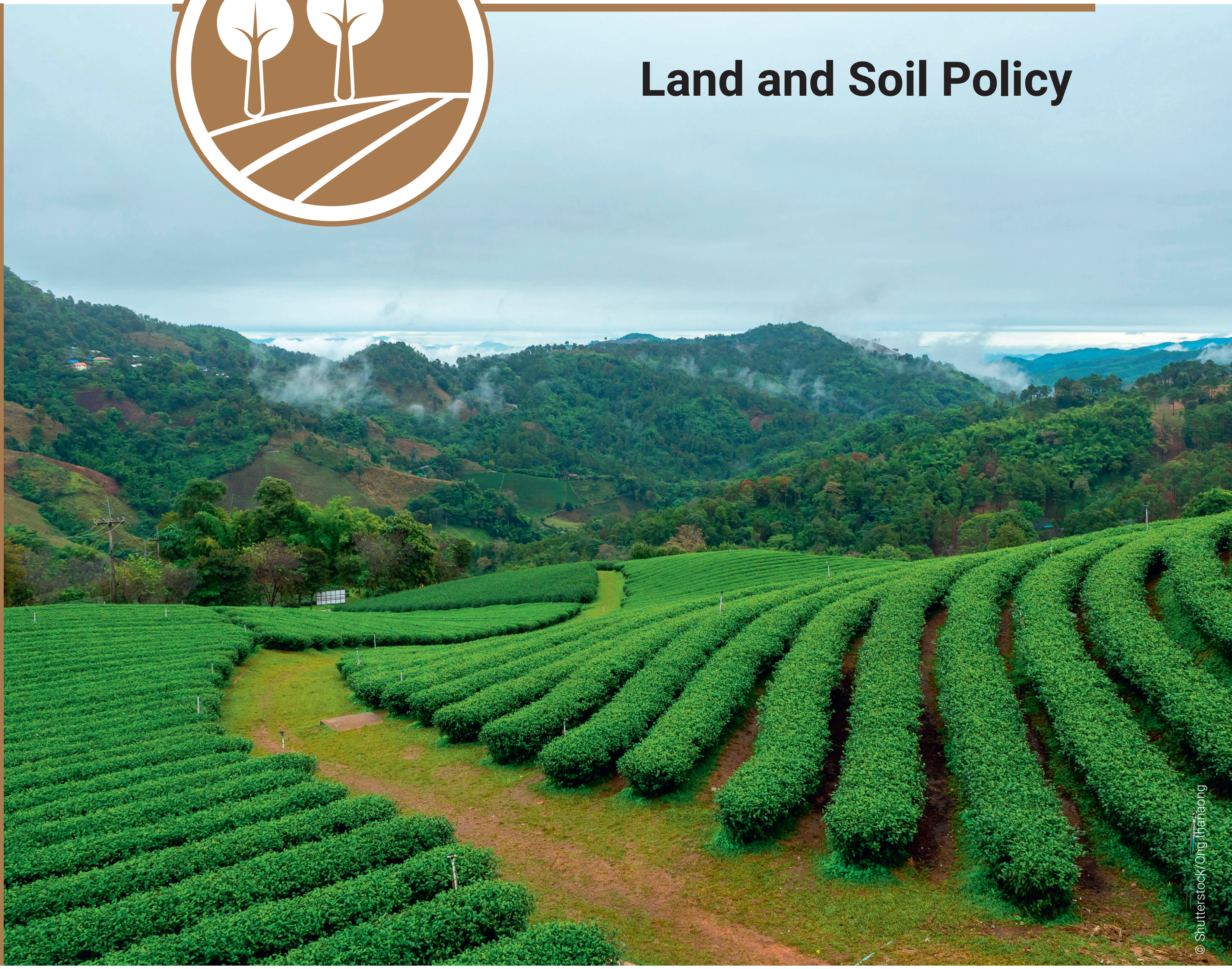
Chapter 15

Land and Soil Policy



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Executive summary

Land protection policies differ between regions and countries from barely existent to well defined (*established but incomplete*). However, their implementation has many shortcomings. Often, national policies addressing socioeconomic development (e.g. economic incentives for agricultural, bioenergy and urban development) have overlooked land degradation side effects. As long as economic growth is not decoupled from environmental degradation, sustainable use and management of land requires policy frameworks that better integrate land management governance across sectors, especially in developing countries. This chapter analyses the effectiveness of policies and policy approaches addressing land quality dynamics in five case studies having different socioeconomic and physical contexts and management approaches. The intention is to draw messages for policy and decision makers when dealing with complex land issues in a context of competing interests and scarcity of resources. {15.4}

Land degradation is likely to be aggravated as long as effective land and soil management policy frameworks are not established at national and international levels (*established but incomplete*)**.** Global trade and land acquisitions, including land grabbing, have direct consequences on the livelihoods of local people and international food trade markets. {15.1, 15.2}

Land degradation and lack of policy action may accelerate migration in some regions (*well established*)**.** The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services notes "by 2050, an estimated 4 billion people will live in the drylands and until then it is likely that land degradation and climate change will have forced 50-700 million people to migrate". This will result in increased hardship for most areas in Africa, South Asia, the Middle East, and North Africa that will be impacted by rapid population growth, low per capita gross domestic product (GDP), limited options for agricultural expansion, increased water stress and high biodiversity losses. {15.1}

Land degradation and desertification could be prevented within the context of local social, economic and political conditions (*well established*). Sustainable land management practices can reverse even severe desertification processes. But the implementation of such practices necessitates policy frameworks that support the involvement and compensation of local people with public money or through public-private partnerships, including direct financing from the private sector alone. Such incentives, however, are country specific and depend on financial resources available. {15.2.1}

Land is a key source of ecosystem functions and services. Consequently, land-use change is the major direct driver of the loss of ecosystems services and biodiversity (*well established*). In 2017, the estimated global ecosystem services losses due to land degradation were between US$6.3 trillion and US$10.6 trillion per year. This estimated loss is equal to 10-17 per cent of global GDP (US$63 trillion in 2010), while halting and reversing current trends of land degradation could generate up to US$1.4 trillion per year in economic benefits if sustainable land management policies would be implemented. {15.2; 15.2.2}

Land policy frameworks to tackle risk to human health from soil contamination are scattered and incomplete (*established but incomplete*)**.** The 'polluter pays' principle is not widely applied and the cost of remediation is very high, preventing its implementation even in developed countries. Lack of knowledge and data gaps further hinder its implementation. Hence a reconsideration of that principle, or otherwise a strong commitment from the government (local, regional, national) to act, is needed to safeguard public health. The contamination of land with heavy metals, pesticides, organic pollutants and other toxic substances severely threatens humans as they are taken up by plants used for food. These effects are even more severe in developing countries that are faced with lack of financial resources and expertise to tackle soil pollution. {15.2.3, 15.2.4}

Sustainable land management is a major instrument for climate change mitigation because it improves carbon sequestration in the soil (*well established*). This is why land and soil policy gained increasing international recognition with respect to climate change negotiations of the 23rd Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP 23) held in Paris in 2015 when the '4 per 1000 Initiative' was launched by the French Government. The initiative promotes enhancement of soil quality, carbon sequestration and soil conservation through improved agricultural practices that mitigate climate change. {15.3.1, 15.4}

High-consumption lifestyles, especially in developed economies, aggravated by food waste, and rapid population growth rates have negative consequences for land and its resources (*established but incomplete*). The increased demand for food and biofuels will trigger agricultural intensification such that biomass production is expected to double by 2050. Policies need to steer sustainable intensification through conservation agriculture practices to mitigate negative effects on soil health and on the environment. {15.2.4}

Land-use planning, sustainable use of land resources and sustainable land management are the answers to balance production with environmental protection (*well established*). Sustainable intensification practices attempt to integrate increasing crop yields with maintaining soil fertility and improving water-use efficiency. Annually, US$75.6 trillion can be gained from implementing global policies that enable sustainable land management. Among many other sustainable land management practices, conservation agriculture that includes also zero tillage provides a good example of technologies that maintain land quality, enhance soil carbon sequestration, mitigate climate change, protect biodiversity and sustain productivity. Policies, economic analysis, science and farming incentives, however, are all necessary to support implementation of these technologies, especially for small landowners, in particular those in the developing countries. {15.2.4}

Land management, restoration and policies need to be tailored according to local conditions (*well established*). Experience has shown that 'one-size-fits-all' is not an option to promote sustainable land management worldwide. Success of policy implementation depends on a number of factors that consider an integrated landscape approach well-matched to socioeconomic and natural characteristics supported by good levels of governance and stakeholder engagement. {15.2.4, 15.2.5}

Implementing the right actions to combat land degradation and support sustainable land management policies has a direct effect on the livelihoods of millions of people across the planet (*well established*)**.** This imperative will become more difficult and costlier if no action is taken urgently. Unfortunately, there is still a disconnect between consumers and the ecosystems that provide the food and other commodities they depend upon. {15.5}

Land is a finite resource that is under human pressure, especially from urban sprawl (*established but incomplete*). Chaotic urban expansion has been observed worldwide mostly on fertile and productive lands and, by 2050, about 80 per cent of the productive soils are at risk of being lost as each year about 20 million ha of agricultural land is converted into urban and industrial developments. The situation along the coastal areas is worst. It is therefore imperative that land-use policies should define a proper allocation of land resources between competing interests. Cities play a major role in land-use changes, so municipal and city planners need to coordinate their actions with a large number of stakeholders, including civil society and establishing public-private partnerships, to ensure sustainable spatial planning, policy coherence, implementation and conflict resolution for both urban settlements and responsible food systems. {4.2.5, 15.3.3}

15.1 Introduction

As noted in chapter 8, land plays a crucial role within the 'Healthy Planet, Healthy People' theme and underpins global efforts towards sustainable development. Consequently, sustainable land management (SLM) is not only essential to promoting and maintaining the great diversity of nature's contribution to people but also in tackling poverty and hunger.

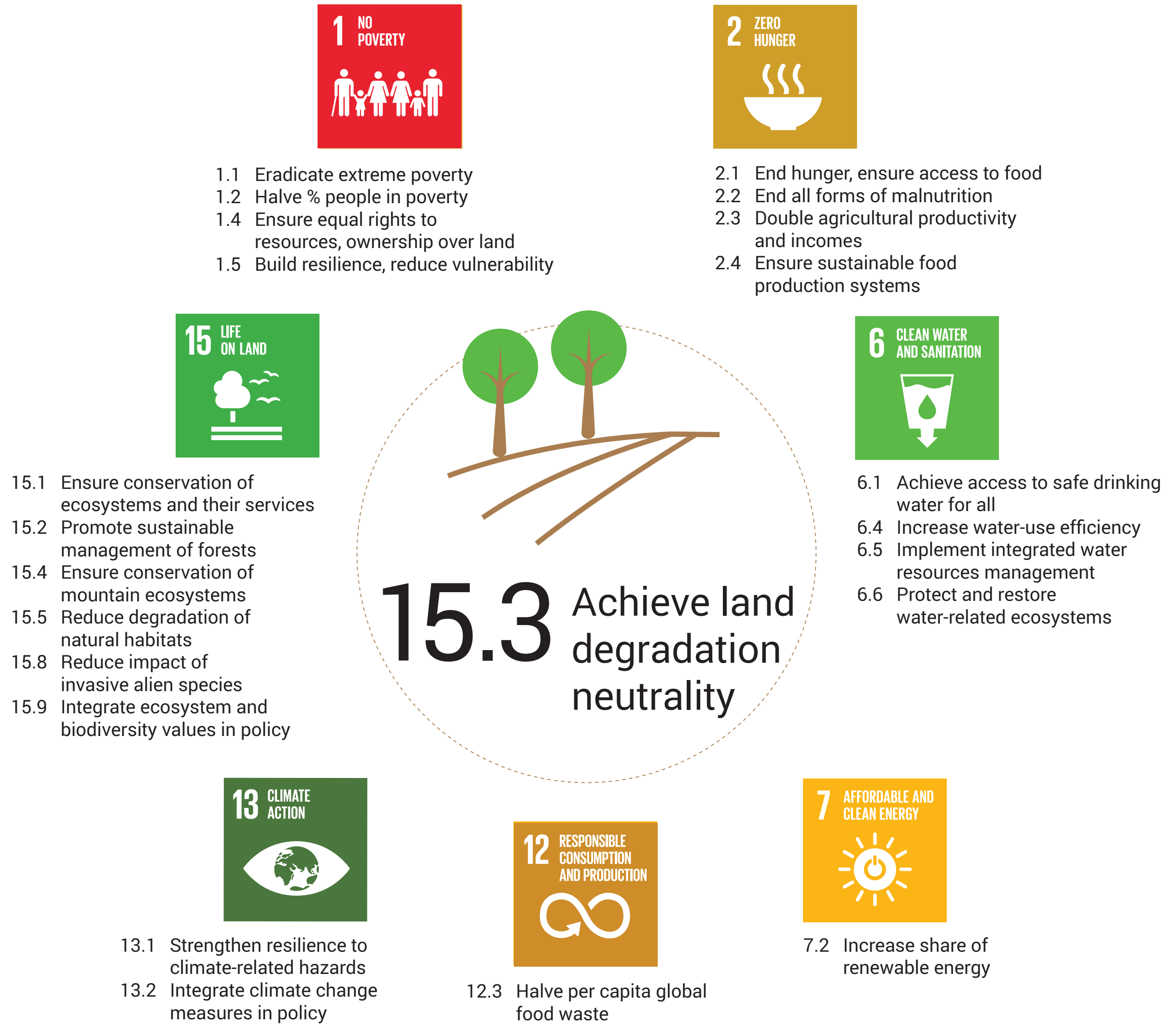
At the international level, the Sustainable Development Goals (SDGs) emphasize the need for SLM among stakeholders for the protection of natural ecosystems that are on the verge of collapse, including increased climate-induced natural disasters. SDG 15 is directly related to the analysis in Chapter 8. Furthermore, SDG target 15.3 focuses on land by demanding action against land degradation and efforts to achieve a land degradation-neutral world. Although land management is explicitly targeted in SDG 15.3, it is paramount for food security (SDG 2), climate action (SDG 13) and also has many interconnections with SDGs 1, 3, 6, 7, 11 and 12 **(Figure 15.1)**.

The driving forces and pressures (see Chapter 2) on land and its resources emanating from population growth, urbanization, economic development, technology and innovation, and climate change have elicited responses at global, regional and

Box 15.1: The Concepts of Land and Soil

The concepts land and soil are not synonyms. Land represents the terrestrial solid part of the earth that is not permanently under water and offers an endless set of services and functions from biomass production to urban living habitats. It comprises soil, vegetation, other biota, and the ecological and hydrological processes operating on it. Soil is the unconsolidated material on the land surface that has been formed by mineral particles, organic matter, water, air and living organisms simultaneously interacting over time. Ecological processes in the soil ensure biomass production, nutrient cycling, carbon sequestration, water filtration and buffering, cooling and hosting biodiversity.

Figure 15.1: Linkage between the land-related SDG target 15.3 and other SDGs



Source: Akhtar-Schuster *et al*. (2017).

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national levels. At the global level, several responses directly or indirectly related to sustainable land and soil management have been initiated as shown in **Table 15.1**.

This chapter provides a comprehensive overview of the current Land and Soil policy framework and the related shortcomings, especially in terms of policy cohesion and implementation, as well as overall effectiveness. The subsequent sections present case studies of different sets of legal and policy instruments, economic tools and incentives, as well as policies and programmes implemented across different countries. The case studies were selected based on the criteria of regional balance, different spatial scales, type of policies and/or governance arrangements, plus their relevance to state and trends of land resources as detailed in Chapter 8 of this report.

15.2 Key policies and governance approaches

An overview of key policies and respective case studies is provided in **Table 15.2**. The cases reflect the variety of driving forces, economic sectors and processes affecting land degradation, and are used as illustrative examples of policy instruments covering a diverse range of spatial scales and time frames of implementation. Despite addressing important drivers and respective policy approaches, the cases here do not

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Table 15.1: Recent milestones in land governance and sustainable development

Year	Milestone
1981	2015 FAO World Soil Charter
1988	Intergovernmental Panel on Climate Change (IPCC)
1992	United Nations Conference on Environment and Development
	Rio Declaration
	Agenda 21
	Global Environment Facility
	United Nations Convention to Combat Desertification (UNCCD)
	United Nations Framework Convention on Climate Change (UNFCCC)
	Convention on Biological Diversity (CBD)
1997	Kyoto Protocol
2000	Millennium Development Goals (MDGs)
2005	Millennium Ecosystem Assessment
2008	UNCCD's Zero Net Land Degradation and Land Degradation Neutrality Initiative
2011	Global Soil Partnership initiated (FAO/European Union)
2012	Rio+20
2015	Sustainable Development Goals (SDGs) and Post-2015 Development Agenda
	Intergovernmental Technical Panel on Soils (ITPS) of the Global Soil Partnership (GSP)
	Land and Soils integrated in the Open Working Group of the Sustainable Development Goals
	Regional Soil Partnerships of the GSP
	International Year of Soils declared by the United Nations General Assembly
	The Economics of Land Degradation
	UNFCCC Paris Agreement
2017	(United Nations Economic and Social Council) United Nations Strategic Plan for Forests 2017-2030
	FAO Voluntary Guidelines for Sustainable Soil Management
2018	UNCCD's Land Degradation Neutrality Fund a public-private partnership for blended finance

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Table 15.2: Typology of policy and governance approaches described in this chapter

Governance approach	Policy instrument(s)	Case studies
Policy mix: command and control, and economic incentives.	Funding programmes and standard setting for best management practices.	Strengthening foreign direct investment management and social and environmental safeguards in Lao People's Democratic Republic
Policy mix: Command and control, plus economic incentives.	Planning and compensation for halting desertification.	The Great Green Wall Project in China.
Command and control.	Setting threshold values for policy on remediation of contaminated sites.	Remedial treatment of Agent Orange-contaminated land in Viet Nam.
Promotion of innovation.	Provision of consultancy and networking for agricultural innovation.	Conservation agriculture and no-tillage cultivation in Australia.
Enabling actors.	Stakeholder network creation for responsible food systems and minimizing food waste.	Milan Urban Food Policy Pact.

address two further key aspects of land degradation that were pointed out in Chapter 8, namely insecure land tenure systems and land grabbing issues on the one side (Section 8.5.3), and teleconnections and spillover effects of consumption of land-based products (food, bioenergy) in one country on land resources depletion in other countries (Section 8.4.1). Both these issues severely affect the social dimension of land degradation impacts (IPBES 2018a).

15.2.1 Funding programmes and standard setting for best management practices

Sustainable land management is strongly influenced by policy frameworks that differ between countries and regions. A main driver is land-use change that has distinct economic and environmental consequences. Economic gains often are responsible for environmental degradation and, in many cases, not all stakeholders benefit from such gains (Castella *et al.* 2013). The case study below looks at these dynamics.

Case study: Strengthening foreign direct investment management and social and environmental safeguards in Lao People's Democratic Republic (Lao PDR).

Foreign investments in Lao People's Democratic Republic have a direct impact on the economic growth of the country and account for more than 50 per cent of gross domestic product (GDP), but they also raise serious environmental issues as the country has been experiencing significant forest depletion since the 1980s. Forests covered nearly 50 per cent of the country in 1982 (Phompila *et al.* 2017), but had declined to 41.5 per cent by 2013.

There are a number of factors that have influenced forest decline (Food and Agriculture Organization of the United Nations [FAO] 2010). They derive mostly from economic activities, such as forest land conversion for agriculture, mostly cash crops, and urban sprawl associated with infrastructure expansion and hydropower production. Other driving forces accelerating deforestation include uncontrolled hunting and logging as well as cleared forest areas converted to livestock grazing (United Nations Development Programme [UNDP] 2014). Economic activities emanating from forest land conversion for agriculture have triggered an increase in the number of land deals in Lao PDR 50-fold from 2000 to 2009 (Schonweger *et al.* 2012). The value of approved foreign and domestic investment projects exceeded US$29 billion by March 2018. All except for US$3.9 billion of this total was generated through foreign investment (US$8.5 billion) or joint ventures (US$16.6 billion) (UNDP-United Nations Environment Programme (UNEP) Poverty-Environment Initiative, UNDP and UNEP 2018).

The second largest type of land concession is related to agricultural investments. Between 1990 and 2007, the area of plantations, especially rubber plantations, increased dramatically from 1,000 ha to over 200,000 ha (Phimmavong *et al.* 2009). As of 2012, these covered more than 330,000 ha. An early study found that 85 per cent of all investment in agricultural concessions came from foreign investors, the five most important being from China (about 50 per cent), Thailand, Viet Nam, Republic of Korea and India (Wellmann 2012). Estimates of the area given to land concessions alone vary between 330,000 ha and 3.5 million ha, but the government has reported that 1.1 million ha was a conservative estimate. This is equivalent to 5 per cent of national territory or 18 per cent more than the total arable land in Lao People's Democratic Republic (Global Witness 2013). Thirteen per cent of all villages in Lao PDR have at least one concession within their village boundaries (Wellmann 2012).

Vast parts of communal lands that lack tenure titles are the target of big foreign companies, which have expanded their land acquisitions in Lao People's Democratic Republic. Unfortunately, this process is accompanied with a new poverty type that affects local people who become dependent on new investors for all of their basic livelihood needs (Messerli *et al.* 2015). In one case, 25 villages were displaced due to a land concession to a Vietnamese rubber company and local communities were prevented from accessing the natural resources upon which they based their livelihood (UNDP and UNEP 2013).

In response to the challenges presented by sustainable development of the environment and natural resources, and at the invitation of the Government of Lao People's Democratic Republic, the joint United Nations Development Programme-United Nations Environment Programme (UNDP-UNEP) Poverty-Environment Initiative supported the government from 2009 to 2015 in developing tools to guide promotion, screening, approval, monitoring and compliance enforcement of investments, and helped build the capacity of institutions to engage with impacted communities and respond to unintended social and environmental impacts of investments in key natural resource sectors. **Table 15.3** gives a summary of the assessment criteria.

Table 15.3: Summary of the assessment criteria for foreign investments

Criterion	Description	References
Success or failure	Success criteria include: benefits derived from the Poverty-Environment Initiative: a first green and pro-poor, quality investment management system; the assessment of development options; greater understanding of positive and negative investment implications; awareness of investors' degree of compliance; improved accountability; and the introduction of the 'green-growth' concept. Although training events and capacity-building took place, several relevant actors, at national and local levels, are not empowered to understand and enforce an equitable investment management system. Notwithstanding capacity-building events, uneven governmental capacity remains a challenge, but officials are showing commitment and appreciation. The lack of clear assignment of responsibilities in investment management remains unaddressed.	Tavera (2015)
Independence of evaluation	The assessment of this Lao PDR experience is part of the Initiative's independent midterm evaluation. Phase I (2009-2012) and Phase II (2012-2015) have been evaluated by an independent consultant at the request of the United Nations Development Programme Country Office.	
Key actors	The Poverty-Environment Initiative country team worked closely with the Lao PDR National Assembly, the Ministry of Planning and Investment, the Department of Environment and Social Impact Assessment, the Ministry of Natural Resources and Environment, the Investment Promotion Department and the National Economic Research Institute.	
Baseline	Before the commencement of the programme in 2011, annual average GDP growth was 7.9 per cent in the preceding decade (Lao People's Democratic Republic, Ministry of Planning and Investment 2011), while the poverty level was 27 per cent in 2007 (World Bank 2010). In 2010, Lao PDR had a GDP per capita of US$1,101.	
Time frame	Phase I took place from 2009 to 2012, Phase II from 2012 to 2015. Phase III (2016-2018) is not included in this case study.	
Constraining factors	There is an urgent need to build poverty-environment awareness and capacity within the National Assembly to make its normative work effective. Although technical staff of the National Assembly received training on compliance, the capacity-building efforts of the Initiative are limited and need to be sustained and expanded. Capacity needs to be strengthened also at the ministerial and, especially, local levels – fundamental for implementation and often hard to reach. Inter-ministerial and vertical coordination (especially with provinces) should be improved to achieve integrated development and equitable investment management.	
Enabling factors	Governmental commitment and involvement are major enabling factors, in particular with respect to the National Assembly, but also with the Investment Promotion Department and development-related ministries (the participation of the Ministry of Planning and Investment was fundamental). Shared and increased poverty-environment awareness by reference managers and staff resulted from the Initiative's efforts and allowed for the prioritization of equitable investment management. Improved assessments and investment data management had started to inform decision-making and create understanding of whether investments were economically beneficial for communities.	
Cost-effectiveness	Foreign direct investments are forecast to lead the country's development and comprise a significant share of its GDP. Their proper management is an important contribution to sustainable and equitable economic growth.	
Equity	Management of foreign direct investments directly addresses equity with regard to impacted communities. Unregulated investing led to cases of village displacement, land grabbing or segregation of resources vital to the livelihood of inhabitants, without necessarily contributing to the country's development (creating local jobs or providing significant revenues to the national government). With the support of the Poverty-Environment Initiative, Lao PDR was able to provide a legal framework and safety net to bind investments to more equitable conditions. This work also contributed to creating awareness among decision makers about equitable sustainable development and to orient the National Assembly and future national development strategies towards this aim. This was already clear during Phase I, which saw the 7th Five-Year National Socio-Economic Development Plan (2011-2015) integrate poverty-environment issues and highlight the objectives of quality growth and equity.	Lao People's Democratic Republic, Ministry of Planning and Investment (2011)
Co-benefits	Tackling the equity dimension in investment management also has external positive implications on the environmental side. It promotes more inclusive and sustainable land management and prevents the depletion of natural resources and biodiversity loss. These practices lead to economic benefits being more fairly distributed among local communities. These points highlight how all three dimensions of sustainable development (economic, social and environmental) are addressed. The Lao PDR case also provides a relevant example of foreign direct investment management for sustainable development that can be shared through South-South learning. The Lao PDR experience has further informed the work of the Poverty-Environment Initiative country projects in Myanmar, Mongolia and Philippines, in particular on investments in extractive industries.	Choi and Gankhuyag (2016)

Criterion	Description	References
Transboundary issues	A more binding investment regulation system might lead investors to flee to other countries with a laxer framework and where standards for compliance are lower. To avoid this, investment management performance should be enhanced, and working with the whole region could harmonize standards. The Lao PDR experience could serve countries beyond Asia and the Pacific, as it is relevant to global efforts to promote inclusive and greener economic growth.	
Possible improvements	❖ Realize a financial sustainability strategy for investment management, owned by the Investment Promotion Department and the Ministry of Finance, to make investment management sustainable. ❖ Enhance data sharing among relevant ministries to promote coordination for management of investments. ❖ Strengthen enforcement for compliance. ❖ Intensify training and ownership of tools for all actors involved, especially at the local level. ❖ Improve management of foreign direct investments in the whole region to avoid investors fleeing to contexts with lower standards. ❖ Strengthen communities' participation.	

An independent evaluation of the joint UNDP-UNEP Poverty-Environment Initiative programme conducted in 2016 rated its performance as "highly satisfactory". The effectiveness of this equitable and comprehensive legal framework is, however, subject to implementation and enforcement that go beyond the programme. The main obstacles to enforcement are lack of institutional capacity, tools and funds for investment monitoring. There are efforts to fill the information gap including improving database management for monitoring compliance. Yet, poor institutional coordination still prevents this data from generating consistent action on compliance and enforcement. There is also limited opportunity for community inputs into the national decision-making process (Tavera 2015; Tavera, Alderman and Nordin 2016). On the other hand, the conditions for equitable and sustainable growth have been laid. The policy effort was successful in providing comprehensive and fair tools and processes to enable quality investments and safeguard communities. There is now a legal framework to empower these actors to take part in development processes, and the country is moving one step closer to ensuring that investment is judged by the quality of its social and environmental benefits – and not just its benefits in economic terms. Community engagement was also enabled (UNDP 2016). These efforts in the investment sector also contributed to increasing decision makers' awareness and political prioritization of sustainable development.

15.2.2 Planning and compensation for halting desertification

The success of any strategy for combating desertification depends on the implementation of sustainable land and water management practices adapted to the specific local geo-biophysical and socioeconomic situation. Well-managed soils slow down the process of land degradation, regulate the water cycle, safeguard biodiversity, conserve landscape multifunctionality and improve the provision of ecosystem services (United Nations Convention to Combat Desertification [UNCCD] 2017a; Zdruli and Zucca 2018).

The general policy approach for combating desertification in terms of the DPSIR framework (section 1.6) needs to tackle the pressure derived from land cover losses, which in many cases are driven by economic incentives to increase agricultural production. Effective policy approaches generally combine command-and-control policies (in extreme cases, forcing farmers to stop farming) and offering incentives, such as subsidized tree planting. The Land Degradation Neutrality approach, included in SDG 15.3 and endorsed by the UNCCD, and the Economics of Land Degradation Initiative have become the mainstream strategic instruments to reduce net losses of land resources and ensure their sustainable management (Akhtar-Schuster *et al.* 2017; UNCCD 2017a); they also address climate change (Sanz *et al.* 2017). A set of management practices – including sustainable soil/land and water management, afforestation and reforestation, agroecology, pasture improvement and controlled grazing, watershed management, water harvesting and sustainable agricultural practices – have been implemented in support of this goal (Rojo *et al.* 2012; Schwilch, Liniger and Hurni 2014; Teshome *et al.* 2015; Marques *et al.* 2016).

Land restoration projects are usually funded with public money and follow top-down approaches (Marques *et al.* 2016). The top-down approach is traditionally applied by national governments, and as such these instruments are often called 'command-and-control' or regulatory instruments (King and Mori 2007; Weber, Driessen and Runhaar 2014). The government defines the rules and norms, and has the right to apply sanctions in those cases where rules are not implemented. Examples of regulatory instruments include standards, bans, permits, zoning and use restrictions (Lambin *et al.* 2014; Weber Driessen and Runhaar 2014). The 'command-and-control' approach is often implemented especially in the developing countries, as can be seen in the following case study.

Case study: The Great Green Wall to effectively decrease dust storm intensity in China

The Chinese Great Green Wall (GGW) is one of the most ambitious projects to combat desertification and control dust storms, similar to the Sahara Great Green Wall stretching from Dakar to Djibouti. The project was originally named the Three North Shelterbelt Forest programme, as launched in 1978; it still retains that same name but is also called the GGW. It is expected to continue until 2050. The programme name has become a common term in China, as the largest afforestation project in the country (Huang *et al.* 2016). It was designed to cover a total area of 4.1 million km^2 (or 42.7 per cent of the total land area of the country **Figure 15.2** (Wang *et al*. 2010).

Figure 15.2: The extent of the Great Green Wall in northern China

Source: Source: O'Callaghan (2014).

Table 15.4: Summary of the assessment criteria for desertification and dust control in China

Criterion	Description	References
Success or failure	Chinese researchers and government officials have reported that afforestation has successfully combated desertification, accelerated soil carbon sequestration and decreased soil erosion. By 2012, the programme had reportedly increased the tree cover from 5 per cent to 12.4 per cent in the programme area, with the cumulative tree planting area reaching 26.47 million ha. The policy showed success in that it reversed the trend of land degradation such that in many places soil carbon sinks are starting to increase. Vegetation cover increased in the GGW region compared to non-GGW regions, which led to a reduction of the dust storm intensity in northern China. During the project, desert expansion has been reduced to about 10 km^2 per year. In addition, about 1,060 km^2 of desert per year is transformed in a good condition. Critics of the programme, however, claim that it may have failed to meet its goals to date. One reason is that the observed decrease of dust storm intensity may simply be a consequence of climatic variability. Second, the programme was implemented only on a small portion of the affected areas and even not those that are known as core areas for dust storm sources. Third, not all of the planted trees and shrubs survived beyond the lifetime of the programme because of mismanagement and/or lack of water. A further point of critique was related to the overuse of groundwater by planting varieties that were not well suited to the arid areas.	Piao *et al*. (2007); Wang *et al*. (2010); State Forestry Administration (2011); Deng, Liu and Shangguan (2014); Sternberg, Rueff and Middleton (2015); Tan and Li (2015); Feng *et al*. (2016); Jiang (2016); Ahrends *et al*. (2017)
Independence of evaluation	There has been no independent evaluation, other than those conducted by Chinese researchers reported above.	
Key Actors	The key actor and investor is the Government of China, with 18 ministries and agencies of the central government and local authorities involved in various aspects of policy formulation concerning desertification control. The State Forestry Administration (SFA) is responsible for coordinating activities among these ministries. The local residents and communities have been involved in afforestation, grassland establishment and related activities. The programme additionally looks for the dynamic cooperation of non-governmental domestic and international entities, including the broad involvement of the private sector.	Lu and Wang (2003); State Forestry Administration (2011); Yin and Yin (2010)
Baseline	Since 1980, dust storm events were classified into ten grades (0-9) according to a visibility range that was being monitored at meteorological stations. The so-called Dust Storm Index (DSI) is equal to the mid value of the visibility for each grade. Despite considerable annual variation, a strong decrease of DSI has been observed since 1985. Also, the number of sandstorm days decreased and reached a low level in 1996. However, because of the complex interactions with vegetation, it was not possible to draw a clear, one-to-one cause-effect relationship between the implementation of the policy and the decrease of dust storm events.	Tan and Li (2015); Xiaoming *et al*. (2016)
Time frame	1978-2050	

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Criterion	Description	References
Constraining factors	The excessive population growth of human and livestock is a challenge to the limited ecological carrying capacity in desertification-prone areas around the world (Pan *et al.* 2013) including in China. In the past decade alone, China invested more than US$100 billion into six key forestry programmes. However, returns for the large-scale tree planting investment in marginal areas may be low or take a long time to materialize. Another shortcoming is related to lack of interest from farmers after the trees have been planted, and lack of knowledge in forest management. Less supervision from local governmental offices and the size of subsidy levels were issues that limited the policy impact effect. Overall, the lower subsidies did not offer a strong motivation for farmers to participate in the programme despite the large amounts of money invested in ecosystem payment schemes to meet Chinese Government ambitions.	Ahrends *et al.* (2017) ; Xu, Song and Song (2017)
Enabling factors	A large number of institutional and administrative capacities have underpinned success to date. Since 1997, the SFA has established several institutions dealing with desertification, including the National Bureau to Combat Desertification, the National Desertification Monitoring Centre, a National Training Centre for Combating Desertification, and a National Research and Development Centre for Combating Desertification – all to conduct research and implement policy programmes on desertification issues. Moreover, in June 2009, the Institute of Desertification was established by the Chinese Forest Academy, which is also under the SFA. The government strongly supports desertification mitigation programmes by allocating significant funding (US$4 billion total during the initial 28 years). Several compensatory measures to increase vegetation have been implemented, including cash incentives to farmers willing to plant trees and shrubs.	Jiang (2016)
Cost effectiveness	"For the period from 2002 to 2006 the Three North Shelterbelt Forest Project has used 4,147 million yuan (US$545.6 million) of investment, created 2,840 million yuan (US$373.7 million) of ecological benefits, and 8,060 million yuan (US$1,060.5 million) of economic benefits." Direct costs of desertification are estimated at 64.2 billion yuan (Chinese Yuan Renminbi - CNY) annually (US$7.7 billion), while indirect costs of desertification are estimated at 288.9 billion yuan annually. Finally, the analysis shows that the costs of the rehabilitation of the lands degraded due to land use cover change are significantly lower than the costs of inaction, with returns of up to 4.7 times for every yuan invested over a 30-year period.	Deng and Li (2016); Jiang (2016)
Equity	Desertification control has mostly depended on the administration, specialists and other social elites for decision-making, while the local people are often inactively participating in the decision-making process. For instance, the local communities did not have the right to decide on control measures of the 'Sand Control Law'. In order to enhance land restoration of degraded areas, the government allocated land-use rights to local people for up to 70 years. This type of policy improved the land tenure issues and increased interest from local people. Government resettled farmers and herders on degraded lands and provided subsidies and compensations for those who participated in restoration activities. However, there is no systematic compensation method or proper regulations in land desertification control to support local people.	(Jiang 2016)
Co-benefits	Polycyclic aromatic hydrocarbons, also known as polyaromatic hydrocarbons, are organic compounds containing only carbon and hydrogen and can be dangerous to human health with cancer being the primary health risk from exposure to them. The implementation of the Three North Shelterbelt Forest Project resulted in atmospheric removal and long-term reduction trends of two polycyclic aromatic hydrocarbon species, phenanthrene and benzo[a]pyrene. A series of studies on the health effects of dust storms in north-western China show that dust events were significantly associated with respiratory and cardiovascular hospitalization (after adjusted the effect of SO_2 and/or NO_2). Events like this are also recorded in India, where in May 2018 it turned to be deadly. Based on published research (e.g. Tan and Li 2015; Wang *et al.* 2012), the frequency and severity of dust storm events have diminished over time thanks to the interventions of the GGW project that, according to the statistical data from National Meteorological Information Center, China (e.g. Tan and Li 2015), has positively affected the health status of the people living in the region and beyond. The other social-economic benefit of the project has been the development of tourism and increasing employment opportunities for local people.	Aunan and Pan (2004); Li and Huntsinger (2011); Huang *et al.* (2016)
Transboundary issues	From the global assessment report on sand and dust storms, it is clear that sand and dust storms from the desert areas of China and Mongolia affect the air and ocean quality as far as Korea, Japan, Pacific Islands and North America (e.g. https://youtu.be/jGPuCeEILeM). Furthermore, there is a Regional Master Plan for the Prevention and Control of Dust and Sandstorms in Northeast Asia, a project involving the governments of China, Japan, Mongolia and Republic of Korea. The goal is to mitigate health effects deriving from dust storms from this region outside north-west China (e.g. in Japan, Korea), emphasizing the long-range transport and the transboundary nature of these events and the need for regional cooperation. Desert dust also plays an integral role in the Earth system affecting air chemistry and climate processes, soil characteristics and water quality, nutrient dynamics and biogeochemical cycling in both oceanic and terrestrial environments.	Goudie and Middleton (2006); Abiodun *et al.* (2012); UNEP, World Meteorological Organization [WMO] and UNCCD (2016)
Possible improvements	Research data from similar ecological areas in the Loess Plateau in China showed that there is competition for water resources between the afforested vegetation and the human water needs. Hence government decisions and policies to combat desertification must be compliant with ecological and people's socioeconomic demands without disturbing the water balance in these areas. This could be achieved by protecting local vegetation in desertification-prone lands and planting suitable vegetation according to local conditions or in specific cases leaving the land to recover without human disturbance. While considering multiple ecosystem services and their potential consequences rather than focusing only on a few services and ignoring other influences, GGW could be a role model for other regions with similar natural conditions. However, the reduction of production of agricultural goods coming along with GGW implementation triggers an increase in agricultural production elsewhere, either within the country or abroad. Respective spillover effects on potential land degradation associated with intensified agricultural production have not been analysed adequately to date.	Xiaoming *et al.* (2016) Ahrends *et al.* (2017)

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GGW is not the only project in China dealing with afforestation. For instance, the Grain for Green programme is being implemented over millions of hectares of crop- and grassland that are degraded or were at high risk of degradation had the farmland practices in use continued (Shuai *et al*. 2015; Xiaoming *et al.* 2016). Another example is the Beijing-Tianjin Sand Source Control programme that looks at ecological restoration and implementation of different types of management practices ranging from controlled grazing and associated restrictions to cropland conversion to forest or grassland not being used for grazing (Middleton and Kang 2017). The experience gained from the Three North Shelterbelt Forest programme was crucial for drafting the National Action Plan (NAP) to combat desertification in China. The first NAP was prepared in 1996, coinciding with the creation of the UNCCD, and was revised in 2003. It was the first NAP in the world to have a monitoring follow-up system to measure the trends of desertification.

The public-private partnership mode, especially with the Elion Resources Group Foundation, is proving very successful. In 2015, the UNCCD awarded the Elion Foundation with the prestigious Land for Life Award for improving the livelihoods of 100,000 farmers and herders in the Kubuqi Desert in Inner Mongolia and for recovering 11,000 km^2 of degraded land into productive areas and promoting the production of green energy.

The GGW's trees provide a barrier against desert winds and help hold moisture in the air and soil, allowing plants to grow. In spite of the very high costs of its implementation, this programme is cost-effective especially for improving human health, biodiversity and livelihoods. Therefore, the Chinese Government plans to expand the reforestation programmes.

15.2.3 Setting threshold values for policy and overall governance on remediation of contaminated land

Pollution is the world's leading environmental cause of disease and premature death (Landrigan *et al.* 2018), and increasing land contamination globally is affecting the sustainability of the land resources and their ability to support life systems (Plant *et al.* 2001; Ballabio *et al.* 2018; Rodríguez-Eugenio, McLaughlin and Pennock 2018). Approximately 342,000 contaminated sites were identified in Western Europe (European Environment Agency [EEA] 2014), while in the United States the Office of Land and Emergency Management (OLEM) oversees 540,000 contaminated sites, impacting 9.3 million ha (Pierzynski and Brajendra eds. 2017) and the Environmental Protection Agency manages approximately 1,400 highly contaminated sites (United States Environmental Protection Agency 2014). Contaminated land containing substances that are potentially hazardous to public health and the environment is found in many places around the world (Tóth *et al.* 2016). Land contamination results from mining, industrial activities, military action, farming, chemical and oil spills and waste disposal (Rodríguez-Eugenio, McLaughlin and Pennock 2018). Secondary soil salinization through excess or unsuitable irrigation is a further, yet unexplored process that threatens human health (Hamidov, Helmin and Balla 2016).

The Stockholm Convention on Persistent Organic Pollutants (POPs), which entered into force in 2004, is one of the Multilateral Environmental Agreements dealing with global policies and treaties to protect human health and the environment. It asks its Parties to adopt measures to eliminate POP releases (UNDP 2009). Many countries have already ratified this convention and are implementing various land remediation policies in compliance with the global treaty. Other conventions dealing with hazardous waste movements between countries and imports of hazardous chemicals include the Basel and Rotterdam Conventions, which have also been ratified by a number of Parties, but have significantly different obligations (Secretariat of the Basel, Rotterdam and Stockholm Conventions 2018).

Generally, land remediation policies adopt mandatory command-and-control approaches, mainly utilizing the 'polluter pays' principle (Rodrigues *et al.* 2009). Nevertheless, in most cases public financial resources are required to clean already polluted areas for the benefit to the common good. Within the DPSIR framework (Section 1.6), this policy approach targets the state of the environment, intending to reduce the quantity of pollutants in the soil. Several national governments have taken concrete steps, including the establishment of relevant policies and institutional frameworks, for the remediation of contaminated lands (Rodrigues *et al.* 2009; EEA 2014). A good example comes from China, which in 2018 approved a new law on soil pollution prevention due to enter into force in January 2019 (Xinhua 2018). The case study below examines the remedial treatment of Agent Orange-contaminated land in Viet Nam as adequate data are available to evaluate the policy outcomes, in contrast to many other sites where such data are missing.

Case study: Viet Nam remedial treatment of Agent Orange-contaminated land

Viet Nam has some of the worst contaminated lands in the world (Lupi and Hoa 2015), which occurred as a result of 2,3,7,8-Tetrachlorodibenzodioxin (TCDD or Agent Orange) contamination as a result of the Viet Nam (or Second Indochina) War (1955-1975). During this war (1961-1972), the United States army used herbicides (Agent Orange) against Vietnamese military installations and this eventually resulted in land contamination, and destruction of vegetation and crops. Decades after the conflict, the Government of Viet Nam initiated the dioxin decontamination programme (Environmental remediation of dioxin contaminated hotspots in Viet Nam) as part of its National Implementation Plan (NIP), developed in line with the regulations of the Stockholm Convention. The programme aims to decontaminate the most heavily polluted areas, to plant trees on 300,000 ha of contaminated land, to help all dioxin victims, offer allowances and health insurance for people with disabilities and enhance research into the effects of toxic chemicals. **Table 15.5** provides a summary of the assessment criteria.

Viet Nam has implemented the land remediation policy backed by a complete framework of laws and regulations with supports from the United States of America, UNDP and some philanthropic foundations. Overall, the policy is positive and effective in meeting its initial objectives, but this is a process that should be based on a long-term strategic planning and monitoring programme. Note that this is a particular case, so policies that should address contaminated lands must reflect local conditions, national regulatory frameworks accomplished by internationally agreed conventions. Budgetary constraints and limitations should not be the justification for non-action when public health and the well-being of entire communities and ecosystems are at stake.

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Table 15.5: Summary of the assessment criteria for land decontamination in Viet Nam

Criterion	Description	References
Success or failure	There are very few cases where dioxin-polluted soil has been effectively decontaminated and it appeared that the only viable solution in most countries has been land filling. The United States Environmental Protection Agency (EPA) states that, "remediation technologies for the clean-up of dioxin-contaminated soils and sediments are still being developed, and many of the accepted techniques rely on thermal destruction." The Viet Nam case shows some sort of success, as the spreading of TCDD in the environment was minimized thanks to the correct implementation of the NIP plan.	United Nations Industrial Development Organization [UNIDO] (2012); Lupi and Hoa (2015)
Independence of evaluation	Most of the evaluation work has been carried out by independent assessments commissioned by UNDP, USAID and UNIDO.	United States Agency for International Development [USAID] (2010); UNIDO (2012); Lupi and Hoa (2015)
Key actors	The key actors in the implementation of the policy include the Ministries of Defence, Environment and Natural Resources, Office 33 Committee, and the Department of Health. Stakeholders that provided the technical and financial assistance were also considered as key actors and included USAID, Czech experts, Bill & Melinda Gates Foundation and the Ford Foundation.	Lupi and Hoa (2015)
Baseline	About 45.000 m^3 of Agent Orange were sprayed by the United States military in about 10 per cent of the then South Viet Nam territory. About 4.8 million Vietnamese people were impacted by the contamination. Over 3 million Vietnamese were exposed to health challenges as a result of the contamination. In response to this, the United States Congress made a financial commitment of US$59.5 million for decontamination of the affected lands and related health-care activities in Viet Nam between 2007 and 2012. The estimated volume of dioxin in hotspots released to the environment was 1,736 g I-TEQ, while the volumes of soil remediated at Bien Hoa, Da Nang and Phu Cat were at least 100,000 m^3, 70,000 m^3 and 2,500 m^3, respectively.	Lupi and Hoa (2015)
Time frame	The process of remedial treatment of the Agent Orange-contaminated land commenced in 1999 with the issuing of Decision 33 which established the National Steering Committee 33 charged with the responsibility of coordination of all Agent Orange-related matters. This was followed by the ratification of the Stockholm Convention, which targeted the phasing out POPs. The time frame for the evaluation of success or failure of the Agent Orange remedial activities was five years.	
Constraining factors	The constraining factors include poor planning and absence of a robust regulatory framework regarding dioxin contamination, inadequate data on dioxin-contaminated lands and weak technological capacities. Other factors are the weak capacities of government ministries and departments for coordination of remediation activities and limited funds available.	UNDP (2009)
Enabling factors	There are several enabling factors, including the political will on the part of the government, which promoted the establishment of the relevant policy and institutional framework for the implementation and coordination of remedial activities. The support of the United States Government and the philanthropic support from the Bill & Melinda Gates Foundation and the Ford Foundation were critical enabling factors that facilitated the remedial treatment of contaminated lands.	
Cost-effectiveness	There is little information on the cost-effectiveness of the land remediation programmes, both in Viet Nam and elsewhere. However, an evaluation of cost-effectiveness of a land remediation programme in the Dominican Republic in a lead-contaminated site indicates that remediation activities reduced health burden associated with land contamination to an acceptable cost and thresholds in line with World Health Organization (WHO) standards.	Ericson *et al.* (2018)
Equity	The involvement of the local communities both in designing project-supported activities and their implementation promoted local participation and ownership, which helped to promote the equity dimension of the policy. Another policy equity dimension is the promotion of access to land that has become usable after the implementation of the remediation programmes.	Lupi and Hoa (2015)
Co-benefits	People and communities affected by dioxin contamination may benefit from employment opportunities during remediation activities. Also, business activities around the airport have benefited from remediation as more viable lands were made available. The project generated considerable health benefits for the country. Without action, the dioxin contamination would have spread, posing severe risk to human health and the environment. Apart from neutralizing the dioxin contamination, a considerable part of the project also focused on health education and risk reduction activities among the communities in the vicinity of the contaminated hotspots. This promoted positive health among the people.	University of the West of England, Science Communication Unit (2013)
Transboundary issues	There are no potential transboundary issues in the implementation of the policy, despite the fact that neighbouring countries were also affected during the Viet Nam war by the same form of contamination.	
Possible improvements	Viet Nam has demonstrated a strong commitment to land remediation policy, but it is not clear what quantity of the contaminated lands have been remediated. This is an important variable needed to accurately assess the policy effectiveness of the decontamination programme.	

15.2.4 Provision of consultancy and networking for agricultural innovation

One generic policy type is the promotion of innovation by land users and farmers alike. It uses instruments such as incentives and provision of education and extension services. Some of the innovation technologies that have expanded over the last two decades include no-tillage (NT) and conservation agriculture (CA). In fact, the two practices are complementary to each other and accomplish similar goals. While NT is not a primary practice in CA, CA is based on two other principles – the introduction of cover crops and crop rotations (Kassam and Friedrich 2011). NT and CA were initially developed to combat soil erosion; however, they can also optimize crop production, promote soil health by keeping soil organic matter and nutrients in place, and by improving water and air quality. NT and CA are both seen as community-driven development processes of acceptance of new principles of agriculture. Yet their global share is limited. NT is primarily practised in North America (32 per cent of the global area under NT) and South America (45 per cent). CA, on the other hand, covers about 11 per cent of the total cropland globally and like NT is most widely located in North and South America that together have 76.6 per cent of the total CA area. Europe is lagging behind with only about 7 million ha, largely found in Russian Federation, France, Spain and Italy (FAO 2016).

NT and CA farming are seen as very promising in terms of soil quality, carbon sequestration and environmental benefits (Reicosky 2015; Haddaway *et al.* 2017), though perhaps less economically beneficial at least in the first years of farming as yields tend to be lower than with conventional agriculture (Vastola *et al.* 2017) – but with time this gap can narrow. The drawback of NT and CA is an increased use of herbicides that goes along with reduced tillage.

Examples of policy instruments include decreased fertilizer taxes and governmental subsidies to farmers that have adopted NT (Lankoski, Ollikainen and Uusitalo 2004). Within the DPSIR framework (Section 1.6), this policy approach is mostly aimed at the pressure, to implement new tillage technologies that cause minimum soil disturbance, improve soil water retention capacity and provide erosion control (Dumanski *et al.* 2006; Serraj and Sidique 2012). The long-term application of NT and CA practices depends greatly on economic viability for farmers, especially those in developing countries (Krueger 2012). They rely largely on government subsides, in particular for the acquisition of agricultural machinery that is suitable for such farming. The International Food Policy Research Institute (IFPRI) projects a big gain associated with adoption of NT cultivation in South Asia and the Pacific as a whole – with up to 32 per cent higher yields of maize and 47 per cent for wheat as compared with baseline scenario (Rosegrant *et al.* 2014).

Case study: no-tillage cultivation in Western Australia

By the late 1970s, arable farming was severely challenged in Western Australia because of drought and soil compaction. Between the 1980s and early 1990s, Australian farmers attempted to identify ways of overcoming the negative consequences of the drought by implementing NT systems (Bellotti and Rochecouste 2014). With the seeming benefits of NT, the adoption rate among other farmers increased reaching around 80-90 per cent by 2008 (Bellotti and Rochecouste 2014). **Table 15.6** gives a summary of the assessment criteria.

The Australian NT implementation was rated effective in soil and water conservation, pest, diseases and weed control, as well as in plant nutrient availability. This is demonstrated in the New South Wales NT programme, where NT contributed to improvement in soil fertility, stabilization of soil acidity, as well as increase in soil organic carbon content (Bellotti and Rochecouste 2014).

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Table 15.6: Summary of the assessment criteria for NT implementation in Australia

Criterion	Description	References
Success or failure	It is recognized that in Australia NT implementation leads to a profound improvement in soil water conservation, increasing the amount of soil water available for crop growth and nutrient uptake. New South Wales farmers adopted an NT programme as a strategy to stem soil nutrient losses from long-term conventional farming practices. The fertility of the soil at the sites improved considerably while soil acidity was stabilized. In addition, there was marked improvement in the organic carbon content of the soil. All these critical positive contributions of NT are key indicators for measuring success or failure.	Bellotti and Rochecouste (2014)
Independence of evaluation	Bellotti and Rochecouste (2014) implemented independent evaluations of the NT programme from Australian No-Till farming associations in 2014.	Bellotti and Rochecouste (2014)
Key actors	The key actors of the Australia NT programme include farmers, Western Australian No Tillage Farmers Association and the Australian Government, which offered tax credit incentives to farmers practising NT agriculture as well as the farmers advisers	
Baseline	The International Food Policy Research Institute (IFPRI) projects a big gain associated with adoption of NT cultivation in South Asia and the Pacific. The Economics of Land Degradation Initiative reports positive data of NT technology implementation in Tajikistan. Nevertheless, for Australia these figures might be lower taking into account the adoption rate of NT technology. Therefore, the potential for expansion of NT in Australia is considered negligible.	Rakhmon (2016)
Time frame	The introduction of the NT commenced between early 1960 and 1980, which was described as the awareness period. Subsequently, farmers experimented with NT techniques resulting in its rapid adoption and diffusion.	
Constraining factors	NT cultivation requires more nitrogen fertilizers for use, especially during the first 2-3 years of NT, which constitutes a serious constraint to farmers with poor access to inputs. The use of herbicides is also a principal requirement for any NT system. In many cases, the use of non-selective herbicides such as glyphosate is associated with NT systems. Extensive use of such herbicides may cause negative impacts on biodiversity and human health. For example, in Europe the future permission to use glyphosate as herbicide in agriculture is currently under heavy scrutiny because of its implications on biodiversity and even possible adverse effects on human health. If permission is not to be extended in the future, the adoption of NT systems might decrease. Future developments in precision agriculture as a new farming system that optimizes returns by reducing inputs enabled by big data technologies and new sensors may, however, allow for dramatic reductions of herbicide needs.	Trigo *et al*. (2009)
Enabling factors	There are several enabling factors for NT adoption in Australia. These include the perceived need for change and the changing complexity of farming. This has helped farmers to quickly understand the skill requirements for the successful practice of NT and they were quick to respond to the skill requirements in the context of NT in Australia. NT systems are also understood as promising instruments for climate change adaptation in agriculture. This thinking has promoted the widespread adoption and support for NT farming among stakeholders.	Bellotti and Rochecouste (2014); Lal (2014); Rosegrant *et al.* (2014)
Cost-effectiveness	Evidence shows that NT is cost-effective, with several soil improvement and agronomic advantages. It is noted that NT improves farm operating budgets. This can vary across locations. There is also some evidence in many areas that, under conditions of good management, NT and CA positively lessen yield variability across seasons, especially in areas with poor rainfall.	Serraj and Sidique 2012; Swella *et al.* 2015
Equity	As far as introduction of NT farming requires large capital investments in new equipment, poor farmers are unlikely to be able to afford this technology. However, statistics show no difference in extent of NT implementation between states in Australia, thus proving affordability of the system for most (80-90 per cent) farmers. There are no losers in NT agriculture in the real sense of it. However, farmers are the main gainers. Under NT agriculture, farmers have the opportunity to intensify cropping as much as possible due to the absence of fallowing in the NT as a CA practice.	Bellotti and Rochecouste (2014)
Co-benefits	NT practices enhance easy management of crop, soil and water conservation and improvements in crop yield, as well as saving of energy, cost and time, and therefore generally contribute to intensification of agriculture. The co-benefits of NT in this context include the farmers, governments and the general public that benefits from increased food production and sustainability of land resources and the environment.	Giller *et al.* (2015)
Transboundary issues	NT transboundary issues is in the areas of its contribution to reduction of global warming. NT contributes to reduction in albedo in cropland areas and thus has great potential for global cooling and reduction of global warming. NT also reduces the emission of nitrous oxide (N_2O), which is a potent greenhouse gas, by as much as 40-70 per cent, depending on rotation.	Wallheimer (2010); Omonode *et al.* (2011)
Possible improvements	NT farming is suggested to be compatible with other technological innovations. IFPRI projections for 2050 suggests testing the following combinations of schemes: (i) NT + water harvesting; (ii) NT + precision agriculture; (iii) NT + heat tolerance; and (iv) NT + drought tolerance. In wetter regions such combinations could compensate some decline of yields reported for areas under NT.	Rosegrant *et al.* (2014)

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15.2.5 Responsible food policy systems to minimize food waste and promote stakeholder networking

The current food system is causing the potentially irreversible depletion of soils, water and biodiversity towards an irrecoverable degree (UNCCD 2017a, see Section 4.4.3). This also brings increased inequalities in accessing sufficient, fresh and healthy food, as well as a growing epidemic of (mal) nutrition-related illnesses, such as obesity, diabetes and heart disease (Rush and Yan 2017).

One attempt to address these challenges brought about the development of urban food policies aimed at integrating food issues and waste (Campoy-Muñoz, Cardenete and Delgado 2017), which in turn could reduce the pressure on land. It is estimated that 30 per cent of all food produced is wasted (FAO 2018); in the European Union alone, 88 million (metric) tons of food are lost annually (Stenmarck *et al.* 2016), amounting to a cost of €143 billion. Much of this loss comes from heavily populated urban areas. Hence, if losses were diminished more land would be available for environmentally friendly agricultural systems such as organic farming or agroecology with minor damages to the environment (Muller *et al.* 2017; Blakemore 2018). Moreover, almost all the biggest cities in Europe (Zdruli 2014) and around the world have expanded at the expense of the best soils suitable for crop production (Bren d'Amour *et al.* 2017).

The formal framing of urban food policy instruments was developed mostly in the last two decades. In the early 1990s, a few pioneering cities began to develop food strategies and food policy councils. Urban food policies represent actions on the part of city governments to deal with food-related challenges that require coordination between departments and policy areas, and the establishment of novel governance structures (International Panel of Experts on Sustainable Food Systems [IPESA-Food] 2017a).

Within the DPSIR framework (Section 1.6), this policy approach targets a set of natural resources drivers as well as rapid urbanization – to reduce unsustainable use of resources. Canada was one of the pioneering countries to develop an urban food policy in 1991 through the establishment of the Toronto Food Policy Council to advise the city on food policy issues, to serve as an advocate for community food security strategies, and to foster dialogue between stakeholders. Other urban food policies schemes are now being implemented around some European cities, such as Amsterdam**,** Ghent, Bristol, Edinburgh and London. A more detailed description is made in this chapter of the Milan Urban Food Policy Pact (De Cunto *et al*. 2017).

Box 15.2: UNCCD Statement on food system

"Our food system has put the focus on short-term production and profit rather than long-term environmental sustainability. The modern agricultural system has resulted in huge increases while soil, the basis for global food security, is being contaminated, degraded, and eroded in many areas, resulting in long-term declines in productivity".

(UNCCD 2017a)

Case study: City collaboration on urban food good practices (Milan Urban Food Policy Pact)

A typical example of the city collaboration on urban food good practices is the Milan Urban Food Policy Pact (MUFPP), which came about in October in 2015. This is an international policy pact signed by a number of cities around the world committed to improving the sustainability of food systems and agricultural land uses in urban areas (Clinton *et al.* 2018). The current food regime may no longer be sustainable given its negative and potentially irreversible impacts on natural resources, which are currently on course to reach an irrecoverable degree (UNCCD 2017a). A transformation in food production distribution and consumption patterns is necessary to accomplish the needed changes in the current food regime and diminish its negative impacts on land and public health. Therefore, urban food policies have been conceived as having the potential to effect the needed changes in the global food sector both in terms of food safety and food security and natural resources use and management (Milan Urban Food Policy Pact 2018).

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By 2030, the United Nations goal is to reach zero hunger (SDG 2). SDG 15 (life on land) is relevant to meeting the zero-hunger goal, but this can only happen with the active support of cities. The MUFPP, currently signed by 167 cities, commits signatories to develop sustainable policies, programmes and initiatives across all sectors that impact urban food systems in six thematic clusters: "(i) governance or ensuring an enabling environment for effective action; (ii) sustainable diets and nutrition; (iii) social and economic equity; (iv) food production including urban rural linkages; (v) food supply and distribution; and (vi) food waste prevention, reduction and management" (Forster *et al.* eds. 2015). The MUFPP Framework for Action is voluntary and aims to accelerate city collaboration and enhance sustainable food systems while recognizing cities' diversity in terms of objectives and targets (Forster *et al.* eds. 2015). All these objectives are closely linked to environmental protection and biodiversity conservation **(Table 15.7)**. A typical example of MUFPP outcomes is the case study in Mexico on sugar-sweetened beverages tax (Colchero *et al.* 2016), described below.

Table 15.7: Summary of the assessment criteria on Milan Urban Food Policy Pact and it impacts in Mexico

Criterion	Description	References
Success or failure	The MUFPP consolidates the role of cities as key actors in the global food system and promotes collaboration linkages among them. Two years after its launch at EXPO 2015 Milan Universal Exposition 'Feeding the Planet Energy for Life', as part of the landmark document Carta di Milano signed by United Nations Secretary-General Ban Ki-Moon on 16 October 2015, the pact is proving to be a useful instrument to promote collaboration among cities on food policies and helping them better implement land-use planning and enhanced environmental sustainability.	European Association for the Study of Obesity (2015)
Independence of evaluation	Although there is no evidence yet of the implementation of an impact assessment of the Milan Urban Food Policy Pact, one of the foremost independent impact evaluations of it was implemented in Mexico.	Colchero *et al.* (2016)
Key actors	The key actors in the MUFPP include the city mayors who signed the pact, and the civil society organization in the cities, private sector and research communities.	
Baseline	Available data shows that as much as 43 gallons of soft drinks are consumed per capita per year in Mexico. In addition, Mexican schoolchildren between the ages of 5 and 11 years consumed 20.7 per cent of energy drinks with about half of them sugar-sweetened, while the majority (64 per cent) of Mexican adults are overweight, 28 per cent obese and 11 per cent of Mexicans have type 2 diabetes.	Flores *et al*. (2010); Bronwell *et al.* (2011); WHO (2015)
Time frame	This initiative was launched in January 2014 by the Mexican Government and the independent evaluation was conducted in 2016.	
Constraining factors	The constraining factors as identified by the Pact include the governance system within some cities with weak capacities of institutions and government departments, as well as poor stakeholder participation at the city level. Another constraining factor is the divergent cities policies that affect municipal authority or jurisdiction.	Forster *et al.* eds. (2015)
Enabling factors	The key enabling factors of the MUFPP implementation in Mexico are the evidence-based results framework of the Pact as well as availability of funding.	IPES-Food (2017b)
Cost effectiveness	Thavorncharoensap (2017) examined the cost-effectiveness of obesity prevention and control through beverages taxes. Results showed that beverages taxes are a relevant and cost-effective measure for prevention and control of obesity. A few city cases reveal some techniques or actions that would result in cost-effective policies. These include microgardens, multiple cooperative start-ups, mobile apps, family shops, popular restaurant programmes and the promotion of urban agriculture.	Forster *et al*. eds. (2015); FAO (2017); Thavorncharoensap (2017)
Equity	Six recommended actions are promoted for social and economic equity: (i) the use of social protection mechanisms such as cash and food transfers to vulnerable populations to increase access to food; (ii) reorientation of school feeding programmes to provide healthy food; (iii) promotion of decent employment; (iv) encouragement and support for social and solidarity economic activities; (v) promotion of networks and support for grass-roots activities; and (vi) promotion of participatory education, training and research.	Forster *et al*. eds. (2015)
Co-benefits	The co-benefits of the policy include local residents who receive support from the city government in many aspects of everyday life, including increased green areas and biodiversity, promotion of local economy that creates jobs, solidarity among inhabitants, better quality food, upgrading of abandoned areas, waste recycling and management, and the creation of a diverse urban landscape for recreation. Furthermore, the policy also dealt successfully with the heat waves and islands inside the city.	Forster *et al*. eds. (2015)
Transboundary issues	This network has the capacity to convene local governments and enhance their role in a multilevel governance structure providing a multi stakeholder platform for communication and exchange of successful implemented policies.	Cinzia and Licomati (2017)
Possible improvements	There are gaps in certain critical areas, including the need for improvement in the level of collaboration among key government departments in the implementation of the Pact, policy coherence and the inclusion of all critical stakeholders in the implementation of the food policy.	Forster *et al*. eds. (2015)

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The MUFPP has implications for the environment, economy, social equity and health of urban populations, and their linkage with rural and urban agriculture. An increasing number of cities are involved in this initiative and many more are expected to join the effort. The third Annual Gathering and Mayors' Summit of MUFPP was held in Valencia, Spain in October 2017 involving more than 400 mayors, experts and city delegates. They called on United Nation agencies to recognize their role in shaping a sustainable food system and create a better living environment inside and outside the cities. The policy efficiency of the Pact in Mexico is reflected with increased awareness among the local people on the health consequences of excess use of sweetened soft drinks and the need to return to traditional food systems.

15.3 Indicators

Land management is explicitly targeted in SDG 15.3 and also has many interconnections with other SDGs, namely SDGs 1, 2, 3, 6, 7, 11, 12 and 13. The SDGs include a total of 244 indicators for which general agreement was reached. Based on data availability and relevance to land and soil policies, three SDG indicators stand out as most relevant for this chapter **(Table 15.8)**:

1. Proportion of land degraded over total land area (Indicator 15.3.1),
2. Terrestrial protected areas as a percentage of total land area (Indicator 15.3.2), and
3. Ratio of land consumption rate to population growth rate (Indicator 11.3.1).

Table 15.8: Indicators for assessing land policy effectiveness and for measuring the progress towards the achievement of global environmental goals

Indicator	Rationale for selection	Addressed in Part A: Yes/No How:	Addressed in the case studies: Yes/No Which	Connection with the SDGs or MEAs	Data sources	Causal chains to policies and other variables impacting the indicator
1. Proportion of land degraded over total land area	SDG indicator 15.3.1: There is scientific and political consensus as well as precedence and agreement.	Yes. Section 4.4.3 on the food system; a 'box' on the Syrian Crises **Box 9.4**: Jordan faces a combined refugee and water crisis.	Yes 2.2 Setting threshold values 2.3 Planning and compensation 2.4 Funding programme plus setting standards for best practice management 2.4 Provision of consultancy	It is an indicator for SDG 15. 'Land degradation' is defined and discussed in UNCCD.	See following sources on land degradation: Gibbs and Salmon 2015; Le, Nkonya and Mizarbaev 2016. FAO has the Global Land Degradation Information System (GLADIS); Sustainable Development Solutions Network [UNSDSN] (2014) noted that data on degraded land has been 'patchy'. Also see UNCCD's metadata.	IPBES (2018a) indicates that proportion of degraded land over total land continues to increase, mostly due to lack of policies or poor implementation.
2. Terrestrial protected areas as percentage of total land area	SDG indicators 15.1.2 and 15.4.1: There is scientific and political consensus as well as precedence and agreement.	No	No	SDG indicators 15.1.2 and 15.4.1.	The United Nations List of Protected Areas (International Union for Conservation of Nature [IUCN] 1994; IUCN 1998; Chape *et al.* 2003) are available online. There is also the World Database on Protected Areas. UNEP-WCMC has the Protected Planet Report. See (United Nations 2018).	Policies for the protected areas had overall positive impacts, especially in developed countries, with less pronounced results in the rest of the world.
3. Ratio of land consumption rate to population growth rate	Since land consumption is the strongest and mostly irreversible form of land degradation, its decoupling from population growth is the core step in maintaining land, also in relation to the nexus to the other SDGs.	Yes. Section 2.2	Yes. 2.1 Stakeholder Network creation	SDG indicator 11.3.1	UN-Habitat for all countries of the world. Data for more than 300 cities are monitored by The City Prosperity Initiative, Lincoln Institute, University of New York and UN-Habitat.	Globally, land cover today is altered principally by direct human use. Evidence from a study on 120 cities revealed a three-times faster growth of urban land cover compared to the growth of urban population. Other variables affecting the indicator are land degradation and crop production.

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These were used in the assessment of policy effectiveness and for measuring progress towards internationally agreed environmental goals with special reference to land and soil.

15.3.1 Indicator 1: Proportion of land degraded over total land

The expansion of human economic activities and the competing interest for land resources have dramatically increased the pressure on land and on terrestrial ecosystems **(Figure 15.3)** and in some cases accentuated political conflicts at local level (Organisation for Economic Co-operation and Development [OECD] 2017). Estimates of global land degradation show that about 25 per cent of all land is degraded, 36 per cent is slightly or moderately degraded, while 10 per cent is improving (FAO 2011; IPBES 2018b). The unit of measurement of this indicator is the area (ha or km^2) of land that is degraded divided by the total land (UNCCD 2017b). This indicator is measured by adding all those areas that are subject to change, and whose conditions are considered as negative by national authorities when measuring and evaluating each of the following three sub-indicators:

- land cover and land cover change,
- land productivity, and
- carbon stocks above and below ground.

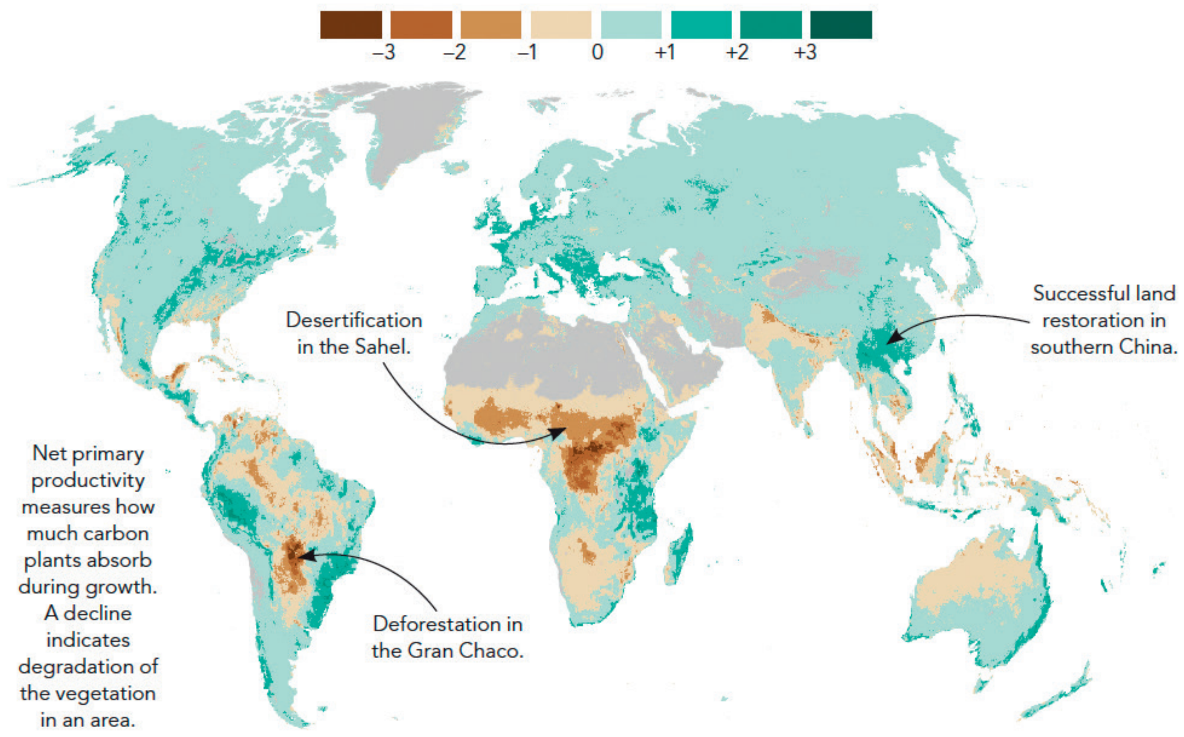
The indicator is linked to several targets and commitments that have been agreed by global, regional and national governments to halt and reverse land degradation and restore degraded land (IPBES 2018b). These include, for instance, the Aichi Biodiversity Targets, the Bonn Challenge and related regional initiatives (e.g. 20x20, African Forest Landscape Restoration Initiative [AFR100] 2018), and SDG target 15.3.

The indicator addresses the nature of land degradation, which is expressed as "the reduction in the capacity of land to provide ecosystem goods and services over a period of time for its beneficiaries" (Nachtergaele *et al.* 2011; Zdruli 2014). Land degradation has direct impacts on the capacity for net biomass primary production, but socioeconomic factors play a major role in its occurrence – such as the link between urbanization and its related soil and air pollution (Prasad and Badarinth 2004; Seto, Güneralpa and Hutyra 2012). In other cases, socioeconomic factors have hindered efforts to cope with land degradation (Lubwama 1999; Chasek *et al.* 2011). This is the case of urban sprawl or the expansion of solar panels promoted by renewable energy policies and lack of well-defined land-use planning guidelines that have accelerated these types of land-use changes at the expense of fertile soils that otherwise should be used for food production or preservation of nature-based contributions to people (Diaz *et al.* 2018).

Policy effectiveness in either halting or reversing the expansion of degraded areas over total land areas have produced limited results; globally, land degradation remains one of the most important degradation processes with huge consequences for food security, environmental consequences and threats to livelihoods (IPBES 2018b).

Figure 15.3 emphasizes the role of soil carbon sequestration as an important indicator directly linked to soil fertility and climate change mitigation. The 4 per 1000 Initiative is promoting carbon accumulation in the world soil at a rate of 0.4 per cent

Figure 15.3: Trends in land degradation and restoration worldwide



Source: World Bank (2018, p. 59).

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per year to stop CO_2 increase in the atmosphere which is major contributor to climate change. The initiative intends to reach its goals by implementing the principles of conservation agriculture and agroecology. The figure shows expansion of desertification in the Sahel, deforestation in Latin America and positive results in land restoration in southern China.

15.3.2 Indicator 2: Terrestrial protected areas as a percentage of total land area

Since the mid-1990s, growing concerns over environmental degradation have led to the current emphasis on the roles that nature plays in maintaining societies (Butchart *et al.* 2015; Diaz *et al.* 2018). In recognition of the significance of this, 193 Parties of the Convention on Biological Diversity (CBD) adopted the 20 Aichi Targets to be met by 2020. Aichi biodiversity target 11 is of particular relevance and commits to a 1.6 per cent increase (from 15.4 per cent to at least 17 per cent) in protected areas by 2020 (CBD 2010). This could also contribute to reducing the loss of natural habitats (target 5), reducing human-induced species decline and extinction (target 12), and maintaining global carbon stocks (target 15). Countries have since agreed on the SDGs' targets (United Nations 2015) for 2020 and beyond, and this is likely to drive the agenda on protected terrestrial areas in the coming decades (Allen *et al.* 2016). SDG 15 specifically refers to land resources and their management.

This indicator measures the proportion of terrestrial protected areas as a share of the total land area expressed as a percentage (United Nations 2015). The purpose of the indicator is to represent the extent to which terrestrial areas that offer ecosystem value in terms of conserving biodiversity, cultural heritage, scientific research, recreation and other valuable uses are protected, in their diversity and integrity, from unsustainable land uses (United Nations 2015).

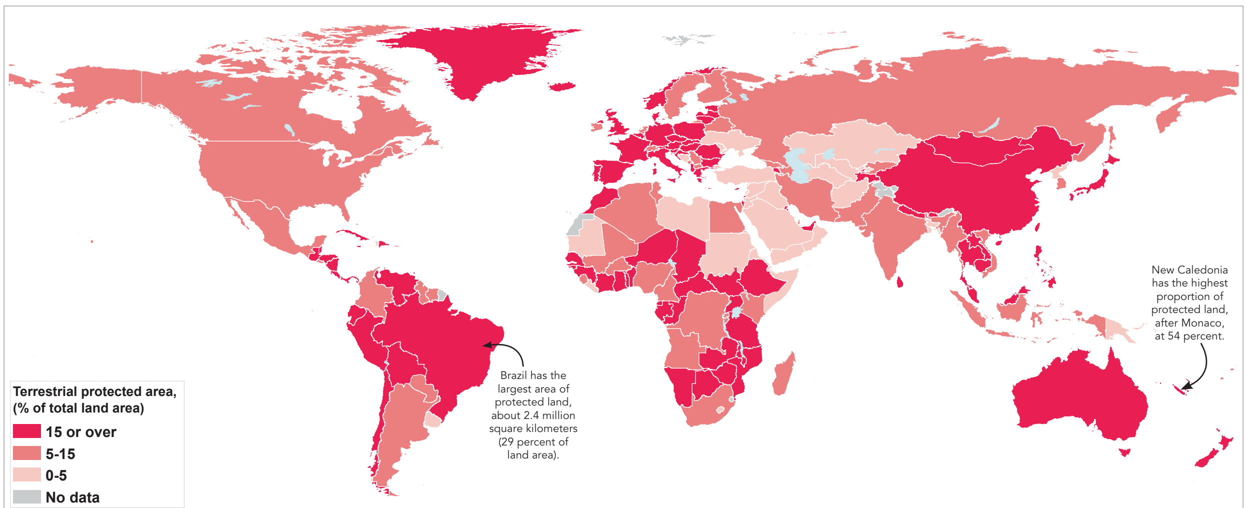
The indicator is calculated using all the nationally designated protected areas recorded in the World Database on Protected Areas (WDPA) (United Nations Environment World Conservation Monitoring Centre 2018). World Bank (2017) data show that the surface area of protected areas for the period 1990-2014 increased from 8.2 per cent to 14.8 per cent, indicating a positive trend reflecting the implementation of national and international policies for them **(Figure 15.4)**.

Governance of protected areas, in particular primary forests, is particularly relevant because evidence points to the impacts of agricultural output prices on deforestation rates both inside and outside of protected areas (Deiro and Escobar 2012). Assunção, Gadour and Rocha (2015), in a study in the Amazon, found high correlations between deforestation rates and agricultural output prices, while Deiro and Escobar (2012) point out that "between 1981 and 2010 an area of 45,000,000 hectares was downgraded or lost with almost 70 per cent of cases occurring since 2008". The authors (Deiro and Escobar 2012), however, conclude that changes in conservation policies implemented between 2004 and 2008 significantly contributed to the curbing of deforestation rates.

Location is another key influencing factor affecting protected areas. Joppa and Pfaff (2009) note that "the positioning of protected areas is not random; they are often located in areas that are inaccessible or unsuitable for agriculture, in remote and topographically challenging areas without transport links, such that they are unlikely to be under pressure from the developmental drivers of land use change".

In general, there is scientific and political consensus, as well as precedence and agreement, on this indicator. However, evidence of the impacts of market prices, management effectiveness and factors specific to other sites have since led to the proposal to incorporate indicators that aid in the measurement of protected area conditions and/or management effectiveness, including more equitable management and representative indicators of spatial coverage (e.g. forest area as a percentage of land area).

Figure 15.4: Terrestrial protected area as a percentage of total land area per country (1990-2014)



Source: World Bank (2018, p. 59).

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15.3.3 Indicator 3: Ratio of land consumption rate to population growth

In 2016, about 54.5 per cent of the global (human) population lived in urban areas and by 2030, the United Nations predicts that 60 per cent of the global population will be urban (United Nations 2016a). The total increase in urban population between 2000 and 2020 is estimated at 1.48 billion, of which 1.35 billion will be concentrated in less-developed regions (United Nations 2012). As population growth increasingly consumes available land, cities expand far beyond their formal administrative boundaries and urban sprawl is visible around them (United Nations Human Settlements Programme [UN-Habitat] 2017).

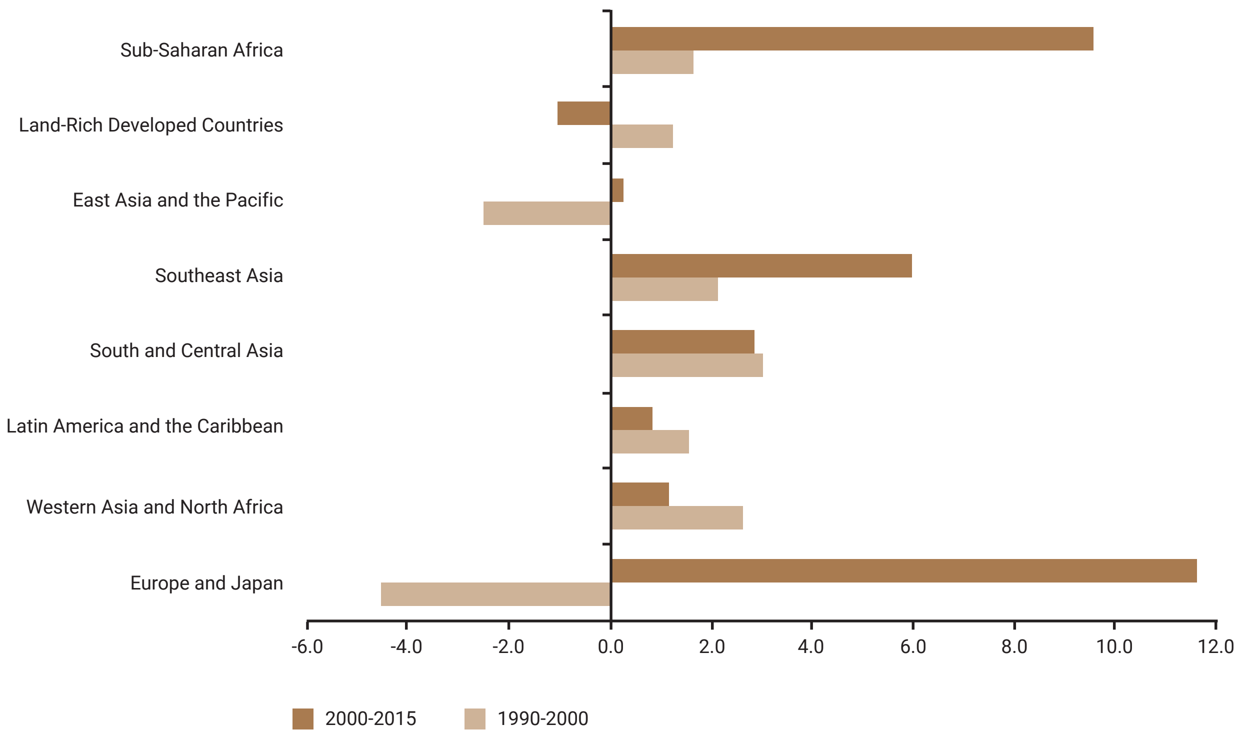
Land consumption rate is computed as a function of: (a) "The expansion of built-up area which can be directly measured; (b) the absolute extent of land that is subject to exploitation by agriculture, forestry or other economic activities; and (c) the over-intensive exploitation of land that is used for agriculture and forestry" (United Nations 2015). Population growth rate shows the increase of population in a country during a certain period, typically one year, expressed as a percentage of the population at the start of that period (World Bank 2017). **(Figure 15.5)**.

The ratio of land consumption rate to population growth is a critical indicator that is closely connected with multiple SDGs. More directly, it is tied in with SDG 11, "Make cities and human settlements inclusive, safe, resilient and sustainable".

The changes in land consumption are largely driven by increases in transport infrastructure, poor urban and regional planning, and land speculation (UN-Habitat 2015). This in turn negatively impacts on the environment (per capita resource use and greenhouse gas emissions). For example, for every 10 per cent increase in urban sprawl, there is a 5.7 per cent increase in per capita CO_2 emissions and a 9.6 per cent increase in per capita hazardous pollution. It also increases socioeconomic and spatial inequalities. For instance, 30 per cent of the global urban population (880 million people) lived in slum-like conditions in 2014; in sub-Saharan Africa, that proportion was 55 per cent (United Nations 2016b).

While evidence shows that poor spatial planning is one of the main factors leading to urban sprawl, effective policymaking is central to managing land consumption (Rosni and Noor 2016). Many governments rely on policies such as land-use restrictions (e.g. urban growth boundaries and minimum-lot zoning); price-based policies such as property taxes (Gyourko and Molloy 2015; Glaeser and Gyourko 2017); and other regulatory systems composed of zoning ordinances, subdivision regulations and building codes, for controlling urban sprawl. Feng *et al.* (2016) conclude that the implementation of land-use planning policy in China played a major role in ensuring the lowest effective rate of change of sprawl. The potential of restoring and reutilizing former industrial and otherwise used land (brownfields) for mitigating land consumption is still underexplored in land planning and policies (Tobias *et al.* 2018).

Figure 15.5: Ratio of land consumption rate to population growth rate by region and period (1990-2015)



Source: UN-Habitat (2015).

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Given the high rates of land consumption in the European Union – 275 ha of agricultural and natural habitats converted to urban sprawl and other forms of land take per day – the EU has endorsed a No Net Land Take by 2050 policy that intends to reduce land consumption throughout the Union, giving priority to greening areas and ecological corridors (University of the West of England, Science Communication Unit 2013).

Seto, Güneralpa and Hutyra (2012) state that varying causal factors make it difficult to observe this indicator on an international scale. The lack of standardized procedures in the delineation of spatial units and recognition of administrative boundaries lead to spatial inconsistencies (United Nations 2018). UN-Habitat therefore proposed a minor revision of indicator 11.3.1 to "Ratio of land consumption rate to population growth rate, including the term *Efficient land use*", where if the ratio is equal to or smaller than 1 it is qualified as efficient.

Other alternate indicators proposed include:

- "Resources per capita invested in human settlement per km^2" (by UNCDF)
- "Percentage of cities with direct participation structure of civil society in urban planning and management, which operate regularly and democratically" (by United Nations Statistical System Organizations)
- "Ratio of land consumption rate to urban population growth rate at comparable scale" (by UNFPA).

15.4 Conclusions

Across the globe, while different land policies and initiatives have been adopted and implemented, it is however difficult to attribute progress in the thematic area to specific policy approaches for several reasons.

Firstly, the transboundary nature of land and its resources (Sikor *et al.* 2013) hinders the assessment of policy effectiveness. Many land resources such as forests cannot be managed at state level alone because they straddle international borders. Activities in one country often have effects on neighbouring countries' land policies and initiatives. This hinders attribution of progress to a specific policy approach with respect to sustainable management of land and its resources (Creutzig 2017). Land tenure is also a constraining factor and global land acquisitions, or 'land grabbing', amounts to more than 42 million ha, mostly in Africa. Food-importing countries have accelerated their acquisitions to enhance food security globally.

Closely related to the above are the challenge of teleconnections. Demand for food in some places generates land uptake in others; for instance, Africa is a net contributor to the food needs of Europe (Bergmann and Holmberg 2016). In this context, sustainable land management policies in a country can be positively (or otherwise) impacted by demand from another country, which also makes it difficult to attribute progress to a specific policy approach. The regenerative capacity of land resources is another major obstacle to attribution of land policies. Food, water, forests and wildlife are all renewable resources. With or without any policy framework, some land resources such as forest systems can regenerate themselves, making attribution to specific forest conservation policy difficult.

The World Bank (2006) provides a set of principles, "where land and resource management policies have been successful" there is:

1. Local community participation in all aspects of the programme
2. Public support for private investment in soil and water conservation
3. Improvement and maintenance of roads
4. Sound macroeconomic management that does not discriminate against agriculture and natural resources
5. Robust local capacity-building by non-governmental organizations and other cooperative-type projects, and
6. Consistent efforts over at least a decade by concerned governments to increase not only land productivity but also awareness of environmental problems and possible solutions at local levels.

Some of these are conditions addressed in the case studies of this chapter. However, there are two emerging policy approaches which hold out promise for the future. The first policy approach involves the use of economic incentives to deal with environmental issues related to land, as the China case study (Section 15.2.2) demonstrates.

The second approach is the Sustainable Intensification of Land Use and Integrated Resource Management (Garnett *et al.* 2013), despite the criticism about the overall benefits of the agricultural intensification concept (Rasmussen *et al.* 2018). This approach is best described by technological advancements that ensure increases in crop production through implementation of sustainable land and water practices, such as conservation agriculture and no-tillage cultivation, as described in the Australia case study (Section 15.2.4) as well as combined cropping systems such as legumes and cereals; agroforestry, agroecology (World Bank 2006) and regenerative agriculture. One of the key lessons learned from the case studies is the importance of a robust institutional framework for policy implementation.

Across the case studies, the establishment of institutional and administrative capacities for policy implementation underpins the success of most of the key policies. The indicators are relevant to key interconnected international goals such as the SDGs and provide evidence of progress towards meeting the policy objectives. For instance, Indicator 2 on terrestrial protected areas as a percentage of total land area is connected to Aichi Biodiversity Targets 13, 11 and 5 and is also relevant to SDG 15 and its respective targets.

The case studies also indicate that evaluation of policy effectiveness in most cases has been commissioned by external stakeholders, while national governments that are often involved in policy design have not shown serious interest in policy evaluation. Land policy evaluation is important as it will provide significant lessons that can be useful in the refinement of policies and implementation of strategies.

One obvious gap is the fact that most national land policies are not linked to international goals. This is important, especially from the point of view of the SDGs, when viewed against the background that the implementation of such policies will have little or no contribution to the attainment of international goals. The Kyoto Protocol did not even mention relation to the role of land and soil in climate change dynamics. When national governments ratify international conventions, it is important that these are backed up with relevant national policies accompanied by baseline indicators to track progress towards reaching policy goals.

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