



Chapter 7

Land and Soil

The rate and nature of land use changes indicate where future environmental pressures are likely to arise. By European standards, Ireland has experienced a relatively high rate of land use change since the early 1990s. Generally, Ireland's soils are considered to be in good condition, with the exception of peat areas, which are particularly vulnerable to external pressures. However, the information available on land and soil is currently not sufficient. It is vital to improve our evidence base, which is required in order to accurately assess and protect these vital resources, and to provide information and guidance to policy and decision makers. The sustainable management of both land use and soils requires an integrated approach; a national landscape strategy and a national soil protection strategy for Ireland need to be prepared and fully implemented. While Ireland has fewer contaminated land problems than most other industrialised countries, an overall policy framework for the identification, management and remediation of contaminated land in Ireland is needed.



Introduction

Land and soil can be considered as an integrated resource in the broadest sense of the term. It is a source of livelihood and enterprise; it is the landscape in which we engage with the world about us; it provides the food, fuel, water, and the basic materials for our wellbeing.

The Irish landscape is the direct result of many hundreds of years of human interventions and land use change. Many of these changes were driven by historical processes and events, such as the forest clearances prior to the 1700s, the Famine and the depopulation of rural Ireland from the 1850s through much of the last century (CSO, 1997). More recently the population growth of the late 20th and early 21st century led to an increase in the extent of built-up areas. However, the overall area of artificial surfaces remains low in comparison with other EU countries, and agriculture is still the predominant land use in Ireland.

The soil of Ireland is an immensely valuable national resource, which formed and evolved slowly over a very long period of time. The regenerative properties of soil are limited, therefore it is considered a finite resource. Soil is a biologically active, complex mixture of weathered minerals, organic matter, organisms, air and water that provides the



foundation for life in terrestrial ecosystems. The general consensus is that soil quality in Ireland is good; however, this is based on limited information.

The Current Situation

Land Use and Land Cover

Land use and land cover (LULC) are the two main means of describing and studying the form and function of the national land surface. Land cover is the physical description of what is present on the surface of the land, e.g. artificial areas, forest, water bodies. Land use describes the terrestrial environment from the human perspective, focusing on its socio-economic usage, e.g. transport infrastructure, pastures and

recreational areas. Land cover and land use are interdependent, and changes in one impact on the other.

The main source of national scale information on LULC in Ireland is the EEA/EPA Corine land cover data series, which delivered a 25 ha scale land cover/land use map of Ireland in 1990, 2000 and 2006, with the next map expected in 2014. Figure 7.1 shows the land cover in Ireland compared to that for Europe according to Corine 2006. The main land cover type in Ireland is agricultural land, which accounts for two-thirds of the national landmass. Most of this is permanent grassland pastures. Peatlands and wetlands are the second most widespread land cover type, covering almost one-fifth of the country, while forested areas

Figure 7.1 Land Cover in Ireland and Europe, 2006 (Source: EPA, EEA)

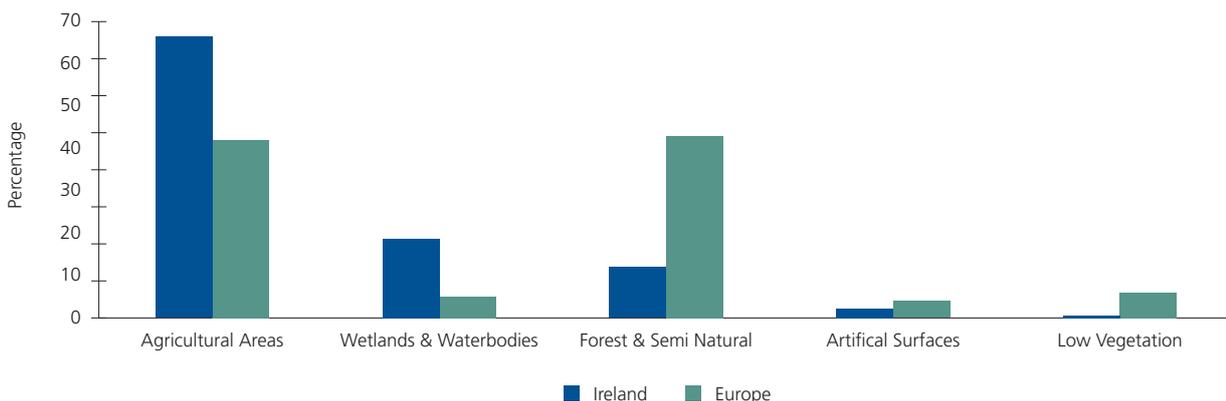


Figure 7.2 Percentage Land Use/Land Cover Change in Ireland 1990–2009 (Source: EPA)

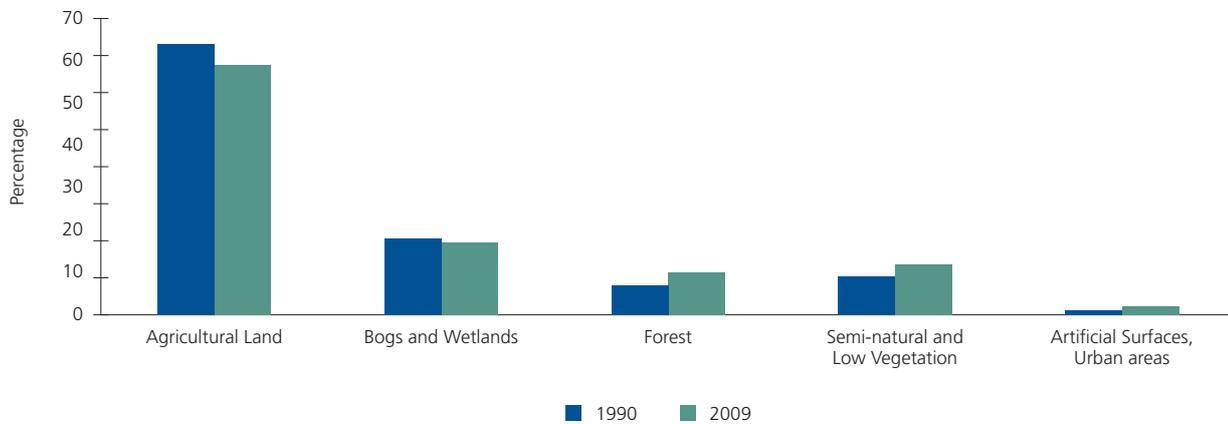
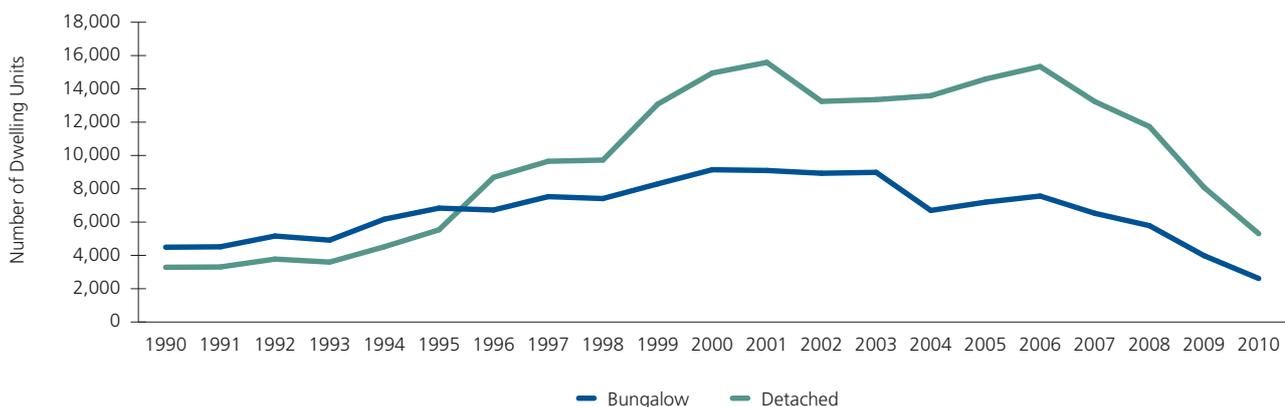


Figure 7.3 New Detached Houses and Bungalows Built in Ireland from 1990 to 2010 (Source: DECLG)



cover over one-tenth of the country. These figures show that despite rapid development in the past two decades, Ireland’s landscape is predominantly rural and agricultural. Artificial surfaces account for 2% of the land surface, which is half the Europe-wide average of 4 per cent. Our agricultural land cover is far ahead of the European average of 42%, while the amount of land that is forested in Ireland is just one third of the European average of 35% (EEA, 2010).

Changes in LULC over time are key indicators of environmental change. Monitoring these changes is important to assess pressures on the Irish environment, allowing the development of strategies and policies to prevent irreversible

damage. The Irish landscape has experienced continual land cover changes for centuries. The change in LULC since the early 1990s is shown in Figure 7.2; this is a relatively high rate of land use change by European standards.

The main changes have been an increase in the amount of forested lands and artificial areas and a decrease in the total amount of agricultural land and peatland. The area under forestry has increased from 7% to 11% of national land cover during this period, primarily due to the planting of peatland and pasture lands with coniferous plantations. The area under artificial surfaces increased by approximately 15% since 2000 to 2% of national land cover (EPA, 2011). This mainly

occurred on former agricultural lands on the periphery of existing urban areas, including the suburbanisation of villages close to larger towns and cities.

There was also widespread construction of single rural dwellings in the countryside. Figure 7.3 shows the rate of construction of detached houses and bungalows in Ireland since 1990. It is assumed that a high proportion of bungalows and a lower proportion of detached houses are one-off rural constructions, many of which involved land-use change. Between 1990 and 2010, approximately 140,000 bungalows were built. This represents 32% of the estimated 440,000 dwellings with independent waste water treatment systems.



Under the Water Framework Directive, water quality sites of high status must be maintained. These sites are particularly sensitive to pressures and their high status can be lost from relatively low level (small area) changes in land use including reclamation of land, agricultural intensification and house building (see also Chapter 4). An EPA-funded research project is under way to provide information and guidance on protecting these high-status sites (EPA, 2012a).

A diverse range of providers contribute to the collation and analysis of land cover and land use data in Ireland; however, there is no clear mandated authority with overall responsibility for the task. It is challenging to present a consistent analysis of change across the entire landscape, and the need for improved coordination and integration of LULC mapping activities is widely recognised within the environmental sector. A study by the EPA in 2010 found that there is a pertinent need for a national high-resolution (1–5 ha scale) land cover dataset specially designed to characterise Irish LULC adequately.

Agriculture

Agriculture remains the largest use of land in Ireland, with two-thirds of land devoted to it. Most of this land is under grass for pasture, silage or rough grazing.

Food Harvest 2020 (DAFF, 2010) projects significant changes in production, particularly in the dairy sector, with a consequent increase in livestock. It is anticipated that much of this will be achieved through changing farm management and resource use with minimal changes to land cover. Nonetheless, integration of environmental considerations with the agricultural objectives must be carefully managed from the start to prevent negative impacts on soil quality and water quality.

Peatland

Almost one-fifth of land in Ireland is categorised as peatland; this includes raised bogs, blanket bogs and fens. They are important ecosystems sustaining a range of animal and plant species. The EPA STRIVE-funded BOGLAND study on sustainable management of peatland in Ireland (Renou-Wilson et al., 2011) found that up to 95% of all peatland exists in a degraded state, with the

worst damage sustained in the 20th century. Peatland continues to be disturbed by domestic and industrial peat extraction, afforestation, wind farms, recreational activities and invasive species.

Natural peatland acts as a long-term carbon store; however, when peatland is damaged this function is reversed and carbon is released to the environment. Release of terrestrial carbon from soil and biomass is a major source of carbon dioxide (CO₂), the main contributor to climate change. Globally, it is estimated that 25% of the current elevated atmospheric concentration of CO₂ is due to historic land use change, primarily deforestation of land for agriculture. The BOGLAND study estimated that Irish peatland releases carbon at the rate of 9.66 Mt CO₂ equivalents per year.

The degradation of Irish peatland has caused a loss of biodiversity at both regional and national levels. The BOGLAND study found evidence of loss of species, loss of habitats and loss of entire ecosystems represented by the damage to almost all raised bogs and fens. In 2010 the European Commission began infringement proceedings against Ireland in relation to continued turf cutting on bogs designated as Special Areas of Conservation. The Government has banned turf cutting in these areas and offered compensation to those affected. Damage to peatland impacts on water quality due to silt release from mechanical peat harvesting, increased nutrient release from drained bogs and increased acidification from afforestation on bogs.

The industrial extraction of peat for energy and horticultural purposes is likely to decline over the next 15–20 years. This is due to the gradual harvesting and depletion of peat from existing industrial cutover bogs, and the limited scope for development of new peatland areas

for industrial extraction. Serious consideration is now being given by Bord Na Móna to the potential use of between 50 and 80 kha of cutaway peatlands as they leave production. This will represent a significant component of land cover and land use change, and may impact considerably on Ireland’s carbon budget in this period.

The BOGLAND study highlights the importance of Ireland’s peatlands, particularly in relation to climate change, biodiversity and water quality. In 2011, the Department of Arts, Heritage and the Gaeltacht (DAHG) launched a public consultation on the development of a National Peatlands Strategy. Such a strategy is urgently needed to prevent further damage and to ensure the sustainable management of peatlands in terms of enhancing, recovering and improving resilience.

Forestry

Forestry accounts for 11% of land cover, which is low compared with a European average of 35%. Figure 7.4 shows historic afforestation in Ireland since 1920. Much of the forest in Ireland is young, with nearly 40% of total forest planted since 1990. This is significant from a climate change perspective, as the annual carbon store in any afforestation since 1990 can be used to offset emissions from other sectors, and helps Ireland



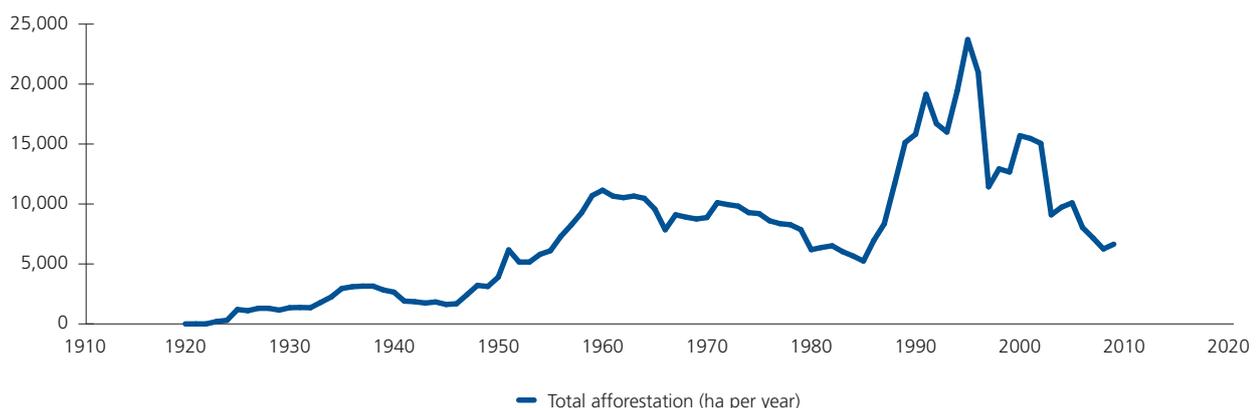
attain greenhouse gas emissions reduction targets. The Programme for Government 2011–2016 sets a national planting rate target of 14,700 ha per annum, an increase on the rate in recent years.

Approximately 75% of the national forest estate is predominantly conifer, composed mainly of commercial timber species but also including some native species such as yew and Scots pine. Since 1997 policies have been in place to increase broadleaf planting, and the Rural Development Programme 2007–2013 sets a target of 30% annual broadleaf afforestation. This target has been reached (and exceeded) in recent

years, primarily through a reduction in afforestation using coniferous trees rather than in an increase in planting of broadleaves.

The management of forest lands is challenging from an environmental perspective. The potential for adverse disturbance of vegetation, soils and landscape during afforestation and forest harvesting is large. These processes can also impact on water quality through acidification and nutrient mobilisation. Also of concern are the location and scale of forestry activities. Although Ireland has notably less forest than other European countries, the rate of afforestation in Ireland

Figure 7.4 Historic Afforestation in Ireland since 1920 (Source: DAFM)



has been relatively high. There is concern that a significant proportion of forest plantation in previous decades was undertaken without due consideration of the long-term potential environmental impacts. Coillte is currently undertaking research on the rehabilitation of inappropriately afforested lands to more sustainable ecosystem types (Coillte, 2012).

In recent years, there has been a trend towards plantation on more appropriate land and soil types driven primarily by the commercial requirements for reasonable productivity and easy access to forest sites, coupled with an appreciation of the potential environmental impact.

Soil

A healthy soil provides us with clean air, food and water. It supports the growth of both plant and animal life while providing foundations for human habitats and structures. This wide range of functions makes soil one of life's most important environmental media, and it should be afforded the same protection as air and water. Particular problems in Europe include loss of soil organic matter, loss of top-soil due to erosion or building activities, contamination and acidification. Historically, little attention has been paid to the conservation and protection of soils. There is relatively little legislation relating directly to soil and soil protection. In 2006, the EU published a Thematic Strategy for Soil Protection and introduced a proposed Soil Framework Directive; this has not yet been finalised. The 2011 Environmental Impact Assessment Regulations for On-Farm

Development supports soil protection in Ireland through the requirements for environmental impact assessments for soil operations such as soil drainage.

The historic lack of attention to soil degradation can be seen not only in the paucity of legislation and soil protection targets, but also in the scarcity of data. Albeit that the degree of certainty is low, the general consensus is that soil quality in Ireland is good. The long growing season, absence of extreme temperatures, and frequent rainfall afforded by our temperate climate are beneficial to soil. The lack of heavy industry in Ireland means that our soils have not suffered from significant amounts of contamination. The large percentage of permanent pasture land has protected Ireland's soils from serious degradation, with the notable exception of peatlands. The production of a National Soils Database (EPA and Teagasc, 2007)



and the Historic Mine Sites project (Stanley et al., 2009) have provided much-needed baseline knowledge on soils in Ireland.

Soil Biodiversity

The immense biodiversity of our soils is the foundation of many ecosystems. The variety of species found beneath the earth's surface in our soils is vast, with an estimated one quarter of all living species on earth in our soils. These biota are the driving force that regulate soil. They have a crucial role in natural cycles, including regulation of the atmosphere, and water quantity and quality. Soil biodiversity provides significantly for human society in a variety of ways including food production, pollution control and development of new pharmaceuticals – the antibiotic penicillin originated from the soil fungus *Penicillium notatum*.

Estimates suggest that only 1% of soil micro-organisms are known today. The EPA-funded CréBeo research project (Schmidt et al., 2011) found species previously unrecorded in Ireland, including 13 predatory nematodes, an earthworm endemic to southern France, and a mite species potentially new to science. It is estimated that the improper management of soil biodiversity on a worldwide basis is equivalent to the loss of 1 trillion dollars per year (EC, 2010).

Soil Organic Matter

Ireland's soils are relatively rich in organic matter, especially our wetter soils and blanket peats. Soil organic matter has a key role in maintaining soil functionalities and water and air quality as well as a crucial function in the carbon cycle. A large amount of the global carbon concentration is stored in our soils. Correct land use management is essential to prevent release of this into the atmosphere, where it would contribute to climate change.

The EU Common Agricultural Policy encourages farming practices that maintain fertility and organic matter levels, thus improving soil characteristics. The Good Agriculture and Environmental Conditions standards are important in improving the relationship between agriculture and soil. The introduction of the Rural Environmental Protection Scheme (REPS) delivered payments to farmers for the provision of these agri-environmental measures; approximately 40% of farmed areas were involved in REPS (OECD, 2010). A holistic approach and good farming practices will maintain soil quality and counteract degradation.

Drivers and Pressures

Land Use

Land is subject to many competing demands. Current land use is the result of a sequence of past human interventions on the natural landscape. Policies related to forestry, renewable energy, agriculture, peatlands and the built environment have associated impacts on land use change and land resource management.

Population Growth

The principal causes of land use changes in urban areas have been the development of housing and associated commercial services built to cater for the increase in the population and consequent growth of suburbs, satellite towns and villages. This increase in artificial surfaces impacts on many aspects of the environment including climate, biodiversity, air quality and water quality.

The coastal zone is a popular residential location, with approximately 60% of the population living within 10 km of the coast. A high proportion of vulnerable ecosystems and priority infrastructures exist in these areas, thus coastal zone management remains a key concern.

Soil Degradation

The degradation of soils is a serious issue across much of Europe, and initiatives at EU level provide a timely incentive to assess critically the condition of soils in Ireland. The EU Commission set up the Thematic Group for Soil Strategy in 2004 to identify the potential threats to soil function. Its analysis identified six degradation processes that impact on soils: soil sealing, erosion, organic matter decline, compaction, salination and landslides. While a number of these processes are naturally occurring, human activity is an additional driver of degradation through poor land management.

Soil Contamination

Soil can be contaminated by a wide range of pollutants, through either point source contamination or diffuse contamination. Contamination from point sources can arise as a result of leakages and accidental spillages from industrial and commercial activities, e.g. petroleum storage tanks, old mine sites, old gas work sites, timber treatment or landfills. Diffuse contamination can arise from activities such as agriculture, forestry, horticulture and domestic septic tanks. The EPA is currently developing guidelines for the management of contaminated land and groundwater at EPA licensed facilities.

Figure 7.5 Volume of Contaminated Soil Sent for Remediation in Ireland 2006–2010 (Source: EPA)

The licensing by the EPA of both Integrated Pollution Prevention and Control (IPPC) and waste facilities covers soils in specific circumstances and where any incident of contamination is found. Figure 7.5 shows the volume of contaminated soil from Ireland sent for remediation from 2006 to 2010, and the fraction exported compared with that managed in Ireland. The overall tonnage of contaminated soil managed decreased significantly after 2008, probably reflecting the lack of land development/redevelopment projects during the economic downturn (EPA, 2012b).

The 2009 inventory and assessment of historic mine sites (Stanley et al., 2009) concluded that of the 32 mining districts assessed, 22 districts will not require any interventions. Seven districts will require further monitoring and three districts (Tynagh, Silvermines and Avoca) will require additional site-specific risk assessment by the landowners. A comprehensive remediation project is currently under way at the Silvermines site, while a full assessment of the Avoca site, where the State is the landowner, has recently been completed. Similar assessments will be required at other sites; however, there is currently no legislative framework in place for this to be accomplished other than the

Programme of Measures under the Water Framework Directive, where water quality is impacted.

Responses

Strategic Environmental Assessment

The EU Strategic Environmental Assessment (SEA) Directive became a legal requirement in Ireland in 2004. The main objective of SEA is to provide environmental protection and to implement environmental considerations into plans and programmes with the promotion of sustainable development. SEA is mandatory for certain plans/programmes in the areas of agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning and land use.

Almost 300 SEAs have commenced in Ireland since their introduction in 2004. Figure 7.6 shows the distribution of these per sector. Of the sectors specified in the Directive, land use planning has had the most significant take-up, accounting for approximately four-fifths of all SEAs undertaken. Water accounts for 9% while the energy and fisheries sectors each account for 4%. It is notable that a number of significant sectors,

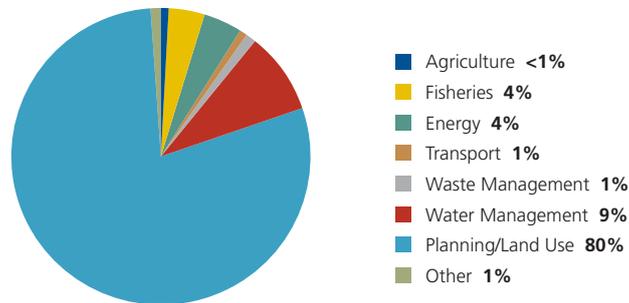
in particular the forestry, tourism, industry and telecommunications sectors, have yet to engage fully in the process.

The EPA commissioned an SEA Effectiveness Review in 2011 to examine how SEA has been implemented in Ireland since its introduction in 2004. The review found that SEA is clearly raising the profile of environmental issues in decision making at plan level among those sectors that have fulfilled their obligations under the Regulations. Overall, it was found that SEA was fulfilling its role and that considerable progress has been demonstrated in applying SEA in Ireland over a short seven years. The findings and recommendations of the review are considered further in Chapter 10.

National Landscape Strategy

The European Landscape Convention, adopted in 2000, emphasises the need to seek the right balance between management planning and protection of a landscape. The National Landscape Strategy Steering Group was established by the DAHG in 2011 to develop a National Landscape Strategy with the aim of sustainable management of change affecting landscape.

Figure 7.6 Distribution of SEA Plans/Programmes (Source: EPA)



Environmental Liability

The Environmental Liabilities Directive (ELD) was enacted in Ireland through the European Communities (Environmental Liability) Regulations (S.I. 547, 2008). The ELD establishes a framework for environmental liability based on the ‘polluter pays’ principle and aimed at preventing environmental damage to water resources, soil, fauna, flora and natural habitats. The central aim of the ELD is to hold operators whose activities have caused environmental damage financially liable for remedying this damage. In addition, the ELD holds those whose activities have caused an imminent threat of environmental damage liable for taking preventive actions. The EPA has been designated the competent authority in Ireland for the ELD and national regulations.

Investment in Research

The revival of a national effort on soils has been supported by significant investment since 2000 by the EPA Research Programme. Research in this area is intended to provide scientific knowledge to underpin the protection and sustainable use of soil. The National Soils Database (EPA and Teagasc, 2007) is the outcome of one project and provided Ireland with a baseline soil geochemical atlas. It provides data point and spatial distribution

maps for 45 elements, including major nutrients such as phosphorus and potassium, as well as trace elements. A map of subsoils is now available from the Teagasc–EPA Soils and Subsoils project (EPA and Teagasc, 2009). The Irish Soil Information System aims to produce a national digital soil map at a 1:250,000 scale with the associated soil information system for Ireland by 2014. This important EPA and Teagasc initiative will address a significant gap in our knowledge of soils in Ireland.

The EPA-funded BOGLAND project provides valuable information on the importance of Irish peatlands to climate change, biodiversity and water quality. The study highlights the extent of the damage caused by antropogenic activities and makes recommendations for the development of a National Peatland Strategy. Land use and land change are a major pressure on water quality and biodiversity. Consequently research in these areas often considers LULC.



Conclusion and Future Challenges

The trend in the past decade towards the development of low-density residential development on the periphery of cities and the suburbanisation of satellite villages and towns has largely ended. Economic circumstances mean it is likely to be some years before there are pressures to convert a significant amount of land for development purposes. The main drivers of land use change over the coming decade will be the agricultural policies of afforestation and *Food Harvest 2020*. As highlighted elsewhere in this report, environmental considerations must be integrated in the implementation of these policies from the start to prevent unsustainable impacts on the environment.

The sustainable management of both land use and soils requires an integrated approach from the key statutory bodies. The proposed National Landscape Strategy for Ireland needs to be prepared and fully implemented. Similarly, a National Soil Protection Strategy, including the identification of soils at risk and addressing the need to establish a soil monitoring network, is required.

The information available on soil is currently not sufficient and it is vital to improve our evidence base to provide information and guidance to policy and decision makers. We can thus strengthen our assessment and understanding of threats and pressures and help identify the measures that are required to address priority issues. A national land use information and analysis capacity also needs to be developed to address the diverse range of information needs at local, regional and national levels. The EPA, NPWS,

Teagasc, Heritage Council and OSi are currently working together to develop an integrated and shared approach to developing such a capacity.

Ireland's peatlands are of immense value and their degradation impacts on climate change, biodiversity and water quality. Inappropriate construction, unregulated extraction and site preparation at peatland sites have been shown to degrade peatland structural integrity over a wide area adjacent to some developments. It is important that these threats to ecosystem function and carbon stocks be minimised through robust and integrated planning, assessment, authorisation, enforcement and management processes. In this context the proposed National Peatland Strategy will be of considerable benefit.

The issues of spatial planning, land use and soil quality are intertwined and interdependent, and this should be reflected in integrated policies and plans at national, regional and local levels. The continued uptake of the SEA Directive across all economic sectors is important, and programme/plan makers across all sectors need to engage fully with the requirements of the SEA process.

While Ireland has fewer contaminated land problems than most other industrialised countries, there is no overall policy framework for the identification, management and remediation of contaminated land in Ireland. National legislation dealing specifically with soil contamination needs to be developed, including a mechanism for remediation of sites.

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