

ANNEX 1

Annex 1: Examples of strategies used in various SDG areas and how they are geared to reaching those left behind.

Nutrition

Context:

Maternal undernutrition is estimated to contribute to 800,000 neonatal deaths and child undernutrition, consisting of stunting, wasting and micronutrient deficiencies, brings about 3.1 million child deaths annually.¹ By 2014, 159 million children under 5 were stunted, and. Progress in reducing stunting has been uneven. Low-income countries only accounted for 15 per cent of the global under-5 population in 2014, but nearly one quarter of all stunted children live in these countries. Less than half of all children under 5 lived in lower-middle-income countries in 2014, yet these countries accounted for two thirds of all stunted children globally.² Because stunting and its consequences are difficult to reverse after 24 months of age, interventions usually target pregnancy and young children.

Commonly used strategies:

Strategies to improve maternal and child nutrition tend to focus on adolescents girls and women, on infants and young children during the first 1000 days of life, on promoting optimal nutrition practices, meeting micronutrient requirements, prevention and treatment of severe acute malnutrition, and disease prevention and management.³ These strategies include promotion of breastfeeding, promotion of complementary feeding with or without of provision of food supplements, micronutrient interventions, general supportive strategies to family and community nutrition, and reduction of disease burden.⁴

Once pregnant and young children are targeted, effective nutrition interventions use a universal approach, focus on reaching food insecure groups, or focus on severe acute malnutrition (to reach the furthest behind). For example, from a comprehensive review of 43 nutrition-related interventions, out of 13 of those that were found to have evidence of effectiveness 11 could be implemented as universal within the target groups, one was universal in nature (e.g. universal salt ionization), and one targeted severe acute malnutrition.^{5, 6}

How 'reaching the furthest behind first' compares with other strategies:

Nutrition interventions that focus on the furthest behind, in terms of nutritional status or vulnerability, are particularly effective for reducing malnutrition. A meta-review of

studies that assessed the potential effect on child survival of scaling up nutrition-specific packages concluded that therapeutic feeding for severe acute malnutrition, which is a form of "reach the further behind first", would save from 620,000 to 917,000 lives, or as many lives as the other interventions combined. In addition, estimates of the effect of scaling up nutrition interventions show that the gains would be greatest in the poorest quintiles.⁷ A review of nutrition-sensitive programmes in the areas of agriculture, social safety nets, early child development, and education, show that they could be enhanced by, among other things, better targeting on the basis of nutritional vulnerability, in addition to targeting based on income or geographical location.⁸

It is important to note, however, that less targeted preventive interventions could be more effective than more targeted recuperative strategies. For example, a large programmatic intervention in Haiti found that given the difficulty to reverse stunting after 36 months of age a strategy of behaviour-change communication and food supplements for all children aged 6-23 months had a larger effect in reducing underweight and stunting than a targeted recuperative and food-support strategy that focused on underweight children under the age of five.⁹

How those left behind and 'furthest behind' are identified: Severe acute malnutrition (SAM) is detected by a weight-for-height Z score [WHZ] <-3, while moderate acute malnutrition (MAM) is characterized by WHZ <-2.¹⁰ In stable non-emergency situations with endemic malnutrition, MAM can often present in combination with stunting.¹¹

Health

Context:

Health is a good example of an area where the need to reach the furthest behind (not necessarily "first" though) has been on the forefront of national and international policy discussions. At the national level, the imperative to leave no one behind in this area is epitomized in discussions on universal health coverage, which have matured in many countries over the past two decades. It is also a constant concern in terms of design of health coverage systems, e.g. for the price of medicines and care that is paid by poor consumers. At the international level, efforts to combat "orphan diseases" especially in Africa have given rise to innovative policy approaches (e.g. advance market commitments). Efforts to reduce the price of medicines have also been ubiquitous and have given rise to action in international forums (WTO). In the case of HIV/AIDS, a range of responses by individual countries and the international community has included international action programmes, the creation of UNAIDS, action at the WTO, and others.

The challenge for leaving no one behind is that the availability of and access to relevant social and medical care is usually inversely related to the need of the population groups.¹² In other words, groups with the most pressing need for medical care tend to be those least likely to receive it. This is particularly central because people within the lower income groups not only tend to have more illnesses but also have more comorbidity.¹³ This can be compounded by the fact that many disadvantaged population groups, such as those in rural areas and poor populations, are also more likely to lack access to clean drinking water, sanitation and hygiene, which are essential for human health.¹⁴

Commonly used strategies:

A common strategy is universal health care, which attempts to guarantee comprehensive health coverage for the entire population. In Australia, for example, the socially disadvantaged are covered through publically funded healthcare via Medicare but actual access to medical care has been found to be limited due to excessive waiting time and scheduling difficulties. On the contrary, those who are privately insured receive care within a reasonable time frame through private appointments.¹⁵

Some programmes of universal care are focused on reaching the furthest behind first. Spain, for example, developed primary care health centres throughout the country but prioritized areas with the highest social deprivation first, which has yielded benign outcomes such as lower death rates.¹⁶ In Thailand, the people are insured through the Civil Servant Medical Benefit Scheme, the Social Security Scheme for individuals working in the private sector, and the so-called “30-Baht Scheme” for those who do not work for the private sector, non-working family members and children. The 30-Baht Scheme is a financially discounted program in order to insure the remainder of the population.¹⁷

Numerous strategies that target a specific population group focus on financially disadvantaged groups such as the unemployed and those working part-time, as well as socially disadvantaged groups such as women, children and seniors. According to the literature, the basis for much of health inequity is determined from early stages of life. Thus, prioritizing interventions at younger ages is a suggested approach.¹⁸

Some northern European countries and some provinces in Canada have attempted to regulate the distribution of health to achieve health equity by refusing to reimburse or pay physicians who settle in medically well-equipped areas. There have also been expansions of network of community health centres in deprived areas, and the benefits of this in the U.S. has been strong with lower low birth weight rates, better care quality and higher preventive service levels.¹⁹ Many developing countries have also made significant

progress towards achieving universal coverage. A study analysing 24 developing countries striving to achieve UHC, including Jamaica, Indonesia, Guatemala, Ghana and Nigeria, , shows that the countries are adopting two broad approaches: So-called “supply-side programs” channel investments to expand the capacity of service provision through increased funding for inputs (for example, human resources) and for reforms such as greater flexibility in staff recruitment, financial autonomy for public clinics, strong organizational protocols, and explicit performance indicators. “Demand-side programs” earmark resources to identified groups in the population and the services they use. They often do this by identifying and enrolling their target population and purchasing health care services on their behalf via output-based payments.²⁰

How ‘reaching the furthest behind first’ compares with other strategies:

The need for strategies that target the furthest behind first is highlighted in the health literature. Studies show that even when universal access to health services is an actively pursued goal, actual access can be skewed towards those better off. For example, in 21 OECD countries, most of which have explicit policy objectives to ensure equitable access to health care, people with higher incomes are significantly more likely to see a health specialist than people with lower incomes and, in most countries, also more frequently.²¹ Such pattern tends to make total doctor utilization somewhat pro-rich, which is further reinforced when private insurance or private care options are offered. While the issues of pricing are an important part of achieving UHC, geographical coverage and inhibiting distances to nearest health facilities as well as lack of quality of care are also barriers to reaching UHC.²²

It has been suggested that health inequality can be improved when considered in conjunction with macro-level factors and other economic and social policies.^{23, 24} Social class indicators and environmental stressors, such as poor housing conditions and high crime and unemployment rates, impact the relationship between individual-level risk factors and health.²⁵ For instance, while early initiation of prenatal care reduces the risk of low-birthweight infants, the protective effect of prenatal care is heavily dependent on the residential context. In high-risk neighbourhoods, the protective effect was low while low-risk neighbourhoods benefited from the care more substantially. Thus, basing policy solely on the individual-level analyses can overestimate the individual-level risks, leading to policy interventions with skewed consequences.²⁶

It is important to be cautious about the different uptake among the different social group in order to prevent widening inequalities. Experimental studies in the areas of accident prevention and use of educational booklets

for pregnant women had a greater impact on those in the higher social classes and exacerbated the inequality gap, emphasizing the eminence of targeted interventions in such cases.²⁷

Environment and Health

Context:

Insufficient attention is being given to ensuring a healthy environment as a means to improve human health and well-being. An estimated 23%²⁸ of total premature deaths were linked to environmental and modifiable factors in 2012 (12.6 million deaths globally), and the poor and other disadvantaged groups are disproportionately affected. Poor air quality and the consequences of inadequate water and sanitation services are among the primary environmental risks that affect health worldwide (see 1.1.7 on water and sanitation). Household air pollution prematurely kills 4.3 million people every year, nearly all in low- and middle income countries.²⁹ It particularly affects women and children, as they are more exposed to fumes from solid fuels used in cooking. Exposure to toxic chemicals due to inadequate workplace and housing conditions and proximity of homes, schools and workplaces to contaminated areas adds to the burden of disease, and its effects have become increasingly evident.³⁰ The effects of exposure to certain types of pollutants are exacerbated by poor nutrition and include, among other effects, influence neurocognitive development. Certain effects of exposure to toxic substances can be transmitted from mother to child, contributing to the intergenerational transmission of inequalities.³¹

Moreover, the world's poorest 3.5 billion people rely more directly on the environment for their basic needs, such as water, food and shelter, so ecosystem degradation affects them the most. Climate change impacts add to vulnerability by affecting the quantity and quality of water, soil degradation, disease patterns, and the frequency and intensity of droughts and extreme meteorological events.³² Again, the most affected are those with scarce access to adequate infrastructure, services and support systems. Over half a billion children currently live in extremely high flood occurrence zones, and nearly 160 million children live in areas of high, or extremely high, drought severity.³³

Commonly used strategies:

The health benefits of addressing environmental problems are not often quantified. As a result, investments and policies to that effect are underprovided. Moreover, for the most part, mainstream environmental policy does not specifically target the poorest or most disadvantaged groups. For some environmental problems, targeting specific groups is, in fact, unnecessary, as these groups will benefit from an efficient global strategy.

For example, as a result of the successful phase-out of nearly 100 ozone-depleting substances through the Montreal Protocol on Substances that Deplete the Ozone Layer (1987), up to 2 million cases of skin cancer and many millions of eye cataracts may be prevented each year by 2030. Moreover, by limiting the loss of stratospheric ozone, the Montreal Protocol helps to safeguard food security by reducing ultraviolet damage to crops and marine ecosystems. Cumulative estimates from 1987 to 2060 show that the global phase-out of chlorofluorocarbons (CFCs) alone will result in an estimated US\$1.8 trillion in global health benefits and almost US\$460 billion in avoided damages to agriculture, fisheries and materials.³⁴

For other environmental problems, however, the approach used can have different results for different groups of people. Where effects are localized or otherwise unequally distributed, environmental policy that does not specifically address the needs of the poorest may exacerbate inequalities. Groups (communities, individuals, countries) that are at a disadvantage in terms of their capacity to act collectively and influence policy design and implementation may benefit less from investments and may be left out in the allocation of scarce enforcement capacity. In some cases, in the absence of adequate policy, the very existence of socioeconomic inequalities may make it easier and cheaper for certain groups to transfer the environmental costs of their activities and lifestyles onto others rather than to internalize those costs.³⁵

How 'reaching the furthest behind first' compares with other strategies:

The choice of instruments for environmental management can have significant implications on who benefits from interventions in environmental matters. For example, in conducting inspections on plants that handle toxic substances, a "police-patrol" approach will conduct regular and uniform inspections, while a "fire-alarm" approach reacts to demands from affected parties. The latter will tend to be of greater benefit in communities with a greater capacity to articulate collectively and reach out to institutional channels, and may leave the most disadvantaged behind. A strategy that reaches the furthest behind first would include a police-patrol approach at least in the most disadvantaged areas.³⁶ Ensuring access to information, participation and justice in environmental matters are necessary components of a strategy to leave no one behind when addressing environmental issues. To reach the furthest behind first, policies need to address the special needs of vulnerable communities. Experiences to that effect include active outreach strategies to engage these communities in the identification and resolution of environmental problems affecting them through technical and financial support, legal assistance, and by providing environmental information in languages and formats

accessible to linguistic minorities;³⁷ legal empowerment of communities;³⁸ and inclusion of equity criteria in impact assessments and licensing criteria.³⁹

In some cases, strategies geared at reaching the furthest behind first are also efficient strategies to address environmental issues, with universal benefits. Replacement of traditional biomass cookstoves with modern fuel cookstoves, and of traditional cooking and heating with clean-burning biomass stoves would have considerable health benefits and would also represent 25% of the share of total avoided climate warming from Short-Lived Climate Pollutants reduction by 2050.

How those left behind and 'furthest behind' are identified:

The definition of those "left behind" varies depending on the type of intervention. Although the common methodology used looks at income distribution, interventions with regards to environment and health linkages tend to take into account the issue of vulnerability, to environmental degradation, targeting those which are most vulnerable to exposure to pollutants, other forms of poor environmental quality, climate change or natural disasters. Vulnerability to environment and health inequities are linked to many other social and economic factors, including the social and economic position of individuals, in relation to social class, age, gender and ethnicity, as well as education, occupation, livelihood and income levels. These factors determine where people live, what they eat, how and when in the life cycle they are exposed to pollution, and what options they have to change their conditions.

Some jurisdictions have adopted a pragmatic approach to enable targeting of particularly vulnerable or overburdened populations, and those that are likely to be unaware of the risks they face or to be unable to effectively take part in decision making. For example, in the State of Massachusetts, United States, the operational definition of "environmental justice populations" is "a neighborhood whose annual median household income is equal to or less than 65 percent of the state-wide median or whose population is made up 25 percent Minority, Foreign Born, or Lacking English Language Proficiency".⁴⁰ The state of California has adopted a screening tool - *California Communities Environmental Health Screening Tool* (CalEnviroScreen) - to identify vulnerable communities that suffer the largest pollution burdens, considering the location of pollution sources and demographic characteristics such as the concentration of children and elderly, low birth weights, asthma emergencies, education levels, linguistic isolation, poverty and unemployment. The tool is used in the allocation of resources obtained through the Greenhouse Gas Reduction Fund, a cap-and-trade programme.⁴¹

Conditional cash transfer programmes

Context:

The multi-dimensionality of poverty has long been recognized. Poor households are likely to suffer from multiple deprivations, including with respect to education, health, and employment, and be more vulnerable to shocks. Conditional cash transfer (CCT) programmes aim at addressing tackling multiple deprivations simultaneously in poor households. These programmes are usually designed with the philosophy that poor families are not able to invest enough in the human capital of their children, leading to poor nutrition, poor health and education outcomes, and use of child labour.

Commonly used strategies:

CCTs often combine components related to education, health and nutrition of the children, conditionalizing the given cash transfers with participation in schooling, natal care, vaccination schemes and so on, while aiming at alleviating current poverty simultaneously. For Brazil's Bolsa Familia for example, the transfer is conditional on pregnant women receiving timely prenatal and postnatal care visits, all children aged 0–5 within the household receiving timely vaccinations and growth-monitoring visits, and all children aged 6–15 attending school at least 85% of school days.⁴²

Some of the programmes aim at giving particular support to girls and women. In the case of Mexico's Oportunidades program for example, the grants given increase as children progress to higher grades at school and, beginning at the secondary level, are slightly higher for girls than for boys. The cash transfers themselves are given to the female head of the family.

Growing interest to CCTs, especially in poor countries was possible through an adaptation of more flexible approaches to encouraging human capital investment and blurring of lines between conditional and unconditional transfers, with some unconditional cash transfer programs (for example, in Kenya, Ghana, and Pakistan) introducing some co-responsibility arrangements with less stringent enforcement than in most CCTs (also called "soft conditionalities). CCTs in Africa are rarely a stand-alone activity. Instead, they usually come as a part of a package of safety net interventions that often also include a public works component. The three largest CCT financing activities in sub-Saharan Africa – Nigeria's Youth Employment and Social Support, Tanzania's Productive Social Safety Net, and Ghana's Social Opportunities Project – all combine a CCT with a public works component. Approaches that combine investments in human capital with CCTs and with the building of community infrastructure through public works have now been adopted by Egypt, Togo, Burkina Faso,

Cameroon, Republic of Congo, Niger, Madagascar, Chad and Mali.⁴³

By definition, CCT programs aim to reach those left behind in a socio-economic sense. The extent to which they have succeeded varies across countries. CCT are the most evaluated form of social safety nets. In recent years, there has been a large number of impact evaluations of CCT programs, and a dramatic shift from Latin America (where most of the initial impact evaluations were concentrated)⁴⁴ to lower-income countries in Africa (where one half of the evaluations conducted in the past 3 years were concentrated) and Asia.⁴⁵ Some of the most notable evaluations published over the last year include the impact evaluation of the Pantawid Pamilyang Pilipino Program in the Philippines.⁴⁶

CCTs, particularly those in Latin America, have been widely assessed, with mainly positive results. In Mexico, newborns in beneficiary families were 127.3 grams heavier and 44.5 percent less likely to be low birth weight than newborns in non-beneficiary families.⁴⁷ Bolsa Familia has increased girls' school participation by 8.2 percentage points.⁴⁸ The probability that a child received all seven vaccines required by age 6 months increased by 12–15 percentage points and increased pregnant mothers' use of prenatal care by 1.5 prenatal care visits on average.⁴⁹ A 2012 evaluation of Brazil's Bolsa Família program yielded evidence of how beneficiary women made decisions that resulted in better living conditions for both children and women.⁵⁰ Bolsa Familia has even been linked to reduced crime rates.⁵¹ The findings of evaluations of Nicaragua's Atención a Crisis underscored the long-term positive potential of health interventions focusing on early childhood intervention. It was found that households who received Atención a Crisis transfers had increased their expenditure on critical inputs into child development (such as more nutrient-rich foods, more early stimulation provided to children, and more use of preventative health care). This had led to improvements in the cognitive outcomes of children aged 36 months old from beneficiary households, and even two years after the program was ended and the transfers had been discontinued, these positive effects continued.⁵²

The success of Latin American CCTs has encouraged developing countries around the world to adopt similar schemes. However, the success of these schemes requires that good quality services are available and physically accessible for the participants and that the public sector has the capacity to run fairly complex transfer schemes.⁵³ In some cases, these requirements have meant in practice, that those furthest behind, for example in rural areas, are left outside of the programme reach. For instance, in Nicaragua, the programme was initially implemented in departments that satisfied minimum administrative and infrastructure requirements.⁵⁴ Colombia's Familias en

Accion (FA) has included poor municipalities with fewer than 100,000 inhabitants, a bank and adequate education and health infrastructure.⁵⁵

Several countries have strengthened linkages between cash transfers and early childhood development (ECD). Conditional cash transfer programs can serve as effective vehicles for promoting early childhood nutrition, health, and development, in addition to their more traditional role of providing income support to the poor and vulnerable. Where ECD services exist, cash transfer programs can help households overcome barriers to access, for instance by making the transfers conditional on health visits, growth monitoring sessions, or attendance in preschool. Cash transfer programs can also help encourage changes in parenting practices to promote early childhood nutrition, psychosocial stimulation, or health. Countries having tested similar approaches include Burkina Faso, Djibouti, Mali, and Niger.⁵⁶

Accompanying measures to promote ECD are also being implemented in middle-income countries. In Indonesia, the conditional cash transfer Program (CCT) program Keluarga Harapan (PKH) covers 3 million poor families nationwide. The program not only provides cash, but also provides beneficiary mothers with skills. Training modules seek to promote sustainable behavioral changes in relation to early childhood education and parenting practices, and extending to such topics such as family finances or microenterprises. The training modules are given during monthly meetings that CCT beneficiaries have at local level, over three years. Messages are harmonized through the use of videos that represent daily situations of a typical CCT family.

How 'reaching the furthest behind first' compares with other strategies:

Some CCT schemes contain an element that aims at targeting the support to the furthest behind in addition to supporting poor families. For example, transfers associated with Bolsa Família consist of a conditional payment per child aged 0–15 years, for up to three children, to "poor" households below a per capita income threshold, but in addition, an additional unconditional transfer is given to "extremely poor" households below a lower per capita income threshold.

Some programmes also aim at providing additional incentives for tackling issues such as school dropouts. In Brazil in 2008, a complementary Benefício Variável Jovem program was introduced, which added variable payments and a schooling conditionality for children aged 16 and 17, requiring attendance at least 80% of school days.

Other programmes are including support to recover from disasters tackling families that are especially vulnerable to hazards, in an effort to minimize the negative effects that these events have in poverty eradication. This is the case,

for example, of Chile (*Chile Solidario*), Ecuador (*Bono de Desarrollo Humano*) and Mexico (*Prospera*, successor of *Oportunidades*).⁵⁷

In Panama, the Red de Oportunidades Led is targeted to the poorest and the indigenous communities. According to one assessment, the programme implementation led to a reduction in child labour among 12–15-year-old children by 15.8 percentage points and to increased elementary school enrolment by 7.9 percentage points in indigenous comarcas.⁵⁸

How those left behind and 'furthest behind' are identified:

CCTs can cover large sections of societies (approximately 26 % in Brazil) or narrower groups (3% in Nicaragua). Good targeting and identification of the group is crucial for the effectiveness of the programme.

Most Latin American CCTs rely on proxy-means tests for identification of the poor. A notable exception is Brazil's Bolsa Familia, which relies on self-declared per capita household income.⁵⁹ CCTs may also rely on geographic targeting to target priority areas, whether based on welfare levels or on other requirements such as minimum infrastructure facilities, or a combination of both.⁶⁰ Some programmes also use community means testing as the way to identify the ones eligible.⁶¹

Payments for ecosystem services

Context:

Payments for ecosystem services (PES) programs were originally designed primarily to meet conservation goals rather than poverty reduction objectives. Conservation strategies can indeed present constraints and challenges especially for the communities and local residents leaving in and around sites identified and designated for the implementation of such environmental conservation programmes. The challenges and constraints include lack of or reduced access by communities to services provided by the ecosystems. These challenges are exacerbated when they directly affect the poor and landless as they are for all intent and purpose effectively locked out of their sources of survival and livelihood. The understanding and practices of implementation of incentive programs such as PES have evolved and the need to balance conservation objectives and socio-economic imperatives are now widely recognized. Involving local residents or users of natural resources in conservation efforts and providing incentives to local communities to support and participate in conservation efforts is now standard practice. In the past three decades, a rapidly growing number of ecosystem functions have been characterized as services, valued in monetary terms and, to a lesser extent, incorporated into payments for ecosystem services (PES) schemes.⁶² Such

schemes have thus become one of the common tools used to manage environmental issues.

Commonly used strategies:

Under a typical payment for ecosystem or environmental services (PES) scheme, the party supplying the environmental services agrees to manage the corresponding resource or the service that provides a flow of benefits to another party according to certain requirements, in return for compensation. Some PES programs are purely private arrangements. However, the majority of the PES programs are funded by governments and involve intermediaries, such as non-government organisations. The majority of existing schemes operate in the areas of climate change mitigation, watershed services and biodiversity conservation.⁶³

The primary focus of PES is on maintaining or restoring ecosystem services, not on poverty alleviation. However, during the past decade there was increasing interest in whether PES could, in addition to environmental objectives, also capture and accommodate poverty reduction objectives, especially in developing countries. A multi-country study based on observations from three tropical continents found that poor (environmental) service providers could broadly gain access to PES schemes, and generally become better off from that participation, in both income and non-income terms.⁶⁴ However, the study pointed out the need to also look at the impact of PES schemes on service users nonparticipants. Several studies including a 2005 study conducted by the World Resources Institute on the Challenges of Pro-Poor PES found that: lack of security of tenure; restriction on land uses; high transaction costs; lack of credit and start-up funds represented serious challenges for the poor who were denied access to benefits.

The various participation filters of PES schemes contain both pro-poor and anti-poor selection biases, and different mechanisms have yielded different results in terms of reaching the poorest. Quantitative welfare effects are by nature small-scale compared to national poverty-alleviation goals.⁶⁵ The study concluded that while some pro-poor interventions are possible through PES, the prime focus of such schemes should remain on the environment.

How 'reaching the furthest behind first' compares with other strategies:

As described above, payments for ecosystem services are not explicitly designed to achieve poverty eradication objectives. The precise design of the payments systems influences the distribution of the payments across participating and non-participating groups; hence, PES can be more or less focused on those furthest behind, depending on the case. Carefully designed PES schemes can become more focused on those left behind ("the poorest") and those unable to cross above the poverty line.⁶⁶

How those left behind and 'furthest behind' are identified:

In evaluations of the pro-poor nature of PES, income and derived poverty indicators are commonly used as a measure for those "left behind". However, the evaluation of the pro-poor nature of PES programs needs to include other poverty indicators as well, such as health, education and other social indicators as gauges for those "left behind".

Access to shelter*Context:*

For shelter policy in developing countries, perhaps the most notable trend in recent decades is with respect to the spatial dimension of poverty. Though the majority of the world's poor continue to live in rural areas, poverty has rapidly become an urban phenomenon. Today, unlike the situation thirty years ago, in many countries – e.g. Russia, Brazil, Mexico - most of the poor reside in urban areas. In other countries, the poverty rate in urban areas is higher than it is in rural areas.

A clear failure of urban interventions in past decades is shown by the inability to eliminate slums. Although the MDG slum target was reached, the number of slum dwellers, in absolute terms, continues to grow, with an estimated 863 million people living in slum conditions in 2012.⁶⁷ This is not only a result of massive migration flows into the cities of the developing world. Surveys in Brazil and India, for example, indicate that in many places slum dwellers are no longer immigrants who recently arrived from rural areas in search of better livelihoods. Today, many of the 100,000 pavement dwellers in Mumbai, for instance, are second generation residents,⁶⁸ as is the case in Rio's Favelas.⁶⁹

The broad environment has significantly changed over the last three decades. Urbanization is no longer thought of only as an engine of growth that occurs as societies grow and specialize. A more robust understanding of how housing and land markets work has emerged in both developed and developing countries. There is now much more available information and an active body of research on real estate economics in general and for developing countries in particular. Many countries have evolved sophisticated financial systems. For instance, many developing countries now have access to market rate housing finance to assist them. This has come with associated crises in some cases.

Commonly used strategies:

Strategies to provide access to shelter in an urban context have a history of several decades if not centuries. In developing countries, urban projects initially undertaken by international financial institutions were usually designed to help develop sites and services in low-income countries.

Most of the initial projects were in capital cities and attempted to show that basic housing services, e.g. shelter, water and sanitation, could be provided at much lower cost than the housing then being provided by the public sector. At that time there was considerable resistance this idea. Most developing country public housing agencies produced expensive and heavily subsidized housing that could only meet the needs of a fraction of the demand. These projects also provided an alternative to demolishing squatter settlements as was done in many countries. The overarching idea of the assistance was to suggest that rather than attempting to replace the informal sector, or see this sector as a "problem", public assistance could be used so that the strengths of this sector could be built upon. Providing just basic services and shelter allowed poor families to expand their units over time as their savings and resources permitted. It also allowed them to use their own labor to maintain and increase their wealth. A change came in the early 1970s with a shift to upgrading of existing slums rather than just the development of new sites.

The second change was to move from shelter-centered projects to broader interventions that included issues such as municipal finance, urban management and inter-governmental relations. Later, other types of interventions were centered on housing finance and broader housing policy environment, as well as disaster relief. Lastly, in the late 1990s, housing micro-finance started to be seen as a way to provide access to housing finance further down the income distribution. Various interventions in housing markets continue to target the low-income rental sector (both public and private).

How 'reaching the furthest behind first' compares with other strategies:

The degree to which urban policy interventions and strategies reach those left behind depend on the specific nature of the interventions and the local context. Yet, some general lessons can be drawn^{70, 71} In general, subsidy instruments have not been a panacea to reach the poorest.

In as much as slums provide shelter to those furthest behind in the urban context, interventions directed at slums reach this category. Their impact, however, depends on the design and implementation of urban interventions.

How those left behind and 'furthest behind' are identified:

The definition of those "left behind" varies depending on the type of intervention. For example, interventions aiming at expanding mortgage markets for individual ownership will focus on those at the margin of formal housing finance, who are typically not at the bottom end of income distribution. Intervention in slums is area-based; in addition, additional criteria within specific interventions may try to further target people or households who are most vulnerable or poor.

Access to drinking water and sanitation

Context:

Improving access to safe drinking water and sanitation has long been recognized as one of the main challenges of sustainable development, with improper water management having a direct impact on human and ecosystem health, food and energy security among many other areas which support human well-being and livelihoods. 147 countries achieved the MDG target relating to access to drinking water, while 95 met the target for sanitation. Over 90 per cent of the world's population now use improved sources of drinking water, and 68 per cent use improved sanitation facilities.⁷² The value to households of access to improved water and sanitation facilities includes direct net savings or expenses from buying water from alternative providers and savings in health expenditure to treat water-borne disease and indirect benefits in terms of time freed up to get water closer or into the household, improved nutrition, increased school attendance especially for adolescent girls and the safety and dignity of improved sanitation compared to open defecation of shared facilities. In most developing countries without universal access, use of improved facilities is higher in urban areas than in rural areas.⁷³ Households not having access to individual piped water connections must rely on alternative sources for water, whose price is often much higher than that of water provided by utility companies. Households in dense urban areas often have few options for improved sanitation and removal of excreta from communities due to a lack of space and service providers.

Investment in water and sanitation has also long been recognized as having a very high social rate of return. For example, in 2004 WHO and UNICEF estimated that the return on investment in water and sanitation services in developing countries ranged between US\$5 and US\$28 per dollar.⁷⁴ Improved access to safe water and sanitation has many co-benefits in other areas. For example, it has resulted in the number of diarrhoeal diseases attributable to inadequate water, sanitation and hygiene to fall from 1.8 million to 842,000 between 1990 and 2012, with all regions experiencing major declines.⁷⁵

Commonly used strategies:

Strategies used all over the world ultimately aim to provide universal access to safe drinking water and basic sanitation. In that sense, they are directly geared to leaving no one behind. In many countries, strategies for universal drinking water coverage are designed within the paradigm of individual water connections provided by a utility company through a network. The precise institutional features of utilities and their degree of autonomy from the government vary widely across countries. However, the challenge facing governments is the same, i.e. to ensure reliable access to

safe water at affordable rates, without compromising the long-term financial sustainability of the water provision system. Strategies for universal coverage of sanitation tend to rely on a mix of extending formal services (sewerage networks and septic tank systems) while encouraging private investment in sanitation improvements.

In countries with a large share of the population without access (e.g. large rural populations), the network structure of water and wastewater service provision provides an incentive for planners to reach "low hanging fruits" first by extending connections in proximity of existing networks or water production plants, thus not necessarily reaching those furthest behind first. Globally, eight out of ten people without improved water, and seven out of ten without improved sanitation, live in rural areas where networked solutions may not be achievable or affordable in the short to medium term, and low cost solutions operated and managed by the communities are still the main option. In countries where the majority of the population has physical access to improved facilities, strategies to facilitate affordability of water become the main channel to reach those furthest behind.⁷⁶

Water tariffs and associated subsidies have traditionally constituted the preferred instrument by which governments have tried to resolve this issue. The majority of water subsidies to households are delivered to customers connected to the network through low tariffs. A frequent way of subsidizing water consumption is through increasing block tariffs where the first consumption blocks are subsidized, while the highest blocks are priced above cost. The costs of wastewater collection and treatment are frequently cross-subsidized by revenue from water tariffs. The construction and maintenance of on-site sanitation systems presents substantial economic burdens to low-income households, but the large number of poor households without sanitation makes it difficult for governments with limited budgets to provide effective subsidies.⁷⁷

Review of the experience accumulated in various countries has provided a number of robust lessons regarding water subsidies. Consumption subsidies delivered only through low tariffs are typically not well targeted to the poorest households. Access factors biased against the poor make subsidies through low water tariffs unlikely to reach the poor. The proportion of households having potential access to the network is often higher for non-poor households than for poor households. In practice, subsidized tariffs have often resulted in regressive redistribution schemes.⁷⁸

In past decades, new practices in the design and delivery of subsidies have emerged. An increasingly common form of water provision consists of a menu of services, differentiated by quality, associated with different tariffs. Typically, subsidies are associated with the lower quality

service. The objective is to target subsidies to the poorer households or neighbourhoods, by allowing households to self-select the form of service they prefer to use, the implicit assumption being that poor households are more likely to use the (subsidized) lower-quality service. Another objective is to achieve a greater coverage with the same amount of investment, lower quality services such as community taps being less costly to provide and covering the needs of more households than private connections.

Direct consumption subsidies are paid directly to households meeting certain eligibility criteria (low income being the most obvious criterion) to cover part of their water bill. The direct subsidy system was pioneered by the Chilean government in 1990, when it was successfully used to soften the distributional impacts of a convergence towards cost-reflective water tariffs. The main advantages of direct subsidies are that they are transparent, explicit, and minimize distortions in the behavior of water utilities and their customers. The main drawbacks are the difficulty of defining suitable eligibility criteria, as well as the administrative cost entailed in identifying eligible households.

Connection subsidies have become more and more frequent, based on the recognition that, for some groups of the population, the main obstacle to connection to the network is not that of paying the monthly water bill but rather paying the initial connection fee. Connection subsidies also provide a strong incentive for water providers to extend the network.⁷⁹

One emerging approach is to provide hardware subsidies on an output basis rather than an input basis. Providing a subsidy on an output basis can ensure that the activity that is subsidized is actually delivered, and can be effective at stimulating demand and leveraging private investment. It can also give incentives to producers to reduce costs and to serve areas which they might otherwise not consider.⁸⁰

How 'reaching the furthest behind first' compares with other strategies:

In general, it is easier to extend a network for water provision from existing networks or from water production centers. To the extent that those furthest behind live farthest from areas already served, strategies to extend water provisions may not spontaneously reach the furthest behind first. Doing so requires a deliberate prioritization of the most underserved areas and groups.

How those left behind and 'furthest behind' are identified:

The most commonly used indicators at the country level are the percentage of households having access to a safe source of drinking water and basic sanitation facilities. However, several scales and categorizations are used, and different

monitoring processes use different definitions of access to water and sanitation.⁸¹ Administrative targeting in various forms is increasingly used to administer programmes that aim to improve affordability of water for the poor. Methods used going from categorical targeting, to selection based on family structure and location, with the most sophisticated methods relying on means testing.⁸² Selection based on family size alone is usually found to perform poorly in targeting the poorest households. The power of geographic targeting depends in large measure on the correlation between poverty and location of households. Geographic targeting has given interesting results in Nepal, but seems to have limited potential in Colombia and Senegal.⁸³ Sanitation subsidies have been delivered using a range of methods, including geographic targeting, means-tested targeting, community-based targeting, and self-selection targeting, with the latter two approaches appearing to be more effective than means-tested systems, which can be costly and generate perverse incentives.⁸⁴

Persons with disabilities

Context:

Persons with disabilities are overrepresented in the furthest behind when looking at almost any of the SDGs. Households with a person with disability are more likely to experience material hardship – including food insecurity, poor housing,⁸⁵ lack of access to safe water and sanitation, and inadequate access to health care.^{86, 87} Children with disabilities are less likely to get an education, less likely to be employed as adults, less likely to start their own families, and more likely to live in poverty.⁸⁸ People with disabilities are more likely to be unemployed and generally earn less even when employed around the world.⁸⁹ On average across the OECD, the income of persons with disability is some 15% lower than the national average and as much as 20-30% in some countries.⁹⁰ Persons with disabilities also have limited opportunities to seek and receive information and knowledge, particularly public, available in accessible, affordable and adaptable formats and tools.⁹¹ This limits their opportunities to make the transition from education to work and ensure full participation in society. They are more likely to die in disasters, to be left behind during evacuation, or may have limited access to emergency shelters and transportation systems^{92, 93} and disaster risk reduction programmes that target people with disabilities remain the exception.⁹⁴

Commonly used strategies:

The needs of persons with disabilities are often addressed through a twin track approach, through specific programs targeting persons with disabilities as well as through provisions added to mainstream community-wide policy interventions.

For example, to address exclusion from employment markets, countries use a variety of mechanisms, such as anti-discriminatory laws and regulations, quotas for persons with disabilities at the workplace and incentives (tax credits, support to the employers for accommodation or workplace modifications), special supported employment, training programmes, and microfinance for self-employment.

Access barriers to health care for persons with disabilities are often complex,⁹⁵ ranging from barriers related to the affordability, to physical accessibility, to communication with health care professionals and so on. In some cases, primary health care can be the best solution for providing health care for persons with disabilities, along with support from specialized services.⁹⁶ This has been proven efficient for example with persons with mental health problems, minimizing stigma and discrimination.⁹⁷ However, targeted interventions can be used to reach those that are not otherwise included in broad-based programmes. Examples of such interventions include outreach teams in Brazil and India follow-up on patients with spinal cord injuries to address issues such as skin care, bowel and bladder management, joint and muscle problems, and pain management,⁹⁸ or ensuring that educational materials on HIV/AIDS for youth are made in accessible formats such as videos with sign language.⁹⁹ In some cases practical arrangements can make a difference for accessibility, such as building ramps to access hospitals and health care centers, or procuring mammography equipment that can accommodate women who cannot stand.¹⁰⁰ A significant shift in the design of mainstreaming ICTs to incorporate accessibility and user functionalities for the widest number of users has been introduced by various producers which provide new opportunities for persons with disabilities to access to information and knowledge.

Strategies aiming towards inclusion of persons with disabilities are by design aiming to reach those left behind. However, in some cases the evidence of real impacts and costs and benefits of these strategies, for example for enhanced employment opportunities, are still lacking and further research is needed.¹⁰¹

How 'reaching the furthest behind first' compares with other strategies:

Some strategies aim to reach those furthest behind. For example, efforts have been made in a number of countries to support inclusive access to justice for children with disabilities. In Zimbabwe, targeted services have been provided to children with disabilities in regional courts, and police seek professional services as soon as a child with disability is identified as a survivor, witness or alleged offender. Stand-by teams of disability experts have been established in regional courts. This has improved communication and interpretation of evidence by court

intermediaries in cases of abuse and rights violations, resulting in effective and consistent prosecution and expeditious adjudication of pending cases by magistrates and public prosecutors.¹⁰² In relation to inclusive social protection schemes, Jamaica, for instance, has combined its conditional cash transfer programme to poor families with children up to 17 years of age with unconditional cash transfers for families caring for children with disabilities, along with free home-based health care visits.¹⁰³ In some countries, access to information and knowledge for students with disabilities, particularly through Open and Distance Learning, is ensured by applying procurement procedures and practices that include accessibility standards and requirements for persons with disabilities from the outset.

How those left behind and 'furthest behind' are identified:

Disability, a complex multidimensional experience, poses several challenges for measurement. Approaches to measuring disability vary across countries and influence the results of research and reviews.¹⁰⁴ Historically, reported prevalence estimates have varied widely because of different definitions of disability and the fact that data has often been of poor quality. However, efforts have been made to address this situation in recent years, and estimates of the prevalence rates of adults with disabilities are becoming more reliable and less varied in quality. The International Classification of Functioning, Disability and Health, known more commonly as ICF, is the WHO framework for measuring health and disability at both individual and population levels.¹⁰⁵ As the functioning and disability of an individual occurs in a context, ICF also includes a list of environmental factors. Determining disability in childhood through survey data is complicated because of the natural variance in children's development, the differing cultural standards of what children are expected to be capable of doing, and the need to use proxy respondents.¹⁰⁶ Recently, UNICEF and the UN Statistical Commission's Washington Group on Disability Statistics have developed a survey module for identifying children with disabilities in surveys.

In terms of reaching the furthest behind, some programmes pay particular attention to persons with multi-layered vulnerabilities, such as children with disabilities.

Access to primary education

Context:

The world has achieved considerable advances in primary education during the life span of the MDGs. For example, the primary school net enrolment rate in the developing regions has reached 91 per cent in 2015, up from 83 per cent in 2000.¹⁰⁷ However, poverty, children's gender, caste, ethnic and linguistic background, race, disability, geographical location and child labour continue to serve as barriers for many children's education.¹⁰⁸

Almost 16 million girls between the ages of about 6 and 11 will never get the chance to learn to read or write in primary school compared to about 8 million boys if current trends continue.¹⁰⁹ In South and West Asia about 4 million girls will never get the chance to learn to read and write in primary school, compared to almost 1 million boys.¹¹⁰ However, future challenges in developed countries seem very different. A recent OECD study shows that girls outperform boys in reading in almost all of the PISA study countries. This gender gap is particularly large in some high-performing countries, where almost all underperformance in reading is seen only among boys, demanding special strategies to address this gap.¹¹¹

Despite improvements in recent decades, children and youth with disabilities are less likely to start school or attend school than other children. They also have lower transition rates to higher levels of education.¹¹² Research shows that disability is a stronger predictor of educational enrolment than either gender or socio-economic class in a study of 11 developing countries.¹¹³

Children in conflict-affected countries account for just 17% of primary school-age children, but more than one-third (36%) of all children who were denied an education in 2012 globally. This failure means that children of primary school age in fragile and conflict-affected situations are nearly twice as likely to be out of school than children in the developing world as a whole.¹¹⁴

Commonly used strategies:

In many countries, education is seen as a primary policy lever to reach those left behind and as a key means of enhancing and democratizing learning opportunities for children coming from disadvantaged families or communities. Although the ways education systems are financed varies widely across countries, a number of countries provide primary and secondary education for free, with some investing extra resources in school districts located in disadvantaged neighborhoods.^{115, 116}

Key factors contributing to enhancements in universal primary education have included abolishing school fees; increasing demand for education through initiatives such as cash transfers, school feeding programmes and take-home rations; increasing the supply of schools and classrooms, investing in teachers' quality and incentives, as well as investing in health and infrastructure.¹¹⁷

Evidence-based policies and strategies to address exclusion in education include elimination of cost barriers through, for example, cash transfer programmes; provision of school meals/nutrition and health services; provision of learning and teaching materials and transport services; second chance/re-entry programmes; inclusive school facilities; teacher training on inclusive education; and language policies to address exclusion.¹¹⁸

To ensure gender equality in education systems, Governments and partners have mainstreamed gender issues in teacher education and curricula and monitoring processes, and have aimed to eliminate gender-based discrimination and violence in education institutions to ensure that teaching and learning processes have an equal impact on girls and boys, women and men, and to eliminate gender stereotypes and advance gender equality. Evidence has found the importance of putting in place special measures to ensure the personal security of girls and women in education institutions and on the journey to and from school, in all situations but in particular during conflict and crises.¹¹⁹

How 'reaching the furthest behind first' compares with other strategies:

Education strategies and policies have encompassed measures aiming to reach groups at a special disadvantage. Focusing on children with disabilities, subject to the context, availability of resources and engagement towards fostering more inclusive societies, countries are adopting different strategies to progress towards inclusive education that addresses the needs of all learners in regular schools. In some countries, segregated educational provision for children with disabilities is still prevalent.^{120, 121} Others have opted for models more geared towards inclusion, which involve the reduction of special school provision by employing whole-school policies and planning to develop inclusive approaches that respond to a wide range of learning needs and diversity of learners. Other models are based on the premise of the development of inclusive regular schooling and inclusive pedagogy, while keeping some separate specialized provision particularly for some specific types of impairments, until provisions to support whole school inclusive policies in regular schools can be provided. Lastly, other approaches are focused on providing additional funding for schools that include children with disabilities by allocating more resources and increasing incentives for enrolment.¹²²

How those left behind and 'furthest behind' are identified:

Many countries have standards by which they assess the education level of children at all levels of schooling. In many countries, detailed statistics are available at a school or even class level on students having difficulty in school or suffering from other disadvantages. In many cases though, in order to identify the furthest behind, household surveys or other methods are required. The UNESCO Institute for Statistics generates estimates of the number of out-of-school children from official administrative data for three age groups: children of primary school age and adolescents of lower and upper secondary school ages. Within each age group, only children in formal primary or secondary education are counted as in school.

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ANNEX 2

Methodology for Chapter 2

The methodology used in the analysis of the interlinkages followed the so-called 'realist review' method, which is considered a rigorous approach to analyse heterogeneous data emerging from various disciplines to identify relationships between different concepts.¹ The method comprises four elements (Figure A). The first step was a search for relevant information and scientific papers on topics relevant to the three areas covered in the nexus. That consisted of: 1) an initial map of the interlinkages assembled by the authors; 2) an electronic bibliographic search, which identified 201 relevant articles; 3) identification and outreach to 147 experts based on the authorship information available in those articles. Twenty-four experts provided inputs, including the identification of linkages and of another set of 97 relevant scientific articles; 4) outreach to experts within the United Nations System to collect relevant information about scientific research on the nexus; 5) outreach to experts outside the United Nations System to

collect information; and 6) bibliographic search of relevant articles that cited those scientific papers identified in the previous four steps.

Although broad, the resulting list of relevant articles can only be considered illustrative of the literature because, among other reasons, the search was mainly done in English language and most of the experts who replied to the invitation to contribute were based in institutions located in developed countries.²

Second, the team of primary reviewers selected a subset of relevant articles based on the inclusion criteria presented in Table A. The focus of the analysis was on studies focusing on the interrelations between the elements of the nexus and that provided empirical results. The third element was the extraction and compilation of relevant attributes, including the direction and magnitude of the interlinkages, measures used, and assumed channels through which one element of the nexus affects the other. The fourth step was the identification of patterns, links, most probable channels within the nexus and the gaps in knowledge.

Figure A. Main elements of the methodology

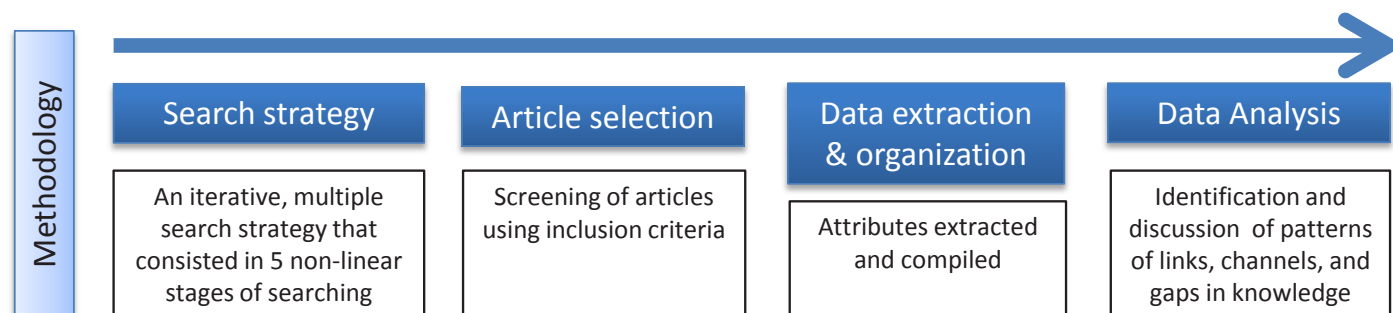


Table A. Inclusion criteria of scientific research

	Study focus and outcome	Study design
Includes	<ul style="list-style-type: none"> • Infrastructure policy, design, plan, provision in the areas of roads, ICT, electricity, water, sanitation, irrigation and its outcome related to inequality or resilience • Inequality and effects on infrastructure or resilience • Resilience design, plan and outcome related to infrastructure or inequality 	<ul style="list-style-type: none"> • Systematic reviews, meta-analysis, case studies, quasi-experimental studies, econometrics
Excludes	<ul style="list-style-type: none"> • Studies with focus and outcome in the same area (e.g. focus on inequality of income and outcome on inequality of health) • Proposal of methodologies to assess resilience or inequality • Studies that focus on other forms of infrastructure (e.g. housing, hospitals) • Resilience against conflicts and security-related shocks 	<ul style="list-style-type: none"> • Non-empirical studies • Estimate of impact of disasters • Editorial, commentaries, letters, opinion pieces

Source: Authors elaborations.

Endnotes

- 1 For an example of the use of the method see Kastner, M, Makarski, J, Hayden, L, Durocher, L, Chatterjee, A, Brouwers, M, & Bhattacharyya, O 2013, 'Making sense of complex data: a mapping process for analyzing findings of a realist review on guideline implementability', BMC Medical Research Methodology, 13, 1, pp. 1-8, Academic Search Premier, EBSCOhost, viewed 30 March 2016.
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ANNEX 3

Scientists' perspectives on crucial emerging technologies for the SDGs until 2030

Bio-technology

*Biotechnology, genomics, and proteomics*¹ are now major driving forces in the biological sciences and are increasingly being applied in the study of environmental issues, medicine and pharmaceuticals, infectious diseases, and modifications of food crops.

Bio-technology has the potential to lead to sustainable solutions for a range of sustainable development issues.² For example, genetically modified organisms could help address food insecurity in developing countries, but their impact on ecosystems, human health and community values may need to be better understood to be considered a truly sustainable solution.³ Experience has shown that deployment of such technologies needs to consider the local situations and possible trade-offs.⁴

Synthetic biology is a field of great promise and possible dangers. Tailor-made medical solutions, gene therapy, technology disruption in the food industry, bio-engineered medicines, and precise bio-inspired drug delivery systems that target specific infected cells - together with stem cells - give many promises. However, if inappropriately used, it could cause irreversible changes to human health and environment.^{5, 6, 7} Synthetic biology requires effective policies and frameworks to manage all stages of their life-time, including manufacturing, distribution and use, as well as safe disposal or where possible effective recycling.^{8, 9, 10}

New and emerging gene-editing technologies and their implications, benefits, and potential ethical problems for biotechnology and medicine have generated international scientific debate, with recommendations to establish norms concerning acceptable uses of human germline editing and harmonize regulations.¹⁰ Genuine "human engineering" may not be far off in the future, when technologies related to gene-editing, stem cells and computational models of the human brain will be combined.

Digital technology

Digital information and communications technologies (ICTs) have continued to rapidly advance. All parts of the world are now major users. Mobile phone ownership in Africa is now comparable to that in the USA, with about one connection per capita. Yet, while some digital gaps have closed, others continually open with the introduction of new technologies. In the context of implementing SDGs in Africa, information and communications technologies may play a role comparable to that of machines in the replacement of labour in the industrial age.¹¹ However, whereas the machines of the industrial era functioned as

isolated and individual artefacts in one local environment, ICTs and knowledge creation exist as a hierarchy of networks that bring about innovations.^{12, 13}

Great technology potential has been accompanied by equally great concerns about social, political, economic and environmental impacts. The new fifth generation (5G) mobile phones enable vastly faster data connections than traditional phones. The "Internet of Things" is emerging and it interconnects physical objects to internet infrastructure. 3D printing enables the making of three-dimensional objects from a digital file, and together with robotics it has the potential to significantly alter the geographical distribution of manufacturing with important impacts on global labour markets and imbalances. "Big data" technologies transform the way governments, citizens, and companies do business, but they have led to concerns about erosion of privacy and freedom of expression. Similarly, wireless sensor networks have great efficiency potentials in many areas, but there are concerns about their impact on privacy, freedom and development.

Big Data and the Internet of Things through the use of huge datasets and Internet-connected sensors potentially adds to the existing toolkit for sustainable development (e.g., in health, agriculture, food security, sustainable urbanization, etc.), but can also introduce risks related to data privacy and security. Because of cloud computing platforms that provide low-cost access to compute and storage capabilities as well as Free and Open Source Big Data and Internet of Things technologies, such technologies can serve as platforms for locally-relevant, pro-poor innovation without significant capital investments. However, this requires the requisite local talent to tailor solutions to local needs. National governments must also consider the limits of big data analysis (especially for causal inference and policy analysis), how such technologies can serve existing national development planning, regulatory frameworks for securing the rights of citizens with respect to privacy and security, and strengthening human capital and the larger ecosystem to effectively use such tools.¹⁴

"Big data" has transformed the volume, velocity, and character of the information that we are able to procure regarding virtually every aspect of human life.¹⁵ Online participatory tools increasing transparency and accountability in global sustainable development governance allow greater access to sharing of substantive information on the issues addressed by the civil society, international organisations and member states for realization of agenda 2030.¹⁶ At the same time, the scientific community highlighted the idea that the most sustainable way to bring the deepest results of the digital revolution to developing communities is to enable them to participate in creating their own technological tools for finding solutions to their own problems.¹⁷

3D Printing (3DP) can cost-effectively lower manufacturing inputs and outputs in markets with low volume, customized and high-value production chains. It could potentially help countries and regions that did not participate in the industrial revolution develop new manufacturing capabilities, especially for low volume, highly complex parts. Applications range from automobile and aerospace manufacturing to rapid-prototyping, healthcare, and education. Low cost consumer 3DP printers can help local people in developing and developed countries to produce a range of useful products, from basic assistive technologies to educational aids. For example, the projects of the Rapid Foundation in India and Uganda have shown that low cost printers are easy to build, use, fix or modify and are robust in remote locations. With expert training, anybody can become comfortable with using these printers in a few hours.¹⁸ Further low-cost applications in science, education and sustainable development are detailed in a recent ICTP open book.¹⁹

3D printing presents a number of challenges, including possibly disrupting existing manufacturing global value chains, decreasing labour demand for housing and construction, and potentially enabling the physical production of illegal 3D models that could pose both economic and security threats. There are potential environmental benefits (lower energy use, resource demands and CO₂), if 3D printing displaces existing transportation and logistics routes for shipping of goods and products. A recent study concluded: “If 3DP was applicable to larger production volumes in consumer products or automotive manufacturing, it contains the (theoretical) potential to absolutely decouple energy and CO₂.”²⁰ However, as 3DP is expected to remain a niche technology by 2025 reductions in energy and CO₂ emission intensities of industrial manufacturing could only be reduced by a small factor through 3DP by that date.

Massive Open Online Courses potentially provide resource-poor regions and individuals more equitable access to world-class education content. Widespread global Internet access is impacting how we learn, as seen in the availability of various online learning platforms such as massive open online courses (MOOCs).²¹ With low-cost replication of recognized content and education, personalized, self-paced learning, and interactive data-driven user interfaces, students potentially have access to material that previously would have been out of reach. However, MOOCs may not provide locally-relevant content tailored to a specific national context. Furthermore, MOOCs could replace the jobs of existing teachers and widen existing educational divides (i.e., providing a disproportionate advantage to individuals with access to the Internet and education). One nonprofit university based in Rwanda combines online learning content with in-person seminars to deliver degree programs that are locally-relevant, appropriately priced,

and stimulate local employment. At this point, the potential impact of MOOCs requires more study, both globally in terms of existing platforms as well as of users in specific national contexts, along with implications for educational systems and employment.

Optimal system use of radio, mobile phone, GIS and remote sensing technologies is considered vital for transforming rural populations.²²

The use of GIS to monitor an ever wider array of parameters at ever higher spatio-temporal resolutions allows us to consistently and constantly measure and monitor a huge array of environmental factors, allowing the enforcement of regulations, which would otherwise be impossible.^{23, 24}

Yet, *data management* remains a challenge for many countries, as they lack both skilled staff and technologies for effectively collecting or reporting reliable data. Many of the commonly used spatial database platforms are proprietary and are too expensive for many organizations in developing countries.²⁵

Nanotechnology

*Nanotechnology*²⁶ is a field of enormous promise and big challenges. It is reported to have high potential for increasing innovation for sustainable development in the energy, water, chemical, medical and pharmaceutical industries.²⁷ *Nanoimprint lithography* is expected to lead to large-scale manufacturing of nanotechnology products with various positive and negative sustainable development challenges. Nano-products might revolutionize many fields including medicine, electronics, energy and water, as well as food industry in the coming years. At present, there are high expectations about high-performing nanomaterial solar cells and nano-technology applications for decentralized water and wastewater treatment, and desalination.²⁸ Recently, scientists in Singapore have demonstrated converting CO₂ into methane using light and amine-functionalized titanium dioxide nanoparticles – this would allow storing intermittent solar energy in the form of natural gas which could then be burned in a carbon neutral way.

The implications of unethical and uncontrolled use of nanotechnology have created an ongoing debate in the scientific community around concerns about their toxicity and environmental impact (e.g., nanowaste).^{29, 30, 31} The OECD and IUCN are currently working with several governments to develop suitable and efficient regulations and policies, and urge a more unified and collaborative approach at all levels to address this potentially hazardous issue through experience- and knowledge-sharing, coordinated research activities, development of guidelines for producers, users and waste-processing facilities^{32, 33} and examination of existing guidelines or policies.³⁴

As nanotechnology can be damaging to environment and human health, it requires effective policies and frameworks to manage all stages of their life-time, including manufacturing, distribution and use, as well as safe disposal or where possible effective recycling.^{35, 36}

There are many promising future, inorganic and organic nanomaterials. Examples include perovskites, gold nanoparticles, graphene, carbon nanotubes, carbon nanodots and conducting polymers. *Carbon based nanomaterials* are very interesting as they rely on abundant carbon and have much potential as high performance substitutes for many materials that are scarce and highly resource intensive in their extraction process. *Iron, cobalt, and nickel nanoparticles can be alternatives to scarce metals* like platinum, rhodium, and gold *for catalysis*. For example, layered iron and nickel nanomaterial are a more sustainable alternative to rare-earth “supermagnets”.

Neuro-technology

Smart technologies will be crucial technologies until 2030 and beyond. They will help societies to monitor, detect as well as respond or adapt to changes in their environment. Smart technologies are already and will become a part of our daily lives.³⁷ For example, smart electricity metering has addressed the problem of the losses of electricity due to theft.³⁸

Emerging technologies in the area of artificial intelligence have received much attention in which computer systems that carry out tasks normally done by humans, such as speech recognition and decision making. Another example is *robotics* which is understood as machines or mechanical systems that automatically handle tasks.

*Mesosience*³⁹ *powered virtual reality* gives us the possibility to realize the logic and structural consistence between problems, physical models, numerical methods and hardware, which, together with the dramatic development of computing technology, is opening a new era for virtual reality.

Digital Automation characterizes the increasing ability of computers to overtake cognitive - and not just physical - tasks, enabling recent innovations like driverless cars, IBM Watson, e-discovery platforms for legal practice, and personalization algorithms for Web search, e-commerce, and social networks. The *potential consequences of automation and artificial intelligence on employment* are emerging areas in need of examination; the expansion of computing and machine intelligence is likely to affect healthcare, education, privacy and cybersecurity, and energy and environmental management. Recent studies are pointing to the possibility that a significant number of jobs - or job tasks - are amenable to automation, leading to a job polarization where demand for middle-income jobs

are reduced while non-routine cognitive jobs (e.g., financial analysis or computer programming) and non-routine manual jobs (e.g., hairdressing) would be less unaffected. At this point, more study is warranted to understand implications for employment and socio-economic development in a specific national context.

Autonomous vehicles or self-driving cars hold the promise to increase traffic efficiency, productivity, reduce traffic congestions and pollution, and save driving time. In 2016, the Dubai Autonomous Transportation Strategy was launched which foresees 25 per cent of all trips in Dubai to be driverless by 2030. The Autonomous Transportation Challenge as launched as a request for proposals to global R&D centres to apply this technology in Dubai. It will make Dubai the world's largest R&D lab for driverless transportation.⁴⁰

Green technology

Green technology refers to environmentally sound technology. Existing technologies as well as new nanotechnology, biotechnology, and digital technology may all be deployed in new ways to reduce non-renewable resource use and to utilise and support ecosystem processes.

Technology change in the energy and materials sectors are key.⁴¹

In the energy sector of developed countries, crucial technologies suggested by experts include smart grids, highly energy efficient buildings, electric vehicles, vastly improved and cheap batteries, nuclear power, hydrogen-fueled vehicles and supply infrastructures, and natural gas technologies. In developing countries, they included new ways of electrification, desalination based on reverse osmosis, small and medium sized nuclear reactors, and mini-grids based on intermittent renewables with storage.⁴²

Cheaper and highly energy efficient fossil fuel power plants will be needed. Highly efficient vehicles including hybrid cars and intelligent transport systems (ITS) technologies for controlling traffic flows will be important.^{43, 44} Large-scale deployment of solar power, and technologies to replace aluminium and other high impact materials are equally important.⁴⁵ Salinity gradient power technology could potentially produce 80 per cent of the global energy demand.⁴⁶ Passive housing technology could make a big difference in energy use, as it results in ultra-low energy buildings that require little to no energy for space heating or cooling.

Decentralized electric power systems are expected to play a very important role in coming years, especially for ensuring that no one is left behind. To this end, RD&D is needed in such systems (efficient appliances, intermittent

supply solar, wind) and in interactions with heat pumps for space heating, heat and power storage and electric mobility. Innovative community and business models will be needed to operate such systems in terms of reliability, affordability, sustainability and safety and privacy. Another component of this emerging technology system will be integrated urban and rural mobility, notably a well-functioning public transport infrastructure, new mobility options (e.g., e-bike, e-car, greenwheels) and in some areas biofuel supply chains.⁴⁷ Hence, deployment of off-grid electricity systems and even direct current can be a core solution to achievement of the SDGs.^{48, 49} They should be given ample research funding.^{50, 51} For example, off-grid electricity could be used to dry grain⁵² and to store and transport perishable food,⁵³ in order to reduce food wastage.^{54, 55} Institutional innovation does not only promote the development and deployment of technologies, but also provides the foundations for paradigm shift. In China, block tariff of household electricity consumption accelerated replacement of incandescent fluorescent lamps with LED lamps. Feed-in pricing of wind-power and solar PV are thought to have contributed to make China the country with highest increase in and the largest installed capacity of wind and solar PV in the world.^{56, 57, 58}

Cookstoves with the emissions comparable to those of an LPG stove would play an important role in the achievement of the SDGs, given the enormous and multiple benefits that could come from the large-scale deployment of such a stove.^{59, 60} Globally, more than 2 billion people rely on traditional use of biomass fuels for cooking and heating and have limited access to clean and efficient energy for lighting. Increasing access to clean and efficient cookstoves and fuels can also ensure lasting, inclusive gains in the areas of poverty eradication, food security, health and well-being, education, gender equality, economic growth, reducing inequalities, sustainable cities, environmental protection, and climate change mitigation. Effective deployment of these technologies requires substantial engagement of women. Developers need to put female users at the center of their concepts, design and deployment stages.⁶¹

Technologies for pollution purification will be of the utmost importance until 2030. New technologies for detection and removal emerging contaminants in stormwater, for drinking water, and wastewater treatment and reuse are emerging. In the future, every gasoline-powered motor vehicle would be equipped with emission purification plant, and polluting enterprises would be installed with comprehensive purifying equipment. Meanwhile, environmentally-friendly energy would be widely used in diverse industries.⁶²

New technologies are emerging that support a transition to a circular economy.⁶³ These include technologies for remanufacturing, technologies for product life-

cycle extension such as re-use and refurbishment, and technologies for recycling.⁶⁴ Social innovation will also play an important role. The level of performance and deployment will depend on material streams and the specific context. Proposed by the EU Circular Economy Package of December 2015, a recycling rate of 65 per cent for municipal solid waste may be achievable by 2030.⁶⁵

Technological advancement should foster an urban metabolism that is sustainable in itself not dependent on other regions for the supply of resources and the discharge of waste.⁶⁶ In this direction, new recycle and reuse technologies and multifunctional infrastructures play a pivotal role. Technologies for integrating centralized systems and decentralized systems for provision of services such as energy and potable water are also emerging.^{67, 68, 69, 70, 71}

A whole range of new *deep sea mining technologies* are emerging, but many of them are not yet commercially viable. These technologies could have greatly impact sustainable development, in view of their impacts on global resource use and their potential benefits for island nations.⁷²

The production of food for half of the world's population continued to depend on fertilisers made by fixation of nitrogen through the Haber-Bosch process. Technologies for nitrogen fixation that are less energy intensive and that avoid very high H₂ pressure would be highly desirable. *Advances in bio-organometallics and materials chemistry are greatly increasing the efficiency of biomimetic analogs of nitrogenase*, a natural enzyme that can fix atmospheric nitrogen at room temperature and pressure without the need of molecular hydrogen.

Improvements in geophysical research and seismic exploration of the ocean floor, through the application of *marine Vibroseis (MV)*, show potential in providing an environmentally safer alternative to airguns, which have negative effects on marine animals.⁷³

Artificial photosynthesis is close to commercialization. It is now possible to produce different carbohydrates directly from CO₂ and water using merely sunlight. Artificial leaves, when immersed in water, directly produces hydrogen and oxygen. These leaves consist of wireless, low-cost, thin film amorphous silicon multi-junction cells.⁷⁴

Endnotes

- 1 *Biotechnology* means the use of genetic engineering and its associated techniques. *Genomics* is the study of the genomes of organisms, i.e., the complete set of DNA within a single cell of an organism. *Proteomics* is the large-scale study of proteins, particularly their structures and functions.
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ANNEX 4

Selected studies analysing NCSDs

Study	Main topic covered
The Earth Council (1997), A Vision and Practical Measures for National Councils as Effective Mechanisms for Sustainable Development, Annex 1. ¹	The report is the outcome of the National Councils for Sustainable Development working group at the Rio+5 meeting held in Brazil. It gives recommendations for future strengthening of the NCSDs.
UNECLAC (2000), Sustainable Development Latin American and Caribbean Perspective. ²	The report takes stock of regional experiences in sustainable development implementation.
UNECA (2005), National Councils for Sustainable Development in Africa: A review of Institutions and their Functioning, Addis Ababa ³	The report takes stock of established NCSDs in Africa and their operations, in the context of the requirement for a balanced integration of the economic, social and environmental dimensions of sustainable development.
Niestroy, I. (2007): Stimulating informed debate – Sustainable Development Councils in EU Member States. A compilation of tasks, capacities, and best practice. ⁴	Commissioned by the German Council for Sustainable Development (RNE), the paper explores two tasks and functions allocated to the sustainable development councils in EU Member States by the EU SDS of 2006, namely stimulating informed debate on SD and involving civil society.
Berger, G. and Steurer, R. (2009), Horizontal policy integration and sustainable development: conceptual remarks and governance examples, ESDN quarterly report, June 2009.	The report explores the meaning of horizontal policy integration in the context of sustainable development. It highlights how the functioning of public administrations may stand in the way of this objective, and what governments can do to overcome existing barriers.
Busch and Jorgens (2009), Governance by diffusion. International environmental policy coordination in the era of globalization, Dissertation, FU Berlin, 2009.	The paper explores systematically the aptitude of diffusion as a distinct mode of international policy coordination, its functioning and its relative importance compared with other, more centralized steering mechanisms.
Niestroy, I. (2012), Sustainable Development Councils at National and Sub-national Levels Stimulating Informed Debate: Stocktaking, Stakeholder Forum Sdg2012. ⁵	The paper aims to provide useful lessons learned on NCSDs. It focuses on the purpose, composition and functions of NCSDs, and reviews common trends and best practices.
Cornforth, J., I. Niestroy and D. Osborn (2013): The governance of scaling up successful sustainability practices: How can National Councils for Sustainable Development organise the wider use of national and regional examples? ⁶	The paper discusses the governance of scaling up, looking at different factors which affect the transferability of successful practices and explores examples of mechanisms for scaling up that could be used by the NCSDs.
Osborn, D., Cornforth, J. and Ullah, F., (2014), National Councils for Sustainable Development: Lessons from the past and present, Stakeholder Forum. ⁷	The report draws on a survey focusing particularly on countries where NCSDs have been seen to function well in order to try to identify best practises and success factors.
Olsen, S.H. and Zusman, E. (2014), Governance and National Sustainable Development Strategies, Institute for Global Environmental Strategies (IGES) Policy Report. ⁸	Lessons learned from five detailed cases from Asia, namely, Thailand, Indonesia, Philippines, Republic of Korea, and Bhutan.
De Vries, M. (2015), The Role of National Sustainable Development Councils in Europe in Implementing the UN's Sustainable Development Goals: Overview and Conclusion, Background Paper commissioned by the German Council for Sustainable Development (RNE) and EEAC. ⁹	The report analyses the main challenges tasks, and functioning of National Sustainable Development Councils in Europe, and their capacity for participating effectively in the SDG implementation.
Niestroy, I. (2015), Governance approaches and tools for SD integration: good practice (what has worked where and why) at national level, paper for the UNDESA/UNEP Technical Capacity Building Workshop Sustainable Development Integration Tools, Geneva, 14-15 October 2015	The paper presents key steps to take for translating the SDGs in national policies and processes and highlights key governance principles and respective integration approaches.

Source: Authors' elaboration.

Endnotes

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ANNEX 5

Examples of emerging issues processes/mechanisms undertaken by UN agencies

Entity and description	Issues
<p><i>Food security and nutrition</i></p> <p>The High Level Panel of Experts on Food Security and Nutrition (HLPE) was established in 2010 as the science-policy interface of the United Nations Committee on World Food Security (CFS).</p>	<p>A 2013 Note on emerging issues in the context of FSN highlighted four challenges: (a) many disciplines involved in the identification and framing of issues, and many different ways to relate them to the four dimensions of food security; b) issues can emerge specifically due to increased interdependencies between, e.g. agriculture and other sectorial issues such as transportation; c) issues can emerge in the future, therefore, requiring foresight tools; and d) contexts change and issues vary, which calls for regularly revisiting them.</p> <p>Participants surveyed were asked to provide in-depth disaggregated information on the effect the emerging issue they put forward had in terms of the number affected, their geographical location, gender and vulnerable group. This aspect of the methodology was already in line with the main premise of the 2030 Agenda of “leaving none behind.”</p> <p><i>Recent completed reports:</i> Water for food security and nutrition (2015), Food losses and waste in the context of sustainable food systems (2014), Sustainable fisheries and aquaculture for food security and nutrition (2014). <i>Underway:</i> Sustainable agriculture development for FSN, including the role of livestock (2016), Sustainable forestry for food security and nutrition (2016).</p>
<p><i>Environment – UNEP</i></p> <p>UNEP’s Emerging Issues Project has identified ten major issues of focus in the year 2015/16 based on the regional and policy relevance, urgency, evidence and newness.</p>	<p>The issues are: 1. Marine plastics and biodegradability; 2. Micro-beads and Cosmetics; 3. Emerging Zoonotic Diseases; 4. Drought and Plant Toxicity; 5. Soil Carbon and Valuation; 6. Loss and Damage; Water Risk Financial Share Pricing; 8. Dust and Sandstorms and Desertification; Illegal Wildlife Trade; 10. New Materials and 3D Printing</p>
<p><i>Marine environmental pollution – GESAMP</i></p> <p>Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body established in 1969 and consisting of specialized experts nominated by nine Sponsoring United Nations Agencies, namely IMO, FAO, UNESCO-IOC, UNIDO, WMO, IAEA, UNEP, and UNDP. GESAMP’s principal task is to provide scientific advice concerning the prevention, reduction and control of the degradation of the marine environment to the Sponsoring Agencies.</p>	<p>GESAMP’s New and Emerging Issues Programme - At its 2015 session, the impact of residues of chronic oil spills in the marine environment was raised as an issue of particular concern. GESAMP was called to carry out a study on disinfection by-products and biofouling to add further knowledge on the subject matter (Report of the 42nd Session of GESAMP, 2015).</p>
<p><i>Science - UNESCO</i></p> <p>Science Report mapping science, technology and innovation (STI) produced annually for the past twenty years. The 2015 UNESCO Science Report: towards 2030, analyses trends and developments in science, technology and innovation policy and governance between 2009 and mid-2015, with a view to providing essential baseline information on the concerns and priorities of countries that should orient the implementation and drive the assessment of the 2030 Agenda.</p>	<p>2015 Report contains chapter on Perspective on Emerging Issues with five articles (a) the increasingly global role universities play, including related opportunities such as educational partnerships, explosive growth in brain circulation, and the digital disruption, while the need to close the innovation gap is identified as among the challenges; (b) increased interconnectedness of the second generation World Wide Web and open science that has helped develop a modern approach to science through information-sharing and data-reuse; (c) the critical role science will have in implementing the 2030 Agenda and the need for an integrated approach to achieve this; (d) the need for a new framework for global science policy, and (e) the contribution of local and indigenous knowledge to the science-policy interface.</p>
<p><i>Disaster risk – UNU-HIS</i></p> <p>United Nations University – Institute for Environment and Human Security (UNU-EHS) and the Alliance Development Works/Bündnis Entwicklung Hilft (BEH) publish the annual World Risk Report, which systematically considers a country’s vulnerability, and its exposure to natural hazards to determine a ranking of countries around the world based on their disaster risk.</p>	<p>The 2015 report examined the connection between food security and disaster risk, drawing on the report’s World Risk Index. One of the recommendations of in the report is that investment in food security should be designed in such a way that the vulnerability of societies towards disasters is lowered. Previous reports have considered Cities as an area of risk (2014) and Health and Healthcare (2013).</p>

Annex 5: (continued)

Entity and description	Issues
<p><i>Digital dividends – World Bank</i></p> <p>The World Development Report 2016, entitled Digital Dividends, analyzes the contribution of digital technologies to development. Noting their rapid spread throughout the world, it also recognizes that the broader development benefits from using these technologies have lagged behind.</p>	<p>The WDR 2016 also examines six nascent or emerging technologies that promise to be far-reaching in their impact on development. They are: fifth generation (5G) mobile phones, with vastly faster data connections than existing phones; artificial intelligence, computer systems that carry out tasks normally done by humans, such as speech recognition and decision making; robotics, understood as machines or mechanical systems that automatically handle tasks; autonomous vehicles, or self-driving cars; the internet of things, which refers to the interconnection of objects to internet infrastructure; and 3D printing, a process that enables to make three-dimensional objects from a digital file.</p>
<p><i>UN Secretary-General's Scientific Advisory Board (UN-SAB)</i></p> <p>In December 2014, the UN Secretary-General invited the UN-SAB to identify for his consideration "scientific concerns about the future of people and the planet." The Board responded by conducting a Delphi study to identify the top challenges for the future of humanity and the planet, identifying "big ideas" to be brought to the attention of the Secretary-General and for him to seek a global response.</p>	<p>The result was the list of top eight challenges presented in this brief for consideration by the UN Secretary-General. These Top Eight Challenges were: one ocean, many countries: building a "blue economy" sustainably, addressing threats to biodiversity and establishing a new paradigm for the global tropics, putting in place a comprehensive strategy against infectious agents, including a global system for immediate response, ensuring investment, as a fraction of GDP, in basic research and basic science education, averting enormous human disasters through prediction, emissions free technology: changing the fossil fuel paradigm, providing drinking water for all, finding solutions for a world overwhelmed by unequal resource use and continued population growth.</p>
<p><i>Intergovernmental Oceanographic Commission (IOC) of UNESCO</i></p> <p>The purpose of the Commission is to promote international cooperation and to coordinate programmes in research, services and capacity-building, in order to learn more about the nature and resources of the ocean and coastal areas and to apply that knowledge for the improvement of management, sustainable development, the protection of the marine environment, and the decision-making processes of its Member States.</p>	<p>An international group of ocean oxygen scientists investigating the threat of deoxygenation globally, supported by IOC-UNESCO, summarized 10 major ocean oxygen issues: increasing temperatures will reduce the capacity of the ocean to hold oxygen in the future; oxygen deficiency is predicted to worsen in estuaries, coastal areas and in oxygen minimum zones in the open ocean; the ocean's capacity to produce oxygen will be reduced in the future; habitat loss is expected to worsen, leading to vertical and horizontal migration of species; oxygen deficiency will alter biogeochemical cycles and food webs; lower oxygen concentrations are projected to result in a decrease in reproductive capacity and biodiversity loss; there are important local decreases of commercially important species and aquaculture production; harmful algal blooms might be stimulated by nutrients released in bottom waters due to hypoxia; reduced ocean oxygen concentrations will lead to an increase in greenhouse gas emissions, thereby initiating feedbacks on climate change; future scenarios for oxygen depend on a combination of drivers related to global environmental change and land-use, which, in turn, act together in affecting marine ecosystems – thus, a multi-stressor approach is important.</p>

Source: Authors' elaboration.

Examples of emerging issues placed within a frame of broader underlying issues: expanded matrix

Emerging Issue	Value to be Sustained	Threats	Opportunities	Causal mechanisms	Responses/Actions	Key Emerging Features
Coping with the increasing impacts of climate changes.	<ul style="list-style-type: none"> Sustainable development 	<ul style="list-style-type: none"> Threat to global: <ul style="list-style-type: none"> Infrastructure Migration Agriculture Environment Biodiversity Etc. Asymmetrical effects of climate change will harm LDCs most as they are most susceptible to risk 	<ul style="list-style-type: none"> Employment of modern energy systems will lead to CO₂ emissions reductions Reduction of emissions gap between countries Development of scientific methods strengthens global economy 	<ul style="list-style-type: none"> 2030 Agenda will not be achieved at the current political pace Slow advancement due to unfamiliarity of collaboration between scientists and politicians 	<ul style="list-style-type: none"> Expansion of communication and infrastructure between stakeholders on all levels Unrecorded/undiscovered CO₂ emissions (sources) to be added to calculations Need of political symmetry Early warning training for countries at risks Financing of big data for remote and developing regions with public access in local languages Response examples from positive cases for stakeholders as mitigation tool 	<ul style="list-style-type: none"> Time lag between political action and impacts of climate change under expediting effects; outpacing climate change relative to expectations and response rate Certain threats have not yet been discovered and in turn mechanisms cannot be formulated yet to avoid them The absence of big data stalls political action
Food, water, and energy nexus.	<ul style="list-style-type: none"> Food and water security Economic, environmental and social stability Energy transition towards decarbonized world 	<ul style="list-style-type: none"> New knowledge on agricultural technology present in the private sector is subject to patents and leads to unavailability of essential knowledge Renewable energy is subject to economic viability; decreasing oil prices make renewable energy less attractive for investors Water pollution and waste water mismanagement 	<ul style="list-style-type: none"> Harvesting rainwater could ensue water and food security Improving way of water harvesting for agriculture will increase agricultural output Wide scale distribution of clean fuels and energy technologies Increase rate of renewable energy More policy framework for integrated landscape management 	<ul style="list-style-type: none"> Initiate developing countries to refocus on rural areas, as they are often overlooked in the strive towards development Exposure of interlinkage between poverty and water access to fund acquisition of underground water sources in developing countries Synthetic protein as response to food insecurity Foster individual voice and agency in underrepresented populations Direct integration of women along the clean energy value chain and food and sanitation programs 	<ul style="list-style-type: none"> As renewable energy has difficulty competing with market prices, it becomes an emerging issue Climate change accelerates food and water insecurity in developing countries most susceptible to risk 	
The need to develop alternative economic models that decouple economic growth resource use and minimize environmental degradation.	<ul style="list-style-type: none"> Social inclusion and environmental protection 	<ul style="list-style-type: none"> Current economic growth models avoid sustainability as a factor because economic advantages of sustainable development is not realized 	<ul style="list-style-type: none"> Taking sustainability into account would allow an environmentally feasible development Pricing sustainability would accelerate the development of sustainable energy due to increased investments 	<ul style="list-style-type: none"> Financing of alternative economic models that prognosticate positive effects of sustainability will increase further investments and funds for economic models 	<ul style="list-style-type: none"> Dimension of pricing sustainability needs to be added to models to highlight economic advantages of sustainable development, i.e. income from waste management Addition of behavioural, cognitive change in every-day life and in models Make transition attractive to overcome fear of cost Promote green jobs and greater resource efficiency 	<ul style="list-style-type: none"> Sustainable development can be economically advantageous, but is not portrayed as such in economic models yet and thus influences allocation of funds negatively with regards to sustainability

Annex 6: (continued)

Emerging Issue	Value to be Sustained	Threats	Opportunities	Causal mechanisms	Responses/Actions	Key Emerging Features
Persistence of poverty globally, including the poor in rich countries; Highly unequal distribution of household wealth across and within nations, including gender equality.	<ul style="list-style-type: none"> • Moral issue 	<ul style="list-style-type: none"> • Less social cohesion • Various humanitarian issues • Unemployment • Poor are falling further behind in rich countries, where a strong middle class limits the opportunities of the lower classes • Within developing countries increased regional disparities between remote and urban areas 	<ul style="list-style-type: none"> • Enhanced services for poor people to close poverty gap • Strengthening behavioural interventions building upon cutting edge psychological and social innovations 	<ul style="list-style-type: none"> • Education, training, skills development and social services, especially for females as they are most vulnerable • Re-examination of poverty indicators • Deploy technology to all sectors • Transparency in political action needed; inclusive agenda • apply big data to overcome poverty or support poverty education/poverty mapping • Strengthen labour market institutions and social protection systems 	<ul style="list-style-type: none"> • Growth no longer guarantees reduced unemployment and poverty 	
Integrated assessment of sustainable development pathways.	<ul style="list-style-type: none"> • Sustainable development 	<ul style="list-style-type: none"> • Lack of understanding sustainable pathways will hinder sustainable development and increase the effects of all related threats 	<ul style="list-style-type: none"> • Existing system may not be efficient, but must be extended and take into consideration sustainable development 	<ul style="list-style-type: none"> • Emerging technologies may not be as costly as economists have predicted • Examples have demonstrated the viability of sustainable pathways 		
The depletion of ocean fish stocks and the exploitation of marine resources.	<ul style="list-style-type: none"> • Healthy ecosystem • Intrinsic value (biodiversity) • Food security 	<ul style="list-style-type: none"> • EEZ: 200 Nordic miles around the coastline which country has control over (can be an opportunity) • Over-fishing • Ecosystem depletion • IRU fishing • Pollution has a negative effect on fish stock and the ecosystem; the contaminated fish stock will negatively impact consumers • Exploitation of the deep sea 	<ul style="list-style-type: none"> • EEZ as opportunity for sustainable management • Food security • Economic growth 	<ul style="list-style-type: none"> • A forum for global marine policy • Extend focus on delta areas, as they will be highly affected in the future • Involve land-locked countries in decision-making processes • Make mechanisms for renewable energy available for developing countries • Dissemination • Technology for monitoring EEZs needs to be made available for developing countries to limit illegal fishing • Need to consider fish migration in the face of climate change • Aquaculture has environmental impacts and positive effects that need to be calculated against each other for the individual case 	<ul style="list-style-type: none"> • High seas have territorial issues making sustainable development highly difficult • Marine ecosystem depletion will enable food insecurity, health threats, and further unknown consequences 	

Annex 6: (continued)

Emerging Issue	Value to be Sustained	Threats	Opportunities	Causal mechanisms	Responses/Actions	Key Emerging Features
Migration and all forms of movement of people across borders due to changes in demographics, weather patterns, and other causes.	<ul style="list-style-type: none"> • Social security and stability • Exchange of culture, knowledge and expertise 	<ul style="list-style-type: none"> • Social disruption • Pressure on economic and social systems, as well as the environment • “Brain drain”; draining countries of educated, highly-skilled individuals weakens the economy 	<ul style="list-style-type: none"> • Application of missing expertise provided by migrating individuals • Individuals can overcome poverty if their expertise is financed in another country • Language and culture as positive influence on economy 	<ul style="list-style-type: none"> • High speed of migration hinders sustainable reaction • Integrated, approach can build up economy from a local to a global scale 	<ul style="list-style-type: none"> • Future coastlines as method for strategic regional planning • Formulating a global migration law • Consider cross-border migration as well as local • Migration as a response to risk as indicator • Different drivers for lower-, middle-, higher-skilled immigrants • “Wins-wins” present in migration should be highlighted • Identify new factors of migration • Expertise in cultures and different language skills can be positively exploited by host nations/economies 	<ul style="list-style-type: none"> • Migration today is emerging under different parameters of economic, political, environmental, and social risk
Political instability and social unrest from increased income and wealth inequalities (Rephrase: The interplay between peace and sustainable development).	<ul style="list-style-type: none"> • Peace • Addressing general inequality and conflicts • Structural balance 	<ul style="list-style-type: none"> • Political instability and social unrest • Threats to overall well-being • Violence • Unjust situations 	<ul style="list-style-type: none"> • To preserve peace 	<ul style="list-style-type: none"> • Increased income inequalities • Widespread unemployment • Geopolitical rivalries • Competition for resources 	<ul style="list-style-type: none"> • Building an underlying framework to reduce conflicts • Reducing conflicts for sustainable development • Justice reinvestment: redirecting resourcing • Invest in prevention and in research • Strengthen labour market institutions and social protection systems 	<ul style="list-style-type: none"> • Political instability has become more emerging • Shift of resources and associated conflicts • Integrated and engaged approach to sustainable development would lead to redirection of investment
Putting in place the blend of governance forms and approaches required for the 2030 Agenda.	<ul style="list-style-type: none"> • The essence of good governance should be sustained 	<ul style="list-style-type: none"> • Type of government in place does not function well for complex, sustainable issues due to its vertical properties 	<ul style="list-style-type: none"> • Opportunity in reasserting control due to the rapid change in environment and the fast paced action needed to control the effects • Opportunity to put mainstream SDG knowledge into policy processes 	<ul style="list-style-type: none"> • Politicians have the incentive to respond with policies since effects of environmental change could occur as soon as during their own term 	<ul style="list-style-type: none"> • Government actions consistent with government aspirations • Cross-governmental action/mechanisms • Other stakeholders should be involved in implementing the agenda, decentralizing the decision making process • Sectors have different incentives that need to be considered when formulating policies • Integrating accountability • Formulate mutual aid responses for natural disasters and hazards • Inform public/consumer about ongoing environmental risks to empower them 	<ul style="list-style-type: none"> • Acceleration of impacts forces rapid responses on the political level • Effects of global changes do not stay within national boundaries, demanding a blend of governance forms and approaches

Annex 6: (continued)

Emerging Issue	Value to be Sustained	Threats	Opportunities	Causal mechanisms	Responses/Actions	Key Emerging Features
Institutional mechanisms and partnership.	<ul style="list-style-type: none"> Political stability and accountability 	<ul style="list-style-type: none"> Usage of "governance" Accountability: multiple relationships of accountability; societal accountability 	<ul style="list-style-type: none"> Involve broader institutional network outside sources 	<ul style="list-style-type: none"> Bedding down institutions in order to do action Institutions are a necessary condition to do anything 	<ul style="list-style-type: none"> Governments should not only be involved but also allow civil societies to play the actions. Establish governance mechanisms for the SDGs, from global to regional, national and local levels 	<ul style="list-style-type: none"> Inclusive institutional arrangements Action from non-centralized control Broader stakeholder engagement Public awareness: societal engagement
The need to protect and restore ecosystems.	<ul style="list-style-type: none"> Ecosystems & ecosystem services 	<ul style="list-style-type: none"> Increasing impacts of climate change Depletion and exploitation Migration Contaminations Urbanization 	<ul style="list-style-type: none"> Decrease inequalities and combat environmental degradation and climate change Develop alternative economic models The potential benefits of mapping local knowledge for climate change mitigation and adaptation purposes 	<ul style="list-style-type: none"> Time lags between scientific findings and policy action Poor understanding of ecosystems in some parts of the world Competition for natural resources 	<ul style="list-style-type: none"> Enhance social and environmental protection in developing countries Integrated and deliberative assessment of sustainable development pathways Putting in place the blend of governance forms and approaches required for the 2030 Agenda including distributed and multi-level governance Involve indigenous people in conservation management planning Design a plan that is not limited to the urban environment 	<ul style="list-style-type: none"> See "Coping with the increasing impacts of climate changes"
Enhancing social protection and environmental protection in developing countries as a means to decrease inequalities and combat environmental degradation and climate change.	<ul style="list-style-type: none"> Social and environmental protection 	<ul style="list-style-type: none"> Intensified climate pressure puts traditional solutions under pressure Social and economic pressure Risks of states abdicating Risks of damaging traditional forms of protection 	<ul style="list-style-type: none"> Social protection systems such as social insurance, sharing risk across social classes as well as across borders Innovation in economic mechanisms to finance support systems for protection Potential for new banking systems and financial methods to grow 	<ul style="list-style-type: none"> Climate change and globalization of the economy is requiring us to innovate in ways to deal with the issues 	<ul style="list-style-type: none"> Strengthening the social security net/social protection systems Build more resilient communities to absorb the shock as well as develop external protection mechanisms Adaptation strategies Development opportunities for new instruments that could provide a new social safety net 	<ul style="list-style-type: none"> Potential accumulation of global and national funds for social transfers from non-governmental sectors Global partnership: Political framework for national and global engagement Public inflows pressuring traditional social protection to become more vulnerable

Annex 6: (continued)

Emerging Issue	Value to be Sustained	Threats	Opportunities	Causal mechanisms	Responses/Actions	Key Emerging Features
<p>Increasing the sustainability, inclusiveness, safety, and resilience of cities and human settlements.</p>	<ul style="list-style-type: none"> • Inclusive, sustainable cities • Social inclusion • Multiculturalism/multilingualism in society 	<ul style="list-style-type: none"> • “Slumification” (sanitation, disease, water, multiple drug resistance, crime, etc.) • Negative social dynamics 	<ul style="list-style-type: none"> • Smart city: using science, technology, and data to provide services to the most vulnerable • Resource-efficient cities: leaders of the cities to be able to more efficiently use the resources (e.g. reduce energy consumption, transportation) 			<ul style="list-style-type: none"> • As the global population increases rapidly and resources decline, the resilience of cities is a key feature towards sustainable development

Source: Collective elaboration by contributing scientists for the GSDR 2016.

