

Chapter 1



Introduction and Context



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1.1 GEO-6: Healthy Planet, Healthy People – humanity's transformative challenge

Providing a decent life and well-being for nearly 10 billion¹ people by 2050, without further compromising the ecological limits of our planet and its benefits, is one of the most serious challenges and responsibilities humanity has ever faced. People worldwide rely on the smooth functioning of Earth's natural life-support systems, in different ways and in different contexts. A healthy planet is a necessary foundation for the overall well-being and further advancement of humanity (United Nations 2015a; Organisation for Economic Co-operation and Development [OECD] 2017a).

Under the theme of 'Healthy Planet, Healthy People,' the sixth Global Environment Outlook (GEO-6) is an integrated assessment which considers various scientific perspectives and inputs from across the world in a holistic manner. The assessment urges the world's decision makers and all citizens to apply the principles of sustainable development to help ensure that Earth's environment remains the foundation of society and of people's well-being and resilience.

GEO-6 aims to answer the following questions:

- ❖ What is the state of the global environment, how is it changing, and what are the major factors and drivers, both positive and negative, influencing these changes?
- ❖ How are people and their livelihoods affecting and affected by environmental change in terms of health, economic prosperity, social equity, food security and overall well-being?
- ❖ Are environmental benefits, responsibilities and risks distributed fairly across different regions, socioeconomic groups and genders?
- ❖ What are the main responses and policy measures that have been taken to strengthen environmental protection and governance at various levels? How effective have they been in terms of improving environmental quality, and resource efficiency?
- ❖ What are the possible pathways, critical opportunities and policies, including Multilateral Environmental Agreements (MEAs) and Sustainable Development Goals (SDGs), to transform the global human-environment system to become more sustainable and contribute to a healthy planet for healthy people? What are the likely consequences if no additional actions are taken?

The first three points above are addressed by the introductory chapters and those in Part A of this report. The chapters in Part B consider the fourth point, on policy effectiveness, and the final point, on the most promising future pathways, is covered in Part C.

GEO-6 comes at a time of great uncertainty about the current trajectory of global human development (United States National Intelligence Council 2017). One major reason is that over the last few decades, human activities, such as human-caused climate change and other human impacts on ecosystems, have transformed the Earth's natural systems, exceeding their capacity and disrupting their self-regulatory mechanisms, with irreversible consequences for global

humanity (Intergovernmental Panel on Climate Change [IPCC] 2014). Humanity has already been seriously affected by ongoing systemic ecological changes, such as climate change and land use change (especially deforestation). These have reached the point that the ecological foundations of human society and natural systems that support other species and provide invaluable ecosystem services are in great danger (Millennium Ecosystem Assessment 2005).

Human activities are causing increasing amounts of pollution, to the extent that this is now recognised as the biggest single risk to human health worldwide (Landrigan *et al.* 2018). Continuing to live on the brink of or outside of ecological limits, from the global to the local, will make it dramatically more difficult to achieve prosperity, justice, equity and a healthy life for all (Crutzen and Stoermer 2000; Crutzen 2002; Steffen, Crutzen and McNeill 2007; Steffen *et al.* 2011; Steffen *et al.* 2015; Steffen *et al.* 2018). The need for humanity to remain within the planetary boundaries' safe operating space and the need to eradicate poverty and accelerate social and economic development are linked by the concept of "a safe and just space for humanity" (Raworth 2012).

To cope with this range of human-induced damages, including climate change, deforestation, desertification, loss of biodiversity, scarcity of natural resources, pollution, and the consequent natural and the associated environmental impacts, is a great challenge. While many old and new societal contradictions and conflicts have to be solved simultaneously (Beck 2009; Beck 2015; Raskin 2016), these accumulative and omnipresent challenges should be addressed as humanity's transformative challenge (Beck 2009), by creating opportunities for further human development which achieve human well-being. This would be, where the universally applied principles of sustainability govern the pathway towards 'Healthy Planet, Healthy People', with no one left behind and endeavouring to reach the furthest behind first (United Nations 2015a).

GEO-6 addresses this transformative challenge, which is taken up by the United Nations 2030 Agenda for Sustainable Development (2030 Agenda) and its 17 SDGs. Transforming human-environment interactions (and related human-human interactions), especially consumption and production patterns and lifestyles, towards sustainability requires a better information base and new, diversified knowledge of planetary systems (Steffen 2000; Schellnhuber *et al.* eds. 2004) and transformative processes within globalized social and economic systems (Schneidewind 2013). This includes the cultural dynamics and ethical foundation of human perceptions and understanding of 'nature and environmental sustainability' (Morton 2009; Lammel *et al.* 2013; Díaz *et al.* 2015; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2015; Pascual *et al.* 2017).

The increasing body of global environmental assessments undertaken by international organizations in cooperation with the global science community and UN Member States provides the knowledge to understand the vital inter-connections and accelerating dynamics of natural ecosystems, socio-ecological systems and the dependence of human life on healthy and natural ecosystems. Increasing use of Earth observation techniques, from outer space and on Earth, in combination

¹ Throughout this publication the term 'billion' refers to 1000 million.



with new tools for data analysis, disciplines like environmental accounting (e.g. Kim and Kim eds. 2016), and environmental economics (Siebert 2008; Wiesmeth 2012; Ghosh *et al.* eds. 2016), has revolutionized our ability to recognize patterns of what causes environmental change and how it impacts life (Chuvieco ed. 2008; Tomás and Li 2017; Mathieu and Aubrecht eds. 2018).

Integrated and systems-based approaches (i.e. those that consider multiple benefits at the same time) enable cross-linkages to be explored and system-wide effects to be managed, so that policies can effectively support a number of social, economic and environmental goals to support human well-being, ensuring that various preconditions for this well-being are in place. These new scientific approaches and methods, including the study of cross-cutting inter-relationships between many areas, facilitate the preparation of more appropriate, equitable and effective policy responses, including shifting investment, production, distribution and consumption towards more sustainable approaches, and the development of better governance capacities at multiple scales. The GEO-6 assessment endeavours to support the vision that equal opportunities for prosperity and well-being for all, within the Earth's ecological limits, will be possible

through sustainable development pathways that are shared and pursued globally.

GEO-6 is intended to be solution-oriented, with these solutions drawing on facts and statistics. Based on multidisciplinary perspectives from various scientific fields, GEO-6 also provides an interpretative framework and tells stories, including successes, failures and aspirations, to help people, governments and the global community work to prevent and repair environmental damage and respond more effectively to environmental changes and opportunities. GEO-6 highlights existing evidence of these environmental changes and reflects on possible pathways and critical opportunities for transformation of the global human-environmental system to become more sustainable in the mid to long term (2030/2050).

GEO-6 is entitled 'Healthy Planet, Healthy People', a conceptual approach that considers the human dimensions for achieving a healthy planet. It underlines the importance of maintaining the integrity of ecosystems and recognizes their interlinkages with socioeconomic systems. It emphasizes that a healthy planet is a necessary foundation for human physical, psychological, social, economic and emotional health and well-being, and is therefore critical for achieving all the SDGs.



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Figure 1.1: Choices to be made to achieve a healthy planet for healthy people

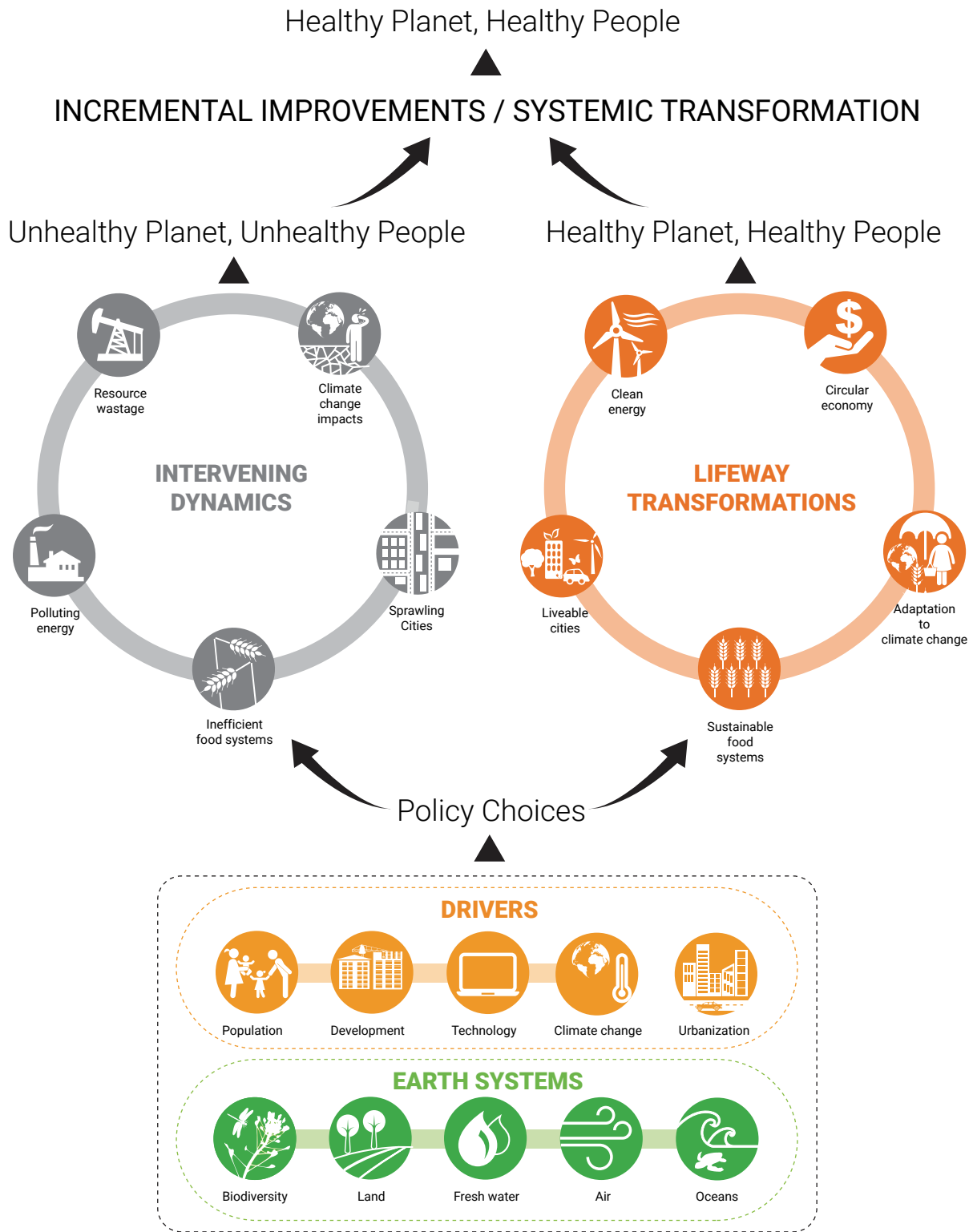




Figure 1.1 illustrates how a healthy planet contributes directly to healthier people by encouraging healthier lifestyles. Environmental degradation increases the burden of disease through exposure to harmful pollutants, as well as through reduced access to the ecosystem contributions from nature. Avoiding these problems will require protecting natural capital through detoxification, decarbonization, dematerialization and restoration of ecosystems to enhance planetary and human well-being.

A healthy planet requires protection and sustainable management of natural capital, in the form of nature's contributions to people, and human capital. People's opportunities in life are affected by humanity's ability to generate sustainable, long-term economic and social prosperity from human, physical and natural assets, the extent of environmental degradation and resource depletion, pollution and climate impacts, in addition to disparities in income and wealth.

This report recognizes that the environmental, economic and social equity dimensions are integrally linked, as they are in the SDGs with their overarching objective to 'Leave no one behind', and that all SDGs are rooted in human rights and dignity. Furthermore, many SDGs have environmental targets, some of which have equity components. Throughout GEO-6, evidence is presented of how fundamentally nature's contributions to people underpin human health and well-being. The SDGs recognize that inequality, including poverty and gender discrimination, results in a sizeable waste of human productivity and prosperity, and limits the scope for effective and accountable civic governance, quite apart from the ethical dimension of fairness and opportunity. Human resources are being underutilized and are not contributing to the sum total of human innovation required to help us live sustainably, demonstrated by the continued poverty in many parts of the world, which Agenda 2030 aims to eradicate (World Bank 2016a). The SDGs also recognize that disparities in access to resources, ecosystem services, income and wealth play an important role in shaping people's opportunities in life (Whitmee *et al.* 2015; OECD 2017), disproportionately affecting women and girls, as well as poor people.

1.2 UNEP's flagship assessment to deliver the environmental dimension of the 2030 agenda

Recognizing these important challenges, governments of the world have sought to better understand the interrelationships across the environmental dimension of the Sustainable Development Goals by requesting the preparation of a sixth edition of the Global Environment Outlook.

1.2.1 Mandate

Member States attending the first session of the United Nations Environment Assembly (UNEA-1) in Nairobi, June 2014, requested:

... the Executive Director, within the programme of work and budget, to undertake the preparation of the sixth Global Environment Outlook (GEO-6), supported by UNEP Live, with the scope, objectives and procedures of GEO-6

to be defined by a transparent global intergovernmental and multi-stakeholder consultation informed by document UNEP/EA.1/INF/14, resulting in a scientifically credible, peer-reviewed GEO-6 and its accompanying summary for policy makers, to be endorsed by the United Nations Environment Assembly no later than 2018.

As requested by Member States (UNEP/EA.1/4) and based on the decision (UNEP/IGMS.2 Rev.2) made by the Global Intergovernmental and Multi-stakeholder Consultation in Berlin, 21-23 October 2014, GEO-6 builds on six regional assessments that were conducted in a similar fashion to the global GEO-6 process and launched in May-June 2016. In addition, the main messages of GEO-6 are compiled in an accompanying Summary for Policymakers, which is drafted by the authors of the main report and negotiated by the governments. See Annex 1-1 for more details on UN Environment's mandate to produce the sixth Global Environment Outlook.

More recently, recognizing that the date of the fourth session of the UN Environment Assembly (UNEA-4) would be shifted to 11-15 March 2019, Member States decided at UNEA-3 to:

... [Request] the Executive Director to issue the sixth Global Environment Outlook report at least three months before the fourth session of the United Nations Environment Assembly;

Also [request] the Executive Director to schedule the negotiations on the summary for policymakers at least six weeks in advance of the fourth session of the United Nations Environment Assembly and to present the sixth Global Environment Outlook report and its accompanying summary for policymakers for consideration and possible endorsement by the Environment Assembly at its fourth session.

With these decisions, the delivery date of the embargoed version of the main report is now the week of 5 December 2018, and the delivery date of the adopted and translated version of the Summary for Policymakers is 28 January 2019.

1.2.2 Role of GEO-6

GEO-6 comes at a critical time for global development, and it will build on the knowledge and experience gained from previous GEOs. Previous GEO editions have already presented substantial evidence that environmental degradation, even within the planetary limits of the Earth's ability to support human civilization, has undermined current and future development, and threatened different aspects of human well-being (United Nations Environment Programme [UNEP] 2007; UNEP 2012a).

GEO-6 explores some issues further, attempting to show the interlinkages across environmental challenges and geo-political, economic, industrial, social, technological and cultural issues, while considering potential transformative sustainable development pathways and policies for achieving the SDGs and other Internationally Agreed Environmental Goals (IAEG). In this respect, GEO-6 aims to apply a wider scope to the discussion of global environmental security (Matthew *et al.* 2010; UNEP *et al.* 2013)



Box 1.1: Concept of Well-being

Human well-being is assumed to have multiple constituents, including:

- ❖ the basic material for a good life, such as secure and adequate livelihoods,
- ❖ enough food at all times, shelter, clothing, and access to goods;
- ❖ health, including feeling well and having a healthy physical environment, such as clean air and access to clean water; good social relations, including social cohesion, mutual respect, and the ability to help others and provide for children;
- ❖ security, including secure access to natural and other resources, personal safety, and security from natural and human-made disasters; and freedom of choice and action, including the opportunity to achieve what an individual values doing and being.

Freedom of choice and action is influenced by other constituents of well-being (as well as by other factors, notably education) and is also a precondition for achieving other components of well-being, particularly with respect to equity and fairness.

Source: Millennium Ecosystem Assessment 2005

Additionally, GEO-6 attempts to further strengthen understanding of the macro perspective of socio-ecological systems (including economics), and also to use a more people-centred approach (UNEP 2016a). GEO-6 underlines that people are part of ecosystems and depend on them, emphasizing the importance of conserving nature not only for its intrinsic value, but also because it is crucial for the well-being of humanity. Such an approach is urgently needed to help address the vulnerability and different conditions and capabilities enabling people to react to hazards and disruptions in daily life (resilience) (Millennium Ecosystem Assessment 2005). With this knowledge, it is hoped that people will be encouraged to respond to the challenge by changing their behaviour as citizens, consumers, voters, politicians, religious leaders and business leaders (UNEP 2016b).

GEO-6 highlights an updated understanding of the relationship between the environment and the economy, which is a foundation of the people-centred approach. This emphasizes nature's contribution to people, the environmental functions that support human well-being (including the benefits of environmental investments, innovations and technologies), as well as the high costs of inaction, business as usual, and stranded assets.

Furthermore, this perspective within GEO-6 helps to better inform future policy decisions by addressing complex distributional impacts and conflicts as the new baseline to design sustainable development policies and governance systems associated with implementation of the 2030 Agenda (World Bank 2016b). Creating such knowledge and its evidence base through this assessment will help to better communicate possible policies, actions and investments that could be used by governments, as well as other stakeholders and citizens, to address current and future development challenges, as well as to explain the benefits of taking such actions. How this perspective is integrated into the GEO-6 assessment is further explained in Section 1.7.

1.3 GEO-6 in a changing global context

The world is facing a wide range of economic, social, cultural and political/military security challenges (World Economic Forum 2017). Despite significant global progress in economic development and poverty reduction in some regions, a large portion of the population in many areas suffers from poverty or extreme poverty, and many people who are not impoverished are still concerned about economic security and future life opportunities. Some areas are experiencing social friction,

growing inequality, poor governance, cultural erosion, reactions against globalization, political instability, large numbers of refugees, large-scale migration and violent conflicts due to these economic and social insecurities, injustices and corruption.

Many of these global economic, social and political/military security challenges are related to the environment in terms of causes, impacts and possible solutions. Moreover, recent scientific concepts of environmental safeguards for society, for example planetary boundaries (Rockström *et al.* 2009; Steffen *et al.* 2011; Steffen *et al.* 2015), explain that the environment is the foundation for human life on Earth. Current methods of generating material prosperity have undermined ecosystem health and caused massive environmental damage, crossing several of these planetary boundaries, to the point where the development of human societies and the 'safe operating space' for human life on Earth is at risk. In this planetary boundaries framework, environmental problems are considered to be inherent systemic problems of humans' deep-rooted transformation of nature and ongoing cultural dynamics, and are not seen only as collateral damage of societal development (Steffen 2000). Biodiversity is also critical for human well-being (Secretariat of the Convention on Biological Diversity [CBD] 2014), as are ecosystem services more broadly (Millennium Ecosystem Assessment 2005).

Clearly, the functions of environmental policy have expanded, and it now contributes to political/military security, economic and social policy and other development activities. Likewise, these other policy areas also have a major influence on the state of the environment. A key implication of these interlinkages is the need for an integrated approach to address environmental, economic and social problems holistically (United Nations 2015b; Jetzkowitz *et al.* 2018). GEO-6 aims to integrate the linkages between the environment, social and economic security, global justice and human well-being, to promote a new framework for sustainability to be an integral part of all aspects of global, regional and national development (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2014a; Lehmann *et al.* 2015; UNEP 2016a; UNESCO 2016).

1.3.1 Environmental and economic challenges and opportunities

The environment is closely related, in both positive and negative ways, to key economic issues such as poverty, prosperity, jobs, production patterns, innovation, and resource availability/scarcity. On one hand, the economy is a major



source of environmental problems, while environmental problems are increasingly causing economic losses. Recent articles have noted that “welfare losses due to pollution are estimated to amount to US\$4.6 trillion per year,” which is “about 6.2 per cent of global economic output” (Landrigan *et al.* 2018, p. 462). Economically, countries are often still guided by an approach of ‘grow now, clean up later’. This report will show that this is simply not sustainable in a world already crossing planetary boundaries on a number of dimensions, a situation which threatens to undermine economic growth if not addressed. In addition, this option is likely to prove far more expensive for most countries, because it is often costlier to clean up later than prevent damage in the first place; it creates stranded assets which lose their value, and is now leading to irreversible negative impacts, including on human health. This renders an economy unproductive and uncompetitive compared with a flexible and proactive approach, capable of managing the transition to a sustainable, innovative and resource-efficient economy that can take advantage of domestic and export market opportunities in fast-growing, environmentally aware markets.

On the other hand, protecting the environment, as well as preventing and mitigating the impacts of pollution, are also major sources of economic opportunity, providing jobs, reducing poverty, driving innovation and addressing resource availability/scarcity and depletion. Positive synergies between the economy and the environment are now more widely recognized (Porter and van der Linde 1995; The Economics of Ecosystems and Biodiversity [TEEB] 2010; OECD 2011; UNEP 2011a; UNEP 2011b; Hepburn and Bowen 2012; United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP] and Korea International Cooperation Agency [KOICA] 2012; Global Commission on the Economy and Climate 2014; Altenburg and Assmann 2017; OECD 2017b), compared with the view that trade-offs exist between the environment and the economy.

The global economic value of ecosystem services was estimated to be about US\$ 125 trillion in 2011 (in 2007 US\$²) (Costanza *et al.* 2014). Still, more effort is needed to communicate this message about positive synergies, as the perspective of the trade-off between the economy and the environment is still reinforced by current methods of calculating economic growth, which generally externalize environmental impacts and emphasize short-term, rather than long-term, perspectives. Especially in nations/regions where people have anxieties about jobs, wages and economic prosperity, there is a risk of weakening support for environmental protection and MEAs if the linkages among these concerns are not well understood. GEO-6 aims to contribute to a more thorough assessment of costs and benefits, as well as the cost-effectiveness of environmental policies and practices, and how they are distributed in society.

Many businesses around the world now understand that environmental problems pose major challenges to their operations, and that addressing them presents significant business opportunities, for example through circular economy business practices (see Chapter 17), in the context of sustainable consumption and production (Lacy and Rutqvist

2015; Ghisellini, Cialani and Ulgiati 2016; Murray, Skene and Haynes 2017; Hopkinson, Zils and Hawkins 2018, see section 17.5 of this report), as well as enabling increases in productivity and profitability (at least in the initial stages of waste reduction and efficiency improvements). It also avoids major liabilities and burdens for future generations. Prominent business groups, such as the World Business Council for Sustainable Development and UN Global Compact, promote environmental sustainability at all levels of society and decision-making.

Environmental protection and environmental business can also be major sources of jobs (International Labour Office [ILO] 2016). In the global energy sector, renewable energy sources are growing much faster than expected, and global annual investment in these systems is now greater than investment in fossil fuels (Renewable Energy Policy Network for the 21st Century [REN21] 2018). It is suggested that ‘clean’ energy (renewable and low-carbon energy) and energy efficiency may have more job creation potential than coal and natural gas (Wei, Patadia and Kammen 2010; Garrett-Peltier 2017; International Renewable Energy Agency [IRENA] 2018; Yihdego, Salem and Pudza 2017). Most recently, in the United States of America, the solar industry accounts for more than twice as many jobs as coal (United States Department of Energy 2017).

Still, many economic trends pose challenges for addressing environmental problems. Many governments face challenges in raising revenue, and deregulation initiatives often focus on weakening environmental standards/regulations (Castree 2008; Steinebach and Knill 2017). The Addis Ababa Action Agenda, which addresses the means of implementation for sustainable development in general, including the SDGs, suggests ways to help governments strengthen their domestic financing capacity (United Nations 2015c).

Globalization has been an overall trend for several decades, and its possible environmental effects have been a major research focus. However, the linkages between economic development and the environment are very complex and difficult to summarize. Some aspects of globalization may worsen environmental problems, while others may be beneficial (Boyce 2004; Gallagher 2009; Clapp and Dauvergne 2011; Newell and Roberts eds. 2016). Identifying such trade-offs and synergies is a major element of the GEO-6 assessment (see chapters 4 and 17).

1.3.2 Environment and social challenges and opportunities

Environmental issues are closely related to social issues such as hunger, consumption patterns, health, education, inequality, gender gaps, waste and sanitation, refugees, migration, conflicts and intolerance. For example, hunger and food, addressed in SDG 2, are linked to agriculture, which in turn is linked to the environment, especially SDG target 2.4 on sustainable agriculture. Environmental pollution harms agriculture, while a cleaner environment will help to improve agriculture, nutrition and health (Landrigan *et al.* 2018).

Education promotes a healthier environment and vice versa (UNESCO 2014b; UNEP 2017a). Environmental pollution, biodiversity loss and climate change are important causes of health problems and environmental diseases, which in turn can negatively affect education and learning, especially

² Readers should assume that all values in this report are nominal market values, unless it is stated to the contrary.



among children; they can also be a hindrance to employment among adults (Mohai *et al.* 2011; Zhang and Zhang 2018). In contrast, cleaning up, avoiding pollution, and protecting and restoring habitats are major opportunities to improve health, which in turn helps people lead fuller and more productive lives. Diseases related to air pollution caused 9 million premature deaths in 2015, accounting for 16 per cent of all deaths globally (Landrigan *et al.* 2018) while in some countries, hazardous air pollution has forced schools to close (Sastry 2002; Li *et al.* 2014; British Broadcasting Corporation [BBC] 2016; Reuters 2017).

The environment is also related to growing social inequality, including gender inequality, in many ways that may put burdens on poor or socially disadvantaged people. These can include unequal access to resources (e.g. land, water, food, seeds), uneven distribution of the impacts of environmental degradation (e.g. the health impacts of climate change and waste), job creation and loss due to shifting consumption and production between geographic areas, and uneven distribution of responsibilities with respect to addressing environmental challenges. Children are particularly susceptible to the negative health impacts of chemicals, due to their rapid growth and development and greater exposure relative to body weight.

In many cases, people's environmental impacts are related to their income levels (Moser and Kleinhüchelkotten 2017). Wealthier people are more able than poor people to insulate themselves from environmental problems, while they have more potential to contribute to solutions through their greater resources and scope for lifestyle changes (UNEP 2016b). This is also related to the geographic, economic and social distribution of areas affected by environmental problems.

The drivers and pressures of environmental change, as well as its state and impacts, have people-centred aspects that need to be taken into account in order to develop effective and just policies in an Agenda 2030 world. This approach is needed to help address the vulnerability and different conditions and capabilities of people to react to hazards and disruptions in daily life (resilience) (Millennium Ecosystem Assessment 2005). People – poor and rich, women and men – affect and are affected differently by environmental changes and related risks. These differences play a major role in related political decisions (Serret and Johnstone eds. 2006; UNEP 2016b). Using this perspective, GEO-6 attempts to interpret how environmental 'equity' will be experienced by different people, so it can inform future policy decisions by addressing complex distributional impacts and conflicts. This perspective provides a new baseline to design sustainable development policies and governance systems for implementing the 2030 Agenda (World Bank 2016).

In Agenda 2030, the sustainable use of the environmental and natural resources is now understood to be complementary and necessary to "end poverty in all its forms everywhere" (SDG 1). Approximately 70 per cent of the world's poor people depend directly on natural resources for all or part of their livelihoods, particularly women and girls, as well as other marginalized groups. Efforts to eradicate poverty and ensure prosperity are directly linked to improving the management of both the environment and natural resources in an integrated way (TEEB 2010).

1.3.3 Environment and political/military security challenges and opportunities

Environmental problems such as land degradation (United Nations Convention to Combat Desertification [UNCCD] 2017) and resource scarcity and depletion, especially water, energy, food and biodiversity, have the potential to be major sources of conflict, security problems and migration (Homer-Dixon 1991; Homer-Dixon 1999; Barnett and Adger 2007; Gupta, Dellapenna and Heuvel 2016). Political/military security problems may be amplified by climate change effects. Water security is being compromised by pollution and unsustainable use, as well as demand exceeding sustainable supply, climate variability, droughts, flooding, etc. Climate change, including related weather extremes, and environmental degradation are already having a range of complex effects, especially in fragile states and ecosystems. For example, they worsen the problems of migrants and refugees (both within and between countries), which in turn contribute to increasing political uncertainty and instability worldwide. Environmental refugees displaced by environmental degradation may also suffer from health problems and difficulties maintaining their livelihoods.

Wars and conflicts are major sources of pollution, especially air, water and soil pollution, waste, greenhouse gases and land degradation. Likewise, addressing environmental problems may provide important opportunities to help address political/military security problems (Brown, Hammill and McLeman 2007; UNEP *et al.* 2013), including by helping to secure livelihoods and reduce the necessity for migration. International funding to war-torn states may be productively aimed at addressing environmental problems through development of sustainable infrastructure, including natural infrastructure and ecosystem restoration, and services such as waste, wastewater and resource management.

1.3.4 Resource availability and scarcity

Resource availability and scarcity problems clearly illustrate the tight interlinkages between economic, social, human, political/military security and environmental issues (Qasem 2010; UNEP 2011a; Pereira 2015). Resources have significant negative environmental and social/health impacts in their production and/or use, for example through mining or other extraction processes.

At the same time, they are important inputs to environmental solutions. Resources are important economic inputs and sources of jobs, and are used in products and services supporting human well-being. This is not just related to the key resources of water, energy and food, which have been extensively researched as 'nexus' issues (UNESCAP 2013; Food and Agriculture Organization [FAO] 2014; International Resource Panel 2015). Phosphorus (Cordell and White 2015) is a key input for food production and other important scarce resources including materials such as rare earth metals (Gupta and Krishnamurthy 2004; Abraham 2015; Graedel *et al.* 2015), are used in many industrial applications including key environmental technologies such as wind and solar energy as well as advanced batteries. These materials, and the many products made from them, also have important military applications. On the negative side, in addition to the environmental damage caused by their production, these

resources are also scarce (Calvo, Valero and Valero 2017), leading to political/military security concerns related to securing their availability.

1.4 Environmental governance

Environmental governance is increasingly important at all levels, including global, regional, national and subnational (local, provincial, etc.) governments, as well as business and civil society stakeholders (Biermann *et al.* 2012; Biermann 2014; United Nations Economic Commission for Europe [UNECE] 2014; Patterson *et al.* 2015; Mortensen and Petersen 2017). New environmental governance challenges are emerging, such as the opening of the Arctic and the advent of new materials, while many old challenges have not been adequately addressed. Greater multi-stakeholder participation in governance is a major global trend, but there is a need for greater synergies between governments and civil society organizations. Many efforts have been made to develop more effective facilitation methods to enable this collaboration (Ansell and Gash 2008; UNECE 2014; Pattberg and Widerberg 2016; Dodds, Donoghue and Leiva-Roesch 2017). This includes new technologies and social media, and citizen science, which engages citizens in scientific research (Kobori *et al.* 2016, see section 25.2) which may be the only way to obtain some kinds of data. Also, governance within the private sector has become an important innovation space.

Environmental problems have always been very complex and closely related with other policy areas (Jordan and Lenschow 2010), but efforts to overcome separate sector/silo boundaries have not made sufficient progress (Adelle and Nilsson 2015). It is now more important than ever to promote the integration and coordination of environmental concerns with other development areas, such as economy, trade, health, water, energy, education, food systems and urban planning (FAO 2014; Le Blanc 2015; OECD 2015; Elder, Bengtsson and Akenji 2016; United Nations 2016; Scheyvens *et al.* 2017).

Moreover, ecosystem boundaries often do not correspond to geopolitical boundaries, so many environmental problems, especially those related to pollution, are often transboundary in nature, such as air pollution, freshwater contamination (surface and groundwater), marine pollution, wastewater, leakages of pollutants, dumping of hazardous and nuclear wastes and species loss. Because many of these transboundary problems are interrelated, there are extensive opportunities to take advantage of co-benefits from policy solutions, but these require greater cooperation and coordination across political boundaries.

Many efforts have been made to develop ways to improve environmental governance, ranging from stronger regulation and enabling policies to support voluntary actions, to stakeholder self-governance. The state has an important role in strengthening environmental governance, including by ratifying and implementing environmental conventions, supporting environmental research and supporting vulnerable populations. Still, the best way forward is not always clear, and further efforts are needed (Ansell and Gash 2008; Jordan 2008; Newig and Fritsch 2009; Biermann *et al.* 2012; Galaz *et al.* 2012; Biermann 2014; United Nations Development Programme [UNDP] 2014; Kanie, Andresen and Haas eds. 2014; Pattberg and Widerberg 2015; Pattberg and Zelli eds. 2016; Biermann, Kanie and Kim 2017).

1.5 The environmental dimension of the sustainable development goals, global environmental governance and multilateral environmental agreements



Until recent years, global environmental governance has mainly focused on MEAs (Najam, Papa and Taiyab 2006; Environment Canada, University of Joensuu and UNEP 2007; Kanie 2007), along with many regional and bilateral agreements (Balsiger and VanDeveer 2012). It has been estimated that there are over 1,300 MEAs and 2,200 bilateral environmental agreements (Mitchell 2018).

Despite these MEAs and five previous Global Environment Outlooks, the state of the environment remains troubled and has continued to deteriorate in many respects (Susskind and Ali 2015; UNEP 2012b), to the point where the environmental foundation for human society is increasingly at risk (Rockstrom *et al.* 2009; Steffen *et al.* 2011; Steffen *et al.* 2015). Moreover, some environmental pollutants, such as plastic waste, marine pollution, military-related waste and pesticides, remain largely unregulated at the global level. There has been insufficient progress in achieving sustainable consumption and production patterns.

Some international agreements and frameworks are working to deal with global problems more comprehensively, rather than focusing narrowly on specific environmental issues. They combine political, economic, social and environmental dimensions, while strengthening the environmental elements. These include the SDGs, the Paris Agreement on climate change, the Sendai Framework for Disaster Risk Reduction, the New Urban Agenda - Habitat III, and the United Nations Convention to Combat Desertification.

The SDGs and the 2030 Agenda are at the vanguard of this trend, bringing an integrated, holistic perspective to sustainable development. They link the environment with other dimensions of sustainable development in order to take advantage of synergies and minimize trade-offs between them. They also represent a major change from the Millennium Development Goals (MDGs). Not only are the SDGs universal and challenging all countries, they also offer a broad sustainability agenda, giving equal attention to social, economic and environmental issues; by contrast, the MDGs had a greater focus on the social agenda, paying insufficient attention to economic and environment issues. Thus, the environment is incorporated into the SDGs more extensively than it was into the MDGs (UNEP 2016c).

Furthermore, where the MDGs mainly aimed at poverty reduction in developing countries (with developed countries committing to a Global Partnership for Development), the 2030 Agenda is a universal one, with goals and targets to be achieved by all countries. According to UNEA, the 2030 Agenda “represents a paradigm shift to replace today’s growth-based economic model with a new model that aims to achieve sustainable and equitable economies and societies worldwide” (UNEA 2016 p.1), noting that “ecosystems and the services they provide, such as food, water, disease management, climate regulation, and spiritual fulfilment are preconditions” for sustainable development, while “unsustainable patterns of production and consumption threaten our ability to achieve sustainable development”.



The environment is represented in all the SDGs. More than half have a direct environmental focus or address the sustainable use of natural resources (UNEP 2016d). Many goals are directly related to the quality of the physical environment, e.g. water (SDG 6), climate (SDG 13), oceans (SDG 14) and land and biodiversity (SDG 15). Other goals are more indirectly related to the physical environment, e.g. via natural disasters (SDGs 1 and 11), food, hunger and agriculture (SDG 2), human health (SDG 3), energy (SDG 7), economic growth and employment (SDG 8), industry (SDG 9) and cities (SDG 11) (International Resource Panel 2014; International Resource Panel 2015; OECD 2015; Lucas *et al.* 2016). For example, SDG 8 emphasizes sustainable economic growth and decent jobs, while one of its targets calls for decoupling economic growth from environmental degradation and improving global resource efficiency in consumption. SDG 12 on sustainable consumption and production, SDG 16 on peace, justice and strong institutions, and SDG 17 on means of implementation are cross-cutting goals that support all other goals and their environmental dimensions. Clearly, the SDGs cannot be achieved without fundamental environmental progress. This is recognized in the 2030 Agenda, which directly calls for an integrated approach to sustainable development (International Resource Panel 2015).

Although the SDGs link the environment much more closely to other development areas, they do not comprehensively represent the global environmental agenda (Wackernagel, Hanscom and Lin 2017). Some important environmental problems are not well reflected in the SDGs, such as mining and natural resource extraction, and the links between gender and the environment (e.g. indoor air pollution from cooking; Elder and Zusman 2016). The climate goal (SDG 13) does not have a target or indicator directly related to the state of the climate, although it references the Paris Agreement, which does have such a target. Moreover, the environmental indicators are not as well developed as those for other areas, and there is less data available to quantify their impacts and/or progress towards achieving the related targets. Many targets have several dimensions, and often the dimension related to the environment is not included in the indicator(s). The SDGs address the goals of many MEAs, although few of the many IAEs are directly mentioned in the SDGs.

Similarly to the SDGs, other major recent United Nations agreements and frameworks, such as the Paris Agreement on climate change, the Sendai Framework for Disaster Risk Reduction and the New Urban Agenda - Habitat III, require substantial contributions from all sectors and actors, as well as significant transformation of economic and social practices. Thus, like the SDGs, these agreements have a broad scope and should be implemented using an integrated approach.

Similarly, major non-United Nations global forums (e.g. the Group of Twenty [G20], the Group of Seven [G7] and the World Economic Forum) focus increasingly on environmental issues and associated risks, especially in relation to the SDGs. In 2015, the leaders and heads of states of the G7 met in Elmau, Germany, and agreed to decarbonize the world economy by the end of this century (G7 2015); at the Ise-Shima Summit in Japan, 2016, the G7 agreed to make concerted efforts to fulfil their SDG and Paris Agreement commitments. At the Taormina Summit in 2017 in Italy, all the G7 members reaffirmed their strong commitment to swiftly implement the Paris Agreement

(except the United States of America, which was in the process of reviewing its related policies). The G7 has been holding environment ministers' meetings regularly. The G20 also adopted an SDG Action Plan (G20 2016).

Other major meetings of environment ministers include the BRICS (Brazil, Russian Federation, India, China, South Africa), the Asia-Pacific Ministerial Summit on the Environment, the African Ministerial Conference on the Environment, and the Tripartite Environment Ministers Meeting among China, Japan and the Republic of Korea. The SDGs provide a framework and common language to bring all these agreements and actions together.

The target and indicator-based approach, which was a key innovation of the MDGs, was also used by the SDGs, as well as by the Strategic Plan for Biodiversity 2011-2020, including the Aichi Biodiversity Targets developed under the CBD (Kanie and Biermann eds. 2017). Many felt that this approach made an important contribution to the MDGs' relative success in mobilizing action and support, although it also has some disadvantages (Fukuda-Parr, Yamin and Greenstein 2014). If this approach is implemented broadly in line with the spirit and language of the SDGs, and not in a narrow instrumental manner, then implementation and accountability may be strengthened (Biermann, Kanie and Kim 2017). Another major innovation for the SDGs and the Paris Agreement is that each country agreed to translate the global goals and targets into national targets and indicators; however, this will introduce the challenge/opportunity of accounting for progress.

Therefore, it is very important for GEO-6 to continue to focus global attention on MEAs, IAEs and its new focus on SDGs and non-United Nations global forums. Still, implementation of some traditional MEAs may also benefit from a more integrated approach, possibly through greater linkages with the SDGs.

One of the main tasks of GEO-6 is to assess progress on the Internationally Agreed Environmental Goals (IEAG) that have been established by MEAs, highlighting gaps between the commitments and achievements of these agreements. More importantly, it will help to inform the global response and institutional capacity-building needed to address the increasing complexity and uncertainties associated with environmental problems and addressing them through global development. Given the urgency of the challenges associated with environment and development, and the limited financial and human resources available to address them, GEO-6 is focused on a holistic and integrated approach to assessment in order to leverage synergies across issues and minimize trade-offs, and to communicate the resulting knowledge.

1.6 GEO-6 in the context of other environmental assessments

To address environmental challenges effectively, their wider impacts on people, economies, societies, markets, institutions, justice, security and culture must be well understood. The GEO-6 process recognizes a need for participatory and integrated environmental assessments (IEAs), and for institutionalized tools and platforms to empower people, organizations and decision makers by co-developing information and relevant knowledge on the state and trends of the environment to inform policy action and adequate responses (UNEP 2015).



GEO-6 is part of the growing body of global environmental assessments (Mitchell *et al.* 2006; Kowarsch *et al.* 2014; Jabbour and Flachsland 2017; Kowarsch *et al.* 2017). Some of these assessments are, or include, regional assessments (e.g. the European Environment Agency's State of the Environment Report) or country-level assessments, while others focus on specific themes, such as the Global Gender Environment Outlook (UNEP 2016e). These assessments are typically conducted by international organizations and programmes, like UNEP through its Environment Under Review sub-programme (UNEP 2018) and create the needed evidence base that brings clarity and transparency to the main concerns facing the planet and humanity. This evidence base includes successes and failures in addressing these issues and, most importantly, provides options for actions to make sure that current and anticipated problems are equitably and effectively addressed. This action-oriented and stakeholder-focused approach has the desired attributes of incorporating feedback from decision makers into the knowledge development process and shortening the time for implementing the information and knowledge. Annex 1-2 lists the IEAs from which GEO-6 draws.

An IEA (such as GEO assessments) follows a common methodology and procedures to ensure the consistent application

of relevant quality standards, and links science to policy by:

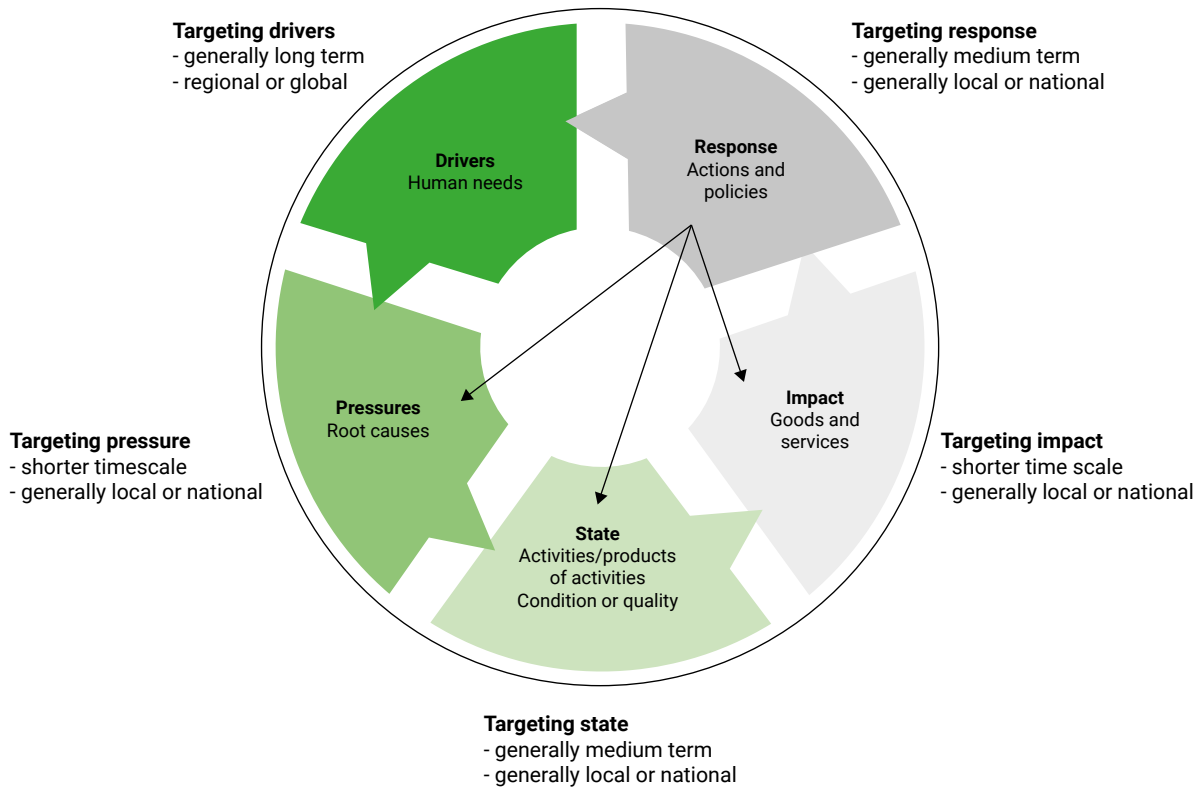
- ❖ analysing and synthesizing existing environmental, social and economic data to determine the state of the environment using the Drivers, Pressures, State, Impact, Response (DPSIR) framework, taking into account all ecosystem components and processes (see Figure 1.2);
- ❖ determining risk and uncertainty in the information;
- ❖ identifying and assessing past and potential policy and management actions;
- ❖ providing guidance for decision makers on the consequences of various policy and management actions, including not taking any action (UNEP 2017b).

1.7 GEO-6 approach, theory of change and structure

1.7.1 Approach

Historically, the GEO process was established as part of the follow up to the adoption of Agenda 21 in 1992, with the aim of placing the status of the environment under permanent review (UNEP 1995 - UNEP Governing Council in its decision 18/27). Since the first GEO in 1997, its approach and structure have undergone several changes and improvements.

Figure 1.2: The DPSIR approach used in GEO-6



In 1995, UNEP adopted the DPSIR causal framework approach for the GEO assessments. This represents a systems-analysis view in which the driving forces of social and economic development exert pressures on the environment, which change the state of the environment. The changing state of the environment leads to impacts on, for example, human well-being and ecosystem health, which then produces human responses to remedy these impacts, such as social controls, redirecting investments, and/or policies and political interventions to influence human activity. Finally, these responses influence the state of the environment, either directly or indirectly, through the driving forces or the pressures. Existing policies increasingly need to be assessed in terms of how they address the drivers and impacts of environmental challenges.

Source: UNEP (2017b)



Box 1.2: Multidimensional aspects of the analysis

GEO assessments are multidimensional in scope, in an effort to incorporate environmental, social, economic, policy, geographic and temporal perspectives to form various threads of evidence to answer the overarching questions. The main approaches used in GEO-6 include the following.

- ❖ The 'Healthy Planet, Healthy People' theme emphasizes the foundational importance of healthy ecosystems and environment for human health. Human health is systematically covered throughout GEO-6 by focusing on the many direct and indirect health-related impacts (e.g. diseases, mortality) deriving from environmental change and deterioration (see Chapters 2 and 4). In addition, health-related objectives are recognized within transformative environmental policies and pathways (Part B). Where possible, health-related impacts are analysed related to social criteria such as age and gender.
- ❖ GEO-6 includes thematic dimensions that track the state and trends of air, fresh water, oceans, land and biodiversity, and constitute a 'state of the environment' report (Part A).
- ❖ GEO-6 presents more than 25 policy case studies that highlight the importance of evidence-based policymaking (Chapters 12-16). The case studies allow examination of how to design effective policies without being policy prescriptive.
- ❖ GEO-6 includes cross-cutting dimensions that combine social, economic and environmental aspects of complex challenges. GEO-6 covers 12 cross-cutting issues (e.g. food, energy, resource use, gender, health, disasters, etc.) throughout the assessment of the environmental themes (Chapter 4) and policy effectiveness (Chapter 17), adding a specific focus on the interlinkages between the environmental and other dimensions of the 2030 Agenda/SDGs.
- ❖ For the first time, GEO-6 examines climate change as both a driver (i.e. built-in climate change) and a cross-cutting issue (i.e. anticipated impacts) in the sustainable development context through its overarching relevance to all other aspects of GEO-6 (Chapters 2 and 4).
- ❖ GEO-6 considers the equity dimension systematically by considering distributional, representational and procedural issues in the various parts of the assessment, highlighting impacts and possible opportunities of environmental policies and future development pathways to overcome inequities.
- ❖ The outlook chapters of GEO-6 (Part C) combine traditional global and scenario-based analysis with local, participative and decision-based analysis. This aims to provide a solution-oriented perspective which considers relevance and efficacy.
- ❖ GEO-6 uses modern tools and platforms (e.g. crowdsourcing) to expand stakeholder engagement in the assessment process (Chapter 23).

Based on the core principles of developing integrated environmental assessments (UNEP 2017b), the scope of the GEO has evolved. A key new feature of GEO-6 is increased emphasis on the interactions and interlinkages between the environment and human health. The changing approach and structure of this GEO reflects the most recent scientific evidence and the new geopolitical context, particularly implementation of the 2030 Agenda. GEO-6 provides the evidence base for addressing the environmental dimension of the SDGs.

The GEO-6 process in itself is part of the effort to strengthen overall capacity-building within the global environmental governance system, in order to increase the level of science-based decision-making on multiple levels (United Nations General Assembly Resolution 2997 of 1972). The GEO is an independent, expert-led, participatory process created to facilitate the interaction between scientific understanding and policy development. Policymakers, as well as a wide range of scientists and stakeholders, are consulted on each edition's focus and methodology through the High-Level Intergovernmental and Stakeholder Advisory Group, the Scientific Advisory Panel and the Assessment Methodologies, Data and Information Group, which provide advice and guidance throughout the GEO process. This participatory and consultative process gives GEO assessments scientific credibility, accuracy and authority, as well as policy relevance.

In addition to producing GEOs, UNEP has a mandate for capacity-building. This is an integral part of the GEO process and works at different levels, using various mechanisms. GEO reports include contributions from leading international experts

from a wide range of organizations worldwide, as well as a team of GEO Fellows who are early-career professionals or students.

The thematic dimensions (state and trends of air, fresh water, oceans, land and biodiversity) were also core elements of previous GEOs, but all the other approaches listed above are new to GEO-6.

Annex 1-3 contains information on the theory of change that GEO-6 is built upon, and Annex 1-4 provides information on how the authors of each chapter have established confidence statements for the main findings of each chapter. These confidence statements can be found in the Executive Summaries for each chapter and are expected to assist policymakers in understanding the extent of the evidence that exists on a subject, and how much of that evidence is in agreement on the findings presented in this assessment.

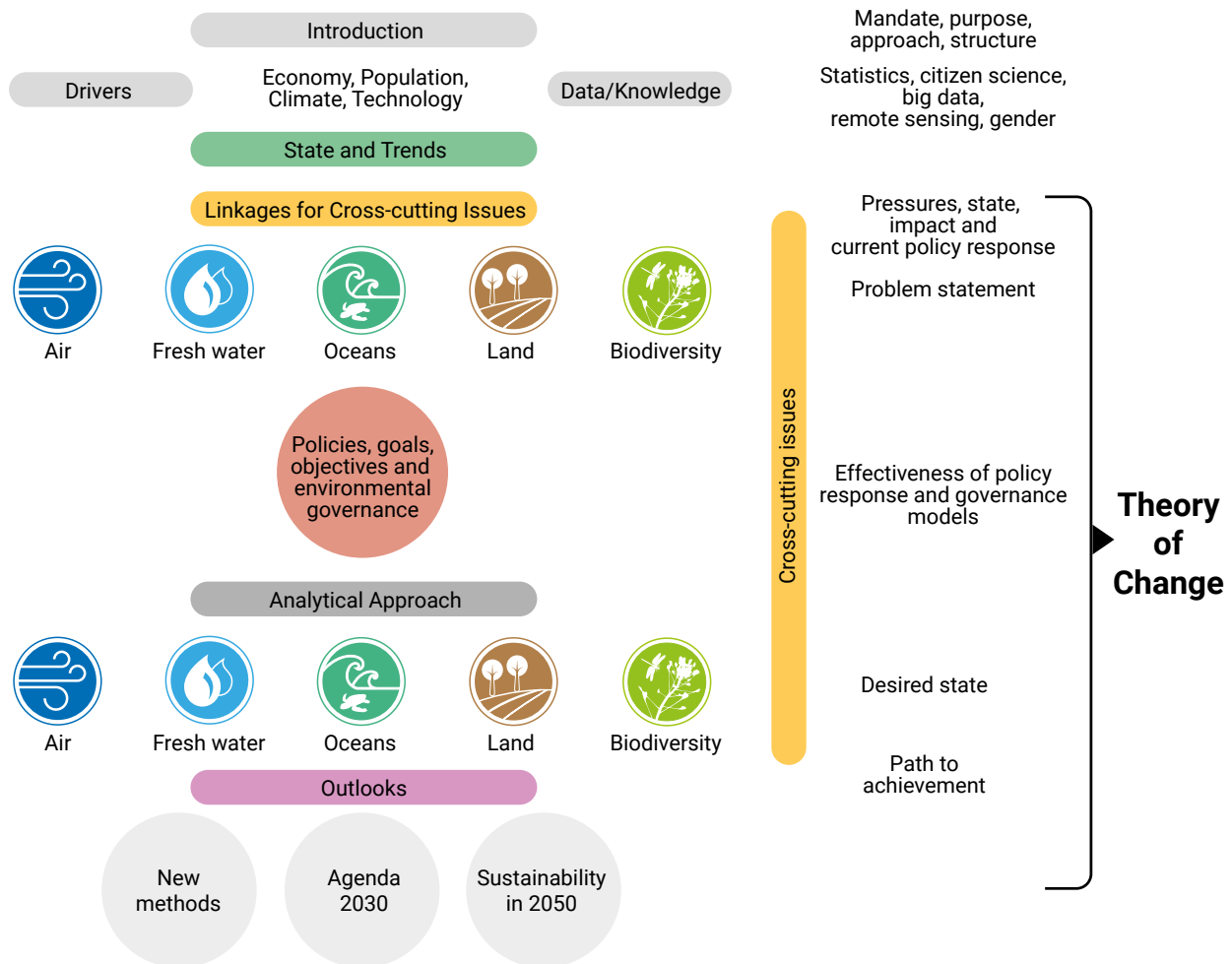
1.7.2 Structure

Based on this mandate and scope, the contents of GEO-6 are structured as shown in **Figure 1.3**.

Three chapters complement this introduction, Chapter 2: Drivers of Environmental Change, Chapter 3: The State of Our Data and Knowledge, and Chapter 4: Cross-cutting Issues. As information and data become more important in society, knowledge creation and use also become even more important within GEO-6, since the organization of data, information and knowledge form the foundation of scientifically sound assessments and informed policy decision-making. Therefore,



Figure 1.3: Structure of GEO-6, with a link to its Theory of Change (see Annex 1-3)



GEO-6 makes greater efforts to explain both changing needs and new opportunities around data, information and knowledge generation derived from UNEP's mandate to deliver the environmental dimension of the SDGs.

The global human system has many deep-rooted path dependencies, which have evolved over a long time. As society and civilization have evolved and developed, the interlinkages between human and environmental systems have become more complex and dynamic. To understand the most relevant structural elements of the human system, GEO-6 systematically examines the overall drivers, for example, population and demographic changes, including the causes of migration, current economic trends and technological developments.

One new element is Chapter 4 on cross-cutting issues, which presents the evidence explaining how the state and trends of the environment are already impacting human systems on various scales. The twelve cross-cutting issues addressed in GEO-6 are also important SDG issues: health, environmental disasters, gender, education, urbanization, climate change, polar regions and mountains, chemicals, waste and wastewater, resource use, energy and food systems). GEO-6 uses a matrix-approach to address these cross-cutting issues,

considering each within the context of the five environmental themes (air, biodiversity, oceans, land, fresh water). This approach helps reflect the growing need to synthesize more effectively our knowledge on the environment's multidimensional functionality and how it already affects human systems.

The analysis in GEO-6 is divided into four parts:

Part A: State of the Global Environment features five thematic chapters providing the latest data and information on the state and trends of air, biodiversity, oceans, land, oceans and fresh water. Chapters 5-9 have a common structure using the DPSIR approach, and each includes information on related policy responses.

Part B: Policies, Goals, Objectives and Environmental Governance, an assessment of their effectiveness evaluates the effectiveness of the current policy landscape within the existing environmental governance structure at multiple scales, based on the policy responses identified in the thematic chapters in Part A, including the cross-cutting issues (Chapters 10-17). The methodology developed for this assessment is based on a combined top-down and bottom-up approach. The results are used to extract guidance for policymakers and to support the promising policy approaches addressed in the final



section of the report. Based on this analysis, Part B also identifies needs for further improvements to the global environmental governance system (Chapter 18).

Part C: Outlooks and Pathways to a Healthy Planet

with Healthy People incorporates the most promising policy approaches from Part B into the pathways of transformation. It combines global and scenario-based analysis (Chapters 20-22) with local, participative analysis (Chapter 23) to identify possible pathways towards achieving the environmental dimension of the SDGs and other MEAs (up to 2030), and assesses long-term or mid-century strategies required for achieving long-term sustainability (to 2050) (Chapter 24). The outcomes and conclusions provide a baseline to guide policymaking and implementation of the SDGs, as well as the development of more transformative pathways to reach scientific targets over a longer time-horizon (to 2050), such as the objective to become a climate-neutral, resource-efficient society. This long-term perspective will help to guide the further development of global, regional and national governance

systems to ensure future human development stays within the Earth's ecological limits, and helps to create a more equitable world with no one left behind. Where possible, Part C emphasizes the economic and social costs and benefits of various options for action and non-action.

Part D: Remaining Data and Knowledge Gaps (Chapter 25)

provides an overview of the data/knowledge trends and issues and identifies the gaps that need to be filled in order to implement the SDGs and achieve the IAEs established in MEAs. This is based on the premise that more data/knowledge leads to better and more effective actions/solutions in more places. A revolution in communications and information technology is creating significant new data and information opportunities beyond traditional environmental monitoring and assessment.

We hope readers – whether policymakers, researchers or citizens – find the analysis and assessment findings presented in the following chapters useful, helping to inform future efforts to address our collective environmental challenges.

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