STUDY

Policy Department
Economic and Scientific Policy

Land Degradation and Desertification

IP/A/ENVI/ST/2008-23

PE 416.203

This study was requested by the European Parliament's Committee on the Environment, Public Health and Food Safety. (Contract reference number: IP/A/ENVI/FWC/2006-172/LOT1/C1/SC20)

Only published in English.

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Manuscript completed in March 2009

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EXECUTIVE SUMMARY

Land is a vital resource enabling the production of food, the preservation of biodiversity, facilitating the natural management of water systems and acting as a carbon store. Appropriate management can protect and maximise the services land provides to society. The degradation of land is, however, common in Europe and across the globe, a consequence of physical, chemical and biological shifts driven by environmental, social and economic pressures.

Land degradation is the consequence of multiple processes that both directly and indirectly reduce the utility of land. Defined by the FAO as a "***process which lowers the current and/or potential capability of soil to produce goods and services***", land degradation is a composite term. ***The extent and type of problems experienced depends upon scale and nature of external pressures combined with the sensitivity and resilience of the land itself*** – determined by on soil character and management. The impacts of degradation processes will depend upon how the land interacts with the surrounding air and water resources, as well as human settlement and land use needs. ***Land degradation can be limited, reversed and avoided through the appropriate management of land. It is, therefore, highly varied in its nature and consequent impacts.***

This report sets out to provide an integrated picture of land degradation issues and actions within the EU. Findings from literature, academic research and policy analysis are brought together within this study, in order to explain: the extent of degradation to date in Europe and globally; the drivers and pressures leading to this; the impacts of degradation both directly upon the land and indirectly in relation to *inter alia* water resources, climate change, food production, biodiversity; the technological innovations that may offer solutions to land degradation problems, specifically focusing on agriculture; policy responses to date in the EU and anticipated future evolution; and the nature of debate and implementation of the UN Convention to Combat Desertification (UNCCD).

THE SCALE OF LAND DEGRADATION – Estimates produced by the European Environment Agency suggest that ***erosion by water and wind affects 16% of European land; while contamination by pesticides affects 19% and excess application of nitrates and phosphates affects 18%***. According to European Commission figures, there are estimated to be ***3.5 million contaminated land sites*** in the EU-25. The impacts of the different degradation processes, varies across Europe with, for example, southern European countries generally considered to experience the most severe water erosion linked to extreme and intermittent rainfall, while northern losses are moderate. By contrast diffuse contamination linked to more intensive forms of agricultural production, is greatest in the lowlands of Western Europe. Global assessments of land degradation estimate 15% of the world's total land area shows evidence of damage, mainly a consequence of erosion, nutrient loss, salinisation and physical compaction. According to the OECD up to 5% of total annual agricultural production is forgone due to soil degradation in some countries.

PRESSURES DRIVING LAND DEGRADATION – The multiplicity of processes that lead to land degradation means that there are numerous pressures driving loss in quality of the resource. These processes are driven by ***high level socio-economic and political needs including economic growth, demographic change, population growth, commodity prices, alternations in diets, concerns over energy security and the need to source more than simply food from the land***. More specifically ***decisions and priorities within specific sectors from agriculture and transport to industry and energy alter the needs and wants in terms of land use***.

Within the study five key factors that will influence the nature of land use into the future, hence land degradation potential, are examined – demography, economy, policy, technology and climate change. From the analysis one key message clearly emerges: ***that pressure on land and intensity of land use looks set to increase into the future. Therefore, the potential for the further degradation of land, and the multiple services it provides, will continue to rise***.

THE NEED TO PROTECT LAND – Land degradation has multiple and complex impacts on the global environment through a range of direct and indirect processes. These affect an array of ecosystem functions and services. Direct, on-site, effects associated with land degradation include the loss of soil organic matter and nutrients, the loss of soil structure, loss of soil biodiversity, loss of water holding capacity and water infiltration, loss of soil, pollution of the land and the sealing of soils. ***Negative consequences can include reduced yields of crops, reduced land value and resilience to future events. This can directly have an impact on food security and ability to adapt to future extreme events for example linked to climate change***.

The direct impacts of degradation are a major cause for concern; however, ***the indirect consequences and the loss of services potentially have greater implications for society.*** Here two examples are explored to illustrate concerns. Firstly, where there is inappropriate agricultural management and there is a consequent loss of organic matter significant quantities of greenhouse gases can be given off. This represents a ***potentially substantive source of climate forcing gases***. In the context of climate change more generally a major concern is future water scarcity and the increase in variability in rainfall. Land degradation is important in this context.

Degraded land that has lost its organic matter and soil structure holds water less effectively, impeding growth. Moreover, reduced infiltration of water will also occur. As a consequence less water will reach underground aquifers and water reaching rivers will do via overland flows – rather than via an array of slower sub-surface routes. Overland flows are quick, and waters will be concentrated into this route reaching rivers more rapidly and as a single input. This will increase the level of peak flow in the river leading to greater flooding potential. The water reaching rivers may also be carrying a greater quantity of sediment leading to increased land degradation, greater potential of pollution of water courses and increased sedimentation, driving future flooding. The lack of infiltration means base flows of rivers are also likely to be lower. ***Land degradation can therefore lead to an increase in flooding and drought events, multiplying the anticipated impacts of climate change***.

External costs of degradation are often larger than direct private costs. Such external costs are important from a policy perspective because they represent a potential cause of market failure. No assessments of costs to society of compaction, soil sealing or biodiversity decline are currently available. ***The total costs of degradation that could be assessed for erosion, organic matter decline, salinisation, landslides and contamination, would be up to €38 billion annually for the EU-25*** (based on assessments by the European Commission). This is likely to be an underestimate given the complexity of the processes and the data gaps.

EFFECTIVE PROTECTION – AVOIDING, LIMITING AND REVERSING LAND DEGRADATION – There are many possible mechanisms that can be adopted to protect our land and maintain healthy soils. The many causes of land degradation mean that solving the challenges posed requires multiple measures. The most appropriate combination will vary depending upon the problems experienced, the inputs and pressure they result from, the extent of the degradation experienced and the underlying resilience of the land and soils. The possible solutions for addressing soil degradation are as diverse and varied as the situations and circumstances under which they might be applied.

They include measures intended to avoid and minimise land degradation, reduce the impacts of ongoing land degradation processes, rehabilitate and manage degraded land. ***Amongst the priorities are: the control of inappropriate urban development; reduced emissions of atmospheric pollutants; improved management of irrigation drainage and flooding; the promotion of sustainable agriculture, ceasing the cultivation of unsuitable soils, reducing impacts of contaminants on farmland and improving waste management***.

Importantly, research and development focused upon protecting our land's viability should not simply focus on developing new technologies or systems for working the land. ***Given the variability and the need for targeted solutions, new mechanisms for in the field of monitoring, effective planning and early detection are vital***. Some of the most effective mechanisms for delivering improved land management involve the careful analysis of land conditions, an understanding of what are the best management techniques for a given area and the integrated planning of land management decisions at the local level.

As one of the most expansive land uses in Europe, agriculture represents a potentially significant source of land degradation. Importantly, however, ***well conceived agricultural practices can help limit damage, protect and help rehabilitate soil health and functionality. The severity of the degradation threat varies based on the type and intensity of production.*** The type of agricultural solutions to land degradation will largely differ according to farming system. To be most effective, however, solutions will be context-specific and need to be tailored to the particular set of conditions.

Within the study the different farming systems and possible technological solutions are examined. Changes to management set out can be divided into key areas including the reduction in the intensity of management, the application of new cropping techniques and the introduction of new technologies or forms of equipment. The limitations to the solutions proposed are also set out. It is noted that ***systems known to exacerbate degradation often persist due to a range of challenges including a focus on short term profitability, traditions or social norms, limited skills or information, a lack of access to investment and a tendency to prioritise other agri-environmental priorities in national administrations.***. The analysis builds largely upon research under the SoCo project, developed in response to a request by the European Parliament.

EU POLICY RESPONSE AND FUTURE PRIORITIES – There is an array of EU legislation that deals, predominantly indirectly, with land protection and avoidance of degradation processes. This report systematically examines the extent of existing EU policy and legal requirements related to land management and degradation. EU requirements and policies impact upon the use of land via requirements and funding mechanisms. These promote certain agricultural management practices, the placing of management considerations on the industrial sector and rules regarding appropriate waste management and control. Moreover EU legislation can indirectly protect soils, for example through measures aimed at reducing emissions to water or air. ***The lack of a primary focus upon land degradation and soil protection within EU measures means action is not consistently directed and integrated. As a consequence the important, complex services provided by healthy soils in terms of food production, water management, resilience to climate change and carbon storage are often neglected.*** Pro-active and concerted efforts have been made at the EU level to address point source land contamination from industry and waste management sources. More subtle processes are often neglected. ***While the combating of degradation processes by other routes can be useful; the lack of the primary prioritisation of land issues can lead to sub-optimal solutions.***

Into the future land degradation issues should be pushed up the policy agenda; given the linkage to food production, water quality and water quantity, and the importance in facilitating adaptation to climate change. New policy approaches for protecting our land, especially perhaps the least visible functions, i.e. organic matter, structure and drainage will need to be developed. Key developments of importance to land degradation noted in the study are: the potential adoption of the framework Directive on soil protection; the adoption of the new proposal for a Directive on industrial emissions; the evolution of agricultural policy priorities and anticipated greater pressure for intensification and competition for land; increasing debate over water scarcity and the implementation of the water framework Directive requiring better consideration of river catchment management; and the importance of effective land management in mitigating and adapting to climate change.

UNCCD AND ITS IMPLEMENTATION IN EUROPE – In 1994 the UN Convention to Combat Desertification (UNCCD) was adopted, entering into force on 26 December 1996. The UNCCD is a key convention for the combating of land degradation, of which desertification can be an ultimate expression. The UNCCD aims to promote effective action to combat desertification through local programmes and supportive international partnerships. This study examines and explains developments under the UNCCD to date and anticipated future efforts. Moreover, the implementation of the Convention within the EU is analysed. Actions undertaken by key Member States in the northern Mediterranean and central and eastern regions were reviewed. In so doing it was identified that across the EU only a third Member States 'affected' or threatened by desertification have submitted national action programmes (NAPs) under the UNCCD. In addition the nature of NAPs supplied varies considerably. ***EU efforts to date appear to be largely focused on actions in third countries, with less attention afforded to problems faced within the EU related to desertification and land degradation***.

Into the future, given the rising profile of land concerns and parallel efforts to address water scarcity and climate change, the UNCCD could have an expanded role. Quality land will be vital across the globe and the UNCCD will be the primary mechanism by which effective protection of land and the services it supplies can be delivered.

CONCLUSIONS – Land is a vital resource for life. Given the importance of climate and hydrological factors in influencing the scale, nature and severity of land degradation, ***climate change is anticipated to increase the pressure on land resources. This coupled with elevated demand for land and predicted intensification of agricultural systems means there will be a strong tendency for land degradation to increase into the future. Unless protection is prioritised and pro-active prevention measures put in place there will be potentially significant consequences for society.*** These range from reduced and more unpredictable crop yields to the degradation of water quality and more extreme flooding and drought events.

Based on the analysis within this report the ***current policy action at the EU and global level appears insufficient in its focus on land protection***. While there is an array of measures in place that impact upon land management, these are poorly integrated and deliver benefits for land only indirectly. ***As a consequence the important services provided by healthy land and soils in terms of food production, water management, resilience to climate change and carbon storage are not properly prioritised and integrated.***

The maintenance of land quality will be important for the future of Europe. In so doing we protect the security of food supplies, our ability to produce other bio-products from the land, enhance our resilience and ability to adapt to climate change, limit greenhouse gas emissions from land, maintain hydrological systems and protect our water supplies. This value appears, to date, not to be fully recognised. Into the future the threats to and the needs placed upon land look set to expand. There is, therefore, a need to develop approaches to deliver tailored solutions to land degradation problems, better recognising local variability and the value to society of effectively functioning land.

1 PROTECTING LAND – FRAMING THE CHALLENGE

1.1 Defining Land Degradation and Desertification

Land degradation is the consequence of multiple processes that both directly and indirectly reduce the utility of land. The consequence of a complex, wide-ranging suite of processes which exert pressure on land and resources, land degradation is defined by the FAO as a "process which lowers the current and/or potential capability of soil to produce goods and services". Land degradation is a composite term, it has no single readily identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, relief) has changed for the worse (Stocking, 2000). The term land degradation is often used interchangeably with that of "soil degradation" and the two are closely linked as soil degradation processes constitute the most significant land degradation processes[1].

Degradation can be the consequence of physical, chemical and biological shifts driven by environmental, social and economic pressures. Importantly, however, the extent of problems associated depends upon the sensitivity and resilience of the land itself. This in turn is defined by the environmental characteristics of the environment, i.e. climate, hydrology, topography, land use and bedrock. Impacts associated will also vary dependent upon how the land interacts with the surrounding air and water resources, as well as human settlement and land use needs. Not only does this make land degradation difficult to define, but also to monitor and combat effectively.

Land, and its soils, is a fundament for life; the substrate for the vast majority of agricultural production and biodiversity on the planet. It also provides broader services, for example, water filtration and the balancing of peak flows linked to rainfall events. The land effects and is affected by the quality of other environmental media, i.e. water and air. It is fundamental to our ability to feed our populations, manage our water supplies and adapt to the extreme events anticipated to result from global climate change. Importantly, if inappropriately managed, land can also contribute significant quantities of greenhouse gas emissions, lead to flood events, periods of drought, reduced farm yields and decreased water quality. Indeed, land degradation is a biophysical process driven by socio-economic and political factors with consequences for society at large.

Desertification is the long-term result of the interaction of different land degradation processes, which can be accelerated under severe drought conditions; although it can occur under very diverse climatic conditions. Agronomists consider soils with less than 1.7% organic matter to be in pre-desertification stage. The UNEP and the FAO have defined desertification as the land degradation in arid, semi-arid, and sub-humid areas due to anthropogenic activities. While this is the definition adopted by the United Nations Convention to Combat Desertification (UNCCD), it is vital to recognise that these processes can occur elsewhere – for example large areas of Iceland have become desertified due to loss of soils and organic matter.

1.1.1 A Focus on Soil Degradation Processes

Soil degradation represents an important key element of any land degradation process. While land degradation can encompass processes not exclusively focused upon soils e.g. hydrology is also of vital importance; soil quality is a fundamental indicator of the health of the land and the extent of degradation.

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[1] Other processes which affect the productive capacity of cropland, rangeland and forests, such as lowering of the water table and deforestation, are also captured by the concept of land degradation.

Soil is generally defined as the top layer of the earth's crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between earth, air and water and hosts most of the biosphere. As soil formation is an extremely slow process, soil can be considered essentially as a non-renewable resource. Soil provides us with food, biomass and raw materials (European Commission, 2006). Soil is subject to a series of degradation processes. The literature (Oldeman et al., 1991; EEA, 1995; Scherr and Yadav, 1996) provides various classifications of soil degradation processes. For example, in 1991, in preparation of the world map on the status of human-induced soil degradation known as the GLASOD (Global Assessment of Soil Deterioration), a general classification of soil degradation was developed by ISRIC (International Soil Reference and Information Centre), in cooperation with FAO and UNEP. In this classification, all forms of soil degradation are grouped into four major types, each including several subtypes:

- Water erosion (i.e. loss of topsoil, terrain definition/mass movement);
- Wind erosion (i.e. loss of topsoil, terrain deformation, over blowing);
- Chemical degradation (i.e. loss of nutrients and/or organic matter, salinisation, acidification, pollution);
- Physical degradation (i.e. compaction, sealing and crusting, water logging, subsidence of organic soils).

The Communication "Towards a Thematic Strategy for Soil Protection" (European Commission, 2002), set out a core list of degradation processes occurring in Europe, and it is this list upon which this study primarily draws. The key degradation processes identified are as follows.

Soil erosion: Soil erosion is the wearing away of the land surface by physical forces such as rainfall, flowing water, wind, ice, temperature change, gravity or other natural or anthropogenic agents that abrade, detach and remove soil or geological material from one point on the earth's surface to be deposited elsewhere. By removing the most fertile topsoil, erosion reduces soil productivity and, where soils are shallow, may lead to an irreversible loss of natural farmland. Soil erosion can be driven by both natural and anthropogenic causes. The later increases the magnitude and frequency of the process (Van Camp et al., 2004 a).

Soil contamination (local and diffuse): This type of degradation refers to the confirmed presence of "dangerous substances" caused by man in such a level that they may pose a significant risk to a receptor in such a way that action is needed to manage the risks (Van Camp et al., 2004 b). Contamination can be local or diffuse. Diffuse contamination is generally caused by contaminants transported over wide areas, often far from the source. It includes heavy metals, acidification, nutrient surplus (eutrophication), etc. Local contamination (contaminated sites) is a problem in restricted areas (or sites) around the source, where there is a direct link to the source of contamination (EEA, 2000).

Soil salinisation: Soil salinisation is a process that leads to an excessive increase of water soluble salts in soil. The salts which accumulate include chlorides, sulphates, carbonates and bicarbonates of sodium, potassium, magnesium and calcium. A distinction can be made between primary and secondary salinisation processes. Primary salinisation involves accumulation of salts through natural processes such as physical or chemical weathering and transport from saline geological deposits or groundwater. Secondary salinisation is caused by human interventions such as use of salt-rich irrigation water or other inappropriate irrigation practices, and/or poor drainage conditions (Kibblewhite et al. 2008).

Decline in soil organic matter (SOM): Organic matter (OM) is an important component of soils because of its influence on soil structure and stability, water retention, cation exchange capacity, soil ecology and biodiversity, and as a source of plant nutrients. Soil OM plays a major role in maintaining soil functions. A decline in OM content is accompanied by a decrease in fertility and loss of structure, which together exacerbate overall soil degradation (Van Camp et al., 2004 c).

Soil sealing: The covering of the soil surface with impervious materials as a result of urban development and infrastructure construction is known as soil sealing. The term is also used to describe a change in the nature of the soil leading to impermeability (e.g. compaction by agricultural machinery) (Kibblewhite et al. 2008). Therefore, sealing of the soil and land consumption are closely interrelated; when natural, semi-natural and cultivated land is covered by built surfaces and structures, this degrades soil functions or causes their loss.

Landslides: A landslide is the movement of a mass of rock, debris, artificial fill or earth down a slope, under the force of gravity (USGS, 2004). Landslides threaten soil functioning in two ways: through the removal of soil from its in situ position, and the deposition of colluvium on in situ soil down slope from the area where the soil mass “failed” (Envasso project website, 2007).

Soil compaction: Soil compaction is a form of physical degradation in which soil biological activity and soil productivity for agricultural and forest cropping are reduced, resulting in decreased water infiltration capacity and increased erosion risk (Envasso project website, 2007). The decrease in pore volume that accompanies compaction is largely due to a reduction in macropores, which provide connectivity for water and gas movements through the soil profile (Kibblewhite et al. 2008).

Loss of soil biodiversity: Soil biodiversity is generally defined as the variability of living organisms in soil and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. The soil biota plays many fundamental roles in delivering key ecosystem goods and services, and is both directly and indirectly responsible for carrying out many important functions including food and fibre production and the provision of certain pharmaceuticals, as well as the detoxification of xenobiotics and pollutants and regulation of atmospheric composition. Decline in soil biodiversity is generally considered as the reduction of forms of life living in soils, both in terms of quantity and variety (Kibblewhite et al., 2008).

1.2 Purpose of and Approach to this Report

This report represents an information paper intended to inform the European Parliament regarding the multi-faceted processes that lead to land degradation, its impacts including desertification and potential solutions for the future – both technical and policy based. Given the complex and broad nature of this subject matter a theoretical model has been used to order the sections of report and provide a clear flow of logic from problem identification through to solutions. The analysis within this report is based upon literature reviews and desk based research conducted during Autumn 2008 and January 2009. Input, especially to the section on agricultural solutions, draws heavily on detailed primary research conducted at the behest of the European Parliament under the Sustainable Agriculture and Soil Conservation (SOCO) project undertaken by the JRC. IEEP was a key partner contributing to this work.

In order to provide insight into the impacts of soil degradation, the dynamics involved, and the feedbacks between the different degradation processes, this report is loosely structured around the Drivers-Pressures-State-Impacts-Responses (DPSIR) framework. Applied, proposed and adopted by the European Environment Agency (EEA), the DPSIR assessment framework offers a basis for analysing the inter-related factors that impact the environment and society, ensuring that issues are covered in a comprehensive way and that all important aspects are analysed. The EEA's DPSIR framework allows analysing the cause-effect relationships of man-made environmental degradation processes with a view to possible policy responses.

Within this report the following core issues are addressed in order to provide a picture of the drivers, state, impacts and responses to land degradation at the EU level. In addition, the nature of the debate and the implementation of the UN Convention on Combating Desertification have been examined. The UNCCD represents the key note global agreement related to land degradation.

This report examines:

- The extent of the problem
- An overview of land degradation in Europe and the world
- Pressures driving land degradation:
    - Exploration of the drivers and pressures leading to land degradation and their interaction;
- Need to Protect our Land:
    - Exploring the consequences associated with land degradation looking in detail at both direct and indirect issues;
    - Exploring potential links to water availability, food production, climate change and biodiversity loss;
- Possible responses and solutions at the EU level:
    - Introducing and explaining possible technical solutions to land degradation;
    - Detailed assessment of possible solutions specific to agricultural land;
    - Analysis of existing EU policy in place and possible future trends;
    - Assessment of indicators examining land degradation;
- Possible Global responses:
    - Detailed analysis of the state of discussions under the UN Convention to Combat Desertification (UNCCD);
    - Review of the implementation of the UNCCD within Europe.

2 LAND DEGRADATION IN EUROPE AND THE WORLD

2.1 Land Degradation in Europe

This section focuses upon soil degradation as this in the key land degradation and one that comparative figures are best available for.

Using a different categorisation of soil degradation types to that adopted in the EU Thematic Strategy on Soil Protection Oldeman et al. (1991 in EEA, 1995) provides a rough estimation of the area in Europe (excluding Russia) affected by major types of soil degradation processes (see Table 1).

Table 1: Areas affected by major types of soil degradation in Europe (EEA, 1995)

Soil degradation type	Area affected (million ha)	Percentage of total European land area
Water erosion	115	12
Wind erosion	42	4
Acidification	85	9
Pesticide contamination	180	19
Nitrates and phosphates	170	18
Soil compaction	33	4
Organic matter losses	3.2	0.3
Salinisation	3.8	0.4
Water logging	0.8	0.1

Soil erosion is regarded as one of the major and most widespread forms of land degradation (EEA, 2003). Indeed, about 16% of the total land area in Europe (excluding Russia) is affected by soil erosion to some degree (Oldeman et al., 1991 in EEA, 2003). In particular, water erosion is a more common form of erosion, contributing to 92% of the total affected area. Three zones of erosion can be distinguished in Europe: a southern zone characterised by severe water erosion; a northern loess zone with moderate rates of water erosion; and an eastern zone where the two zones overlap and where former intensive agricultural practices caused significant erosion problems (EEA, 2000).

EEA (1995) claims 3.2 million hectares (ha) suffer from **losses of nutrients or organic matter (OM)** in Europe (see Table 1). The decline of OM is of particular concern in the Southern countries, where 74% of the soil has less than 3.4% organic matter, but also in parts of France, the United Kingdom, Germany and Sweden.

Soil contamination is one of the most widespread types of soil degradation in Europe: 180 million ha are affected by pesticides; 170 million ha by nitrates and phosphates; and 85 million ha by acidification (EEA, 1995). The number of potentially contaminated sites in the EU-25 has been estimated at approximately 3.5 million (European Commission, 2006). Based on available data, losses deriving from industrial activities and former waste sites are the major causes of local contamination in most of the countries analysed. For diffuse contamination, hot spots are located in those areas where the intensity of agricultural chemical use is highest: in the lowlands of Western Europe (Denmark, the Netherlands, Belgium, Luxembourg and the north of France) (EEA, 2000).

The surface area affected by **salinisation** is estimated to be 3.8 million ha in Europe (EEA, 1995) (see Table 1). Salinisation is strongly tied to site-specific soil properties, climatic conditions, and unsustainable irrigation systems. In this regards, it is observed that its distribution is mainly restricted to South Eastern Europe, where semi-arid or arid conditions prevail. For example, salinisation affects 16 million ha or 25 % of irrigated cropland in the Mediterranean (EEA, 2003).

All agricultural soils in developed countries display some degree of subsoil **compaction**. Estimates in 1991 suggest that the area of degradation attributable to soil compaction in Europe may equal or exceed 33 million hectares (ha) (EEA, 1995). Recent research has showed that compaction is the most widespread kind of soil physical soil degradation in Central and Eastern Europe and has affected over 62 million ha, or 11% of the total land area (EEA, 2003).

Soil sealing has the greatest impacts in urban and metropolitan areas, where large areas of the land are covered with buildings and infrastructure. Over the past 20 years, built-up areas have been steadily increasing all over Europe (EEA, 2003). In already intensively urbanised countries like the Netherlands or Germany the rate of soil loss due to surface sealing is high. In the Mediterranean region, soil sealing is a particular problem along the coasts where rapid urbanisation is associated with the expansion of tourism. Very high rates of sealing are now predicted for countries like Portugal, Finland or Ireland where urbanisation levels have been low to date.

Regarding **landslides**, mass movements occur more frequently in areas with highly erodible soils, steep slopes and intense precipitation, such as the Alpine and the Mediterranean regions. In Italy more than 50% of the territory has been classified as having a high or very high hydro-geological risk, affecting 60% of the population or 34 million people. More than 15% of the territory and 26% of the population face a very high risk (Görlach, 2004; European Commission, 2006).

2.2 Land Degradation Globally

One of the most important studies on land degradation designed for the purposes of international comparison is the Global Land Assessment of Degradation (GLASOD) mapping exercise by Oldeman (Oldeman et al., 1991). The results of the GLASOD survey were initially published as a map at a scale of 1:15 million, showing the dominant (most severe) type of degradation for each mapping unit as a colour, and the degradation severity as intensity of colour. This highlights which type of degradation is dominant in each region, but makes it difficult to isolate the degree of severity of each type.

Table 2 shows degree of soil degradation by percentage of area covered. GLASOD has shown that damage has occurred on 15% of the world's total land area (13% light and moderate, 2% severe and very severe), mainly resulting from erosion, nutrient decline, salinisation and physical compaction. Combining the world figures for strong and extreme degradation gives the best current estimate of land which has been largely, and for most practical purposes irreversibly, destroyed by land degradation. The total is 3.05 million km^2, or 305 million ha (UNEO, 1994).

Table 2: Degree of soil degradation by sub-continental regions (% of total area) (UNEP, 1992)

	None	Light	Moderate	Strong	Extreme
Africa	83	6	6	4	0.2
Asia	82	7	5	3	<0.1
Australasia	88	11	0.5	0.2	<0.1
Europe	77	6	15	1	0.3
North America	93	1	5	1	0
South America	86	6	6	1	0
World:					
Percentage	**85**	**6**	**7**	**2**	**<0.1**
Area (thousand km^2)	**110**	**7490**	**9106**	**2956**	**92**

3 PRESSURES DRIVING LAND DEGRADATION

The geographical distribution of land and soil degradation depends on several factors. Degradation is the consequence of physical, chemical and biological shifts driven by environmental, social and economic pressures. Importantly, however, the extent of problems associated depends upon the sensitivity and resilience of the land itself. This in turn is defined by the environmental characteristics of the environment, i.e. climate, hydrology, topography, land use and bedrock. Anthropogenically induced pressures and natural factors therefore interact to determine the nature and extent of degradation in a given locality.

The pressures driving land degradation can be divided into two different classes. There are a suite of macro level social and economic pressures that are driving changes in the management of land and our environmental systems. These shifts lead to increased pressure upon our land and soil resources and as a consequence increase degradation potential and are summarised in section 3.1. Macro pressures drive decisions at the local level resulting in actions and management practices that can directly or indirectly place pressures upon the land and soil, leading to degradation. These localised pressures and their interaction with environmental conditions are explored in section 3.2.

3.1 Macro Pressures Driving Land Management Changes

There are a number of broad social and economic trends which in turn lead to pressure upon land. These include economic growth, demographic dynamics, urbanisation and different human activities such as tourism, agriculture, transport, and industry/energy activities. These impacts are compounded by anthropogenically induced changes in environmental conditions leading to climate change and water stress. These trends can eventually result in degradation processes, for example through changing intensity of land use.

For example, urbanisation, suburbanisation and urban sprawl are the most important drivers of soil loss due to soil sealing. These processes are in turn driven by complex socio-economic factors including the land development policies, migration from urban areas and economic growth. Priority macro level drivers are explained briefly below:

- **Demography:** An increase in population results in an increased demand for housing and other facilities, such as offices, shops, and public infrastructure. This, in turn, can lead to an increase of soil surface with impervious materials as a result of urban development and infrastructure construction and deforestation.
- **Economy:** A booming economy results in construction of new commercial and industrial buildings. Further, economic growth creates new jobs and thus attracts more workers, leading to population growth, and construction of new houses and infrastructure. With a rise in incomes, people often choose to build larger houses, leaving smaller, older houses vacant. A change in the price of agricultural or forest products can, furthermore, affect landowners' decisions to keep land in those uses. Also, policies aimed at supporting agricultural prices provide an incentive to keep land in farming. While agriculture does not necessarily lead to soil degradation, there is some evidence that the move to intensive agriculture has aggravated the impact on soil quality.
- **Policy:** International, national, regional, and local planning and policies influence greatly the rate at which land-use and land-cover changes, which in turn can result or avoid certain degradation processes. Furthermore, certain policies aim specifically at protecting soil (such as the Thematic Strategy for Soil Protection in Europe), or indirectly (such as the CAP reform).

- **Technology:** Technological developments influence the intensity of activities e.g. agricultural mechanisation, improvements in methods of converting biomass into energy, use of information-processing technologies in crop and pest management, and the development of new plant and animal strains through research in biotechnology. Such developments often alter the usefulness and demand for different types of lands. Extension of basic transport infrastructure such as roads, railways, and airports, can further take up land resources and result in their overexploitation and degradation.
- **Climate change:** Changes in short-term variation, as well as long-term gradual changes in temperature and precipitation, is expected to be an additional stress on rates of land degradation. Climate change-induced land degradation is expected through (Eswaran et al., 2001):
  - changes in the length of days and/or seasons;
  - recurrence of droughts, floods and other extreme climatic events;
  - changes in temperature and precipitation which in turn reduces vegetation cover, water resource availability and soil quality;
  - changes in land-use practices such as conversion of lands, pollution, depletion of soil nutrients.

  Research suggests that climate change-induced land degradation will vary geographically. The underlying adaptive capacity of both the ecosystem and communities will determine the extent and direction of impacts. Regions that are already constrained by issues such as land quality, poverty, technology constraints and other socio-economic constraints are likely to be more adversely affected. On the other hand, there is increasing evidence that land degradation is a driver of climate change.

These pressures are anticipated to increase into the future and will consequently require greater emphasis and attention; for example, population growth and an increase in the ageing population. The former would result in an increased demand for food, thus increased food production and pressure on land. The latter can result in a growing number of households, though with fewer members, which in turn can lead to increasing surface area consumption for residential uses as well as associated transport infrastructure, and therefore sealing, compaction and an increase in the land that needs to be dedicated to these uses with consequent elevated pressure on remaining farmland etc.

Climate change, as explained above, is an issue of paramount importance for societies and the links between climate mitigation and adaptation with the quality of our lands and the services they provide will need further consideration into the future. For example, the effects of soil erosion will worsen in the future due to changes in climate influencing rainfall patterns. Meanwhile, the scale of extreme events associated with climate change, could be exacerbated by a failure to protect lands structure and hydrological flows.

3.2 Localised Pressures Influencing the Scale of Degradation

Specific approaches to the use and management of land, driven by the factors set out in 3.1, can place pressure upon soil and land resource’s potentially resulting in their degradation. These pressures at the micro level ultimately promote land degradation; the extent and rate of degradation is determined by the interaction between these anthropogenic pressures and the naturally occurring local environmental conditions.

Environmental factors, mainly biophysical processes and attributes, can determine the kind of degradative processes, e.g. erosion, salinisation, etc.

These include land quality as affected by its intrinsic properties of climate, terrain and landscape position, climax vegetation, and biodiversity, especially soil biodiversity (Eswaran et al., 2001). Depending on their inherent characteristics and the climate, lands can be more or less resistant, or stable, or vulnerable and extremely sensitive to degradation. Fragility, extreme sensitivity to degradation processes, may refer to the whole land, a degradation process (e.g. erosion) or a property (e.g. soil structure).

Actions exerting pressures upon soils and land include emissions of pollutants to air, water and land, land abandonment, agricultural intensification and management practices, deforestation, forest fires, waste disposal, inappropriate water management and extraction of natural resources. The nature and severity of these processes are in turn driven by the macro pressures described in section 3.1.

Table 3 below demonstrates the link between key land and soil degradation processes anthropogenic pressures and environmental factors that might increase or influence the scale of the degradation process.

Table 3: Overview of the causative factors of different soil degradation processes (EEA, 2003; European Commission, 2006; Görlach et al., 2004; McDonagh et al., 2006)

Soil degradation process	Anthropogenic Pressures Driving Degradation	Environmental Factors the Level of Degradation
Soil erosion	- Unsustainable agricultural practices o Late sowing of winter cereals o Overstocking o Poor crop management o Abandonment of terraces o Tillage (use of heavy machinery) o Inappropriate irrigation methods on slopes - Soil disturbance e.g. ploughing up-and-down slopes - Removal of vegetative soil cover and/or hedgerows - Poor maintenance of drainage systems - Changes in land structure (land levelling or disappearing of landscape elements such as hedges, shelterbelts, etc.). - Inappropriate use of heavy machinery, in agricultural and forestry practices, but also during construction works	- Rainfall patterns and climatic conditions (e.g. long dry periods followed by intense rainfall on fragile soils, such as in the Mediterranean area) - Land cover patterns - Steep slopes
Decline OM	- Conversion of grassland, forests and natural vegetation to arable land - Deep ploughing of arable soils causing rapid mineralisation of labile components of OM - Overgrazing, with high stocking rates - Soil erosion, by water and wind - Leaching - Forest fires and deforestation - Extraction of peat from mires and peatlands - Drainage of wetlands	- Clay content (influences the capacity of soils to protect organic matter against mineralisation and therefore influences rates of change in organic matter content) - Vegetation pattern - Soil biodiversity - Climatic conditions

Soil degradation process	**Anthropogenic Pressures Driving Degradation**	**Environmental Factors the Level of Degradation**
	- Poor crop rotation and plant residue management such as - burning crops residues - Accelerated mineralisation due to management practices such as continued tillage	
Sealing	- Growth in urbanisation and transport infrastructure (= Increased impervious material - Movement of population	

Contamination	- Point sources
	  o Leaching from industrial and mining installations and storage tanks
	  o Inadequate waste and waste water treatment and disposal
	  o Accidents
	- Diffuse sources
	  o Use of chemicals in agriculture
	    ▪ Use of pesticides and fertilisers
	    ▪ Spread of sewage sludge and compost
	  o Atmospheric deposition
	  o Illegal waste dumps and landfill sites not properly managed
		- Buffering capacity
		- Filterability
		- Drainage
		- Soil structure
		- Vegetation and soil biodiversity
		- Climatic condition

Salinisation	- Inappropriate irrigation practices, e.g. with salt-rich irrigation water and/or insufficient drainage - Over exploitation of groundwater (coastal areas) - De-icing of roads with salts	- Low rainfall - High evapotranspiration rates - Physical or chemical weathering - Transport from geological deposits (natural processes due to a high salt content of the parent material) - Natural disasters in coastal areas, such as tsunamis
Landslides	- Interference with slope morphology o Constructing over-steepened slopes - Deforestation and land abandonment - Extractions of materials	- Climatic conditions (i.e. rainfall, snow melt) - Seismic activity - Soil structure and aggregate stability
Compaction	- Agricultural or construction machinery (e.g. wheels, tracks or rollers) - Grazing animals - Large constructions works and recreational sites	- Soil structure - Macro porosity - Bearing capacity

Loss of biodiversity	- Unsustainable agricultural practices
	  o Intensive soil tillage, pesticide
	  o Use and monocultures
	- Other forms of soil degradation, in particular soil erosion, contamination, acidification, salinisation and compaction
		- SOM content,
		- Chemical properties of soils (e.g. amount of soil contaminants or salts),
		- Physical properties of soils such as porosity (affected by compaction or sealing).

3.2.1 Interactions between Land Degradation Processes

It is not always possible to identify particular land degradation processes occurring and often several will take place in conjunction, or will mutually reinforce each other. For example, soil biodiversity is affected by other forms of soil degradation, in particular soil erosion, contamination, acidification, salinisation and compaction. The OECD (2003) claims that there is a strong link between soil erosion and soil biodiversity. Loss of soil biodiversity intensifies soil erosion, while erosion negatively affects soil biodiversity, decreases activity and species diversity of soil biota, and reduces the amount of microbial biomass. In addition, soil biodiversity is closely related to soil organic matter (SOM), since soils with adequate amounts of organic carbon have good structure, allow more water and air infiltration and help provide favourable biological habitats (OECD, 2003).

When considering the causative factors of soil degradation, it is therefore necessary to consider these interrelations. Some of them are presented inTable 4.

Table 4: Interactions between different types of soil degradation (Görlach et al., 2004)

Degradation process	Description of the interaction with other types of soil degradation
Soil erosion	- It may increase the severity of flooding events by reducing the potential of soils to absorb rainfall. - It leads to accelerated decline in organic matter. - Increased soil erosion negatively affects soil biodiversity (decreases activity and species diversity of soil biota and the amount of microbial biomass).
Decline OM	- Declines in OM may have an important impact on soil biodiversity, which is closely related to it (i.e. soils with an adequate amount of organic C have a good structure). - It intensifies soil erosion (on the other hand, an adequate amount of organic C makes soil more resistant to erosion). - Declining OM contents in soil are also associated with ongoing desertification.
Sealing	- Increased soil sealing may intensify flooding. - It may increase soil contamination (e.g. run-off water from sealed housing and traffic areas is normally unfiltered and contaminated with chemicals). - It may reduce soil biodiversity (e.g. soil sealing affects the fragmentation of habitats).
Contamination	It can have, alone or in conjunction with acidification, a negative effect on soil biodiversity
Salinisation	It may reduce soil biodiversity (as those species of fauna and flora that are not tolerant to increased salinity cannot survive).
Landslides	Landslides can contribute to soil contamination
Compaction	- It may give rise to water and wind erosion. - It may increase the severity of flooding events by reducing the potential of soils to absorb rainfall. - It may cause biological degradation.
Loss of biodiversity	With reduced biodiversity, the soil is less stable and more prone to erosion, as well as leaching and run-off causing water contamination.

4 THE NEEED TO PROTECT LAND - THE IMPACT OF LAND DEGRADATION

Land degradation has multiple and complex impacts on the global environment affecting a wide array of ecosystem functions and services. These impacts can directly impact the land in a specific location and its productivity, or indirectly impact on broader resources and the environmental baseline. Such impacts have consequences for global development including impacting upon food security, human health, water availability and our ability to adapt to climate change. In this study we classify the impacts as direct/on-site impacts (any changes in soil functions experienced locally) and indirect/off-site impacts (those affecting other media, ecosystems and human populations more or less remote from the degraded soil, including, for example: changes in forest health; food productivity, climate change; or water stress), which are further discussed in the following sub-sections.

4.1 Direct (On-Site) Effects

Some on-site impacts that have been described in the literature are presented in Table 5 for the different land use degradation processes.

Table 5: Overview of direct impacts of land degradation processes (EEA, 2003; European Commission, 2006; Görlach et al., 2004; McDonagh et al., 2006)

Degradation process	Direct impacts
Soil erosion	Loss of soil
	Changes in crop production
	Reduction of the water holding capacity of the soil (which might result in floods and landslides)
	Damage to infrastructures due to excessive sediment load
	Restrictions on land use hindering future redevelopment and reducing the area of productive and valuable soil available for other activities
	Land value depreciation
Decline OM	Reduction in soil fertility (due to changes in the soil structure, the water retention capacity and the nutrient reserve)
	A decline in OM leads directly to a loss of biological activity and biological diversity of soil. This in turn can affect the soil's capacity to absorb pollutants, and therefore, soil may became more prone to leaching, affecting ground and surface water quality
	Reduced water infiltration due to changes in soil structure, hence higher flood risk
	Increased erosion
Sealing	Changing water flow patterns, increasing a run-off of water and eventually resulting in a higher risk of floods
	Impact on water quality: run-off water from housing and traffic areas is normally unfiltered and may be contaminated with harmful chemicals
	Disruption of gas, nutrients, and energy fluxes
Contamination	Reduction of the buffering and substance conversion capacities of soil
	Damage to soil biodiversity (uptake of contaminants by soil biota and plants)
	Land value depreciation
	Loss of soil fertility due to disrupted nutrient cycles
Salinisation	Negative impact in the agricultural yield. For example, it has been estimated that in certain Central Asian countries, salinisation reduced cotton yields from 280 to 230 tonnes/km^2 (EEA, 2003)
	Reduced water infiltration and retention resulting in increased water run-off
	Land value depreciation
	Loss of soil biodiversity

Degradation process	Direct impacts
Landslides	Damage to property and infrastructure
	Loss of fertile soil
	Contamination of soil due to damage to infrastructure such as pipelines and storage facilities
	Land value depreciation
Compaction	Loss of soil fertility due to changes in soil structure, i.e. due to reduced oxygen and water supply to plant roots
	Reduced water infiltration and retention resulting in increased water run-off
	Higher erosion susceptibility
	Changes in the quantity and quality of biochemical and microbiological activity in the soil, which results in a reduced biological activity. This affects organic matter development and soil biodiversity and, as a result, soil productivity.
	Land value depreciation
Loss of biodiversity	Changes in soil structure by affecting the stabilisation of organo-mineral complex
	Reduced food web functioning and consequently crop yield losses
	Reduced soil formation
	Reduced nutrient cycling and nitrogen fixation, which in turn affects soil fertility
	Reduced resilience of the soil to endure pressures
	Reduced recycling of organic waste/litter
	Reduced water infiltration rate and water holding capacity
	Negative impacts on biodiversity outside of soil
	Impaired degradation of pollutants (important for e.g. clean ground water)
	Reduced biological control of agricultural and forestry pests

4.2 Indirect (Off-Site) Effects

4.2.1 Impact on Climate Change

Some recent studies show that land use and cover have an important role as a climate forcing effect and demonstrates the importance of including land cover change in future climate change scenarios. For example, estimates of historical contributions of agriculture to atmospheric carbon dioxide (CO_2), the amounts and rates of carbon lost as a consequence of deforestation and conversion of land to agriculture and other soil-vegetation-atmosphere carbon fluxes, all suggest that land degradation has had a very significant impact, through raising atmospheric CO_2 concentrations, on climate.

Land degradation contributes to climate change through two main processes: production of greenhouse gases (GHGs) and changes in temperature and precipitation through, for example, changes in land cover or direct contribution of dust to the atmosphere. There are also important feed-back loops operating between climate change, land, vegetation and land degradation, particularly in drylands, where climate warming and droughts may promote desertification, further soil erosion, dust storms and changes in albedo (McDonagh et al. 2006).

Production of GHGs

Soil is a major store of carbon. Global terrestrial carbon stocks amount to between 2,221 Pg[2] C and 2,477 Pg C, depending on which estimate is used. Of this, 1,567 Pg C are held in the soil and 657 Pg C are held in plants (IPCC, 2001).

[2] 1 Pg = 1 petagram = 1015g = 1 billion tonnes = 1 gigatonne = 1 Gt

CO_2 is released when vegetation is cleared and burned and when SOM is mineralised. It takes place when the dynamic equilibrium between SOM breakdown and replenishment[3] is disturbed (under agriculture, tillage and other practices will promote further SOM decomposition). When this happens, SOM breakdown exceeds replenishment and there is a net loss of CO_2 from the soil (McDonagh et al. 2006). For example, it has been estimated that land-use change activities (total) were responsible for emissions of 2.0-2.2 Pg C/yr in the 1980s and 1990s while the release of carbon due to tropical deforestation amounted to 1-2 Pg C/yr during the 1990s (15-35% of annual fossil fuel emissions) (Houghton, 2005).

Even modest changes in SOM, may have an appreciable effect on the content of atmospheric carbon. Most of the contribution to atmospheric CO_2 made by the soil is associated with the conversion of land to agriculture.

Soil contamination can, on the other hand, promote the removal of great amounts of nitrogen from the soil back into the atmosphere as nitrous oxide through the denitrification process than would occur naturally. Nitrous oxide, as one of the greenhouse gases, consequently influences the climate change process.

Compaction can result in poor aeration of soil, as mentioned before, which in turn, may cause a loss of soil nitrogen and emissions of GHGs through denitrification in anaerobic sites.

On the other hand, carbon sequestration in agricultural soils achieved by some land management practices has a potential to contribute to climate change mitigation. Nevertheless, the effect of soil management practice on carbon sequestration varies with many factors such as soil texture, cropping systems, time, location and climate/soil feedbacks. Some sources estimate this to be around 2 Pg of carbon annually[4].

As part of the EU Climate Change Programme, the potential of soils for carbon sequestration was estimated to be equivalent to 1.5-1.7% of the EU's anthropogenic CO_2 emissions during the first commitment period of the Kyoto protocol (European Commission, 2002). Certain land degradation processes, such as the loss of biodiversity, can result in a loss of carbon sequestration potential.

Changes in Temperature and Precipitation

Deforestation and conversion of land to pasture or cropland can impact on other atmospheric components leading to consequences for the local, regional and global climate. Indeed, land degradation can also significantly affect climate due to land surface changes that impact on surface energy budgets (e.g. by increasing albedo) or affect surface evapotranspiration.

There are indications that dust storms have relatively minor but increasing impacts in climate change, including absorption and scattering of solar radiation affecting air temperatures; influence on marine primary productivity; promotion of ocean cooling; modification of rainfall amounts through effects on convectional activity and cloud formation. Dust storms have always existed as natural phenomena but their increased frequency and severity is one of the manifestations of land degradation, particularly in drylands (McDonagh et al. 2006).

Finally, it is important to highlight that there is a strong relation between the regional and the global climate, thus impacts of land degradation on the regional climate might have in the long term consequences at the global scale. For example, the rainforests of the Amazon play a crucial role in regulating the general circulation of the atmosphere.

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[3] Through litter fall, plant root die off and decomposition

[4] Estimated organic carbon level in the topsoil derived from the European Soil Database.

As deforestation and land degradation become more extensive, the resulting reductions in evapotranspiration and atmospheric heating may weaken moisture recycling and deep convection in the atmosphere over the Amazon, with major repercussions for South American climate (Foley et al. 2007).

4.2.2 Changes in the Water Balance

Soil plays an integral part in the regulation of the water cycle and therefore, changes in the soil conditions and land cover can have important impacts in the water balance. As indicated in the previous section, land degradation processes, and untimely desertification, can have an important impact on local, regional and global climate, which in turn can result in changes in the water balance (e.g. evapotranspiration, precipitation, etc.). For example, soil moisture levels determine the portion of energy that is used in evaporation and transpiration processes.

Besides the impacts on climate, land degradation processes can affect infiltration and soil retention capacity of soils, which are related to surface run-off and groundwater sources recharge.

For example, the increase impervious materials (soil sealing), mainly in urban areas, may have a great impact on surrounding soils by changing water flow patterns, reducing groundwater recharge (reduce soil water Infiltration) and increasing a run-off of water and eventually resulting in a higher risk of floods

Compaction could result in reduced infiltration of rainwater, lower recharge of groundwater aquifers, and hence a less regular flow of both groundwater and surface streams. Salinisation and decline of SOM can have similar effects on infiltration (e.g. SOM decline changes soil structure, which can affect water infiltration).

Erosion, on the other hand, lowers the water-holding capacity of the soil, which in turn can lead to an increased occurrence of floods and landslides.

Hence preventive and remedial actions to combat soil degradation will lead to improved water quality and less flood events.

This seems to be an issue of great relevance, particularly in the context of increasingly frequent water scarcity conditions. Nevertheless, research on the relation between land degradation and changes in the water balance seems to be still scarce.

4.2.3 Food Production and Safety

Land degradation can impact both directly and indirectly and in many ways food security, which is influenced by food production, but also its distribution and accessibility. The key soil characteristics that affect yield are nutrient content, water holding capacity, organic matter content, soil reaction (acidity), top soil depth, salinity, and soil bio mass. Processes affecting such characteristics can potentially reduce crops yield, thus food production.

Some authors claim that the impacts on productivity are highly site-specific and some work has indeed shown that the sensitivity and resilience exhibited by a soil are strong determinants of the impact of degradation on productivity (McDonagh, 2006).

In any case, land degradation can threaten the food security of people in fragile environments, particularly those whose livelihoods rely largely on agricultural activities. In fact, the evidence compiled by the International Food Policy Research Institute (IFPRI), suggests that soil degradation has already had significant impacts on the productivity of about 16% of the globe's agricultural land (Scherr, 1999). Box 1 describes more in detail the effects on food production that have been experienced in China.

Box 1: Impacts of land degradation on grain yields in China (Scheer, 1999)

> Different studies for China have found that degradation had reduced grain yields. One calculated that for the period 1983-89, total grain production would have been 60% higher in the absence of a deteriorating environment. Increased floods and drought caused 30% of this yield loss, erosion 19%, salinity 0.2%, and increased multiple-cropping intensity 11%. Environmental degradation during the same period cost the country as much as 5.6 million metric tons of grain per year – a figure equivalent to nearly 30% of China's yearly grain imports in the early 1990s. Without the effects of a deteriorating environment, mostly erosion, rice yields would have grown 12% faster in the late 1980s and early 1990s. Erosion affected maize, wheat, and cash crops in North China the most, reducing production by up to 20% in the 1980s and 1990s.

Soil erosion and nutrient depletion, or a combination of both, caused (directly) by inappropriate land management, are often the main causes of decline in food production. Erosion can indeed impact on crop production due to a decrease in plant rooting depth and disruption of nutrient cycles. For example, the estimated range of losses through soil degradation for two important crops is shown in Table 6. On plot and field scales, erosion can cause yield reductions of 30 to 90% in some root-restrictive shallow lands of West Africa. Yield reductions of 20 to 40% have been measured for row crops in Ohio and elsewhere in Midwest USA. Crop yield losses in 1989 due to past erosion ranged from 2 to 40%, with a mean of 6.2% for Sub- Saharan Africa (8.2% for all Africa). In the absence of erosion, 3.6 million tons more of cereal (8.2 million for the continent), 6.5 million tons more of roots and tubers (9.2 million), and 0.4 million tons more of pulses (0.6 million) would have been produced in 1989 (Eswaran et al., 2001).

Table 6: Calculated loss in grain yield due to losses in nitrogen through erosion (adapted from Berry et al., 2003)

Crop	**Yield lost (kg) per kg N lost**	**Range of nutrient loss N (kg/ha)**		**Range of nutrient loss N (kg/ha)**	
	(crop response rate)	Low	High	Low	High
Maize	9.6	36	429	0.345	4.12
Wheat	6.9	36	429	0.248	2.96

It is also important to highlight that the real impact of land degradation on food production could have been masked until now by yield growth due to greater use of technology and inputs over the last few decades.

Furthermore, another aspect that has to be taken into account is that the uptake of contaminants in the soil by food and feed crops and some food producing animals can have an impact on the safety of products.

4.2.4 Biodiversity

Alteration of soil processes leads to changes in the functioning of ecosystems, and many environmental problems which become apparent in other media actually originate within the soil (EEA, 2000). Disruption to ecosystem functions inevitably diminishes the diversity of above- and below-ground biodiversity.

The potential impacts of deforestation on above-ground biodiversity are especially large and well documented. Impacts of other forms of land degradation on biodiversity are less clear, particularly regarding the effects on below-ground biodiversity, likely to be the most severe.

For example, erosion, sealing, overgrazing, and silting of low-lands can also result in loss, modification, and fragmentation of habitats, which is one of the major threats faced by threatened birds, amphibians, and mammals (IUCN, 2004)

Contamination represents a great threat to soil biodiversity, mostly by causing soil acidification and nitrogen depositions. Acidification favours the leaching of nutrients and the release of toxic metals, which may reduce soil fertility and damage beneficial soil micro-organisms, slowing down biological activity (Montanarella, 2006). Ammonia and other nitrogen deposition (resulting from emissions from agriculture, traffic and industry) cause the unwanted enrichment of soils and subsequent decline of biodiversity of forests and of high nature value pastures. In some European forests the nitrogen input already reaches such extreme values as 60 kg N per hectare per year (compared to pre-industrial deposition which was below 5 kg) (Montanarella, 2006).

The largest threat to soil biodiversity and ecosystem services is the cumulative effect of stress on stress, which is prominent in heavily modified landscapes: persistent stresses, like that of heavy metals, combined with periodic short term stresses, such as drought, strongly reduce the stability and resilience of soil ecosystem services (Griffiths, 2000).

In turn, damage to soil biodiversity (e.g. uptake of contaminants by soil biota and plants) renders the soil more vulnerable to soil degradation processes. Soil organisms create structural porosity in soils, by forming aggregates of variable size and resistance. The rate at which water moves, is detoxified and stored, is determined in large part by soil organisms, yet, the contribution of soil invertebrates to water storage and detoxification is rarely acknowledged. Furthermore, soil invertebrates bind soil particles together. These soil aggregates are more resistant to erosion than individual soil particles, thus contributing to the reduction of surface run-off and of water erosion, while increasing soil moisture for plant growth. Currently, no figures are available on the amounts of water infiltrated and stored in soils as a consequence of invertebrate activity, although these effects are well documented and indicators exist (Lavelle, 2006).

4.2.5 Human Health and Development

Many of the possible impacts of land degradation on human health are indirect, mediated through its impacts on climate, biodiversity, hydrological systems, etc. Others are direct impacts including, for example, the health problems resulting from erosion (mainly air erosion) due to dust and particles in the air (dust particles have been shown to cause a wide range of respiratory disorders including chronic bronchitis and lower respiratory illness) or experienced by people living on and in the surroundings of a contaminated site.

A Millennium Ecosystem Assessment (MA) synthesis on ecosystems and human health from 2005 is perhaps the most comprehensive assessment on the linkage between human health and ecosystem services (MA 2005). Appendix 1 presents a table that summarises the potential impact of land degradation on the infectious diseases extracted from the mentioned MA Health report.

Research also illustrates the role that land degradation, particularly in agricultural areas, can play in migration and demographic patterns. For example, Berry et al. (2003) show that the degradation of agricultural lands in Mexico can contribute directly to cross-border migration via its impacts on household incomes in the agricultural sector. The data collected in this study demonstrate that high levels of environmental stress and high population pressures at the municipal level are associated with poverty. As poverty is a major determinant of migration, environmental degradation may be seen to influence migration through its impacts on poverty in the agricultural sector. The results of the analysis show a systematic inverse relation between environmental stress variables and income levels. At the municipal level, high levels of environmental stress are highly associated with poverty, which in turn, is highly correlative with migration.

Since much of the land degradation in Mexico is the result of human factors, particularly unsustainable land management practices, it follows that programs to improve these practices will likely have a positive impact on stabilising agricultural incomes, reducing the acceleration of poverty rates, and, by extension, reducing the incidence of cross-border migration (Berry et al, 2003).

4.3 Costs of Land Degradation and Desertification

The social and environmental cost of soil degradation can be divided into on-site (private) and off-site (external) costs. The off-site costs include, for example, reduced carbon storage, damage to public infrastructures, such as roads and water storage facilities, as well as inter-farm cost caused, for example by increased salinisation of irrigation water supplies. The spatial distinction between on-site and off-site impacts has already been introduced.

The external costs are often larger than the direct-private costs of degradation. Such external costs are important from a policy perspective because they represent a potential cause of market failure.

There have been various estimates of the on-site and off-site costs associated with soil degradation, focussing mainly on the extent of land affected, the cost of repair and the value of loss production.

A full discussion of methods for measuring the economic cost of degradation lies beyond the scope of this study, but examples may be given. Most studies focus the analysis on a specific land degradation process, mainly erosion. For example, early estimates of the annual cost of soil erosion across UNEP countries in 1980 hovered around US$ 26 billion, about half the cost borne by developing countries. A decade later, Dregne and Chou (1992) proposed $28 billion per year as the cost of dry land degradation. Pimentel, Allen, and Beers (1993) valued the plant nutrients lost annually just through sediment loss and nitrogen in water run-off at $5 billion, or 0.4% of the annual global value added in agriculture (Scheer, 1999).

In another study, it was estimated that the total annual cost of erosion from agriculture in the USA is about US$44 billion per year, about US$247 per ha of cropland and pasture. On a global scale, the annual loss of 75 billion tonnes of soil costs – at US$3 per tonne of soil for nutrients and US$2 per tonne of soil for water – the world about US$400 billion per year, or approximately US$70 per person per year (Eswaran et al., 2001).

In the UK, the total external cost of pollution to agriculture has been estimated at £2.34 billion per year. Significant costs arise from contamination of drinking water with pesticides (£120 million per year), nitrate (£16 million), Cryptosporidium (£23 million) and phosphate and soil (£55 million) (McDonagh, 2006).

In some more comprehensive studies, further analysis of different land degradation processes is carried out. For example, taking the GLASOD estimates as a basis, a calculation was made for eight countries of the South Asian region, with a total population of 1,200 million (Young, 1994). Relative production loss for the Light, Moderate and Strong degrees of degradation were taken as 5, 20 and 75% respectively. These reductions were applied to average cereal yields over the affected areas. Fertility decline was estimated on a nutrient replacement basis. The cumulative effect of human-induced land degradation was estimated to cost these countries a sum of the order of US$10 thousand million per year (table 7).

Table 7: Annual cost of land degradation in the South Asian region (on-site effects) (Young, 1994)

Type of degradation	Cost, US$ thousand million per year
Water erosion	5.4
Wind erosion	1.8
Fertility decline	0.6 – 1.2
Waterlogging	0.5
Salinisation	1.5
Total annual cost	9.8 – 10.4

The agricultural domestic product of these countries at the time of the survey was ÚS$ 145 billion. The cost of degradation is therefore equivalent to a loss of 7% of the economic value of agricultural production. Inclusion of the off-site effects of water erosion (e.g. siltation of reservoirs), and other off-site effects (e.g. on-costs of processing) would increase this value substantially, certainly more than 10%. This loss occurs annually, and will continue to do so unless measures are taken to check and reverse land degradation.

Finally, a study commissioned by the Environment Directorate-General and carried out by Ecologic and BRGM to assess the economic impacts of soil degradation (Görlach et al., 2004). This study performed a review of exiting literature and test cases to perform an economic assessment (empirical estimates) of soil degradation in Europe. These estimates as well as results from other sources were considered for the quantitative analysis in the impact assessment of the thematic Strategy on soil. Table 8 provides an overview of costs (on-site and off-site) that could be quantified for different land degradation processes.

Table 8: Estimated total annual cost of land degradation in Europe (European Commission, 2006)

Degradation process	On-site costs	Off-site cost	Total
Erosion	€588 million*	€6,7 billion*	€7,3 billion
Decline of soil of SOM	€2 billion	€1.4 and 3.6 billion	Between €3.4 and 5.6 billion
Compaction	-	-	
Salinisation	Between €114 and €277 million	€44 million	Between €158 and 321 million**
Landslides			Between €11 to 600 million per event
Contamination	€192 million*	€17,1 million*	€17,3 million*
Sealing	-	-	-
Biodiversity	-	-	-

*Intermediate bound

**Estimates for three countries (Spain, Hungary, and Bulgaria)

No assessments of costs to society of compaction, soil sealing and biodiversity decline are currently available. The total costs of degradation that could be assessed for erosion, organic matter decline, salinisation, landslides and contamination, on the basis of available data, would be up to €38 billion annually for the EU-25.

In general, we observe that studies tend to limit their scope both geographically and regarding the land degradation process being considered. In this regard, we observe that a majority of studies focuses on the cost of erosion, whereas other aspects of soil degradation receive less attention. Geographically, a large part of the available evidence stems from North America and Australia, with comparatively few European studies. Finally, most studies investigate the impacts of soil degradation in relation to agriculture and very few consider off-site impacts.

These economic costs must be taken into account, together with productivity and environmental- related effects, when setting over all policy priorities and strategies.

5 SOLUTIONS AND RESPONSES TO THE LAND DEGRADATION CHALLENGE – AN INTRODUCTION

5.1 Introduction to Solving the Land Degradation Challenge

The multiple causes of land degradation mean that solving the challenges posed requires multiple measures. The most appropriate combination will vary depending upon the problems experienced, the inputs and pressure they result from, the extent of the degradation experienced and the underlying resilience of the land and soils. Within this report a distinction has been made between broad approaches to addressing land degradation, and approaches specifically of use on agricultural lands. This is felt valuable given the importance on agriculture in terms of land use across Europe and its impact upon a large proportion of Europe's lands.

The possible solutions for addressing soil degradation are as diverse and varied as the multitude of situations and circumstances under which they might be applied. Broadly actions could be classified as follows:

- Measures to avoid and minimise land degradation (prevention measures and those aiming at enhancing the resilience of soil);
- Measures to reduce the impacts of ongoing land degradation processes;
- Measures to recover, rehabilitate and manage degraded land.

Often more than one technique or measure is needed to solve a land degradation problem at a given locality. Measures that address the problems *in situ* or infield are preferable. There are many "end of pipe" solutions to combat for example sediment, resulting from soil erosion from entering water courses. Such end of pipe solutions, however, do not retain the productive capacity of the land, but prevent the off-site impacts of degradation. The former is vital if land is to remain productive and functioning into the future.

A final challenge when attempting to solve land degradation problems is that processes can be interlinked. It can, therefore, be difficult to identify the underlying cause of a given problem. For example, a farmer may fail to properly manage the nutrient balance of a field leading to a decline in organic matter content over time; this loss of organic matter in turn can degrade the soils structure; when combined with heavy rainfall this will result in soil erosion and sedimentation of nearby water courses. Often the soil erosion is the most visible impact, and therefore action is taken to combat this rather than underlying causal factors.

Importantly techniques of interest in combating soil degradation are not purely those employed when working with the land or soils. In the field of land degradation there are important innovations taking place in terms of monitoring, planning and early detection. These are equally important as innovations in terms of action to be taken. This is because, given the many underlying factors that contribute to land degradation, action will have little positive impact or be inefficient if not properly targeted. Monitoring, information systems and better planning are fundamental to the achievement of land protection: they inform well tailored hence effective decisions.

5.2 Protecting and Rehabilitating Land

5.2.1 Land Management

Mechanisms that deliver considered approaches to land management, based upon the characteristics and sensitivities of the land and soils are potentially of importance if Europe is to make the best, most efficient use of these resources. Closely aligned to land use planning, this would ensure that quality and potential of land and soil as a resource, are taken into account when making decisions in terms of appropriate development in a given location – for government funded projects this might in future include the addition of criteria in terms of the approval of funds related to the appropriate use of the land resource and preventing its degradation. In order to deliver more comprehensive land and soil protection decisions such as where to site certain types of agricultural production, urban expansion and industrial activity should take account of the nature of the land and soils as well as the services they deliver. This will become increasingly important into the future given pressures and the needs our land resource will need to deliver are anticipated to intensify.

Within the SoCo study (Guy et al, 2008), analysis of the management of agricultural land identified that some of the most effective solutions to dealing with land degradation are the mechanisms for coordinating activities with the natural conditions in a given location. Working with the land through soil plans to identify areas of risk and as a consequence the appropriate uses and management techniques.

5.2.2 Soil Degradation Detection and Monitoring

Identification and assessment of the status of land degradation and desertification processes is essential to make informed decisions on financial and labour investments that should be made in its control.

Computers and satellites have brought development of two new technologies that are especially valuable in combating land degradation. Satellites have made possible global positioning systems (GPS) that can locate an object on the earth's surface with unprecedented accuracy. That accuracy permits repeated sampling of, for example, sites where vegetation changes are being monitored. The great utility, in this case, is that permanent markers do not have to be placed at sampling sites. GPS enables data to be collected in exactly the same spot year after year even in remote uninhabited areas (Dregne, 1998).

The second significant technology utilizing computers is vastly improved Geographic Information Systems (GIS). It is now possible to use computer software to stack images of any maps and analyze them singly or in any combination. GIS overlays greatly facilitate construction of maps that combine such different maps as those of population, road systems, location of crop and forest lands, etc in a way not previously possible. Assessment of degradation and desertification risk is the major contribution of GIS to combating desertification (Dregne, 1998).

Furthermore, strategies for sustainable use of soil must consider long term data on the rainfall, soil loss and run-off and contrast this information with the total soil and crop management practices including tillage, crop choice, nutrient management and conservation measures. For designing such strategies some of these variables need to be predicted for a given agro-ecological condition. System modelling approaches can be successfully used for such predictions.

In the case of some degradation processes, such as pollution for example, passive sampling technologies can be used for early warning of soil pollution. In the case of pollution, technology exists that is contaminant specific.

5.2.3 Permanent Vegetative Cover - Alternative Land Use Systems

Changes in land use, such as abandonment of marginal land with very low vegetation cover and increases in the frequency and extension of forest fires, have a strong impact on soil resources. Indeed, erosion and other degradation processes can result from a combination of harsh climate, steep slopes, thin vegetation cover and poor agricultural practices. In turn, severe erosion can lead to a complete loss of the soil cover (EEA, 2003). The agroforestry approach can be successful as alternative land use. A combination of grasses, legumes and trees optimizes land productivity and conserves soil, moisture and soil nutrients while producing forage, timber and fuel wood on a sustainable basis.

In this regard, Spanish researchers monitored run-off and soil erosion under different (aromatic) plant covers in order to understand the effectiveness of the vegetation in protecting soil surfaces against erosion in comparison with bare-soils. Their analysis has been performed on the south eastern region of Spain, a region where aromatic and medicinal plants, such as thymus or lavender, are traditionally cultivated (Durán Zuazo et al., 2006). The main results of their investigation are:

- Compared to bare-soils, plant cover decreases run-off by 41% to 81% depending on the plant types.
- Compared to bare-soils, plant cover decreases soil erosion by 58% to 98% depending on the plant types.

The authors conclude that the cultivation of (medicinal and aromatic) plants helps prevent run-off and soil erosion on steep slopes. The results of the study also show that even medium-sized plants have a significant effect on reducing soil degradation.

5.2.4 Water Optimisation Techniques

As both too much and too little water may lead to soil erosion, water management is often an important key to prevent land degradation particularly water erosion. In this regard, a combination of mechanical, agronomic and vegetative practices can help in arresting soil loss and run-off in cropped lands.

Mechanical measures like contour, graded bunding and bench terracing are designed for lands of different slopes as permanent structures. Contour bunding in cultivated lands intercepts the run-off, reduces soil loss and provides increased opportunity time for water intake.

Other potential measures to combat water erosion include the exclusion of open streams of water from irrigation systems, to dig protective dykes and trenches and to create water accumulation reservoirs. Furthermore, the irrigation system can incorporate progressive methods of surface watering (discrete watering on furrows, automatic watering and so on) in addition to the technology of dropping irrigation, to make economic use of irrigation water and reduce water erosion driven by unsustainable irrigation practices.

5.2.5 Measures to Avoid Industrial Pollution

In order to prevent hazardous emissions to soil and groundwater from storage and handling of chemicals, the safety of industrial installations should be ensured (Van Camp et al., 2004 a). Possible mechanisms for achieving this include the following, which may be used in combination:

- Design and operation of facilities in such a way that potential pollutant cannot escape;
- Single-walled underground containers are not sufficient;

- Quick and reliable detection of leaks of substances and their prevention from escaping and properly disposal. When not double-walled and provided with a leak indicator, the facilities are, as a rule, equipped with a collection system/device of a tight and durable design. As a matter of principle, collection chambers may not have any discharge openings;
- Operating instructions including a monitoring, maintenance and an alarm plan are drawn up and observed;
- Contaminated soil can be reduced by educating staff on how to avoid leaks and spills.

5.2.6 Technologies for Management of Salt Affected or Water Logged Soils

Establishing a washing and drainage system may reclaim land affected by salinisation. However, this may be expensive and technically difficult. On the other hand, salt-capturing crops may be a suitable treatment (Van Camp et al., 2004 a). Indeed, a number of afforestation and agro-forestry techniques are now available for rehabilitating the salt-affected soils. Tree species such as *Acacia auriculaeformis*, *Casuarina obesa*, *C. equisetifolia*, and *Eucalyptus camaldulensis* are highly tolerant to soil salinity thus suitable for plantation in such areas (ENVIS, 2006).

The sodic soils can be reclaimed or moderated by the application of gypsum. The requirement of gypsum has been standardized. With proper choice of crops only the upper 15cm of soil needs to be amended by application of gypsum (ENVIS, 2006).

5.2.7 Treatment of Contaminated Soils

Contaminated land needs to be managed properly. Some of the most important tools in this regard include:

- Preventing contamination or limiting its impacts through appropriate spatial planning and siting of installations that may provoke and risk, the effective management of the application of chemicals and storage within agriculture and pollution prevention control systems and environmental management systems designed to limit activity that may lead to a risk;.
- Contaminated land risk assessment i.e. identifying where land may be contaminated and with what in order to provide a basis for action;
- Clean up and risk control techniques i.e. actions performed on site to manage contamination once it has occurred.

In terms of addressing land which has become contaminated, there are a multitude of possible techniques that might be adopted. These can be classified in a variety of ways including the following:

- Removal of Contaminated Soil to Landfill – as either hazardous or special waste;
- Containment of Contaminant – this can be achieved through encapsulation of the material or capping;
- Removal of Contaminant from the soil via biological, chemical and physical processes including the use of anaerobic bacteria, fungi or phytoremediation, i.e. plants that take up and metabolise the contaminants.

Box 2 – Phytoremediation – Using plants to remediate soils

Plants take up nutrients and material from the land and soils during growth. Phytoremediation, also commonly referred to as bioremediation, is the use of plants to make soil contaminants non-toxic through the targeted take up of pollutants. Certain plant species for example have the ability to hyper-accumulate metals within their structure meaning that they can take up significant quantities of certain substances from the soil without the contaminants preventing their growth. These, rather than the soils, can then be removed and disposed of; in some cases it is has been noted that it is also possible to recover the metals absorbed. Where applicable phytoremediation can prove less expensive and disruptive to the landscape, although perhaps it is a longer term solution, than techniques such as the removal and replacement of contaminated soils.

Categories of phytoremediation include phytoextraction (the use of plants to remove contaminants from soils), phytovolatilization (the use of plants to make volatile chemical species of soil elements), rhizofiltration (the use of plant roots to remove contaminants from flowing water) and phytostabilization (the use of plants to transform soil metals to less toxic forms, but not remove the metal from the soil). The use of plants and associated rhizosphere organisms or genetically modified plants designed to metabolize toxic organic compounds has also been noted to have potential (Cunningham, 1996). Plants or their mutualistic organisms supported in their roots and rhizomes can be altered to promote metal uptake or alternatively promote activity that makes metals soluble hence accessible to plants within the soil matrix.

An example of a hyperaccumulative plant is Thlaspi genus of herbs commonly known as pennycress. This has the ability to take up significant quantities of zinc and cadmium, removing the excess from soils. Researchers have identified that in normal plants, the activity of zinc transporter genes is regulated by the zinc levels in the plant, however, in Thlaspi, these genes are maximally active at all times – independent of plant zinc levels – until you raise the tissue zinc levels to very high concentrations. This results in very high rates of zinc transport from the soil and movement of this metal to the leaves (USDA, 2000).

5.2.8 The Notion of Appropriate Technology

An important aspect that has to be taken into account when considering the application of technology for combating land degradation is its appropriateness. Indeed, the application of certain technologies and methods can be completely fruitless unless they are adapted to the region where they are applied. A process for determining the appropriate application of technology should take account of the following (Kishk, 2004):

- be self-perpetuating, that is, intended to stimulate the innovative processes that will allow for continuing advances;
- be adaptive or easily transformed or begun on a different level depending on the social and cultural needs and the technical capacity of the country;
- cost-effective, at least in the long run;
- provide for optimum use of local resources;
- promote self-help and self-reliance;
- makes use of local experiences and promotes local participation;
- be ecologically sound;
- imply increased education;
- build the capacities of local institutions;
- be relatively easily learned by the people who are going to use it;
- be equally accessible to poor and rich groups;
- ensure its side effects can be handled efficiently by local institutions;
- not create or increase unemployment problems.

6 LAND DEGRADATION SOLUTIONS LINKED TO PARTICULAR AGRICULTURAL SYSTEMS

6.1 Introduction

Approximately forty seven per cent of Europe's land area (Eurostat) is dedicated to agricultural production. Agricultural practices can be tailored to protect or improve soil health. If inappropriately managed, however, agricultural production can lead to significant, extensive and complex land degradation processes. The severity of the problem depends upon a range of factors, including the type and intensity of agricultural production, as well as specific climatic, geographic and agronomic conditions. These factors combine to result in different sets of pressures on the land, which in turn cause different types of land degradation problems and of varying degrees of severity. The type of agricultural solutions to land degradation will largely differ according to farming system. To be most effective, however, solutions will be context-specific and need to be tailored to the particular set of conditions.

This section of the report, therefore, briefly sets out the main farming systems in Europe and the types of land degradation associated with them. A range of options and solutions for preventing or reducing the risk of land degradation are then set out.

6.2 Farming Systems

The wide climatic and geographic ranges of Europe provide opportunities for many different types of agricultural production managed at different intensities. For the EU-27, the European Commission (2006) estimates that 47% of total land area is used for agriculture. Just under two thirds of the UAA is used for arable cropping, one third for pastures and 6% for permanent crops (Eurostat, 2008).

In general terms, the agricultural sector in northern and western Europe is characterised by a progression to fewer, larger farms, increasing specialisation and regional concentration in production, and a decline in the agricultural labour force and aspects of the skills base. Intensification of production has led to the increased use of fertilisers, larger field sizes, and the use of larger and heavier machinery. Simplification in crop rotations, reduction of permanent grasslands and of the use of spring crops is also observed. In contrast, in many parts of southern and central Eastern Europe, and the mountainous regions of the Mediterranean, a gradual cessation of agricultural management and eventual land abandonment and associated loss of labour and skills is being experienced (Farmer *et al*., 2008).

6.3 Arable Systems

Arable production is the agricultural system with which the greatest risks of land degradation are associated. All Member States produce arable crops (such as wheat, barley, maize, rye, colza, sunflower and peas) and production is most prevalent in the fertile areas of the Parisian Basin, the north of France, the east of Germany and Denmark (European Commission, 1999) but is also carried out in areas of lower productivity on lower grade land, for example in the Mediterranean.

The intensity of cropping, including the levels of inputs such as fertilisers and pesticides to the cropping system, as well as agronomic and climatic factors such as soil type, relief, and water and nutrient availability, all affect the level of risk of land degradation. Soil erosion, soil compaction, decline in soil organic matter and potentially soil and water contamination are associated with poor management in arable systems.

For example, soil erosion can be caused by arable cropping on slopes, especially if the ground is left bare over winter or when crops are planted in rows, leaving the soil more exposed to intensive summer rainfall events (Gay *et al*., 2009). In several regions of Europe, harvesting between September and November when rainfall is heavy further increases the risk of soil compaction, due to the use of heavy machinery on wet or waterlogged soils, and therefore of soil erosion (Gay *et al*., 2009).

6.3.1 Horticulture and Permanent Crop Systems

Horticulture and permanent crop systems are a serious cause of land degradation in the Mediterranean region in particular, where production practices severely increase the depletion of water resources, leading to soil erosion, salinisation and soil and water contamination.

In Member States such as Greece, Cyprus, Spain, Italy and Portugal, permanent crops such as olives, cotton and tobacco are often cultivated on poor soils with scarce water and nutrient resources. When intensively managed, with high levels of irrigation and chemical inputs to compensate for poor growing conditions, these production systems are associated with high soil erosion rates, chemical run-off leading to soil contamination, and the risk of salinisation. As the climate changes, water scarcity is likely to increase and higher inputs may be required to compensate for these poorer conditions, which will only serve to increase the severity of the land degradation problems experienced.

6.3.2 Livestock Systems

Livestock production is widespread across the EU and can lead to certain forms of land degradation. The type and severity of land degradation experienced will depend on the type of livestock (for example, cattle, sheep, goats, pigs, poultry), and the intensity and method of production (for example, the degree to which livestock are housed, grazed, where they are grazed and the grazing intensity).

Beef and dairy farming is most prevalent in Central and Northern Europe (Eurostat, 2008). Sheep production is concentrated in two main areas of Europe – the western part of the Atlantic region and the Mediterranean countries (Poux *et al*., 2006), and is generally situated on less fertile agricultural land in comparison to bovine production (Poux *et al*., 2006). Pig farming is most prevalent across Germany, Spain and France, and poultry production is concentrated mainly in France, UK, Spain, Poland and Germany (Eurostat, 2008).

The main land degradation problems associated with beef and dairy systems are erosion, compaction, soil contamination and the pollution and eutrophication of water systems. Erosion and compaction are caused directly by poaching due to stocking densities that are higher than the carrying capacity of the land, and by the associated intensive crop production (often monoculture) for feed. Although many of the incentives for overstocking have been removed with the introduction of decoupled payments through the CAP in 2005, high stocking densities continue to cause problems within intensive beef and dairy systems as well as grazing systems within the Mediterranean where the soils are more fragile. Inorganic fertilisers, organic manures and slurries, and silage effluent contribute to pollution by nitrates, phosphates and sedimentation, potentially resulting in eutrophication (Alliance Environment, 2007). Particularly where farms have become more specialised, the imbalance between the amount of animal waste produced and the arable land available for its recirculation results in a highly enriched soil nutrient concentration (Kirchmann and Thorvaldsson, 2000).

6.3.3 Semi-subsistence[5] Systems

Traditional semi-subsistence farming systems are characterised by low land use intensity and input use and are often of high nature value (HNV) (Beaufoy *et al.*, 2008; Beaufoy *et al.*, 1994). Although these types of production practices are in decline across much of Europe, they are still significant within many parts of Southern, Central and Eastern Europe, including Spain, Italy, Greece, Bulgaria, Hungary, Poland and Romania. 'HNV' farming systems account for approximately 25% of the EU agricultural area.

These farming systems are under pressure as competition for land and resources increases and access to CAP support is difficult to obtain (Beaufoy *et al.*, 2008). If semi-subsistence farmers are unable to support themselves into the future, the dual risks of land abandonment and intensification increase, which may increase the risk of land degradation, such as erosion and reductions in soil organic matter and biodiversity.

Land abandonment may, however, provide benefits to previously farmed land, depending on the type and intensity of the farming practices, and whether these practices increased the risk of land degradation themselves. In predominantly agricultural areas small-scale abandonment can lead to increases in habitat and species diversity, or provide opportunities for managed habitat restoration projects that can provide the growth and succession of plant species which are beneficial to soil structure and fertility (Farmer *et al.*, 2008). Where there is fertile soil, adequate rain and fairly level terrain, abandonment leads to improved vegetation cover, reduced erosion and increased soil organic matter. However, in semi-arid regions with thin, poor soil, especially when in steep terrain, abandonment can lead to severe problems of soil degradation, erosion and landslides (Farmer *et al.*, 2008).

6.4 Agricultural Solutions

There are a large number of different actions that can be undertaken by farmers to improve the health of their soils either limiting, preventing or even reversing degradation processes. Agricultural solutions to degradation involve altering management practices where there is a risk of land degradation. The changes in management can be divided into a number of areas and include:

- reducing the intensity of management;
- applying new cropping techniques; and
- introducing new forms of machinery and/or technological equipment.

There are a range of instruments to encourage the uptake of agricultural solutions to land degradation. For example, they may be enforced through regulation, incentivised through financial support, or encouraged by the provision of advice and knowledge transfer by specialist organisations and networks. Annex I of this report provides detailed case examples of the application of different management techniques across Europe developed as part of the detailed analysis under the SOCO project on Sustainable Agriculture and Soil Conservation.

Many land degradation processes arise from the intensification and specialisation of production, as fewer cropping rotations and increased inputs lead to increased pollution and soil erosion, and decreases in soil biodiversity and organic matter (Poux and Ramain, 2007; Reidsma *et al.*, 2006). However, the impact of management practices can be assessed only in relation to regional or local circumstances.

[5] Subsistence farming is defined in the Encyclopaedia Britannica as farming in which nearly all of the crops or livestock raised are used to maintain the farmer and his family, leaving little, if any, surplus for sale or trade.

An appropriate stocking density on permanent pasture, for example, will depend on the carrying capacity of the particular habitat, and in the way that it is managed. There may be considerable differences in the environmentally sustainable stocking density between holdings or even fields (*Beef & Dairy report*). Within arable systems, reduced input use will benefit soils, and soils on steep slopes may benefit from a permanent crop cover to improve soil structure, potentially decreasing the risks of erosion and run-off.

Examples of some of the main solutions to land degradation caused by agricultural production practices are set out below.

6.4.1 Managing Inputs

Organic Farming

Organic farming avoids the use of artificial fertilisers and pesticides in production, applying compost and recycled farmyard manures in their place, and by doing so this can increase soil fertility. As a result, organic farming has positive effects on soil biodiversity and organic carbon content, and soil contamination and water pollution are decreased (Gay *et al*., 2009).

Reducing the Length of the Grazing Season and Grazing Intensity

Practicing grazing only during periods of the year when weather conditions do not exacerbate the vulnerability of soils to degradation can be crucial to mitigating soil erosion and compaction. In periods of wet weather, structural damage to soils caused by poaching is increased, therefore best practice is to minimise or prevent grazing during these periods.

However, economic pressure to extend the grazing season, particularly in order to reduce costs of silage and animal feed, is high and so in many cases, where opportunities for housing stock over winter are limited, managing the movement of animals more effectively so that land is not overgrazed and pasture has time to recover is a more desirable option. Regularly shifting pastoral herds across fields or between temporarily erected paddocks provides recovery time for soil and plant cover, decreasing the risk of run-off and erosion and providing a higher proportion of lush grass for the animals. In addition, the location of feeders and drinking troughs can be regularly moved or relocated to less sensitive locations (Heathwaite *et al*., 1990).

Appropriate Application and Storage of Manure and Chemical Inputs

Confining the spreading of manure and input of chemicals to drier periods of weather, to concise quantities, and on slopes which are not susceptible to high run-off rates reduces the risk of run-off and therefore of diffuse pollution. Increases in soil organic matter and plant growth may also be observed as the efficient retention of nutrients by the soil is facilitated. Simple spreading plans based on climatic and soil conditions can provide a cost-effective solution to pollution and erosion through run-off.

Injecting slurry directly into the soil is an environmentally preferable practice to uniform surface spreading, delivering the slurry directly to its target and reducing the risk of run-off (Gay *et al*., 2009). However, the need for expensive equipment and the lack of training are barriers to the wider implementation of this practice.

When storing slurry for application in safe periods it should be kept in secure, covered containment, preferably located away from water courses to avoid potential pollution events. Secondary uses of excess or stored livestock wastes should be considered, such as bio-energy production.

6.4.2 Appropriate Crops and Cropping Techniques

Crop Rotations

Alternating the main productive crop with crops which provide greater protection to the soil when susceptible to increased rainfall reduces run-off and increases soil organic matter content. Alternating humus producing and depleting crops within the rotation reports a positive effect upon soil organic matter whilst also contributing to weed control and reductions in plant disease and insect pests (Gay *et al*., 2009).

Cover Crops

Cover crops are sown after the main crop before winter, and reduce soil erosion and nitrate leaching by covering soil that would otherwise be left bare, and by providing root systems to maintain and improve soil structure. The residues of the cover crop also increase soil organic matter and provide an additional source of nitrogen for the following crop regime, as well as mitigating contamination through nitrate leaching by taking up residual nitrates in the soil (Gay *et al*., 2009).

Cover crops should exhibit slow growth during the development of the main crop and rapid growth following harvest. They should survive winter conditions and the mineralisation of nutrients during their decay should be suitable for the main crop (Kirchmann and Thorvaldsson, 2000).

Box 3: Case example – cover crops

A LIFE project (LIFE00 ENV/E/000547) performed between 2001 and 2004 to assess the effectiveness of cover crops in mitigating erosion in orchard crops in the Doñana National Park Area, Spain, reported reduced erosion rates in the majority of its thirty-three test sites. In total, an estimated 345,000 tonnes of soil erosion was prevented by the installation of the cover crops. Considerable improvements in the overall soil structure of sloping terrain were reported, along with associated improvements in water quality as a result of reduced chemical run-off due to increased soil retention. Vegetation cover was also highlighted as beneficial for pest control, which has potential benefits for sustainable food production. The beneficiary of the project, the Asociación de Jóvenes Agricultores de Sevilla (ASAJA), considered that the technique could be applied successfully in most of Europe's orchard-growing areas.

For more information, see http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s_ref=LIFE00%20ENV%2FE%2F000547&area=2&yr=2000&n_proj_id=1912&cfid=615886&cftoken=9524bd1657ba64b1-4296ACA0-D094-91A4-87343BEAAEFE045A&mode=print&menu=false%27)

Intercrops

Intercrops can reduce erosion and increase the nutrient and organic matter content of soils.

Intercrops are planted between the rows of the main crop, providing extra coverage of the soil surface and root systems beneath, reducing the speed of overland flow and the mobility of soil particles, hence limiting soil erosion. As these "green manure" species grow they also fix nitrogen from the air, increasing soil fertility (Gay *et al*., 2009). As with cover crops, intercrops such as lupines, mustard and clover may be harvested for fodder or extra income, or ploughed into the soil to further increase organic matter.

A potentially more cost-effective solution is to "undersow" crops with grass, as grass species are considered to use less seed than intercrops such as those listed above (Gay *et al*., 2009).

Changing Crop Varieties and New Crops

The SoCo Project (2009) reports new varieties of maize in the United Kingdom and of winter wheat in Belgium, which mature quicker and therefore can be harvested earlier when soil moisture conditions should be more favourable. Greater protection against run-off and an increased build-up of organic matter can then be provided for the soil over winter through the application of one or more of the techniques described below, providing a good example of agricultural solutions working in concert to address multiple soil degradation processes. It could be envisaged that Genetic Modification of crops might in future further aid this adaption of new crops to address soil and land degradation challenges. This might encompass the adaption of crops to improve soil cover, augment organic matter during growth e.g. in the case of legumes or require less water or different hydrological needs enabling reductions in irrigation.

6.4.3 Tillage Techniques

Reduced Tillage

Reduced tillage is reported to decrease the risks of soil erosion, soil compaction, and declining soil organic matter. Soil structure and its water infiltration capacity are improved by tilling the soil less frequently and/or at a shallower depth than conventional tillage, and the risk of compaction decreases as trafficking by machinery is reduced. Effectiveness may depend on the combination of the practice with the use of cover-, inter- or undersown crops, the characteristics of the cropping system and the underlying soils (Gay *et al*., 2009).

Case studies conducted in a number of countries across Europe as part of the SoCo project (2009) reported decreased soil erosion and compaction in Germany and Spain, as well as equivalent or higher yields than those under conventional tillage, and favourable reductions in fuel, equipment and labour costs to farmers, which help to drive uptake.

The practice is primarily applied to maize crops, but also rapeseed, for which it is considered most favourable under wet conditions. In addition, long-term studies have shown that intensive tillage can reduce water infiltration and carrying capacity rates in the Guadalentín basin’s almond permanent crop systems in southern Spain and therefore have increased the interest in reduced tillage as a solution to erosion and compaction.

No-tillage/Direct Drilling

Soil experts interviewed for the SoCo project (2009) suggest that no tillage has the advantage of nearly permanent soil coverage leading to decreased soil erosion and the reduction of nutrient loss from leaching and run off. No tillage again saves time and fuel, and yields remain consistent, although reductions in root crop yields are possible (Gay *et al*., 2009). Direct drilling provides the same benefits, using specific tilling machines to sow directly into undisturbed soil in which seed was sown.

Box 4: Case example – no-tillage and cover crops

The Erosion-Productivity Impact Calculator (EPIC) (Williams, 1995) modelled the potential EU-wide environmental benefits of adopting no-tillage and cover crops, using examples of two crops (barley and non-irrigated maize).

EPIC produced the following results (summarised in Gay *et al*. (2009)):

- In comparison with conventional tillage, no-tillage can make an effective contribution to the reduction of erosion across Europe;
- Most of the benefit (between seven and twenty-three% reduction of erosion) is achieved in France, northern Italy, central Europe, Portugal and south-east Spain;
- Southern regions benefit most from the introduction of cover crops;
- Cover crops are generally an effective means of reducing erosion in non-irrigated maize;
- A trade-off may exist between reduced erosion rates and increased water stress when using cover crops in water-limited environments.

Contour Tillage and Planting Row Crops in line with Contours

Reduced tillage practices often appear beneficial on flatter land or on slopes of limited angle at low risk from water erosion. They will, however, offer limited protection on slopes of a significant gradient or where higher risk crops such as maize are grown. Ridge and contour tillage systems reduce the vulnerability of soils particularly susceptible to overland flow and erosion, and small earth barriers within the ridges can be created with specialised machinery to stem the flow of water and particulate matter (Gay *et al*., 2009). These practices require careful planning as the risk of erosion and landslides may be increased if misplaced relative to an area's topography.

Conservation Agriculture

Conservation agriculture is a holistic management system incorporating no-tillage, reduced tillage, cover crops and crop rotation.

The implementation of this approach may require significant capital investment (e.g. in sowing machines) and training. Furthermore, reservations are commonly expressed over conservation agriculture and the practices of reduced- and no- tillage, regarding the perceived need for increased herbicide inputs to combat weed growth.

Box 5: Case example – conservation tillage

The LIFE project "SOWAP" (Soil and Water Protection - LIFE03ENV/UK/000617) investigated soil and surface water protection using conservation tillage in northern and central Europe, between 2003 and 2006.

The SOWAP project concluded that conservation tillage could reduce soil erosion by up to ninety-eight% and that soil structure and function were improved, reporting higher levels of soil carbon, nitrogen and soil moisture. Conservation tillage was also shown to reduce water run-off by as much as ninety%, although results were not as consistent as those for soil erosion as location and crop types had a significant effect on success. The effective reduction of nutrient losses was also significant.

For more information, see http://www.sowap.org

6.4.4 Machinery Adaptations and Adjustments

Adjusting Machine and Wheel Sizes and Pressures

Larger vehicles reduce the number of tramlines and the number of repeat trips made with trailers for harvested crops. Adapting tyre pressures and increasing wheel size spread machinery loads and pressure on the land. The SoCo project (2009) reported these practices as almost universally effective methods of reducing soil compaction and consequently run-off and erosion.

Costs of new tyres and the impracticalities of time and labour in checking and maintaining tyre pressures are considered barriers to uptake, which is consequently low (Gay *et al*., 2009).

Controlled Traffic Tramlines

High-technology GPS equipment is used to restrict machinery movements along very precise lanes, preventing widespread soil compaction by concentrating compaction to these "tramlines" only.

There is some evidence that this approach is effective, however it is not widely applied due to the high initial costs of machinery and technical equipment, and it is often seen as an option only for large farms (Gay *et al*., 2009). The ability of GPS to provide accurate guidance under different weather conditions is refuted by experts.

6.4.5 Maintenance of Landscape Features

Maintenance and Management of Landscape Features

Farmland features help to protect against soil erosion, decline in organic matter and biodiversity, and landslides.

Trees, woody linear features, walls and terraces can all help to prevent landslides across run-off and erosion pathways (Pretty, 1998), and increase soil infiltration rate and capacity. However, with features such as walls and terraces, their capacity to prevent landslides depends on sustained management and is soon lost if management ceases (Poyatos et al., 2003).

The range and level of benefits provided by farmland features are influenced by many factors, including their size, context and position, which must be considered in relation to agronomic and climatic factors, and the management and/or disturbance of the feature and its surrounding land (Farmer *et al*., 2008).

Buffer Strips

Buffer strips contribute to an improvement in the quality of watercourses by improving soil structure and increasing soil infiltration rate, reducing the flow of agricultural run-off. This action has particular relevance to reducing pollution and eutrophication in water courses. Buffer strips allow leguminous plants to flourish, and help to boost soil fertility and organic matter (Farmer *et al*., 2008).

Patch Features and Afforestation

Maintaining or installing fallow, common, or unutilised agricultural land, and the practice of targeted afforestation, can all help to improve soil biodiversity, organic content and soil structure, which in turn can help to prevent run-off and soil erosion due to increased filtration and prevention of surface capping (Pretty, 1998).

6.4.6 Water Management

Drainage

The effective installation and maintenance of drainage systems can reduce water logging in areas of high rainfall or soil water content, leaving soil less vulnerable to compaction and erosion and salinisation.

Box 6: Case example – drainage as a solution to salinisation

In Belozem, Bulgaria, an extensive state-sponsored drainage and irrigation system installed in the 1960s produced a considerable reduction in soluble salt content in the soil after 3-4 years, and a large part of the land surrounding the village was reclaimed.

About 1,500 hectares of land were irrigated by this system, however following the agrarian reform and land restitution of the 1990s, the irrigation system fell into disrepair. The groundwater table often rises above the critical level and poses a considerable threat that salinisation will revert to previous, serious levels.

For more details, see Gay et al. (2009)

Drip Irrigation

In the arid and semi-arid regions of Europe, efficient irrigation systems are crucial to avoiding water loss through evaporation, and to ensure scarce water is delivered directly to plant roots. If irrigation cannot be avoided, drip irrigation is widely considered to be the method of delivering water in the most efficient, targeted way (Gay *et al*., 2009; Holtz, 2007; Kirchmann and Thorvaldsson, 2000).

Irrigation water must be salt-free to avoid intensifying the effects of salinisation, and methods for recycling wastewater for agricultural use are being explored. Kirchmann and Thorvaldsson (2000) consider that water in areas of scarcity should preferably be used to support a biomass of high economic value, and low value biomass should be produced where there is a plentiful supply.

6.5 The Limitations of Agricultural Solutions

Clearly, when crops and cropping systems are identified as high-risk in terms of land degradation, agricultural solutions should be pursued. However, the crops and practices known to exacerbate the degradation effects are often maintained in production for reasons of:

- Short-term profitability;
- Tradition and social norms;
- Limited skills and information;
- Lack of access or funds for investment in training or machinery; and
- Lack of investment in infrastructural projects such as irrigation and drainage systems.

Furthermore, agricultural and environmental policy can act as a driver for the provision of agricultural solutions to land degradation, through the regulation of farming practice; incentivisation and funding for beneficial farming practice and capital goods such as machinery; and the provision of advisory services.

6.6 Conclusions – Appropriate Agricultural Solutions

Agricultural production exerts pressure over an extensive are of land in Europe. While good practices can protect Europe's soils, often agricultural production results in a range of complex, and often interacting, degradation processes. This pressure and the risk to degradation will be intensified by climate change and increasing water scarcity.

Importantly, however, there are a large number of different actions that can be undertaken by farmers to improve the health of their soils either limiting, preventing or even reversing degradation processes. Agricultural solutions to land degradation are not always mutually exclusive and may prove most effective when applied in concert. Similarly, they may be used to address a particular degradation process. It is clear that solutions must be applicable to specific climatic and agronomic factors, and that careful consideration of these factors is necessary to ensure their success in mitigating or preventing land degradation. However, many of the solutions listed in section 3 have been reported as successful across the different regions of Europe.

Reducing the intensity of management and the appropriate application of inputs are generally recognised as solutions to reduce soil erosion, soil compaction and agricultural run-off, across a range of farming systems. The choice of appropriate crops and cropping regimes, and the use of cover and intercrops, have been shown to improve soil structure, biodiversity, fertility and organic matter content in arable systems, and case study examples of the holistic management system of conservation agriculture have reported reduced erosion and water run-off rates, improved soil structure and function, and higher levels of soil carbon, nitrogen and soil moisture.

New technology provides solutions with reported success such as controlled traffic tramline farming. Access and funds are required for the installation of often expensive equipment, however solutions such as drip irrigation to provide efficient water provision to Mediterranean crops are crucial to mitigate serious risks of degradation and desertification.

The IAASTD (2008) considers that traditional and local knowledge has had extensive, positive impacts on land degradation, and that participatory collaboration in knowledge generation, technology development and innovation has been shown to add value to science-based technological development in soil and water management. Traditional and local knowledge on the applicability of crops and farming techniques should be shared within communities and across regions of similar agronomic and climatic conditions.

It is often easier to identify the systemic cause of local or point land degradation processes and the most appropriate agricultural solution, than it is for diffuse processes such as organic matter decline and water pollution; and the range of limitations of agricultural solutions provide barriers to effective uptake. These are some of the inherent difficulties facing the task of reducing land degradation by agricultural practice.

7 EUROPEAN POLICY ADDRESSING THE LAND DEGRADATION CHALLENGE

7.1 Introduction to EU Policy Measures

Land degradation results from a broad array of anthropogenic induced processes both direct i.e. the addition or amelioration of the land surface, its hydrology and its soil or by the indirect deposition of material conveyed by other media i.e. via air and water sources. Land degradation can also conversely result in the impacts upon other environmental media. As a consequence there is a vast array of EU legislation that deals, predominantly indirectly, with land degradation processes.

EU requirements and policies impact upon the use of land via requirements and funding promoting certain agricultural management practices, the placing of management considerations on the industrial sector in terms of pollution prevention and rules regarding appropriate waste management and control. Moreover EU legislation can indirectly protect soils. Measures promoting water quality and quantity requirements can both reduce inputs from water onto land and restrict inputs to water via land based contamination and sedimentation – leading to better management approaches. The same principles apply to air quality.

The following section presents the array of different EU policy measures that exist, categorised by sectoral categories, which have a relevance to land degradation. The specific land degradation processes to which each measures relates is set out. In addition, a brief summary of implementation approaches within the EU is set out. Policy areas of interest include:

- Agriculture and rural development;
- Forestry;
- Water;
- Pollution prevention and control – encompassing air pollution and waste management;
- Soil; and
- Strategic environmental policies.

There will be considerable variability in policy approaches to address land degradation across Europe. Different Member States also operate their own array of national measures within these different fields, importantly also including more detailed requirements on land use planning (an area of limited EU competence). In addition, the Member States interpret and implement EU measures differently depending upon their existing national legislation, local cultural and environmental conditions.

7.2 Understanding Existing EU Initiatives

The table below presents the policies and legislation already in place within the EU that impacts upon land management and therefore land degradation processes.

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Agriculture and rural development			
Habitats Directive (92/43/EEC); Birds Directive (79/409/EEC); Natura 2000.	Avoiding pollution and the deterioration of agricultural soils are implicit preconditions for the protection or recovery of habitats and species under both of these Directives. Natura 2000 is an ecological network of nature protection areas comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and Special Protection Areas (SPAs) under the Birds Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats, and therefore protects these areas at risk of land degradation and desertification.	Protecting designated areas from agricultural intensification or deforestation; Where there is effective implementation it may help to prevent: - Declining soil biodiversity, fertility and organic matter content; - Soil contamination; - Soil erosion; - Soil compaction; - Soil sealing.	EU-27. Member States must provide a report every six years on the implementation of the Habitats Directive, and every three years on the Birds Directive.
Council Regulation 1782/2003/EEC – Article 5 – Cross-compliance GAEC standards	Farmers claiming direct payments through the SPS and SAPS are obliged to maintain all agricultural land in good agricultural and environmental condition. This entails compliance with standards relating to soil protection, maintenance of soil organic matter and soil structure, as defined by Member States.	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	EU-27. Conditions are established mostly at the national level (or regional in federal Member States) under headings set out in Annex IV of Council Regulation N° 1782/2003,
Council Regulation 1782/2003/EEC – Article 5 – Cross-compliance requirement to maintain permanent pasture	Member States are required to ensure that land which was under permanent pasture at the date provided for the area aid applications for 2003 is maintained under permanent pasture. (1 May 2004 for New Member States and 1 January 2007 for Bulgaria and Romania).	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	EU-27.

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Council Regulation 1782/2003/EEC – Article 4 - Cross-compliance SMRs	The Statutory Management Requirements (SMRs) strengthen the enforcement and control of 19 EU Directives relating to the areas of the environment, public health and animal health and welfare, as listed in Annex III of Council Regulation 1782/2003.	In reinforcing the implementation of EU Directives, SMRs potentially (or indirectly) target: Declining soil biodiversity, fertility and organic matter content; Soil contamination; Soil erosion; Soil compaction; Soil sealing.	EU-15 plus Malta and Slovenia. In the new Member States applying the "Single Area Payment Scheme" (SAPS), only GAEC standards and the permanent pasture requirement are mandatory. In the other new Member States where the SPS or other CAP direct payments are operated, Cross-compliance applies fully[6].
Council Regulation on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs (2092/91/EEC)	Annex I to the Regulation specifies the principles of organic production for plants, livestock (cattle, pigs, sheep, goats, horses and poultry) and bees, and all products thereof. Annex II explains which substances may be used as pesticides, soil fertilisers, feed and detergents for animals, along with any exceptions.	Soil and water contamination; Declining soil biodiversity, fertility and organic matter content; Soil erosion; Soil compaction.	EU-27. Regulations only apply to land which is farmed organically.
Council Regulation on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (EC) No 1698/2005. Agri-environment Schemes (under Axis 2)	Incentive payments for protecting the environment and conserving the rural landscape beyond the baseline level stipulated by Cross-compliance. Measures are chosen from a menu and may specifically address land degradation risks through support for practices such as extensification and organic farming, although the extent of which varies across Member States.	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	EU-27. Compulsory for Member States to introduce agri-environment schemes within their Rural Development Plans (2007-2013).

[6] The timetable for the implementation of SMRs in the other Member States is spread out between 2009 and 2011 for the EU-10 (minus Malta and Slovenia) and between 2012 and 2014 for Bulgaria and Romania (European Court of Auditors Special Report No 8/2008 (2008) (pursuant to Article 248(4), second subparagraph, EC) *is cross-compliance an effective policy?* ECA, Luxembourg).

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Council Regulation on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (EC) No 1698/2005. Less Favoured Area Measure (under Axis 2)	Financial support for maintaining the countryside in areas where agricultural production or activity is more difficult because of natural handicaps, for example difficult climatic conditions, steep slopes in mountain areas, or low soil productivity. LFA payments are granted annually per hectare of utilised agricultural area. Beneficiaries are required to farm for at least five years from the first payment and to farm a minimum area under eligibility criteria, both fixed at the Member State level.	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	Implemented in all EU-27 Member States, however it is not a compulsory measure, and payments are not provided for all farms in the designated LFA zones.
Council Regulation on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (EC) No 1698/2005. Afforestation measures (under Axis 2)	Payments are made to support, sustain, and avoid land abandonment in forested areas and holdings, and for afforestation and the establishment of agroforestry systems through compensation payments for establishment maintenance, and loss of income.	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	EU-27.
Council Regulation on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (EC) No 1698/2005. Farm modernisation (under Axis 1)	Measures under Axis 1 can provide farmers with training courses and demonstrations on the sustainable management of natural resources, or the results of new research and technology; funds for investment in machinery and infrastructure; cooperation with the development of new technologies and techniques; and support for food quality schemes, all of which may be used to improve production techniques and the management of farm waste.	Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil and water contamination.	EU-27. The applicability of farm modernisation measures depends on the Member States' choice of available measures.
Training and advice	Measures can be used to develop training courses and provide demonstrations for farmers which could be used to improve understanding of management practices needed to reduce land degradation. Such measures are often associated with incentive-based schemes and payments.	Agricultural land abandonment; Desertification; Forest fires; Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content.	Potentially applicable across the EU-27.

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Forestry			
EU Forest Action Plan - COM(2006) 302 final	The Action Plan focuses on four main objectives: to improve long-term competitiveness; to improve and protect the environment; to contribute to the quality of life; and to foster coordination and communication. Eighteen key actions are proposed by the Commission to be implemented jointly with the Member States during the period of five years (2007–2011).	Agricultural land abandonment; Desertification; Forest fires; Associated risks to: Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content.	EU-27. The Action Plan provides a framework for forest-related actions at EU and Member State level, serving as an instrument of coordination between EU actions and the forest policies of the Member States.
Water			
Water Framework Directive (2000/60/EC)	The implementation of the WFD is a priority in order to address mismanagement of water resources with the objectives of preventing and reducing pollution, promoting sustainable water use, protecting the aquatic environment, improving the status of aquatic ecosystems and mitigating the effects of floods and droughts. The WFD has the flexibility to develop specific drought management plans in relevant river basins.	Water and soil contamination; Associated risks to: Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content.	EU-27. By December 2009, Member States are to publish River Basin Management Plans and programmes of specific measures to meet quality standards. The Directive requires action to monitor state authorities up to 2015.
Nitrates Directive (91/676/EEC)	Designed to protect the European Community's waters against nitrate pollution primarily arising from the application and storage of inorganic fertiliser and manure from agricultural sources. It requires Member States to designate “Nitrate Vulnerable Zones” where there is significant nitrate concentration found in fresh water. One or more action programmes are to be set up in each Member State and codes of good agricultural practice apply, limiting the total quantity of nitrate in manure applied to the land. The Directive also promotes beneficial cropping techniques such as rotations and winter cover.	Water and soil contamination; Associated risks to: Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content.	EU-27. Implementation is ongoing in all new Member States, for whom action programmes are now established. Three out of ten new Member States (Malta, Slovenia and Lithuania) took a “whole territory approach”, implementing an action programme on the whole territory, in addition to seven of the EU 15 (Austria, Denmark, Finland, Germany, Luxemburg and the Netherlands, Ireland).
Groundwater Directive (80/68/EEC)	The purpose of this Directive is to prevent the discharge of certain toxic, persistent and bioaccumulable substances into groundwater. Two specific lists of substances are set out – those on list I are prohibited and list II are limited.	Soil and water contamination; Infiltration.	EU-27. Implementation reports produced

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Flood risk management Directive (2007/60/EC)	This measure requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. Member States are required to develop flood management plans taking account of land use, water and soil management.	Hydrological flows – speed of overland flows; Soil erosion.	EU-27. National flood management plans to be produced
Addressing the challenge of water scarcity and droughts in the European Union (COM(2007)414)	This Communication represents an initial set of policy options to increase water efficiency and water savings. It highlights the importance of land use planning and the better management of river catchments.	Hydrological flows – speed of overland flows, infiltration and soil water storage capacity	Communication, setting out policy options for the future
Pollution prevention and control			
Integrated Pollution Prevention and Control Directive (2008/1/EC)	This measure requires industrial and agricultural activities with a high pollution potential to have a permit. This permit can only be issued if certain environmental conditions are met, so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause. The permit includes provision to operate in line with best available techniques, to return the site to its original state once the activity is over and specifically highlights the need to set requirements in relation to soil, water and air protection (among others).	Contamination of land – direct and indirectly via air and water sources	EU-27
National Emissions Ceilings Directive (2001/81/EC)	This measure sets ceilings for the emissions of four key pollutants: Sulphur Dioxide (SO^2), Oxides of Nitrogen (NO^x), Volatile Organic Compounds (VOCs) and Ammonia (NH^3). The purpose of the Directive is to combat damage from acidification, eutrophication and the formation of ground-level ozone. It sets upper limits for the total emissions in 2010 of the aforementioned pollutants.	Contamination of land via air pollutants – acidification and eutrophication	EU-27 Member States set national targets to be achieved via national measures
Large combustion Plants Directive (2001/80/EC)	This Directive aims to reduce emissions of acidifying pollutants, particles, and ozone precursors. It specifically sets emission limit values for SOx, NOx and dust.	Contamination of land via air pollutants – acidification and eutrophication	EU-27 Plant greater with a thermal input is equal to or greater than 50 MW

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Plant Protection Products Directive (91/414/EEC)	This Directive regulates the authorisation, placing on the market, and use and control of plant protection products in agricultural and commercial use.	Soil contamination; Declining soil biodiversity, fertility and organic matter content.	EU-27. Authorisation of a product is granted by the Member State on whose territory the product is placed on the market for the first time, and the Directive provides for mutual recognition of authorisations across Member States, provided plant health, agricultural and environmental conditions are comparable.
Sewage Sludge Directive (86/278/EEC)	Regulates the use of sewage sludge on agricultural land, by limiting and restricting applications in such a way as to prevent harmful effects on soil, vegetation, animals and man. To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil.	Soil and water contamination; Declining soil biodiversity, fertility and organic matter content.	EU-27. Member States fix the periods for which the use of sewage sludge is prohibited on agricultural land, and report every four years on the use of sludge in agriculture.
Waste framework Directive (2006/12/EC)	Requires Member States to take the necessary measures to ensure that waste is recovered or disposed of without endangering human health and without using processes or methods which could harm the environment. In particular this should be carried out without risk to water, air or soil.	Contamination of land and water	EU-27. New measure to be implemented in Member States
Landfill Directive (99/31/EC)	The Directive's objective is to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills and preventing/reducing the adverse effects of the landfill of waste on the environment, in particular on surface water, groundwater, soil, air and human health. Requirements are set for the acceptance of waste to landfills, their management during use and provisions for after care/remediation.	Contamination of land and water	EU-27.

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
Mining Waste Directive (2006/21/EC)	This Directive applies to waste resulting from the extraction, treatment and storage of mineral resources and the working of quarries. Sets specific requirements upon waste management of mining waste, which has proved particularly hazardous in the past – prevention contamination of the land and water supplies. Focus on preventing major accidents and hazards resulting from this material.	Contamination of land and water	EU-27.
Soil			
Thematic Strategy for Soil Protection (COM(2006)231	Strategy sets out the model for an European approach to soil protection, including identifying key threats to soil quality in Europe. The strategy explains why further action is needed to ensure a high level of soil protection, sets overall objectives and explains what kind of measures must be taken. It establishes a ten-year work program for the European Commission. This is complemented by a proposal for a new framework Directive on soil protection, which is currently being debated under the codecision process.	Soil erosion; Soil compaction; Soil biodiversity; Soil salinisation; Decline in organic matter; Soil sealing.	Strategic principles but no binding requirements Complemented by the proposed framework Directive on soil protection
Strategic Environmental Requirements			
EU Sustainable Development Strategy (SDS) European Council DOC 10917/06	The EU SDS sets out a single, coherent strategy on how the EU will more effectively live up to its long-standing commitment to meet the challenges of sustainable development. The strategy sets overall objectives and concrete actions for seven key priority challenges for the coming period until 2010: Climate change and clean energy; Sustainable transport; Sustainable consumption & production; Conservation and management of natural resources; Public Health; Social inclusion, demography and migration; Global poverty and sustainable development challenges.	Soil and water contamination; Soil erosion; Soil compaction; Declining soil biodiversity, fertility and organic matter content; Soil sealing.	EU-27. The strategy proposes mechanisms for improving the coordination with other levels of governments and calls upon business, NGOs and citizens to become more involved in working for sustainable development[7].

[7] http://ec.europa.eu/environment/eussd/

Policy / Programme	Description	Land Degradation Processes Targeted by the Policy / Programme	MS Implementation
EIA Directive (97/11/EC)	Directive on the assessment of the effects of certain public and private projects on the environment, amending Directive 85/337/EEC. The EIA procedure ensures that environmental consequences of public and private projects are identified and assessed before authorisation is given. The public can give its opinion and all results are taken into account in the authorisation procedure of the project. Direct and indirect effects of a project on the following factors are considered: human beings, fauna and flora; soil, water, air, climate and the landscape; material assets and the cultural heritage.	Soil sealing.	EU-27. Member States set the mandatory levels of EIA for projects.
Liability Directive (2004/35/EC)	Sets out rules related to liability for environmental damage affecting habitats and species, damages to water or land. Requires that the polluter be held liable for damage and that damage be remediated. Fundamentally important in terms of providing an infrastructure for the remediation of land and resources to combat land degradation.	Land and water degradation	EU-27

7.3 Future Policy Developments

Into the future there are several key legislative measures under development that may offer alternative policy basis for addressing the protection of land and the limitation of soil degradation. This includes the finalisation of the new Directive on soil protection and the new recast proposal on industrial emissions – the potential impacts of which are outlined below. In addition there are a number of policy priorities whose focus is ancticipated to alter in the coming decade including the evolution of agricultural priorities, an increase in attention given to water quantity and the evolution of efforts on climate adaptation. All of these will influence the use of land in Europe.

Existing Legislative Measures to be Adopted

- *New Directive on soil protection* – Currently this proposal for a framework Directive remains under debate within the co-decision process. While the first reading opinion has been adopted by the European Parliament, progress has been stalled by objections from specific Member States regarding the implementation costs. If adopted in its current form the measure would require Member States to better map areas at risk of soil degradation or priority areas for action. In addition, specific requirements are set out in particular related to contamination and sealing. This would be the first legally binding EU measure specifically devoted to soil and land degradation.
- *The new proposal for a Directive on industrial emissions* – This proposed measure would recast and amalgamate seven existing EU measures on industrial emissions. This will replace Directives including importantly the IPPC Directive and the large combustion plants Directive. This measure is aimed at streamlining protection of the environment from industrial emissions including to water, air and land. Importantly, the measure also strengthens the importance of the protection of soils and groundwater linked to contamination.

Anticipated Evolutions in Policy Priorities

- *Evolution of agricultural priorities* – Within the agricultural system it is anticipated, over coming years, that pressure towards intensification will continue. This is anticipated to be the consequence of a confluence of drivers including the liberalisation of agricultural policies, the continued high level of commodity prices and restructuring in new Member States pushing more extensive systems towards intensification. Moreover pressures in terms of competition for land is increasing, traditional agriculture is faced by pressure from the production of biomass for alternative uses from energy to plastics, demographic change and urban expansion and the pressure to feed an expanding population with evolving dietary needs. Intensification can be linked to many of the land and soil degradation processes identified in the agricultural system, and therefore unless alternative and improved mechanisms for dealing with land and soil issues across all land uses are developed, problems might be anticipated to increase.
- *Increasing prioritisation of water quantity issues* – The debate on the quantity of water available to meet our needs looks set to increase in profile. Hydrological flows over the land, infiltration rates and retention capacities of the soils are integrally linked to the debate on the availability of water. Degradation of land linked to sealing by urban uses or inappropriate management practices in rural areas will increasingly come under pressure as we attempt to ensure that water remains available for our needs, and that extreme rainfall events (predicted to become more frequent and unpredictable linked to climate change) do not result in increases in flooding and destruction.

- *Increasing importance of land management in mitigating and adapting to climate change* – The need for rapid and decisive action to combat climate change and adapt to the associated consequences we are already seeing, is paramount. This will be of importance to the debate on land degradation. Firstly the degradation of soils can lead to emission of significant quantities of greenhouse gas emissions. We are beginning to see an increase in the profile of this among policy makers, primarily as a consequence of the debate over biofuels and associated land use change. This issue would be anticipated to increase in profile and importance across the land use sphere and within agricultural polices. Moreover, adaptation to climate change will become a debate of increasing importance and priority, linked to that on water scarcity and availability. Degraded soils offer less flexibility in terms of adaptation and less resilience to unpredictable climate conditions. The importance of high quality and land conditions is likely to increase as we begin to live in a more unpredictable world.

7.4 Monitoring Policy Effectiveness and Implementation – the Use of Indicators

Land degradation is notoriously difficult to monitor due to the complexity of soil as a medium, and the linkages to other environmental elements such as water and air emissions. Indicators have a particular role in attempting to identify land and soil degradation risk areas and targeting policy measures appropriately. Given the underlying complexities linked to the local nature of soil problems based upon its properties interacting climatic and topographic factors, efforts to date have largely focused upon the mapping of underlying natural conditions, land cover patterns and as a consequence land degradation risk factors.

At the European level the Corine land cover mapping exercise, developed by the European Topic Centre on land use and spatial information, identifies land use and land use change across Europe. Based on 44 different land use classifications, Corine provides basic input to European risk maps such as for erosion, land contamination and soil sealing linked to urban sprawl (ETC, 2000). European specific tools such as Corine have been complemented by global work by the Food and Agriculture Organization of the United Nations (FAO). For example maps of national soil degradation across the globe have been produced using information from the GLASOD survey (FAO online tool) during the 1980s. FAO maps link natural characteristics of the land to other factors such as population number to develop an assessment of land degradation risk.

More specific indicators of land quality are produced by the European Environment Agency (EEA 2007), however, to date specific measures tend to focus on those threats that prove easiest to estimate based on land use and natural condition. For example, the EEA has several measures related to contaminated sites including an overview of contamination affecting soil and groundwater in Europe, the management of contaminated sites, estimated allocation of expenditure for management of such sites and progress in management of such sites across Europe. Within this there are also assessments specifically of the acidification and eutrophication of land (EEA online tool). These contamination indicators are complemented by assessments based on land take and land use change linked to agricultural, forestry, semi-natural, natural systems and urban development (EEA, 2005). These demonstrate the level of shift in land take by urban and other artificial land development, indicating the changing pressures placed upon land in Europe and as a consequence the different degradation threats.

Within the agricultural indicators arena, a separate array of potential indicators exists for measuring land degradation. Within the OECD's work on agricultural indicators, two indicators linked to land degradation are highlighted as of importance (OECD, 2001). These are the risk of water erosion and risk of wind erosion. These assessments are based on the combination of information on the inherence vulnerability of soils, their use and management. At the European level, the EEA holds indicators such as the level of organic farming in different EU Member States. The prevalence of certain land management practices, such as organic farming, can be used as a proxy indicator of land quality however importantly there is not necessarily a one-to-one relationship between certain management practices and good quality land. For example organic farming has been used as an indicator in the past. However, many experts note that what is actually important is managing land in line with the inherent properties of the soil, climate and topography. A badly managed organic farm may also lead to equally devastating soil erosion.

In conclusion there have been attempts to develop indicators to monitor land degradation characteristics. Following massive, data intensive exercises these have succeeded in providing an information base, mapping the land use, soil conditions and risk factors at a high level; providing a broad picture of risk. Separately there have been exercises looking at specific land degradation problems, but typically those with the clearest causal relationships, i.e. contamination and erosion. There is no indicator that combines all the multiple pressures that impact on land to provide an overview of land degradation risk. Importantly there are no clear indicators in place for the more subtle but important land degradation processes such as organic matter loss or soil biodiversity loss. There is much work to be completed in this arena before a clear picture of all these processes can emerge to inform policy making and implementation.

7.5 Conclusions – EU Policy Protecting Land and Mitigating Degradation

Policy in the field of land degradation is vast but tends not to focus upon land degradation as its primary priority. Measures predominately are directed at water protection, air pollution, maintenance of broad environmental conditions on agricultural land or high level policy for environmental protection. There is still a lack of an EU measure bringing together soil and land degradation concerns and integrating action. This means that the complex benefits and services associated with high quality land and soils are often not adequately prioritised and preserved. The most proactive and concerted action to date, as in many fields, has been to address point source land contamination within the industrial and waste sectors. The implementation of the water framework Directive, is also anticipated to have significant impact going forward, especially upon soil erosion. Agricultural policy action, has the potential to be significant. Action to date, however, has been relatively unfocused upon soil and land protection and instruments insufficient.

While the combating of degradation processes by other routes can be useful; the lack of the primary prioritisation of land issues can lead to suboptimal solutions. For example, the water framework Directive is anticipated to be a powerful tool with incentives to prevent eroded soils being transported into surface water courses. However, unless this measure is implemented from a land focused perspective, it can lead to solutions purely intended to protect the water courses and not retain soil resources and the utility of the land such as sediment traps.

Into the future land degradation issues are anticipated to shift up the policy agenda given the linkage to food production, water quality and importantly quantity and the importance of resilience in light of climate change. New policy approaches for protecting our land, especially perhaps the least visible functions i.e. organic matter, structure and drainage, will become a priority.

8 THE UN CONVENTION TO COMBAT DESERTIFICATION

8.1 An Introduction to the UNCCD

The 1992 United Nations Conference on Environment and Development (UNCED) called for the UN General Assembly to elaborate a Convention to combat desertification in countries experiencing serious drought and/or desertification, particularly in Africa. The resulting UN Convention to Combat Desertification (UNCCD) was adopted in June 1994 and entered into force on 26 December 1996, ratified by 50 countries. To date there are 193 Parties to the Convention.

The UNCCD aims to promote effective actions to combat desertification through action programmes and supportive international partnerships. Countries affected by desertification, land degradation and drought (DLDD) comply with the Convention through the development and implementation of national action programmes, as well as regional and sub-regional action programmes. According to the Convention, these programmes must adopt a democratic, bottom-up approach that enables local people to reverse land degradation through self help. Governments in countries affected by DLDD are responsible for producing this enabling environment through politically sensitive changes such as improving systems of land tenure and empowering women and farmers. All other Parties under the Convention are obliged to support affected countries by providing finance and facilitating the transfer of relevant knowledge and technology (UNCCD, 2005).

The Convention is managed by the **Conference of Parties (COP)**, a decision-making body, responsible for reviewing the implementation of the Convention. It meets every two years and is made up of national governments that have ratified the Convention as well as regional economic integration organisations, such as the European Union. The COP is assisted by its **Secretariat**, the **Global Mechanism (GM)** and two subsidiary bodies, namely the **Committee for the Review of the Implementation of the Convention (CRIC)** and the **Committee on Science and Technology (CST)** (UNCCD, 2008a). An overview of the UNCCD bodies and their role is provided in Box 7.

The following sections examine in more detail recent and anticipated future developments within the UNCCD. Specifically the role of the Parliamentarians' Round Table and its Steering Committee is examined, including the role of the European Parliament representatives within this format. The approaches to implementation of the UNCCD within the EU are then examined. This provides an overview and specific case examples from both the Mediterranean and Central and Eastern European regions.

Box 7: The UNCCD bodies

Conference of the Parties (COP): the COP is the supreme decision-making body and periodically reviews the implementation of the Convention. It meets every two years and, up to 2008, eight sessions have been held. It comprises ratifying governments and regional economic integration organizations, such as the European Union. Special provision is made for national and international agencies and qualified NGOs to participate in the COP, as NGOs in particular have played a prominent role in the Convention process through raising public awareness and lobbying. The main duties of the COP are to review reports from the Parties, which detail their activities to implement the Convention, and to make recommendations based on these reports. It also has the power to make amendments to the Convention or to adopt new annexes, as dictated by changes in global circumstances and national requirements.

Convention's institutions:

Secretariat: located in Bonn (Germany), the Secretariat provides services to the COP by arranging its meetings, preparing documents, coordinating with other relevant bodies, compiling and transmitting information, and facilitating consultations and other actions. It also provides assistance and advice to affected developing countries, in the compilation and communication of information required under the Convention.

Global Mechanism (GM): the GM helps the COP to promote funding for Convention-related activities and programmes. This mechanism was not conceived to raise or administer funds. Instead, the GM encourages and assists donors, recipients, development banks, NGOs, and others to mobilize funds and to channel them to where they are most needed. It seeks to promote greater coordination among existing sources of funding, and greater efficiency and effectiveness in the use of funds.

Subsidiary bodies:

Committee for the review of the Implementation of the Convention (CRIC): established after COP5, the CRIC assists the COP in regularly reviewing the implementation of the Convention. It considers reports from country Parties and observers, as well as information and advice from the CST and the Global Mechanism, draws conclusions and proposes to the COP concrete recommendations on further steps in the implementation of the Convention. The review is to be conducted along thematic lines decided by the COP. Its mandate and functions were renewed at COP7.

Committee on Science and Technology (CST): it provides the COP with information and advice on scientific and technological matters relating to combating desertification and mitigating the effects of drought using the most up-to-date scientific knowledge. It is multi-disciplinary, open to the participation of the Parties and composed of government representatives with relevant expertise. It reports regularly to the COP on its work, including at each of the sessions of the COP.

Source: UNCCD, 2008a

8.2 The State of Debate – UNCCD Recent Developments

8.2.1 Decisions taken at COP8 of the UNCCD, Madrid in 2007

The UNCCD COP 8 met on 3-14 September in Madrid. 28 decisions and 1 resolution were adopted. A comprehensive list of decisions is provided in Annex II.

Notably, the UNCCD adopted a **10-year Strategy** plan and framework ('The Strategy') to enhance the implementation of the Convention in 2008-2018 (decision 3/COP.8). The Strategy is meant to be a blueprint to reform the secretariat and the UNCCD's subsidiary bodies, and to guide the Convention stakeholders and partners for the next 10 years. It aims to forge a global partnership to reverse and prevent desertification and land degradation and to mitigate the effects of drought in order to support poverty reduction and environmental sustainability. Its mission is to provide a global framework to support the development and implementation of national and regional policies, programmes and measures, raising public awareness, standard setting, advocacy and resource mobilisation. The Strategy builds on a number of long term and short-medium term objectives, set out in Annex II.

The Parties to the UNCCD are requested to implement the Strategy and align their action programmes to its objectives. The progress made in the implementation will be reported at the ninth session of the COP (COP 9). The guidelines set up in the Strategy will then be translated into concrete work programmes by the UNCCD bodies – the CRIC, the CST, the Secretariat and the Global Mechanism.

Other relevant decisions taken include the **collaboration with the Global Environment Facility (GEF)** (decision 6/COP.8), which is meant to implement a Focal Area Strategy on Land Degradation, provide adequate financial resources, facilitate access to funds by affected Parties and simplify its funding procedures.

A number of decisions (7, 9 and 10/COP.8) focused on the **work of the Committee for the review of the implementation of the Convention (CRIC) –** whose mandate was renewed at COP8, and whose terms of reference will be revised at COP9. It was also decided that the seventh session of the CRIC was to take place in Istanbul in and was to be a special session on methodological matters to further advance the new 10-year Strategy.

Other decisions related to the **functioning of the Committee on Science and Technology (CST)** (especially decisions 12 and 13/COP.8). It was decided that the CST Bureau should hold at least one intersessional meeting per year to review the decisions taken by the COP and other related matters. In light of the new 10-year plan, the COP8 decided that each ordinary session of the CST should be organised in predominantly scientific and technical conferences-style format, focus non one specific topic at a time, develop recommendations on such priority themes and involve other organisations and institutions' expertise.

8.2.2 Developments since COP 8

Since COP 8, the UNCCD institutions and subsidiary bodies (Secretariat, GM, CST and CRIC) drafted their strategic plans and a two-year operational programmes. Furthermore, the UNCCD bodies met in a number of strategic meetings to discuss the COP follow-up and implementation of the 10-year strategic plan, namely:

- First Extraordinary Session of the COP – *New York, 26 November 2007*
- First UNCCD High-Level Policy Dialogue (HLPD) - *Bonn, 27 May 2008*
- Seventh Session of the CRIC (CRIC 7) and First Special Session of the CST (CST-S1) – *Istanbul 3-14 November 2008*

Summaries of the outcomes of these meeting can be found in Annex II.

8.3 The UNCCD Parliamentarians' Round Table and its Steering Committee

8.3.1 The Parliamentarians' Role in the Context of the UNCCD - Overview

The **Parliamentary Round Table/Forums** are held since 1998 in parallel with the ordinary COP sessions. The Round Table discussions offer a positive context for exchange of views and interaction between MPs on sustainable development issues as they relate to desertification, land degradation and drought. .

At Round Table 5 in 2003, a **Steering (Standing) Committee** was created to assure the follow-up of the different agreements adopted at the round tables. The body is composed of parliamentarians representing six geographical groups (Africa, Arab Countries, Asia/Pacific, Europe and Latina America and the Caribbean) plus an Inter-Parliamentary Union (IPU) representative. Its members are elected at every round table.

Round Table 5 also established a **Parliamentary network on the UNCCD (PNoUNCCD)**, "*a network of information, interaction and influence with the aim of increasing parliamentary involvement and efficiency in the fields of combating desertification, soil erosion and land degradation, of pooling information and of ensuring greater parliamentary input into international negotiations and organisations*".

The latest Forum, at its seventh session, met in Madrid (Spain) in 12-13 September 2007. About 60 parliamentarians participated, representing 40 countries and the European Parliament.

The parliamentarians' Declaration adopted at the Seventh Session of the Forum was presented at COP8, and included as an annex to the COP report (UNCCD, 2007a). The declaration raised concerns over the lack of strong achievements in the area of desertification. Parliamentarians also acknowledged the slow progress in the implementation of the Convention. They pointed out that many affected parties do not give high priority to land degradation in their development plans, do not promote sufficiently the mobilisation of financial resources, and deplored a general neglect of rural policy, linked to lack of peasant participation. Despite 97 national action programmes (NAPs) were developed, it was noted that their priority activities were not yet being carried out in practice. Furthermore, the role of parliaments appeared to be weak. In some cases their proposals were not followed by their respective governments and many of their commitments were not realised – including the promise to make better use of the UNCCD Parliamentary Network. In general, it was observed that the UNCCD suffered from insufficient political and public attention.

Parliamentarians hence called for implementing UNCCD issues into core development policy framework. Among concrete proposals, they suggested to recognise topsoil as a global public good, establish an International panel on desertification, a UNCCD peer-review mechanism, the publication of a regular '"green accounting'" government reports, the holding of Youth Summits, a Soil protection Prize, and the transformation of parliaments and their members into real agents of sustainable human development and desertification control. National governments were called to reinforce climate change policy, enhance international cooperation, ratify – if not already done – the Kyoto Protocol and combine sustainable development and water access with the deployment of renewable energies and other energy polices and rural development.

Greater commitments were sought on the part of parliaments and their members to, among others, strengthen national legislation and its harmonisation with UNCCD provisions, mobilise public opinion, mobilise financial resources, monitor actions taken by governments and build more partnerships with policy-makers, scientists, the private sector, and NGOs and community-based organizations. A better and increased use of the PNoUNCCD was also expected.

The Seventh Session of the UNCCD Parliamentarian Forum in Madrid also elected its new Steering Committee. The President is Hon Aristides Lima, from Cape Verde (Africa). Its members will be in place for a two-year term, until the ninth Parliamentary Forum scheduled at COP9 (UNCCD, 2007a).

8.3.2 Outcomes of the Steering Committee meeting in Cape Verde in December 2008

The Steering Committee of the Seventh UNCCD Parliamentarians' Forum met in Praia (Cape Verde) on 1-2 December 2008. Four members participated, including the Steering Committee President Aristides Lima, and Cristina Gutierrez-Cortines from the EU (UNCCD, 2008e).

The meeting focused on the measures taken by the UNCCD since the adoption of the Strategy, the outcomes of CRIC 7 and the CST Special Session, the role of Parliamentarians in the implementation of the Strategy and the alignment of planned activities to it, as well as on the program of work of the next UNCCD Parliamentarians Forum in 2009 at COP 9.

The steering committee members analysed the achievements and failures of the previous seven Parliamentary Round Tables/Forums. It particular, it was highlighted that the round tables had not proven to be front runner in formulating specific demands on desertification to the COP. Many commitments made by parliamentarians were not taken up and in some cases the initiatives taken were not given adequate visibility. It was also argued that sometimes the UNCCD Secretariat failed in taking up parliamentary inputs. (UNCCD, 2008e)

In developing a "to-do list", Parliamentarians agreed on a range of measures to help combat desertification and land degradation as well as mitigate the effects of desertification, land degradation and drought (DLDD) for lawmaking bodies. The UNCCD secretariat was invited to rely more on the parliamentary inputs. It was also suggested that IPU should take part in the works of the Parliamentary Forum and its Steering Committee and support the strategic objectives of the UNCCD Strategy., as well as integrated the PNoUNCCD into its own programme, budget and structures. It was also argued that the PNoUNCCD needs a stronger "Focal Point" and regular funding. The commitments made at the Madrid Forum in 2007, and included in the Parliamentarian declaration at COP 8, were also reaffirmed. (UNCCD, 2008e)

The Steering Committee is also expected to examine the establishment of performance indicators and create a two-year work program (2010-11) of the PNoUNCCD, in order to facilitate a more effective assessment of parliamentary efforts. The Committee is also expected to present a draft statute for the PNoUNCCD to the next Parliamentary Forum (UNCCD, 2008e).

8.4 The Future of the UNCCD - Challenges and Key Issues Moving Forward

8.4.1 Key Issues for discussion at COP9

The COP8 agreed on the agenda items to be discussed at the next COP9 that will take place in Buenos Aires, Argentina in Autumn 2009.

Among key issues the agenda will include:

- the programme and budget for 2010-2011,
- review of the implementation of the Convention (including a review of the report of the CRIC and of the CST, additional procedures/mechanism to assist the CRIC and the maintenance of a roster of experts or the creation of ad hoc panels);
- the promotion of relationship with other conventions and organisations;
- consideration of the follow-up to the World Summit on Sustainable Development and 16th and 17th sessions of the Commission on Sustainable Development;
- the preparation for the Decade of Deserts and Combating Desertification (2010-2020).

Interactive dialogues with relevant stakeholders – including ministers, NGOs and members of parliament, will be included on agenda items of relevance to them.

The Executive Secretary is expected to prepare a preliminary work plan for 2010-2013 for COP9. {CRIC report]

At the upcoming COP parties will have to find an agreement, for the first time, on the **implementation of the 10-year Strategy**. The debate will hence have to move from discussion on 'theoretical' objectives and plans to the 'practical' implementation of these objectives, i.e. how the Strategy should be made effective at national, regional and local level. Parties are expected to make 'bold' decisions and express renewed commitments to control desertification and land degradation. The debate is also meant to lead to agreement on financial contributions to affected developing countries.

Another important issue to be discussed at COP9 will be **the role of subsidiary bodies**, which should become robust enough to facilitate the implementation phase of the Strategy.

The CST should be able to effectively support and advise parties through an enhanced role of scientific and technology correspondents. Many are calling for a role comparable to that of the International Panel on Climate Change (IPCC) for the Framework Convention on Climate Change (UNFCCC). CST advisory role hence should be strengthened, especially now that the Committee is expected to support the parties in the implementation of the Strategy. The fact that now, according to the Strategy, the CST session will have a specific conference-style format is meant to allow scientist including those not nominated by parties to contribute to the debate, hence providing real value added to the discussions.

The role of CRIC will also need to be revamped. So far the Committee has worked on an ad hoc basis, but now more prominent decisions on its format and functions are needed. The Committee should be made more permanent, and it should be robust enough to review the implementation process based on submission of national reports.

As for the GM, at the last COP the parties reached agreement on the assessment of its activities and evaluation of its function. The GM essentially is not a funding mechanism but rather an advisory body, which should provide information on available sources of funds and advice on innovative methods of financing and sources of financial assistance. A report from the Joint Inspection Unit under the terms of reference given by Parties will be made available at COP9 for consideration. .

COP9 will also have to discuss and agree on the Programme and **Budget of the Convention for the biennium 2010-2011**. The debate on this topic is likely to be influenced by the current international financial crisis. Decisions taken on financial matters will hence show, more than ever, how committed the Parties are to combat desertification and land degradation despite economic contingencies.

Another important point to be discussed at COP9 will be the **participation of civil society** to the UNCCD process. A decision on this regard will have to be taken by the parties on the basis of a proposal to be tabled by the Secretariat, which opens for a more visible and active role of civil society, including NGOs, the private sector and other relevant stakeholders.

Overall, if the adoption of the Strategy in COP8 was a proof of a renewed commitment to achieve the UNCCD objectives, the parties are now called to demonstrate even more that goodwill can be turned into action. COP9 is expected to be a turning point, where parties will have to decide on matters that are critical to a full and effective implementation of the UNCCD.

8.4.2 UNCCD and other international bodies

The UN Convention Biological Diversity (UNCBD), the UN Framework Convention on Climate Change (UNFCCC), and the UN Convention to Combat Desertification (UNCCD), known as the Rio Conventions, are the three main international legally-binding agreements for sustainable development. Obvious links and synergies exist between the three Conventions, and a joint liaison group enable exchange of ideas and experience among them.

With the increasing prominence of climate change in the international political agenda, the UNCCD is particularly focussing on the links between climate change and land degradation/ desertification, through improved synergies with the UNFCCC. The UNCCD is working with the UNFCCC Secretariat to explore ways to strengthen sustainable land management. Issues related to mitigation and adaptation are being discussed at institutional and country level. The UNCCD has followed with interest the recent UNFCCC COP meeting in Poznan and it is expected that the upcoming UNFCCC COP in Copenhagen, will consider the potentials of land and soil fertility as part of the solution to address climate change.

The UNCCD advocates for full consideration on land degradation/desertification issues in the UNFCCC agenda, and for effective decisions to be made at international and national level. In particular, the EU arena is expected to implement activities linked to the preservation of soil. EU Member States, especially those facing land degradation, should advocate for progress on climate and soil fertility interaction, as this is considered a win-win approach. Among EU Member States, countries such as the Netherlands, France and Germany have been already supporting activities at national level for the implementation of the three Conventions. However the process has been slow, and more impulse to expedite action on the ground would make a difference.

8.4.3 The role of Parliamentarians

Parliamentarians represent an advisory group providing views on desertification and land degradation and insights on actions taken at national, regional and local levels. Reports produced by the Parliamentarians' Forum are well appreciated by the UNCCD and usually annexed to the COP reports. There is clearly scope for national/regional parliaments to be more active, especially on the implementation of the Strategy, observing and reporting what is being done by parties and advising decision makers accordingly. They can represent a strong link between the Convention and national/regional policy makers.

In the EU, parliamentarians will have an important role to play for instance in the context of climate change policy, and especially on the negotiations within the UNFCCC, as they will have the opportunity to raise desertification and land degradation issues in national and international discussions. Some parliamentarians are aware of the importance of the link between climate change and land degradation and already advocated for further attention of decision makers on this linkage. Nevertheless, as many are not yet engaged in the process, a more active role of Parliaments is needed to highlight the importance of land degradation and recognition of sustainable land management potentials to address the Climate Change adaptation and mitigation strategies.

8.5 Implementation of the United Nations Convention to Combat Desertification in the European Community and in EU Member States

The European Community ratified the United Nations Convention to Combat Desertification (UNCCD) on 26 March 1998. The Convention came into force in the Community on 24 June 1998. As a party to the Convention, the EC supports the implementation of the UNCCD through dialogue, bilateral development cooperation assistance at the national and regional level, and support for programmes in affected countries that directly / indirectly seek to combat desertification and mitigate the effects of drought. All EU Member States (with the exception of Estonia[8]) are Parties to the UNCCD.

Several EU Member States in Central and Eastern Europe[9] (CEE) and the Northern Mediterranean[10] are considered to be "affected"[11] by drought and / or desertification. Under the provisions of the Convention, affected countries are obliged to:

- prioritise efforts to combat desertification and mitigate the effects of drought, allocating adequate resources to this purpose;
- establish appropriate strategies and priorities within the framework of national sustainable development plans/policies to combat desertification and mitigate the effects of drought;
- address the underlying causes of desertification, paying attention to contributing socio-economic factors;
- promote awareness and participation by local communities with the support of non governmental organisations in efforts to combat desertification and the effects of drought; and
- create an enabling environment by strengthening relevant existing legislation, enacting new laws and establishing long-term policies and action programmes.

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[8] As of 2 November 2008

[9] EU Member States within the CEE regional category are: Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Other countries in this category include: Croatia, the Former Yugoslav Republic of Macedonia, Serbia, Albania, Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Russian Federation, and Ukraine.

[10] EU Member States within the northern Mediterranean regional category are: Cyprus, Spain, France (observer), Greece, Italy, Malta, Portugal and Slovenia. Other countries in this category include: Croatia, Turkey, Montenegro, Bosnia and Herzegovina, Andorra, Monaco (observer) and San Marino.

[11] Affected countries are those countries whose lands include arid, semi-arid, and / or dry sub-humid areas (defined in the Convention as those areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65) affected or threatened by desertification. The decision as to whether or not a country is considered 'affected' is taken by the country itself.

Affected countries are also required to prepare national action programmes, and where appropriate sub-regional, regional and joint action programmes (which outline practical measures to combat desertification and mitigate the effects of drought) and report regularly on their activities to implement the Convention. Annex IV on "Regional Implementation Annex for the Northern Mediterranean" and Annex V on "Regional Implementation Annex for Central and Eastern Europe" of the Convention provide specific guidelines for implementation of the Convention in these two regions.

All other EU Member States that are Parties to the Convention, have obligations to provide financial resources and other support for the plans and strategies of affected developing countries, particularly those in Africa, and least developed countries, to combat desertification and mitigate the effects of drought; promote the mobilisation of new and additional funding and resources, including from the private sector and other non governmental sources; facilitate access to appropriate technology and knowledge by affected countries; and to report regularly on their activities as donor countries.

8.5.1 Implementation of the UNCCD in the European Community

Council Decision 216/98/EC formally approves the Convention on behalf of the European Community and recognises that desertification is a "major environmental problem caused by complex interactions among physical, biological, political, social, cultural and economic factors". The Decision notes that while the EU has adopted measures in areas governed by the Convention and that Community environmental, development cooperation, and research policies contribute to the objectives of the Convention; the Convention's provisions to combat desertification in the northern Mediterranean area[12] will help tackle regional environmental issues and its provisions "may be taken into account" in future measures for economic and social development. An attached declaration of competence sets out the Community's competence with regard to matters governed by the Convention. The declaration notes that the Community has competence in adopting measures to protect the environment, "in particular to combat desertification"; and competence in areas of agriculture; development cooperation; and trade. The declaration goes on to list a number of Community legislative acts which contribute to combating desertification. This list includes research programmes in the field of environment; general provisions such as a Council Resolution on a Community action programme relating to the environment and sustainable development; and Community financial instruments relating to: development cooperation; regional development; cohesion policy; agricultural support mechanisms; and measures related to forests and woodland. The declaration also states that "the Community will in future be able to assume additional responsibilities by the adoption of legislative instruments or cooperation measures specifically designed to combat desertification".

The EC's latest report submitted to the UNCCD CRIC in March 2007 highlights EU policies, activities, and programmes from 2001 to 2005 that support the implementation of the UNCCD. The report focuses on EU development programmes, partnership agreements, and external assistance provided to developing countries in Asia, Latin America and the Caribbean, Central and Eastern Europe, the Mediterranean and the Middle East which directly or indirectly contributes to combating land degradation in these regions. In terms of supporting the implementation of the Convention, the report maintains that the mainstreaming of sustainable land use management issues within the development strategies of partner countries is the most effective way of ensuring implementation. The UNCCD is viewed as a Convention for sustainable development, and land degradation and desertification are seen as being closely related to development issues.

[12] At the time the Decision was adopted, no CEE countries were EU Member States.

The report notes that over the 2001-2005 period, the Community provided €338.3 million to projects that address issues covered by the UNCCD; in particular €322.6 million was focused on projects that directly/indirectly targeted land degradation abatement. These projects focused primarily on the integrated use and management of land and water resources. The Community also spent a significant proportion of overseas development assistance (ODA) on research into the abatement of desertification and land degradation – having provided support for 26 research projects totalling €15.7 million over the 2001 to 2005 period which primarily focused on education and training activities and soil conservation and erosion abatement. The report notes that the majority of Community financial support for projects in the south and east Mediterranean and Central and Eastern Europe is focused on sustainable land use management measures. The Community also provides financial support to region-wide and world-wide projects, with a particular focus on those projects concerned with soil conservation and erosion abatement.

Given that the report is focused on activities in developing countries, there is no coverage of relevant measures in EU Member States to implement the Convention. However, there are some insights regarding candidate countries including: Turkey – which is reported to have a number of operational activities and a strong research base, however the issue of desertification is said to not feature prominently in agreements with the EU. The report also mentions a number of research projects in the Mediterranean region which focus on desertification and water resource issues.

8.5.2 Implementation of the UNCCD in "Affected" EU Member States

The Northern Mediterranean Region

Among countries in the northern Mediterranean group, Greece, Italy, Portugal, Spain and Turkey are in the process of launching a **Sub-Regional Action Programme (SRAP)**, having already presented the terms of reference for the programme in 2001. The objectives of the SRAP, as outlined in the terms of reference are to: harmonise the national action programmes of Annex IV countries and improve coordination of activities; provide information to help the Commission identify priority issues and develop appropriate environmental and structural policies for the region; establish a network to support regional and local authorities in setting up partnerships for prevention and mitigation projects eligible for EU funding; promote principles for the preservation of natural resources and increase awareness that appropriate policies and interventions can halt the spread of desertification.

The terms of reference also identify a series of trans-national topics to combat desertification in the region and provide details of objectives and expected results under each topic. The trans-national topics identified are:

- Most sensitive areas in terms of desertification hazard;
- Common regional benchmark and indicators for process and mitigation;
- Collection, analysis, and exchange of technical and scientific data;
- Exchange of data and information;
- Involvement of civil society within the SRAP process;
- Traditional knowledge and practices that safeguard the quality of the regional landscape; and
- Connection with existing regional and sub-regional initiatives.

The expected results of action in the above mentioned trans-national topics include *inter alia*: the development of a common approach to sensitive areas; identification of areas that require the development of pro-active drought contingency planning; the creation of a regional network for planning needs; the development of benchmarks and indicators to measure progress in combating desertification at the national and regional level; the establishment of a regional desertification observatories network and a Regional Clearing House Mechanism for the exchange, harmonisation and dissemination of information related to dry-lands protection and management issues.

As of January 2009, Italy, Greece, Portugal, Spain and Turkey had adopted National Action Programmes (NAPs) to combat desertification. Other affected countries from the northern Mediterranean region are in the process of developing their NAPs. The NAPs of the four EU Member States are summarised in Annex III.

The Central and Eastern Europe (CEE) Region

Among countries in the CEE region, some interest has been expressed in terms of addressing problems at the sub-regional level, particularly with regard to drought management in south eastern Europe. The Drought Management Centre for South Eastern Europe, based in Slovenia, was launched in April 2007 and aims to provide a more comprehensive framework for improving early warning and drought monitoring and mitigation techniques; and to create a regional drought preparedness network for countries with similar geographical characteristics and drought patterns. Romania is the only EU Member State to have presented a NAP to date. The Romanian NAP and national reports on implementation of the UNCCD submitted by Poland, the Czech Republic and Hungary and summarised Annex III.

8.6 Conclusions: The UNCCD and its Implementation in Europe

National, sub-regional and regional action programmes are the main instruments for the implementation of the UNCCD in affected country parties. However, as outlined above, of the fifteen EU Member States considered to be affected or threatened to some degree by desertification only five (Greece, Italy, Portugal, Spain and Romania) have adopted national action programmes (NAP) to date. Other countries are said to either have launched the process of preparing their NAP or are in the process of finalizing NAPs.

Through an examination of the NAPs of EU Member States it is apparent that there is no defined structure for a NAP, which means that the comparison of countries' progress is difficult, and the omission of important details may occur. The sectoral approaches or priority areas identified by each country differs, reflecting varying national circumstances on a geographical basis and the capacity with which they can respond to address the causes and effects of desertification and land degradation. The NAPs also differ in their effectiveness in terms of facilitating implementation of the Convention, which varies according to the level of detail provided for prescribed measures to combat desertification, the proposed institutional framework, and the implementation/monitoring mechanisms envisaged. Countries in the Northern Mediterranean and CEE regions still have different national capacities to implement the UNCCD and the overall number of NAPs is still below the targets of the Bonn Declaration (decision 8/COP4). This is largely a result of the limited participatory process in the preparation of NAPs and structural changes in certain countries in the region.

In terms of the EU's approach to implementation of the Convention, as reflected in Council Decision 216/98/EC and reports submitted to the UNCCD, this is largely focused on EU actions in third countries. Little attention is afforded at this level to the problems facing a number of EU Member States concerning desertification and land degradation within their national territories.

Into the future UNCCD representatives have highlighted the desire to firmly entrench and integrate principles of sustainable land and soil management within the UNFCCC and other linked international conventions e.g. UNCBD. This importance of the role of European Parliamentarians is highlighted in terms of promoting the links between efforts related to land protection and those on climate change and biodiversity.

9 CONCLUSIONS AND KEY MESSAGES

Land and soil health are essential if we are to maintain levels of food production, adapt to and mitigate climate change and retain natural hydrological flows. As clearly demonstrated within this report land degradation represents a complex interaction of multiple processes leading a decline in the health and utility of land and its soils, and consequent depletion of resources and surrounding media. Estimates of agricultural production forgone due to soil degradation (central to land degradation more broadly) are up to five percent of the total annual production in some countries (OECD, 2001). The quality and health of land and its soils is affected by many aspects of environmental management. Land degradation is, therefore, a consequence of many factors whereby pressures generated by inappropriate land use and broader pollution interact with natural vulnerability determined by local climate and topography.

There are, however, many known mechanisms by which land can be protected, and degradation limited or rectified. The appropriate solution will vary depending upon the land use in a locality, the resilience and character of the land and the extent of degradation. There is no one solution, and measures need to be tailored to local conditions. Innovations within the field of monitoring, planning and assessment are, therefore, a critical first step and foundation of an effective strategy. These should be promoted along site developments in approaches for remediation per se; providing for locally tailored solutions that deliver more effective action.

To date the most effective measures for addressing land degradation have dealt with point sources of contamination, both in terms of direct land contamination and through the reduction in contaminants in water and air e.g. through industrial pollution and waste law. These sources, and causal links, are easiest to identify and simpler to address. The broader challenge of dealing with degradation across landscapes has yet to be met. This will be important to address in future if Europe is to retain its soil resources, agricultural productive capacity and maintain appropriate hydrological flows.

Into the future pressure on land in Europe looks set to increase. Demand for new land uses from urban expansion to the development of new sectors requiring biomass generation, e.g. bio-energy and bio-plastics, are increasing the demand for land. Increasing commodity prices combined with elevated demand look set to drive agricultural intensification. As climate change leads to less predictable patterns of rainfall the functioning of river catchments and the retention capacity of water in soils will become vitally important in order to limit flooding and conversely water stress. Importantly, land and soil quality and management will also be key to Europe's ability to adapt to climate change.

To date policy action at the EU level has often not primarily focused on land and soil protection issues, with the main responsibilities resting on the Member States - who in turn have given variable priority to land and soil quality issues. Improvements have been made in the fields of air quality and protection of our water resources, which in turn deliver benefits for the land. To deliver healthy, productive soils and maximise the benefits they provide as carbon stores and for water management there is need to recognise the importance of our land and soil resources and provide them adequate legal protection.

At the international level the UNCCD has primarily acted as a venue for debate and discussion, rather than leading to tangible action. European level implementation of the UNCCD appears to have focused upon efforts to assist third countries rather than addressing the problems experienced within Europe. Given the interlinkages between land degradation and issues associated with water availability, biodiversity and climate change mitigation and adaptation; there is a potential future role for the UNCCD in linking up with international action in these broader fields. This would provide a more integrated approach to land management and may help reprioritise land protection needs.

In conclusion, into the future the threats to and the needs placed upon land look set to expand. There is, therefore, a need to develop approaches to deliver tailored solutions to land degradation problems, better recognising the value to society of effectively functioning land supported by healthy and robust soils. In so doing the EU can help deliver upon other concerns such as food security, the protection of water resources, management of flooding, adaptation to and mitigation of climate change.

LIST OF ACRONYMS

BAT	Best Available Technology
CBD	Convention on Biological Biodiversity
CEE	Central and Eastern Europe
COP	Conference of the Parties
CRIC	Committee for the review of the Implementation of the Convention
CST	Committee on Science and Technology
DPSIR	Drivers-Pressures-State-Impacts-Responses
DLDD	Desertification, Land Degradation and Drought
EAFRD	European Agricultural Fund for Rural Development
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EPIC	Erosion-Productivity Impact Calculator
FAO	Food and Agriculture Organisation
GAEC	Good Agricultural and Environmental Condition
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GLASOD	Global Assessment of Soil Deterioration
GM	Global Mechanism
GNP	Gross National Product
GPS	Global Positioning System
HLPD	High-Level Policy Dialogue
HNV	High Nature Value
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPU	Inter-Parliamentary Union
IRAP	Italian Region Action Programme
ISRIC	International Soil Reference and Information Centre
IUCN	International Union for Conservation of Nature
IUNG-PIB	The Institute of Cultivation, Fertilization and Soil Science – National Research Institute (Poland)
JRC	Joint Research Centre
LFA	Less Favoured Area
MA	Millennium Ecosystem Assessment
MEP	Member of the European Parliament
MUAF	Mendel University of Agriculture and Forestry
NAP	National Action Programme
NATO/CCMS	North Atlantic Treaty Organisation's Committee on the Challenges of Modern Society
NCCD	Italian National Committee to Combat Drought and Desertification
NCSA	National Capacity Self Assessment
NDS	Hungarian National Drought Strategy
NGO	Non-governmental Organisation
ODA	Official Development Assistance
ODE	Centre of Desertification (Spain)

OECD	Organisation for Economic Cooperation and Development
OM	Organic Matter
ONS	National Drought Observatory (Spain)
OTD	Technical Office of Desertification (Spain)
PAND	Spanish National Action Programme
PNoUNCCD	Parliamentary network on the UNCCD
POP	Persistent Organic Pollutants
PNR	National Irrigation Plans (Spain)
RBM	Results-Based Management
SACs	Special Areas of Conservation
SAPS	Single Area Payment Scheme
SMRs	Statutory Management Requirements
SOCO	Sustainable Agriculture and Soil Conservation
SOM	Soil Organic Matter
SPAs	Special Protection Areas
SPS	Single Payment Scheme
SRAP	Sub-Regional Action Programme
STC	Science and Technology Correspondents
UNCCD	United Nations Convention to Combat Desertification
UNEO	United Nations Environment Organisation
UNEP	United Nations Environment Programme
VOC	Volatile Organic Compound
WFD	Water Framework Directive

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ANNEX I – MEASURES IDENTIFIED WITH THE SOCO PROJECT AS OF IMPORTANCE FOR ADDRESSING LAND DEGRADATION PROBLEMS ON AGRICULTURAL LAND

Table 9: Measures Outlined in the SoCo (2009) Case Studies to Help Address Salinisation caused by Capillary Action from Ground Waters and by Application and Evaporation of Irrigation Waters.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Salinisation caused by capillary action from groundwaters	Bulgaria	**Arable Land**	**Combined application** of: 1 – mulching with crop residues and returning organic matter to the soil 2 – summer fallow periods after harvesting winter cereals 3 – deep tillage 4 – Subsoiling	1 – Straw from winter cereals placed on the soil surface decreases evaporation in summer and improves soil structure, organic matter, and nutrient content 2 – ?? 3 – Deep tillage (up to 30 cm) improves drainage and restricts vertical salt infiltration. 4 – Breaking up compacted subsoil without inversion increases infiltration and decreases upward capillary action from saline groundwater	When applied individually, these measures have a marginal effect in terms of yield and farm income. It is therefore recommended that they are applied in concert.	++ when applied in concert, + when applied individually. Subsoiling and mulching also have ancillary benefits. The former acts against compaction and increasing drainage through the soils. The latter improves soil structure, protects the surface, reduces evaporation in the summer months, and improves organic matter content.
Salinisation caused by capillary action from groundwaters	Bulgaria		Altering crop rotations to more appropriate **plant types better suited to conditions** (e.g. winter cereals) and ensuring a **cover crop** during summer months	Introducing crops that cover the soil surface, especially during the hot summer months, will reduce the danger of secondary salinisation. Planting of salt tolerant varieties within the rotation will increase the ability to utilise available land	Even ?salt-?tolerant plant growth is usually stunted by growth in unfavourable areas. Limited impact is realised if the underlying saline conditions are not being dealt with by utilising other mechanisms in concert.	+

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Salinisation caused by capillary action from groundwaters	Bulgaria	**Arable Land / Grassland**	**Chemical melioration**	Application of high pH, calcium-based materials, most commonly gypsum to solonized, solonetz and sodic solonchak soils	Relatively high material costs for all available materials. Calcium chloride reacts faster than gypsum but is more expensive. The product can be obtained at low costs as it is an industry by-product, however transport costs are a limiting factor. Farmers working in cooperation can lower these costs.	++ This practice is considered one of the best methods of improving solonetz soils, leading to improved soil quality and crop productivity, enabling the growth and high yields of crops sensitive to sodic conditions. The case study reports examples of tripled yields following application.
Salinisation caused by capillary action from groundwaters	Bulgaria	**Linear Land Elements**	**Tree strips and small spinney** development	Deep tree roots facilitate soil drainage and improve salt leaching	This is a long-term measure on uncultivated land and requires salt- tolerant species (e.g. Honeylocust, black locust, varieties of oaks, black poplar, white poplar, tamarisk and rugosa rose)	+ Improved drainage
Salinisation		**Farm Infrastructure / Linear Land Elements**	**Protection of Water Collection Elements**	By reducing water salinisation, soil salinisation follows	This measure is indirectly linked to soil conservation, and whilst not harmful, offers little extra support to direct measures	+/-
Salinisation via evaporation**,** desertification	Greece Spain	**Farm Infrastructure**	**Drip irrigation**	Greece - The most water saving sensitive system of irrigation in the case study area. Spain - drip irrigation is nowadays the most common technique for irrigation in the case study area	Very expensive - authorities in Greece estimate the cost of installation at around 2,100 Euro per hectare with a life expectancy of around 10 years. However, drip irrigation is subsidised by the farm modernisation scheme. Consequently, experience has been accumulated over the years and over the different variants under which the scheme has operated.	++ It is unanimously argued that drip irrigation has a high potential to contribute to soil conservation. Not in Spain! – need to discuss this.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
					The Spanish case study notes that drip irrigation makes water use much more efficient but it tends to increase salt concentration. On sectors of South East Spain drastic decreases in soil quality and productivity due to salinisation have been attributed to this practice (Pérez-Sirvent et al., 2003).	
Salinisation caused by capillary action from groundwaters	Bulgaria Spain		**Irrigation** - using waters with a lower salt content, brought in from other areas	Freshwater helps to leach out excess salts from the soil	Using water from a centralised irrigation system is an important measure for reducing the salinisation in the area. This requires communal management and if not managed properly leads to an unreliable water supply and encourages farmers to rely on local, salt rich waters Spain - irrigation with fresh water can promote piping by removing carbonates and facilitating the piping process - ???	++
Salinisation caused by capillary action from groundwaters	Bulgaria		**Drainage** - Installation and effective ongoing management of an appropriate drainage system (including drainage canals), combined with appropriate irrigation	Lowering the level of saline groundwaters prevents upward capillary action of saline waters	Success is reliant upon the proactive maintenance of this system. Essential maintenance includes cleaning and unblocking the drainage canals, which is not technically difficult, but it does require organisational and financial motivation. At present in the case study area, drainage canals have been neglected due to a lack of centralised action.	++ In Belozem (BG), the digging of the main drainage canals, in concert with the modernisation of the irrigation system in the 1960s, produced a considerable reduction in soluble salt content in the soil after 3-4 years. According to the case study, without irrigation in concert with appropriate drainage, the impacts of all other measures will only be temporary.

Table 10: Measures Outlined in the SoCo (2009) Case Studies to Help Address Soil Erosion by Water, Organic Matter Decline and Compaction (Note: The Degradation Process Cited As The Predominant Reason For Adoption Is In Bold, While Ancillary Challenges Addressed Are In Normal Script)

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Soil Erosion by water, organic matter decline, soil compact	Germany Belgium Czech Rep. UK France Italy Spain	**Arable Land**	**Reduced tillage**, including non inverting soil tillage and mulch tillage	Reducing the level and impact of tillage on land, by ploughing at a lower depth, or mulching to reduce weed growth and the need for regular tillage to suppress the growth of weeds. Germany - In the case study region, application varies by crop type and cropping regime. Reduced tillage is extensively applied to maize and winter wheat (but only when cultivated after a leaf crop such as sugar beet), but not for crops with high demands for seedbed preparation. Belgium - Reduced (conservation) tillage is applied to 10% of the total agricultural area. Of those farmers interviewed by the MESAM-project who do not adopt conservation tillage, 70% would be interested if they obtained professional support – n.b. this seems to apply to CA holistically. The case study reports this as the, “most effective measure against soil erosion”.	There exists universal criticism that weeds are likely to increase in abundance, requiring higher levels of herbicide use, and that sowing regimes become less flexible. Yields remain the same, although root crops can potentially reduce. In the long term, reduced tillage may result in greater nitrate losses than conventionally ploughed fields (Catt et al. 2000), and long-term compaction, requiring extra techniques such as subsoiling.	+ Both farmers and soil experts agree that reduced tillage positively affects soil properties, including soil structure and water retention capacity. Crops under reduced tillage therefore have more water available to them and run-off is reduced. Likewise, organic matter and microbial activity increases, leading to better soil aeration and improved soil fertility, reducing soil erosion risk and nutrient loss. Further benefits reported include fewer crossovers within the field, hence reduced soil compaction risks; labour, equipment, and fuel cost reductions; reduced concentrations of sediment and phosphorus in run-off (Withers et al., 2007).

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
				Spain - Rates of adoption are not high - experts consider that less than 20% of farmers apply this practice. UK - Following promotion by farm advisors and farming press, and through discussion with farming peers, application has increased.		(-) The technique requires a higher use of herbicides. However, if an improved soil structure is achieved then these chemicals will infiltrate the soil, rather than being lost in surface run-off.
Soil Erosion, organic matter decline	Germany Belgium Czech Rep. Spain France Italy n.b. not applied in UK, with reason		**No tillage** or direct drilling	Traditional methods of tillage are totally abandoned with new mechanisms applied to plant, establish and manage the crop. Under this system the cover within the field is not removed. Direct drilling involves sowing directly into undisturbed soil. Stubble from the previous crop and subsequent weed growth are removed by grazing during the fallow, and the stubble remaining is usually burnt after the seasonal break of rain. The fallow is sprayed with a contact herbicide prior to sowing. Belgium - Of those farmers interviewed by the MESAM-project who do not adopt conservation tillage, 70% would be interested if they obtained professional support – n.b. this seems to apply to CA holistically..	Costs of investment in new, appropriate machinery. Weeds are likely to increase in abundance, and sowing regimes become less flexible. For the optimal function of soil conservation systems it is necessary to add biotechnical and technical measures. Germany - Costs for conversion to no tillage lead to low uptake in the case study region, along with additional management levels. Belgium - Continuous no till agriculture is very rare nationally, due to the high disturbance of the soil with the formation of ridges and harvest of root and tuber crops. Moreover, organic manure is often applied and needs to be incorporated in order to minimize ammonia losses (D'haene, 2008).	+ Soil experts suggest that no tillage has the advantage of nearly permanent soil coverage leading to decreased soil erosion, reducing nutrient loss from leaching and run off. No tillage saves time and fuel, and yields remain the same (although reductions in root crop yields are possible). UK - since negative conclusions from initial trials, more has been learned about how these techniques can be used on different soil types. If soil moisture levels are carefully monitored and the land is worked under optimal conditions, then this method could be used successfully.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
					UK - initial trials by farmers on heavier clay rich soils showed these techniques led to compaction, which resulted in increased overland flow. Flexibility within the farming system is required to enable the land to be worked under optimal conditions. The heavy reliance on contractors may preclude this as contractors have their own schedules that they need to keep to.	Spain - No-tillage seems to provide a buffering of crop productivity in the driest years (Gómez et al., 1999; Ordoñez-Fernández et al., 2007). Alvaro-Fuentes et al. (2008) demonstrate that no till increases soil carbon more effectively than reduced- and conventional tilling. Ordoñez-Fernández et al. (2007) reinforce this conclusion and report increases in N and P content of the soil, in a long term study, adding that direct drilling is particularly effective in dry years.
Soil erosion by water, diffuse pollution	UK Belgium Greece Spain		**Contour tillage / ploughing**	Tillage practices parallel to the contours of steep slopes (some suggestions of 10% gradient – e.g. Greece) Spain - Rate of adoption by farmers is not high - experts consider that less than 20% of farmers apply this practice	Universal reports of unpopularity for reasons of application difficulty and fragmentation/yield reduction. Costs are considered relatively low in the UK, as no additional equipment is required; however they are considered noteworthy in Belgium, along with time loss. UK - Restricted in the study catchments because of the size and shape of the fields. Complex topography can lead to convergence points and ultimately to breakthrough and soil erosion. It can also concentrate flows onto headlands where again flow can converge.	+/- Can be used effectively to retain water on the contour, but is very dependent on the topography of the region and can induce negative effects if misplaced. Most farmers found the technique reduced run-off and erosion.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
					Most farmers who had tried this technique had only done so recently after recommendation by advisors, having been deterred because of the need for specialised equipment. Greece - On certain parcels the process is dangerous and farmers adopt a more convenient ploughing pattern that does not protect soil against erosion.	
Soil erosion by water, compaction	UK,		Altering crop rotations to more appropriate **plant types better suited to conditions** (e.g. winter cereals)	New varieties of maize are now becoming available that mature quicker and therefore can be harvested earlier, when soil moisture conditions should be more favourable. This allows a winter cereal to be planted earlier and to become established over the wet winter period, offering greater protection to the soil surface over winter.	This is a relatively new approach being introduced to the Axe & Parrett region, and has potential for future application	? New approach, with potential to yield positive effects.
Soil erosion by water, diffuse pollution	UK Spain		**Restrictions on row crops**	Grass cover introduction on slopes, as “row crops” are notorious for promoting overland flow especially when planted perpendicular to the slope. Some land capability classifications recommend that permanent grass cover should be used on slopes steeper than 7 degrees. In Spain, rate of adoption by farmers is not high and experts evaluate less than 20% of farmers apply this practice	This may not be practicable or economically viable on farms where cultivatable land is limited.	+ Overland flow potentially reduced, but application faces dispute

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Soil erosion by water, diffuse pollution	UK Denmark France		**Cover crops**	Crop (i.e. other than the usual cultivated on the land) grown over winter periods to reduce run-off. e.g. forage rape or mustard grown over winter between wheat and barley, or growing cereals after maize or sowing rye grass after maize. Denmark - farmers are obliged to keep "catch crops" on their land, as well as winter cover crops.	Perceptions that additional costs of seed and labour exceed economic return. The choice of cover crop is very important to ensure effectiveness, and can even induce detrimental effects. UK - The main cover crop in the case study area is grass; however, its effectiveness to protect the soil depends on the age and quality of the sward (Scholefield and Hall, 1985). Young, reseeded pasture and overgrazed swards, which both have lower sward densities, can lead to increased risk of compaction and erosion (Clarke et al., 2008). The practice is not widespread in the region. Denmark - Cover and catch crops provide indirect, unplanned – even if obligatory?? - protection against wind erosion.	+ Unanimously agreed by farmers and experts that cover crops protect the soil at vulnerable times and reduce run-off, resulting in lower nutrient and soil losses and consequently less diffuse pollution. Cover crops can also utilise nutrients that may otherwise be leached at vulnerable times. Sowing two crops in the same area increases the biodiversity of the field and may have additional environmental benefits in terms of additional habitat. In the UK, farmers consider costs as relatively low because the crop either provides nutrients in the form of green manure, or a fodder crop that would have to be grown regardless.
Soil erosion by water, organic matter decline, diffuse pollution	Greece France	**Grassland**	**Maintaining Green Cover (Parcels with slopes over 10%) in Greece**	The maintenance of green cover during the rain period on parcels with slopes of over 10% is an old farming practice that was widely adopted in Greece.	During the last year only, certain parcels were cultivated (and thus ploughed) earlier than usual in order for some farmers to get two cultivations in one period, attributable to changes in world cereal prices and in the common organisation of cotton markets (EU cotton regime) - certain farmers chose to cultivate cotton later, growing cereals first for which higher prices were expected.	+ The economic efficiency of maintaining a green cover on the parcel during the rain period is significant because it incurs no cost to the farm – opportunity cost?? - and is very beneficial as it provides fodder for animals.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Soil erosion by water, diffuse pollution, soil erosion by wind	UK Belgium Czech Rep. Denmark France	**Linear Land Elements**	**Grass buffer strips / shelter belts**	Belgium - 35% of farmers interviewed for the MESAM project adopt grass buffer strips as barriers to run-off. Denmark - Shelter belts are implemented for biodiversity purposes, but provide associated protection against wind erosion.	Additional costs for implementation, and reduction of parcel size and yield. Grass buffer strips and grass corridors need to be well maintained, and sown species well considered, to ensure permanent and dense soil cover. Generally, a maintained grass filter strip is used to treat very shallow or sheet flow. Filter strips have high efficiency when used in combination with other best management practises such as direct drilling seed of wide row crops (maize, sunflower) into stubble mulching. Shelterbelts (in Denmark) will be most effective against wind erosion when planted perpendicular to the prevailing wind direction. Against water erosion they should be along contour lines or across flow paths.	+ Also provide associated biodiversity benefits
Erosion by water	Greece		**Preservation of Uncultivated Islands within the Field**		Indirect benefit on soil run-off	+/- This measure is indirectly linked to soil conservation, and whilst not harmful, offers little extra support to direct measures
Erosion by water	Spain		**Retention Ponds**			
Erosion by water	Spain		**“Soil conservation structures”**	Construction and maintenance of structures such as banks and walls (unfarmed features)	Spain - importance of SCS has diminished significantly in the last 50 years. Many of the structures on rainfeds are not adequately maintained or simply are abandoned.	+ Significantly reduce off-site impacts facilitating the existence of sinks for run-off and sediment coming from channels, hillslopes or other agricultural fields.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
				75% of farmers maintain vegetated banks and 25% conserve stone walls (a costly task) indicating that they are much more prone to adopt this kind of measure than that of reduced tillage or similar	This is because maintaining these structures is costly. Also, SCS adapt badly to modern agriculture relying on machinery, irrigation infrastructures, etc. Intensification and irrigation has eliminated many of the SCS, and on newly cultivated land, structures have not been installed.	Therefore, a dense network of SCS acts diminishing landscape connectivity to water and sediment fluxes having a very positive effect on the reduction of erosion risk (Bellin et al., in press).
Soil erosion	Greece Spain	**Farm Infrastructure / Linear Land Elements??**	**Maintaining terraces and natural borders**	Maintenance and upkeep of stone terraces where they exist, as well as natural borders, in order to reduce slope gradient strength.	Associated biodiversity benefits with maintenance. An ageing population makes maintenance particularly difficult, necessitating worker hire and increasing costs. Spain - Experts estimate that 20-40% of farmers use bench terraces. However, in traditional agriculture the rate of implementation of this kind of structures was much higher. Interviews show that more than 75% of farmers agree that maintaining terraces and benches with vegetation is beneficial for soil conservation	+/- Terraces and natural borders that are along the contour of the plot reduce the speed of water run-off and decrease the risk of surface soil erosion. However, labour costs and time are significant.
Soil erosion, loss of organic matter, compaction	Italy	**Reduced tillage, cover crops,**	**track reduction**			Prevents compaction of soil
Soil erosion	Greece Spain		**Harvesting from the Centre to the Boundaries of the Field**, following spirals			+/- This measure is indirectly linked to soil conservation, and whilst not harmful, offers little extra support to direct measures

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Erosion by water, compaction	Spain		**Afforestation**	More details to be provided based on Spanish case study – but they're not!		
Organic matter decline, soil erosion by water	Germany (UK) Belgium Czech Rep.		**Intercropping** with "green manures" - simultaneously growing the main crop in proximity and interspersed with species such as lupines, mustard and clover.	Intercrops provide coverage of the soil surface between rows of the main crop reducing speed of overland flow and the mobility of soil particles, hence limiting soil erosion. As the green manure species grow they fix, in particular, nitrogen from the air, increasing soil fertility. The intercrops can be harvested for fodder, or ploughed in to further increase organic matter. Germany - Intercrops used in the Uckermark include mustard, clover, oil radish and Phacelia. Clover and oil radish are used as fodder for livestock. Intercrops are primarily used on organic farms, although interest is increasing generally as prices for artificial soil additives are increasing. Belgium – Primary intercrops in West-Flanders are white mustard, grasses (mostly Italian rye-grass) and phacelia. Almost all interviewed farmers sow intercrops. UK - Not widely used in the case study catchments.	There are universal concerns that intercrops decrease water availability for the main crop. High costs associated with labour, preparation of seedbeds and purchasing of seeds (costs for mustard seed were noted to be particularly high in Germany), are off-putting if a return can not be gained from the intercrop e.g. by being sold as fodder. Dry summers can prevent the germination of intercrops and undersown crops, and the promotion of pests & disease is also reported (e.g. white mustard when used in cabbage rotations). Germany - within the Uckermark, only 20% of the UAA is intercropped, predominantly due to concerns over water availability. Farmers also consider the economic efficiency to be relatively low compared to other soil conservation measures. Belgium - Farmers perceive sowing seed as expensive, and the Flemish government stopped subsidising intercrops in 2007. Most farmers lament the decision but continue to apply the measure nonetheless. Experts indicate, in contrast to farmer opinion, that the effect of intercrops on the build-up of organic matter is limited.	+ Beneficial impact on organic matter and nutrient content of the soils. Protection of soils during heavy rains, thereby reducing soil erosion, is also key, and intercrops can also enhance biodiversity.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Organic matter decline, soil erosion by water	Germany (UK)		**Undersown crops**	Undersowing crops with grass, considered to use less seed than intercropping therefore offering a cheaper solution in comparison. Germany – applied to maize crops predominantly. Clover is used by one organic farmer to increase nitrogen content. UK - Not widely applied in the case study catchments. The main examples are maize and cereals (whole crop for silage).	Concerns regarding competition for water between the main crop and the undersown crop, which can reduce the yield of the main crop, and dry summers can prevent the germination of undersown crops. Germany - Application is limited in the Uckermark due to the additional costs of seeding, labour and machinery, and farmers are sceptical that the costs are balanced by the benefits.	+ Benefits of improving organic matter content of soils and the elimination of weeds.
Organic matter decline	Germany		**Alternating humus producing and depleting crops** within the rotation	Germany - Crop rotation considerations are applied to over 80% of the UAA. Organic farmers in particular cultivate grain legumes such as lupines, peas or forage legumes such as clover and fetch as a green manure for their fields. Organic farming normally has a wider crop rotation, in order to control weeds, disease etc without chemicals. By doing so vulnerability to soil degradation can be reduced. But why the distinction b/w humus producing & depleting??	Appropriate approach varies, depending upon the crop grown	+ It is considered that a wide, healthy crop rotation has a positive effect upon soil organic matter through the accumulation of humus. In addition this contributes to weed control, and reductions in plant disease and insect pests.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Organic matter decline, soil erosion	Belgium Greece		**Appliance of plant residues / Incorporating organic matter**, rather than burning cultivation residues	Residues of grain maize and earth foam are applied to the soil as exogenous organic matter (i.e. compost). In Greece, measures to incorporate legumes into soil were considered positive before suspension from GAEC	Time and labour costs, with concerns over economic returns. Appliance of secondary waste products creates a potential risk of hazardous matter. Burning the residues during Autumn had the risk of leaching the nutrients away from the plot by a sudden heavy rain. Greece - The practice upsets social norms, as farmers argue that soils with burned residues were/are healthier, however the public's demand for controlling forest fires ignited by residue burning has had an impact on farmers' attitudes. Incorporation into the soil is not easy when the soils are dry at the end of a prolonged dry summer season, and application has not been easy in certain areas of Greece, but not in Rodopi.	+ Reported to increase soil organic matter and reduce erosion.
Soil Compaction, soil erosion by water??	UK	**Arable Land / Grassland**	**Subsoiling** and **soil aeration**	???	Subsoiling is less effective at reducing shallow surface compaction associated with pasture, than it is at breaking up compacted zones at depth. This is because the soil is often more moist under pasture because of a higher organic matter content near the soil surface which retains moisture, which prevents effective shattering of the surface soil layers. According to farmers and farm advisors, soil aerators are more effective than subsoiling in reducing shallow subsoil compaction.	++ Both subsoiling and aeration have the potential to increase yields, reduce surface run-off and increase soil water retention capacity. One farmer reported a 25% increase in crop yield following subsoiling, and reduced run-off from the field.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Soil compaction, soil erosion	UK	**Farm Infrastructure / Grassland**	**Restricted animal movement - temporary paddocks**	Temporary paddocks are erected and moved regularly. One of the interviewees divided a 6 ha field into 2 ha paddocks, a different paddock being used after each milking.	Time and labour	+ The advantages of this system include a higher proportion of lush grass in the animals' diet, less damage to soil structure and increased recovery time for the grass sward and soil structure.
Soil Compaction, soil erosion by water	Germany Denmark	**Farm Infrastructure**	**Controlled traffic tramlines**	Concentration of agricultural machinery on defined tramlines, reducing traffic and therefore compaction over the broader area.	Investment costs for GPS systems are considered high (low uptake in the Uckermark for this reason). Few low-cost options to follow tramlines without high-tech support exist, and they are considered to be low precision. Concerns over the high levels of compaction along tramlines. Denmark - Associated increases in erosion are reported, which may require a combination of techniques to loosen soils (e.g. by a harrow tooth) occasionally.	+
Soil Compaction, soil erosion by water	UK Spain		**(Subsurface) drainage**	Installation of new drains / maintenance of existing. UK – Some new drainage has been installed recently by a few farmers in the case study region. Maintenance mainly involves those installed through grant aids between 1940 and the 1980s. Spain - Experts estimate that 20-40% of farmers use ditches to combat on- and off-site erosion.	UK - Some original (1940-18980s) drains still function efficiently, but not all, and the level of maintenance / installation required, or the extent to which this implementation is likely to occur, is not clear. Spain - Rates of implementation were traditionally much higher than today	+ In the UK, extended grazing and field operations reported as possible as drains reduce soil water logging, leaving the soil less vulnerable to compaction and poaching.

Soil Degradation Process	Case Study	Farming technique	Practices	Action	Preconditions/Caveats	+/- impacts
Soil Compaction, soil erosion by water	Germany UK Denmark		Adjusted **wheel size and pressure**	Wheel size is increased and tyre pressure lowered to increase the surface area of tyre impacting on the ground surface and spreading weight more evenly.	Costs associated with purchasing new tyres (measure not widely implemented in the German case study for this reason). UK - Intensification of farming practice has seen a steady increase in the size and weight of vehicles, though this can be offset by adjusting wheel size and pressure. Another method of avoiding the heavy loading during spreading of slurry would be the use of a self driving spreader with hoses, connected via a pipeline to the slurry tank.	+ Larger vehicles reduce the number of tramlines and the number of repeat trips made with trailers for harvested crops. In Denmark, farmers and experts agree that this practice is beneficial to the soil and the avoidance of compaction.

Table 11: Measures Outlined in the SoCo (2009) Case Studies to Help Address Diffuse Pollution Linked to Nutrient Enrichment

Soil Degradation Process	Case Study	Farming technique	Practice	Action	Preconditions/Caveats	+/- impacts
Soil contamination, soil erosion, organic matter decline, compaction	Belgium Greece UK	**Arable Land**	**Organic farming**	Farmers do not apply chemical fertilisers, pesticides, herbicides, etc., which contribute to soil contamination. Waters (inland) are also protected. Organic agriculture also sets up a range of Good Farming Practices that assist efforts to combat soil erosion, enhance organic matter and avoid compaction from the use of heavy machinery.	Organic agriculture is voluntary and often depends on subsidies for uptake. Greece - Low subsidies maintain low levels of uptake in comparison with other MS. "Many problems and obstacles should be overcome before organic agriculture can have a significant (in quantitative terms) effect on soil conservation."	++ The value of the measure for soil protection is significant. Organic farmers make efforts for the enrichment of soils in organic matter and avoidance of soil and water contamination. Furthermore, organic agriculture is not based on the use of heavy machinery and therefore soil compaction is avoided.
Soil (and associated water) **Contamination**	Spain		Reductions on **applications of pesticides and fertilisers**	No statistics on uptake / details on reduction levels provided, only noted as a "viable alternative"		

Soil Degradation Process	Case Study	Farming technique	Practice	Action	Preconditions/Caveats	+/- impacts
Soil (and associated water) **Contamination**	Germany Belgium UK Spain		Restrictions – makes this sound too legislative?? on the **amount and timing of liquid manure**	Slurry tends to have a lot of readily available N and can increase P; risks of increasing diffuse pollution of these nutrients if rainfall occurs soon after application (Smith et al., 2001). Germany - Regulated by the Federal Fertilisation Ordinance nitrogen fertilisers can only be applied to covered soils on arable land between 15 November and 15 January. Belgium - Manure Decree,. Spain – "restricting liquid manure application is one of the main farming practices used to control soil degradation. Similarly the restriction of application of manure and N and P fertilisers is used." UK - Within the study catchments, the recommended maximum rate of application on high risk areas is 50 m3/ha (MAFF, 1998).	Measures need to be adapted to reflect different crop systems and soil types. The incorporation of slurry should be done as quickly as possible when applied to bare soil (within 6 hours; MAFF, 1998). Belgium - Vegetable farmers find the restrictions imposed by the Manure Decree economically difficult, and consider that advice is lacking, whereas arable farmers do not report a problem. Spain - when comparing this practice to the practices preventing water erosion, uptake is quite low, at less than 20%. Experts consider the cost-effectiveness of this measure as very high.	+/- Measures are very positive in mitigating this important soil degradation process, however it requires careful application.

ANNEX II – THE UNCCD AND ITS FUTURE

a) The Objectives of the UNCCD Strategy

The UNCCD 10-year Strategy is guided by four long-term (ten years or more) **strategic objectives**:

1. *To improve the living conditions of affected population.* This is expected to improve and diversify the livelihood base of affected population, generate income from sustainable land management and reduce population vulnerability to climate change, climate variability and drought
2. *To improve the condition of affected ecosystems.* This is expected to enhance land productivity and ecosystem goods and services and reduce their vulnerability
3. *To generate global benefits though effective implementation on the UNCCD objectives* – as there are expected to contribute to the conservation and sustainable use of biodiversity and the mitigation of climate change
4. *To mobilize resources to support the implementation of the Convention through building effective partnership between national and international actors* - leading to increased financial, technical and technological resources and improving enabling policy environments.

It also aims to achieve five short-medium term (three to five years) **operational objectives**:

1. *Advocacy, awareness raising and education:* To actively influence relevant international, national and local processes and actors in adequately addressing desertification/land degradation and drought-related issues – e.g. improving communications, organising relevant international forums and involving civil society and scientific community
2. *Policy framework:* To support the creation of enabling environments for promoting solutions to combat desertification/land degradation and mitigate the effects of drought – e.g. identifying and addressing desertification/land degradation drivers, revising NAPs and integrating them into relevant plans and policies, mainstreaming UNCCD objectives into development cooperation programmes and introducing mutually reinforcing measures among desertification/land degradation, biodiversity and climate change.
3. *Science, technology and knowledge:* To become a global authority on scientific and technical knowledge pertaining to desertification/land degradation and mitigation of the effects of drought – e.g. supporting national monitoring and vulnerability assessments, developing a baseline of data, improve the knowledge on biophysical and socio-economic factors, and of the interactions between climate change adaptation, drought mitigation and restoration of degraded land, ensuring that effective knowledge-systems are in place and science and technology network institutions are engaged.
4. *Capacity-building:* To identify and address capacity-building needs to prevent and reverse desertification/land degradation and mitigate the effects of drought – e.g. undertaking national Capacity Self Assessments (NCSA) and implementing the actions there identified
5. *Financing and technology transfer: To mobilize and improve the targeting and coordination of national, bilateral and multilateral financial and technological resources in order to increase their impact and effectiveness – e.g. developing integrated investment frameworks and mobilising adequate resources (including innovative financial sources) to support domestic measures and facilitate access to technology.*

b) Full list of decisions taken at COP 8

The decisions and resolution taken at the COP8 meeting of the UNCCD are listed below.

Decisions

1/COP.8 Strengthening the implementation of the Convention in all regions

2/COP.8 Follow-up to the outcome of the World Summit on Sustainable Development relevant to the Convention and preparation for the sixteenth and seventeenth sessions of the Commission on Sustainable Development

3/COP.8 The 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018)

4/COP.8 Activities for the promotion and strengthening of relationships and synergies with other relevant conventions and relevant international organizations, institutions and agencies

5/COP.8 Mobilization of resources for the implementation of the Convention

6/COP.8 Collaboration with the Global Environment Facility

7/COP.8 Additional procedures or institutional mechanisms to assist the Conference of the Parties in regularly reviewing the implementation of the Convention

8/COP.8 Improving the procedures for communication of information, as well as the quality and format of reports to be submitted to the Conference of the Parties

9/COP.8 Programme of work of the seventh session of the Committee for the Review of the Implementation of the Convention

10/COP.8 Date and venue of the seventh session of the Committee for the Review of the Implementation of the Convention

11/COP.8 Roster of independent experts

12/COP.8 Functioning of the Committee on Science and Technology

13/COP.8 Reshaping the operation of the Committee on Science and Technology in line with the recommendations of the Intergovernmental Intersessional Working Group 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018)

14/COP.8 Networking of institutions, agencies and bodies

15/COP.8 Land Degradation Assessment in Drylands

16/COP.8 United Nations Convention to Combat Desertification fellowship programme

17/COP.8 Final report of the Group of Experts

18/COP.8 Programme of work of the Committee on Science and Technology

19/COP.8 Rule 47 of the rules of procedure

20/COP.8 Procedures and institutional mechanisms for the resolution of questions on implementation

21/COP.8 Annexes containing arbitration and conciliation procedures

22/COP.8 Relations between the secretariat and its host country

23/COP.8 Credentials of delegations

24/COP.8 Special segment: interactive dialogue sessions

25/COP.8 Report on the seventh round table of members of parliament

26/COP.8 Declaration of non-governmental organizations attending the eighth session of the Conference of the Parties

27/COP.8 Programme of work for the ninth session of the Conference of the Parties

28/COP.8 Date and venue of the ninth session of the Conference of the Parties

Resolution

1/COP.8 Expression of gratitude to the Government and people of Spain

c) Developments since COP 8 – A Detailed Review

Since COP8, the UNCCD institutions and subsidiary bodies (Secretariat, GM, CST and CRIC) drafted their strategic plans and a two-year operational programme. Furthermore, the UNCCD bodies met in a number of strategic meetings to discuss the COP follow-up and implementation of the 10-year strategic plan, namely:

- First Extraordinary Session of the COP – *New York, 26 November 2007*
- First UNCCD High-Level Policy Dialogue (HLPD) - *Bonn, 27 May 2008*
- Seventh Session of the CRIC (CRIC7) and First Special Session of the CST (CST-S1) *– Istanbul 3-14 November 2008*

The **First Extraordinary Session of the COP** convened in New York on 26 November 2007 to complete the budget discussion and approve the UNCCD's core budget for 2008-2009, amounting to € 14,896,000 (GTZ, 2008).

A **High-Level Policy Dialogue** was held in Bonn, on May 2008. The event discussed ways to forge the global partnership, provide the right global institutional platform and enact the reforms requested by the UNCCD 10-year Strategy.

In view of the upcoming CRIC7 and COP9, the High Level Policy Dialogue brought forward a number of measures and recommendations on partnerships, advocacy, funding, knowledge and science and regional implementation matters. With regard to *partnership* it was highlighted that affected countries should prioritise the fight against DLDD and undertake adequate reforms, while developed country parties were invited to earmark additional funds before COP9. The UNCCD Secretariat and the GM were required to provide advice and support, and the role of the private sector in implementing the Strategy was emphasized. As for *advocacy*, calls were made for a 'Stern report' on land degradation, pilot studies and collection of stronger scientific evidence. The UNCCD Secretariat was also invited to organise a global private-sector forum. In terms of *budget*, additional funding and investments for combating DLDD were called for, including innovative tools such as market-based mechanisms or carbon funding. Regarding *knowledge and science*, the need for markers and quantitative targets to assess the effectiveness of the Convention was stressed. A better understanding of the link between climate change issues and mitigation in the context of the UNCCD was suggested. An intergovernmental panel on land and soil should be created, while the International panel on Climate Change (IPCC) should develop a report on climate and land degradation. In the context of *regional implementation*, it was noted that cooperation between regions remain an important tools for implementation, and that better scientific dialogue should identify the advantages of addressing certain issues at regional level (GTZ, 2008).

The **seventh session of the CRIC (CRIC7)** and the **first special session of the CST (CST-S1)** convened in Istanbul (Turkey) from 3 to 14 November 2008. 145 Parties and a number of UN, intergovernmental and non-governmental organisations attended the meeting and discussed ways to further advance in preparing for the implementation of the ten-year Strategy. The CST identified a number of guidelines to select a minimum set of indicators – which are meant to create a common standard to make analysis at global, national, and local level feasible, and increase the effectiveness of the implementation of the Convention.

The Committee, in consultation with national science and technology correspondents, is expected to select such set of indicators, to finalized during scientific consultative meetings to be held next year and submitted to COP9 for consideration. It was also announced that the ninth session of the CST (CST9) will be held in 2009 back-to-back with a Scientific Policy Dialogue, and will be organized in a predominantly scientific and technical conference-style format, as now requested by the Strategy, to ensure peer scientific review (UNCCD, 2008b and c).

The CST session was followed by **CRIC7**, where the participants highlighted the importance of political awareness and the central role of national, sub-regional and regional action programs, as well as the need to develop performance indicators (in the context of the results-based management approach recently adopted by the UNCCD-RBM) and review the accomplishments of work plans and programs. Concerns were raised over the availability of resources for the implementation of the Strategy. More clarity was also called for on the roles of the different participants in the implementation of the Strategy (UNCCD, 2008d).

The delegates agreed on reporting principles and performance and impact indicators that will measure progress in the implementation of the Convention. Assessment of national capacity to implement the new reporting system will also be conducted in all regions. The new reporting format will provide opportunities for affected country Parties to address their success and constraints in implementing the Convention and its 10-year Strategy. For developed country Parties, future reporting should focus on providing information about how the Convention has been mainstreamed into their development cooperation strategies. Another significant step was the proposal to strengthen the involvement of civil society organizations in the review process. Important deliberations were also taken with regard to the review and monitoring system, the subsidiary bodies and institutions assisting the process, and the format of future meetings of the Committee. The main institutional and procedural reforms required by the 10-year Strategy are expected to be completed and put into action at COP9 in late 2009.

ANNEX III – IMPLEMENTATION OF THE UNCCD WITHIN MEMBER STATES

The following represent the detailed analysis of the actions taken by a sample of key Member States deemed 'affected' by desertification in the EU. Affected countries are those countries whose lands include arid, semi-arid, and / or dry sub-humid areas (defined in the Convention as those areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65) affected or threatened by desertification. The decision as to whether or not a country is considered 'affected' is taken by the country itself.

a) Northern Mediterranean Region

GREECE

The Greek National Action Programme (NAP), adopted in 2001, sets out a series of clear objectives, as outlined in Box a below.

Box a: Objectives of the Greek National Action Programme

1. Determination of threatened areas and their extent;
2. Estimation of the effectiveness of applied policy and measures taken;
3. More effective application and use of existing structures and institutions;
4. Elaboration of additional political, institutional, economical, social, and technical measures, and proposals on mechanisms required for their specification and implementation;
5. Formulation of a national strategy, to prevent and mitigate desertification, and to promote sustainable land and water use, and to secure biodiversity, while minimising social conflicts concerning land use;
6. Promotion of public awareness and encouraging active participation of affected populations and of their local agencies to the formulation and implementation of local and specialised measures;
7. Selection and formulation of priorities and pilot – actions;
8. Demographic and socio-economic rehabilitation of areas facing desertification;
9. Establishment of a network for early diagnosis and warning;

Source: *Greek National Committee for Combating Desertification, (2001), "Greek National Action Plan For Combating Desertification (Extended Summary)"*

These objectives establish a sense of purpose for the NAP and involve evaluating the current state of desertification in Greece and planning for the future through both rehabilitation of already degraded areas and mitigation of further damage.

The NAP sets out the factors and processes of desertification in Greece and general measures to prevent and mitigate desertification, which include:

- Determination of threatened areas;
- Increasing information and awareness of groups involved;
- Establishment of agencies responsible for application and monitoring;
- Land use planning and its implementation;
- Allocation of necessary financial resources;
- International cooperation;
- Selection of pilot areas;

- Restoration of affected areas;
- Research; and
- Legal and institutional measures.

The successive chapters of the NAP outline specific measures for combating desertification in each of the following sectors: agriculture, forestry, fauna, stock-raising, water resources and socio-economic factors. Two tables summarise the preventative and corrective measures in the short, medium and long term, the consideration of approaches in the short, medium and long term identifies how measures for these time horizons can differ.

The NAP is concluded with a section on general instructions on the implementation of the action plan. The measures and actions outlined in the NAP are to be taken in the following order:

- Development of a general policy and strategy for combating desertification;
- Development of the necessary legal and institutional framework;
- Securing necessary funds;
- Promotion of public awareness;
- Adoption of incentives for stakeholders;
- Exact demarcation of affected zones;
- Initial implementation of the Action Plan in the designated pilot areas;
- Design and application of detailed local projects;
- Evaluation of results and updating of both the local projects and the NAP; and
- Implementation of the NAP throughout the affected zone around Greece.

The NAP assigns the responsibility for implementing and monitoring the outlined measures to the Greek National Committee for Combating Desertification.

ITALY

Italy's National Action Programme (NAP), approved in 1999 lists laws, decrees and decisions that the NAP complies with. Four pages are given to describing the NAP itself. The NAP does not identify any specific objectives and adopting a regional approach. Italian Regions and watershed authorities are expected to adopt measures and strategies in the form of specific programs to combat drought and desertification in vulnerable areas. The four priority sectors to be addressed in regional programmes are:

- *Soil protection* in areas vulnerable to desertification, this includes agricultural areas with intensive and marginal production, areas at risk for accelerated erosion, areas damaged by contamination, pollution, fires, fallow and abandoned areas;
- *Sustainable management of water resources*;
- *Reduction of environmental impact from productive activities*; and
- *Land restoration.*

A list of broad measures is outlined for each priority area, but no detail or specific direction for enacting these measures is provided in the NAP and it is unclear how they are to be implemented, nor who is responsible for this.

The regional section is followed by a section on national activities, which identifies possible measures for information, training and research, proposed by the Italian National Committee to Combat Drought and Desertification (NCCD). The NCCD was established in 1997 and is expected to *inter alia* promote and coordinate support for Italian regions and watershed authorities to identify “areas vulnerable to desertification”; promote the adoption of standards and methods better suited to understanding, preventing, and alleviating desertification phenomena in these areas; and collect uniform soil data for the whole country.

The NAP also identified the following areas of intervention:

- assessing the efficacy of existing regulations such as those on water resources management, land management, forests, etc;
- promoting coordination among relevant State actors (relevant Ministries, Regions, Authorities at basin level.), other bodies and non-State actors to elaborate inter-sectoral programmes;
- promoting an integrated management of water resources, soil, forests, landscape taking into account the negative impacts of human activities.

The 2006 Italian national report notes that, following the adoption of the NAP, some administrative regions of Italy have approved the Italian Region Action Programme (IRAP) to Combat Desertification.

PORTUGAL

The National Action Programme for Portugal (NAP), presented in 1999, is described in its introduction as “a tool offering guidance for action” to combat desertification. The NAP discusses the extent and causes of desertification in Portugal and the indices used to assess this. The development of the NAP is seen as helpful experience to contribute to the Sub-Regional Action Programme for the Northern Mediterranean (see above).

The five strategic objectives of the NAP are outlined in Box b below:

Box b: Objectives of the Portuguese National Action Programme

1. Soil and water conservation
2. To fix the working-age population in rural areas
3. Recovery of affected areas
4. Campaigns to raise public awareness of the issue of desertification
5. Making the fight against desertification an integral part of general and sectoral policy

Source : *Direcção-Geral Das Florestas and Instituto de Promoção Ambiental - Portugal, (1999), “National Action Programme to Combat Desertification: Portugal”*

These strategic objectives are followed by more specific objectives, which include *inter alia*:

- Using regional, rural and local development as a determining factor in fixing population in regions susceptible to desertification and drought;
- Improving conditions for sustainable agricultural activities;
- Expanding and improving forests and their management;
- Identifying those areas most affected and allocating resources to recover degraded areas; and
- Designing water resources management policy to ensure territorial integration;

"Axes of intervention and operational guidelines" are detailed for each strategic objective, providing more precise measures by which to implement the Convention. In terms of the objective of soil and water conservation, actions outlined include: drafting and applying codes of good practice for farming and forestry; supporting investment in small-scale irrigation schemes; reinforcing support for the continuation of farmland areas within forests; undertaking measures to structure land ownership patterns; expanding support for biological farming and the certification of quality products; adapting aid to drought conditions; ensure the issue of desertification is taken into account in the Regional Forest Plans and in Management Plans; condition activities aimed to defend water courses; monitor urban/industrial pollution; manage water resources in an integrated way; and drafting emergency plans for drought situations. In terms of action to support the objective of recovery of affected areas, proposed measures include: support for the recovery of farming records; promoting the drainage and conservation of soils; reinforcing support for afforestation and forest protection; adapt agro-environmental measures to the objectives of combating desertification; and moderating the type and level of support provided to agriculture and forestry depending on the degree of susceptibility to desertification. Although these measures are fairly broad, they direct action to the appropriate area, thus facilitating the implementation of the objectives.

The NAP recognises that assessment and evaluation of progress is essential to the success of the NAP and recommends that a National Committee to Coordinate the Fight against Desertification be set up, along with a National Desertification Observatory to monitor and assess the implementation of the NAP. The NAP concludes with further advice on implementation, monitoring and assessment.

SPAIN

In August 2008, the Spanish Ministry of Environment and Rural and Marine Environment published the National Action Program to Combat Desertification (known by the Spanish acronym - PAND). The programme has been under discussion since 2000 and identifies reforestation, the control of grazing and improved water management as the most effective means of combating desertification. The Spanish Ministry of the Environment, in collaboration with the Ministry of Agriculture, Fisheries and Food and the autonomous communities, will be involved in the implementation and monitoring of the PAND.

The main objectives of the PAND are to contribute to achieving sustainable development in affected areas of the country, in particular by preventing land degradation and promoting restoration of affected land; to identify factors contributing to desertification and measures required to combat desertification, and to mitigate the effects of drought.

The underlying principles of the PAND are summarised in Box below.

Box c: Principles of the Spanish National Action Programme (PAND)

1. The integration program in the national sustainable development policy
2. Flexibility to changing circumstances and territorial sensitivity to adapt to different socio-economic, cultural, biological and geophysical conditions;
3. Special attention to preventive measures for land that is not yet degraded land, but subject to the risks of desertification
4. Promote the coordination and institutional design and development of policies needed to implement the various sectoral activities
5. Encourage participation of all sectors

Source: *Ministerio de Medio Ambiente y Medio Rural y Marino, (2008), Programa de Accion Nacional Contra la desertification*

The PAND establishes principles for the coordination of sectoral actions aimed at combating desertification, and defines specific action to be developed by the Ministry of Environment and Rural and Marine Environment in the fight against desertification. The PAND proposes an institutional framework of the Centre of Desertification in Spain (ODE) and the Technical Office of Desertification (OTD).

The third Spanish report on national action to combat desertification, presented in 2006, outlines various measures taken in sectors closely related to desertification, including rural development, agriculture, forestry and water resources management. These measures include:

- Integration of environmental considerations in price and market policies;
- Strengthening of the agri-environmental measures programme;
- Programme on afforestation of agricultural land;
- Restoration of vegetation cover and increase of wooded area;
- Promotion of sustainable forest management;
- Increasing resources in the fight against forest fires;
- Improving forest defence and protection**;**
- The development of Special Action Plans for danger situations and drought and an early warning global system of hydrological indicators by National Basin Bodies;
- Creation of the National Drought Observatory (ONS) to cover every Spanish water administration and set up a centre of knowledge, early warning, mitigation and monitoring of the national effects of drought;
- Integration of groundwater management and protection as a key point in the hydrological planning, and thus the elaboration of a Groundwater Action Plan for every basin; and
- Actions in National Irrigation Plans (PNR) to incorporate environmental requirements in land and water management.

Furthermore, national water management policy has strengthened its links with action to combat desertification and drought, and is now clearly oriented towards the rationalisation of demand for water resources against the increase of supply capacity. The report also notes that Spain is changing its perception / concept of drought. In the past drought was considered a cyclical or sporadic problem resulting from irregular climate, for which emergency solutions were considered the only possible answer. Whereas drought is now being treated as a structural problem, to be combated via appropriate management-based strategies focused on an integrated approach to planning and management.

b) Central and Eastern Region

ROMANIA

The Romanian National Action Programme (NAP), presented in 2000, contains a detailed description of the physiogeographical characteristics of Romania and the factors that generate desertification, degradation and drought in the country. Affected areas are identified and a strategy for prevention and control of desertification, land degradation and drought is outlined including the context of the national political, legislative, institutional frameworks.

The two general objectives of the NAP and six priority areas for action are outlined in Box d below:

Box d: Objectives and priorities of the Romanian National Action Programme

General objectives:

- To eradicate and prevent desertification, drought and land degradation in vulnerable areas
- To eradicate and prevent land degradation in wet areas

Six priority axes for action:

- Development and improvement of legislation
- Institutional development - capacity building
- Development of human resources
- Development of technical and scientific potential
- Rural development in areas vulnerable to desertification
- Rural development in wet areas vulnerable to land degradation

Source: *Based on Forest Research and Management Institute, Research Institute for Soil Science and Agrochemistry, National Company "National Institute of Meteorology, Hydrology and Water Management" - Romania, (2000), "National Strategy and Action Programme Concerning Desertification, Land Degradation and Drought Prevent and Control",*

The NAP goes on to detail various practical measures to prevent and control desertification and drought (including measures to protect environmental components under drought conditions, rehabilitation and development of irrigation systems, forest belts and passages, improving hydrological systems in dammed water areas, slope terracing, promoting alternative and drought resistant crops and special soil management, ecological rebuilding of dry woods, water resource management in areas of drought, and improving supplementary water resources); measures for controlling land degradation with regards to eroded soils, land slides, salt affected soils, sand and sandy soils, compacted soils, acid soils, soil with low organic matter and macronutrients content, and polluted soils; increasing public awareness and education; improving scientific research and education development; support for economic activities in particular ecological agriculture and forestry; and a financial fund for the realisation of strategic objectives. In terms of action to develop and improve legislation, objectives include: improving legislation on water use; "perfection" of legislation on soil protection; improving legislation on reclamation of degraded lands and halting torrential phenomenon; and promoting the legislative framework to combat drought and desertification. An annexed table provides a summary of the actions planned under each priority axis, along with their expected costs, time and institutions that will be involved.

The NAP also outlines the main existing documents/legislation related to or regulating issues concerning desertification, land degradation and drought prevention/ control. As part of institutional capacity building, a National Committee for desertification, land degradation and drought prevention and control is established with responsibility for implementation of the NAP. A unitary database, including the use of Geographical Information Systems (GIS), is proposed for monitoring purposes and indicators are identified by which to measure changes during monitoring.

POLAND

The latest national report from Poland, submitted to the UNCCD in 2006, on actions undertaken to implement the Convention focuses on actions taken in selected third countries, including the provision of development assistance, financial, and educational support. In terms of implementation of the Convention in Poland itself, the report states that the main focus of actions is on raising awareness of the Polish public of the problem of desertification; and on scientific research regarding drought, desertification and the interrelated problems of climate change. The Ministry of Environment is responsible for implementing the Convention and for counteracting drought and mitigating its effects in Poland.

The report highlights a number of national legislative measures and programmes which aim to counteract the effects of droughts, including the Water Law Act (2001); Forest Act (1991); and Agricultural and Forest Land Protection Act (1995). The Water Management Strategy adopted in 2005 is of particular relevance and is accompanied by an action plan which requires *inter alia*:

- the development of an action plan to counter the effects of drought in Poland;
- the development of the National Water Retention Plan;
- the construction of retention basins and stages of fall;
- support for development of technical measures for small retention (e.g. small water basins, weirs, drop gates, stages) and non-technical measures (e.g. forestation, protective zones of vegetation, protection of ponds, marshes, etc.);
- and the more rational use of water and investments to ensure good quality.

Furthermore, in order to alleviate the effects of drought on agriculture, the government can introduce various short-term measures including temporary allowances in farming taxes, reducing land tenure rent, and providing social aid for affected farms; as well as providing more systematic solutions such as disaster credits for resuming production in affected areas, the provision of preferential credit and guarantees; and speeding-up advance payments from direct additional payments. The report goes on to state that the implementation of the above mentioned measures is expected to result in a 25% reduction of the risk of drought losses by 2020 (when compared to 2003).

More recently, provincial programmes for small water retention have been developed for irrigation and work has commenced on the national farmland irrigation programme which aims include *inter alia* measures to reduce the effects of drought. The Institute of Cultivation, Fertilization and Soil Science - National Research Institute (IUNG-PIB) is participating in the development of the national strategy for preventing soil drought up to 2020.

The national report notes that, in accordance with the provisions of the Convention, Poland will aim to prevent further soil degradation and strive for the re-cultivation of degraded land (in particular post-industrial land); the reforestation of uncultivated land (including so called marginal land); and will aim to reduce the phenomenon of hydrological drought. Future objectives / measures include: increasing forestation; developing agricultural and forestation melioration programmes; expanding the response system for extraordinary threats to drought; further development of drought monitoring methods and forecasting methods; starting an agro-meteorological service for planning and realization of tasks to counteract and reduce the effects of drought; and the development of a soil protection strategy and an action program for its implementation. The report notes that the effective implementation of unified protection measures (including soil protection policy) is complicated by the disperse structure of Polish agriculture and the prevalence of small, family-owned farms.

On the other hand, the national ownership of forest reserves facilitates the consistent implementation of sustainable forest management measures; while a low level of agricultural production intensity, favours the implementation of agro-environmental programs.

CZECH REPUBLIC

The national report of the Czech Republic submitted in 2006 states that "the Czech Republic does not belong to the countries affected by desertification, but only to the group affected by moderate soil degradation (e.g. soil exhaustion due to agricultural overuse, contamination with chemicals)". The national report focuses on official assistance provided to affected developing countries through projects addressing issues such as soil degradation, hydrogeology, hydrology and forestry. Action at the national level is not covered in the report.

In December 2006, the Czech Republic established a Regional Reference Centre (RRC) called "Soil Conservation strategies and planning" hosted by the Mendel University of Agriculture and Forestry in Brno (MUAF) which serves 22 country partners in the CEE region. The centre provides details on available sources of information and databases on soil degradation and conservation and contributes to the sharing of best practices in the region.

As noted in a Czech report to the UN Commission on Sustainable Development, "a specific goal in the protection against detrimental effects of water, including drought, is to retain water in the landscape by optimizing landscape structure and its exploitation, and taking preventive measures, both natural and technical". The Czech River Basin Management Plan outlines goals concerning water protection from the detrimental effects of drought which include: implementing adaptation measures specified in the National Programme for the Reduction of Climate Change Impacts; integrating other resource management sectors and regions in long-term evaluations of demand for water resources; enforcing the concept of handling rainwater in urban drainage areas, allowing for rainwater accumulation, infiltration and direct use; ensuring the requirements of "good agricultural and environmental condition" and cross-compliance take into consideration an increase in water infiltration; create appropriate research and development programmes; restore existing water reservoirs by removing sediment; and protect areas suitable for artificial accumulation of surface water to compensate for climate change impacts.

HUNGARY

The second national report of implementation of the UNCCD in Hungary, submitted in 2006, notes that drought is a considerable risk, particularly on the Great Hungarian Plain, that signs of desertification can be found in other parts of the country and that the problem of drought is compounded in certain areas by soil erosion. The report notes that combating desertification and drought is a significant priority in Hungary, in light of long-term observations and studies on the impacts of climate change. Intensive research work has been carried out in Hungary on the evaluation of the effects of drought; determination of the reasons and circumstances in which drought occur; the effects of drought on plant production and animal husbandry; and methods for reducing the harmful impacts of drought.

The report outlines the national legislation that forms the basis of national plans and strategies in relation with drought, desertification and land degradation, including the National Development Plan, Act LIII (1995) on the general rules of the protection of the environment, Act LIII (1996) on nature conservation and Government decision 2142/2005 (VII 14) on the preparation and elaboration of the National Drought Strategy and the National Action Programme related to the fight against drought and desertification in the country.

The Hungarian National Drought Strategy (NDS) was elaborated in 2006. The Strategy provides the strategic planning framework for the protection and sustainable management of ecosystems in drought-prone areas, and summarises the concepts, methods, steps and sources of prevention and drought mitigation in the country. Key elements of the strategy include: the promotion of water-saving farming methods (e.g. tillage systems, the application of organic manure, the use of certain types of agricultural machines); plant protection and weed control; amelioration and irrigation; afforestation and plant breeding; and the improvement of observation systems. A National Action Programme (NAP) on drought mitigation is to be prepared on the basis of the NDS.