pollution, fisheries, food and employment in the Baltic Sea

The Baltic Sea is a semi-enclosed sea surrounded by nine countries. For centuries it has enabled crucial sea transport for international trade and, more recently tourism, and has provided livelihoods and food security through its fisheries. The interaction between human activities, in particular agriculture and wastewater discharge, has impacted the health of Baltic marine ecosystems through nutrient pollution and resulting eutrophication. This has in turn affected fish stocks and their carrying capacity. Despite sustained reductions in nutrient pollution since the 1990s, the marine ecosystem appears to have tipped into a eutrophied, oxygen-deprived state that is difficult or even impossible to reverse, and fish stocks are not recovering (HELCOM 2010). As a result, employment and economic activity in fishing and other marine industries are strongly constrained.

4. DISCUSSION

4.1 State of knowledge and general agreement about interactions

Each of the six goal areas in focus poses significant challenges in terms of synthesizing knowledge and assessing knowledge gaps. However, some patterns emerge. The poverty and industrialization, innovation and infrastructure goals pose general analytical difficulties because they are highly multidimensional, but at the same time there are very rich bodies of literature, in both academia and international agencies, regarding their interactions — with each other and with environmental aspects, for example. However, a general research difficulty emerges regarding poverty. The distinctly multidimensional concept of poverty that is current today (Alkire and Santos 2014) makes it to some degree analytically inseparable from many other goal areas, such as health or education.

The food goal presents, relatively speaking, a clearer picture of interactions and there is a strong base of experience to draw from about how these interactions can be governed (although this does not necessarily make it easier to actually govern them). The health goal presents a more mixed picture in terms of the state of knowledge, where the knowledge base on maternal and child health and on infectious diseases is stronger than that on non-communicable disease and mental health, at least at the level of international organizations. This field, and how it interacts with urban development, with diets and with social inclusion, is rapidly evolving.

The oceans goal has a strong scientific legacy but there still are significant gaps in terms of basic knowledge of the current state of the oceans, seas and marine resources and how they interact with other sectors. As a complex natural system, mostly hidden from direct view, there are also research challenges that are highly specific (e.g. seabed data). Finally, the gender equality goal’s interactions with other areas is a more recent area for research than for the other five, although there is a long history of promoting gender equality. At the same time, the available knowledge suggests that gender-based action is a highly important, low-hanging fruit for reinforcing a whole range of, in particular social and economic, SDGs, whereas negative interactions emanating from gender equality did not appear at all.

At the level of targets for these six goals, the positive interactions identified significantly outweighed negative ones. For Goal 5 on gender equality, no negative interactions were detectable. In other areas, such as Goal 14 on oceans there were some apparently significant negative interactions, and addressing them will require adequate institutions and governance measures.

Looking beyond the six goals examined here, Goal 8 on growth and employment is intimately linked with industrialization and infrastructure. Interactions emanating from Goals 10, 11, 12 and 16 on, respectively, inequality, cities, sustainable consumption and production and peace and justice appear highly complex and are likely to be difficult to untangle. Indeed, it has been difficult to assess
interactions between the six goals in focus here and these four. Finally, many of the targets under Goal 13 on climate and Goal 15 on ecosystems on land, are relatively well studied in terms of how they are affected by economic and social change, but we need to know more about how their achievement affects other goals.

4.2 Comments on context dependency

More often than not, the interactions observed in this paper are generally applicable. However, their significance depends on the degree to which targets are being met or approached in different contexts, and this differs substantially between lower-income and higher-income countries. The poverty reduction agenda interacts substantially with most other goals, but these interactions become less significant moving up the income ladder, even if they do not disappear altogether. Sometimes, the nature of the interaction shifts in interesting ways. For example, Goal 2 is often summarized as “end hunger”. Using such language makes it predominantly a low-income country priority. However, the goal contains many aspects very relevant for high-income countries. For example, “all forms of malnutrition” is not only lack of food (under-nutrition) but also bad food (leading to micronutrient deficiencies) and also the growing obesity epidemic across the world. Obesity interacts strongly with education in one direction in high-income countries (better education enables better nutrition habits), while under-nutrition interacts strongly with education in both directions in low-income countries (where better nutrition enables school performance and, conversely, education enables better nutritional choices in households).

The goal area interactions most affected by place-specific context and resources are predominantly linked to the natural resource and environment-related goals, such as oceans, food, energy, water and sanitation, climate change and terrestrial ecosystems. Since, of these, only oceans and food are included in this paper, the geographical context has not been as big a factor as it was expected to be. The interaction between climate change and health in the context of urban areas is, however, highlighted as a geographically dependent interaction.

This paper has only been able to examine governance related to the interactions to a limited degree, mainly due to space constraints and the complexity that this entails. This is, however, a rich area of research and it can also be viewed as an interaction emanating from efforts at addressing several of the targets under Goal 16, such as 16.6 on effective and transparent institutions, 16.7 on inclusive decision-making, and 16.10 on access to information and fundamental freedoms. What is beyond debate is that a multilevel (rather than purely international) institutional response is appropriate to govern interactions. In principle, governance must always be targeted at the appropriate scale of management.

4.3 Addressing interactions in government: institutional challenges for integrated policy-making

Most states govern public policy sectors such as health, energy, agriculture and education through sectoral ministries and agencies. There are very good reasons for this, such as the need to have specialization of competence and establishing clear accountability relationships. However, the trade-offs are well known: the lack of joint agendas and coordination often leads to inefficient or even contradictory policies and actions. Therefore, many governments and international organizations are interested in looking at how to work across policy sectors and coordinate them better. In this respect the 2030 Agenda, which puts great emphasis on policy coherence (even giving it its own target, 17.14) is a mirror of the aspirations that already exist at the national level.

As integrated decision-making and policy coherence have been “holy grails” of public administration in the past two decades, a significant experience base has also developed around barriers and enablers to governing the interlinkages among policy sectors (e.g. Jordan and Lenschow 2008).
Scholars of international political and policy research have also promoted the idea of governing interlinkages at the “earth system” (global) level (Biermann et al. 2012). There is not space in the current paper to go into these bodies of literature on institutional implications at national or international scales in depth, but a few generic lessons can be highlighted.

Working through cross-sectoral governance systems and linking them to new research and knowledge requires relatively advanced capacities within the government machinery. Even if most analytics are not carried out internally within the ministries, resources are required for engaging expert competencies, through routine engagement with universities, think tanks, and scientific advisory bodies.

One institutional implication for integrated approaches has to do with foresight mechanisms. The aspirations of the 2030 Agenda are far reaching, and many will only be achieved in the long term (possibly beyond 2030). Also, pursuing integrative policies by leveraging positive interactions may have longer payback times and require longer planning horizons than one-goal approaches. The systematic consideration of global trends and possible futures, including through scenario building and visioning exercises, not only enables the long-term view but also brings to the fore interactions among policies (GCPSE 2014). A barrier is that much of today’s governmental actions are coloured by short-termism. For example, this has been pointed to as a reason for the infrastructure deficit in both high- and low-income countries.

Institutions such as futures commissions and secretariats for strategic foresight can be established. An interesting example comes from Finland, which has established a cross-departmental foresight institution. The Prime Minister’s Office and Sitra, the Finnish Innovation Fund, coordinate the national foresight network and support foresight activities, and individual ministries present future reviews within that framework. The process in place for exploring possible futures also allows the government to engage with stakeholders, researchers and businesses through the national foresight network, as well as the parliament. The Finnish foresight mechanism, including its flagship Foresight 2030 Report, is a reference point for assessing government performance. It traverses election cycles and includes mechanisms for cross-party collaboration.6

Integration in administrative practice requires communication systems and consultations across sectors. This can take different forms, including interdepartmental committees, inter-agency consultation mechanisms, top-down integration mechanisms (such as a sustainable development unit at the centre of government) or councils, commissions or secretariats for sustainable development (OECD 2014; United Nations 2016, chap. 4). Building such institutions to enable integrated approaches to decision-making is one thing, but making them effective is another. Integration faces institutional barriers, including both formal and informal incentives in government bureaucracies. In many jurisdictions, narrowly framed policy objectives in agencies create a disincentive to coordinate with others. Although the rhetoric often embraces integrated approaches, when it comes to actually evaluating performance, one public-sector agency does not often get credit for taking into account or contributing to the achievements of another.

5. CONCLUSIONS

The paper has shed light on how integrated approaches to SDG implementation can deliver much more effectively on the 2030 Agenda. For example, even if health and well-being were the only concern, priorities could be more effectively addressed if food, diets and nutrition were included as parameters in the health policy framework. This inclusion may be reinforced by working through schools or women’s groups. Many opportunities await those governments that are able to create institutional frameworks that promote and enable such integrated approaches.

This kind of assessment to support policy-making can be an important investment in a crucial knowledge base for policy-makers and planners wishing to move forward with effective implementation strategies. It can reveal sectors where indirect so-called knock-on effects can be expected – and where coalitions of the willing are most likely to emerge. And it can identify where and with whom trade-offs need to be negotiated.

However, in an agenda as broad as the SDGs the number of potential interactions is vast, and there will be political, institutional and cognitive limitations to how far large complex problems can be taken into account in policy-making. Integration is not only a technical exercise but also a political one. And the risk inherent in taking an integrated and comprehensive approach to a policy question – of overburdening the process and delaying urgent decisions – needs to be weighed against the benefits.

Thus, an integrated view and diagnostic of the interactions in the 2030 Agenda does not automatically mean that holistic, complex institutional arrangements are an effective response. In many cases, existing sectoral institutions offer the required competencies. What matters, first and foremost, is that the interactions with policy areas that are under the aegis of other institutions are taken into account in the problem framing and design of action. Too often, this does not happen today.

The sample of interactions presented here is still relatively limited compared with all possible interactions. More comprehensive mapping depends on longer term, in-depth research work going goal by goal, at national or possibly country-group level, also including trends in data and correlations over time. The international sustainable development community thus clearly has its work cut out, including the United Nations agencies, the scientific research community, research funding agencies, and national governments. Building up a robust international knowledge base about interactions cannot be done only at the national level. This knowledge base needs to become institutionalized in order to be cumulative and comparable, so as to maximize learning over time and exchange of knowledge between countries.

However, even for areas where scientific agreement and the knowledge base appear to be relatively strong, there is often fierce political disagreement. Although scientists and analysts overwhelmingly agree on positive interactions between, say, renewable energy deployment (target 7.2) and climate change mitigation (target 13.2), this assessment is often challenged in national political debates. Shifts in political interest are, of course, entirely normal and also normally mitigated through strong institutions.

One such institution could be an openly accessible knowledge platform containing systematic and robust analysis of the SDGs and their interactions, and how they might play out in different contexts. The framework for such an institutional knowledge base needs to be intuitive and accessible for non-experts, so that scientists, policy-makers and practitioners can jointly explore how the SDG puzzle fits together and how the 2030 Agenda can be effectively implemented in a given context. At present, a number of semi-qualitative approaches are being piloted (e.g. United Nations 2015; United Nations 2016). Quantitative integrated assessment modeling efforts adapted to the SDGs are also being piloted (e.g. van Vuuren et al. 2015). The scoring applied here with the seven-point scale opens the way for a third and complementary approach. It may be worth institutionalizing these efforts further, perhaps under the auspices of the United Nations.
REFERENCES


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