DESIRE REPORT series

Drivers, Policies and Laws in DESIRE Study sites

- Identified drivers of land degradation with specific reference to the study areas at field, local and policy level (***del. 1.3.1***)
- Report on the main drivers of desertification (law and policy) as well as of the impact of desertification (***del. 2.1.2***)

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ISRIC World Soil Information

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1 Introduction

1.1 Background

Within DESIRE, information on drivers of desertification and on existing policies relevant for desertification plays an important role, because this information is used in WB5 to define policy scenarios for modelling with PESERA/DESMICE. These scenarios, and their results, form one of the cornerstones of the policy-relevant results that will be obtained by DESIRE.

The information for this report is based on reporting by the coordinators from the DESIRE study sites, in both WB1 and WB2. Each study site received questionnaires from ISRIC, responsible for WB1, on the institutional setting and stakeholders and their information needs. The information for those questionnaires was compiled during stakeholder workshops (through stakeholder questionnaires) by the study site coordinators, and the questionnaire on the institutional capacity was received from relevant institutions in the country of the study site, through the study site coordinators. The information on drivers and policies was compiled by the study site coordinators and was based on a standardized reporting format for all study sites (see Appendix 2) that formed the basis of the study sites descriptions reported on in deliverable 1.2.1. This format specified the information that should be reported on, in terms of general information on the study site, biophysical setting, socio-economic conditions, institutional and political setting, relevant end-users/stakeholders, and past- and ongoing projects (see reporting format Appendix 2). Another source of information about desertification drivers were the indicator questionnaires that were completed in the framework of WB2. Some partners have compiled a more elaborate report on the desertification drivers, policies and laws in their study sites (Greece, Tunisia, Botswana), see appendix 4.

In addition to this, all DESIRE study site coordinators listed separately the relevant degradation types in the study sites, the perceived drivers of desertification and policies relevant to the desertification issue, their possible impact if known and the responses to desertification, and other relevant socio-economic and environmental factors.

1.2 Definitions and concepts

Land degradation in drylands is commonly known as desertification. Drylands are defined as those areas where the ratio of precipitation to evapotranspiration is 0.65 or lower (also referred to as aridity index). The dominant land use on drylands is pasture and rangelands (88 percent), while only nine percent are in rainfed cropland, and three percent are under irrigation (UNEP 1992a).

Many definitions of desertification and degradation are used and sometimes the terms are used interchangeably.

UNEP (1992b) defined desertification as 'land degradation in arid, semi-arid, and dry sub-humid areas resulting mainly from adverse human impact'.
Degradation implies reduction of resource potential by one or a combination of processes acting on the land. These processes include water erosion, wind erosion and sedimentation by those agents, long-term reduction in the amount or diversity of natural vegetation, where relevant, and salinization and sodication (UNEP, 1992).

Drylands
More than 50% of the world land mass is covered by drylands that is the habitat for over two billion people. Drylands support nearly 40% of the global population (CIESIN 2000; Diechmann and Eklundh 1991). The distribution of these dryland populations vary within each region and among the aridity zones comprising drylands. Figure 1 shows the global extent of drylands.

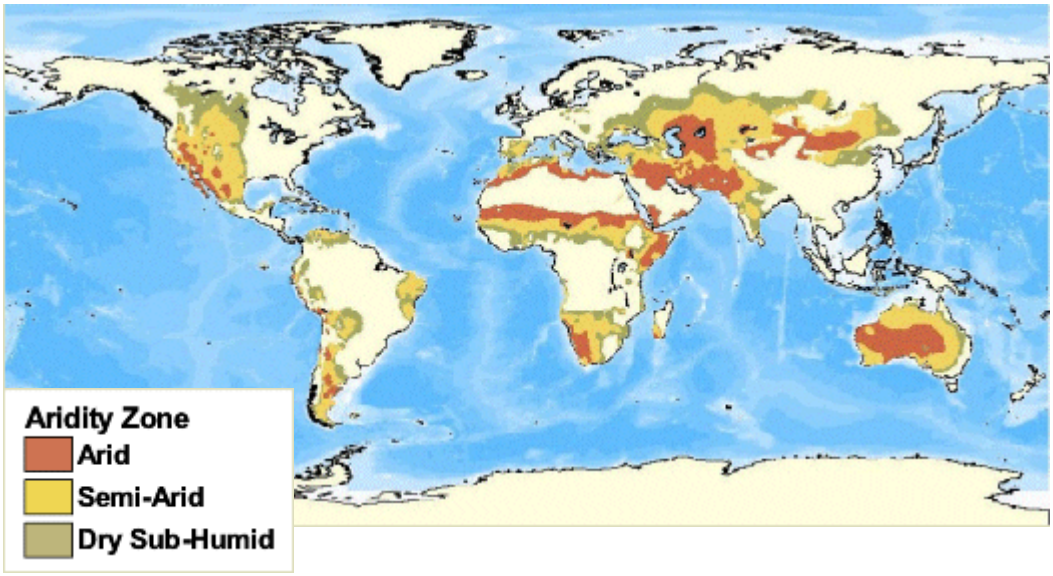

Figure 1: Extent of global drylands (Diechmann and Eklundh 1991).

Land degradation is discussed in this report in terms of the factors that cause land degradation ('drivers') and the policies and actions that aim to reduce land degradation ('responses'), although policies are sometimes drivers too.
The theoretical framework commonly used for this is the DPSIR framework (OECD, 1993).

Dryland ecosystems

Four dryland subtypes are widely recognized: dry sub-humid, semiarid, arid, and hyperarid, showing an increasing level of aridity or moisture deficit (MEA 2005). Dryland ecosystems have high climate variability and associated

environmental changes. They are inherently non-equilibrium systems and ecosystem dynamics are essentially event-triggered (Puigdefábregas 1998). In the process of desertification a general climatic trend may intensify towards greater aridity, or it may initiate a change in local climate. It is a complex process that often has multiple causes. Desertification processes are often non-linear (Baartman *et al.* 2007) and occur at varying rates in different climates. In assessment and monitoring of desertification the challenge is to discriminate between inherent phenomena and characteristics that are part of the long term natural variability of the ecosystem, such as drought and climate variability, and conditions where the ecosystem is driven beyond its resilience thresholds (Puigdefábregas 1998).

2 Objectives

Agricultural, environmental, and development policies have an impact on the sustainability of land use and management. WB1 assessed drivers for desertification as well as opportunities for sustainable land management in each study site. The objectives were 1) to provide information on drivers and policies to other Working Blocks as well as to study site and 2) to provide input to the policy scenarios that are modelled in WB5.

Work package 1.3.1 was to deliver: A list of desertification drivers with specific reference to the study areas at field, local and policy level. The drivers identified will be used amongst others for, formulating scenarios in the PESERA model runs.

Work package 2.1.2 was to deliver: A report on the main drivers of desertification (law and policy) as well as of the impact of desertification, based on the indicator questionnaires that were used in WB2. A description of the indicators for the different study sites can be found in deliverable 2.1.1, while their analysis is described in deliverable 2.2.1.

3 Drivers and Policies

In the northern Mediterranean (UNCCD Annex IV), as in other areas around the world struggling with desertification, the main driving forces and processes that cause desertification can be linked in a cause-effect structure, see Fig. 2 (DESIRE 2007). Primary factors are climate, soils, topography and socio-economic activities, which by themselves or in combination cause a number of temporary or permanent changes in the landscape, leading to degradation of vegetation and soils. Increased runoff and soil erosion also cause off-site effects such as flooding and siltation of surface waters. Moreover there are additional feedbacks from the vegetation and soil

degradation processes to all primary factors, so that the desertification processes may enter into a downward spiral that leads to irreversible degradation of the whole system. Climate is one of the main driving forces of desertification. In many parts of the world prolonged droughts are followed by wetter periods. Dryland ecology can respond quickly to temporal and spatial variability in available moisture, and plants and animals recover rapidly, but, in the longer term, degradation reinforces the tendency to drought.

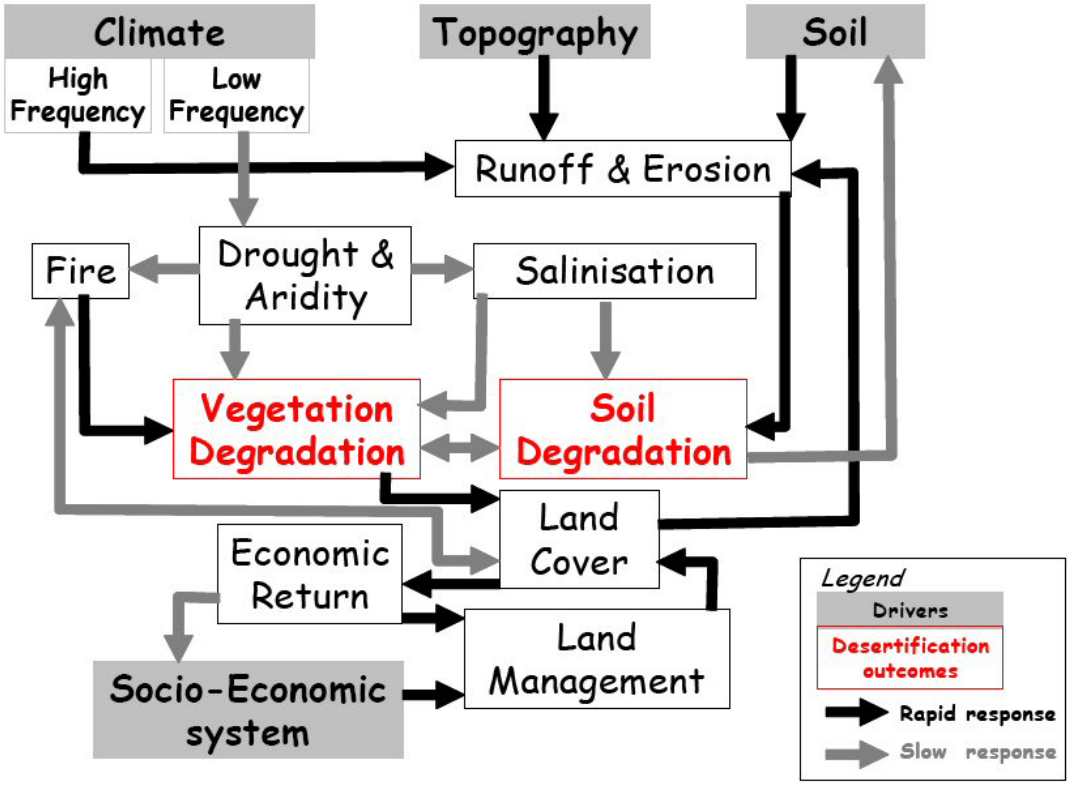

Figure 2: A basic conceptual view of the relations between the primary drivers of change, climate, soil, geomorphology and socio-economic drivers, and the resulting changes in processes and the degradation effects on vegetation (including agricultural land use) and soil. Source: (DESIRE 2007)

The DPSIR framework

The DPSIR framework (Driving force, Pressure, State, Impact, Response) provides a structure for decision makers to assess the impact of past measures on the status of the environment or to formulate effective measures; see Box 1. It is an extension of the pressure-state-response model developed by the Organization for Economic Cooperation and Development (OECD 1993). This framework has been adopted by the European Environment Agency (European Environment Agency 1995). The framework is a simplified conception of reality and a pragmatic approach to structure information. The methodology was chosen to structure and analyse the data because the framework assumes cause-effect relationships between

interacting components of social, economic, and environmental systems. It helps to discriminate between inherent characteristics of ecosystem and causes for change (drivers) and the associated processes (pressures), the impact on the ecosystems and/or society, and the responses of society (e.g. policies, land management methods) to influence the environmental quality decline. The framework defines driving forces that exert pressures on the environment. The pressures may induce changes in the state or condition of the environment. The subsequent impacts on socio-economic and biophysical attributes cause society to respond by developing or modifying environmental and economic policies and programmes aimed to prevent, minimize or mitigate pressures and driving forces (Figure 3). Describing the causal chain from driving forces to impacts and responses is a complex task, and tends to be broken down into sub-tasks, e.g. by considering the pressure-state relationship (Kristensen 2004).

Box 1: Description of the components of the D-P-S-I-R framework

Driving Forces: These are the underlying social and economic activities that lead to environmental change. Population growth, poverty, agriculture and industrial production are common examples.
Pressures: These are pressures on the environment which result from the driving forces, for example pollution of air, water and soil from industrial production, or depletion of fish stocks through human consumption.
State: This component describes the current state of the environment and recent trends in environmental quality.
Impacts: These are the consequences of the pressures on the environment, for example reductions in biodiversity, soil degradation, poor human health, and lack of clean, safe water.
Responses: This component describes the human responses to environmental change, including policies and management strategies to reduce environmental damage, rehabilitate damaged environments and encourage sustainable development. (Source: National SOE: www.environment.gov.za)

The DPSIR approach recognizes the dynamic nature of land degradation. The status of land degradation is defined relative to a previous situation, when driving forces exerted pressure on land. The status of the land is a result of this pressure, which in turn may have an impact and may drive a future response. Time is an intrinsic factor therefore in the framework and needs to be considered in use of the methodology at all levels.

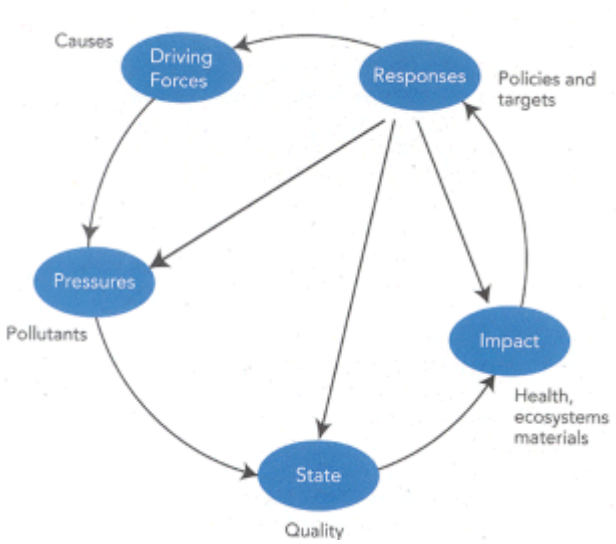

Figure 3: Example of the DPSIR framework (Cefas 2008).

Use of DPSIR in this study

The use of the DPSIR modelling framework made it is possible to gauge the effectiveness of responses. As a first step, data and information was gathered on policies, desertification status and processes and on socio-economic conditions. In analyzing the data, the different data items were structured in and formulated to elements fitting the DPSIR chain. Then possible connections between these different aspects were then analyzed.

4 Drivers, pressures, impacts, responses, and policies in the Study Sites

4.1 DESIRE study sites and desertification issues

Table 1 summarizes the general climatic conditions, dominant land use and the main desertification forms that feature in the DESIRE study sites.

The climate in the DESIRE study sites ranges from (semi-)arid to sub-humid. Rainfall distribution and average annual rainfall varies considerably between sites. Average annual rainfall is typically below 600 mm, often below 300 mm and sometimes below 100 mm.

The dominant land uses are mostly dryland farming and pastures, with increasing importance of irrigated arable farming and other forms of capital intense farming.

Most sites have various forms of land degradation occurring in and around their study site. The dominant desertification type reported is soil erosion by water, except for the Turkish and the Botswana sites where wind erosion is

the major degradation form and Greece-Nestos, where salinisation is the most important degradation process. Vegetation and biodiversity decline and soil salinisation are other degradation processes reported in several sites. Some site report groundwater depletion, decreased productivity/ carrying capacity, soil fertility decline, and runoff. Other sites report seawater intrusion in the groundwater (Greece, both sites) and water logging (Russia, Novy). Water pollution under intensive forms of agriculture is reported in the Spanish and the Greek (Crete) site.

Table 1: DESIRE study sites, their climate, land use and desertification issues.

Study site	Climate	Dominant land use	Dominant desertification issue / process
Spain, Guadalentin basin	Semi-arid to sub-humid Mediterranean	Dry land farming and irrigated orchards	Soil erosion
Portugal, Mação, Gois	Intermediate Atlantic and the Mediterranean climate (P_{annual}: 580 mm)	Pasture land for extensive grazing and shrub land and forest	Forest fires, soil erosion, bio-diversity loss
Italy, Rendina basin	Intermediate between humid-subhumid and subhumid-semiarid	Arable land (60%)	Soil erosion, Mass movement, soil slip
Greece, Crete	Dry sub-humid Mediterranean	Olives and pastures	Soil erosion, soil compaction
Greece, Nestos river basin	Intermediate Mediterranean and mid-European type	Irrigated agriculture	Salinisation, soil degradation
Karapinar, Turkey	Continental climate, average annual precipitation of 284 mm	Irrigated arable farming	Wind erosion, Ground water depletion
Eskisehir, Turkey	Dry continental climate with an annual precipitation of 380 mm	Rainfed farming (cereals)	Water erosion, wind erosion
Sehoul, Morocco	Semi-arid (annual rainfall generally varying between 200-600 mm)	Arable farming (dryland and irrigated),	Forest degradation and overgrazing Soil erosion, ground water depletion
Tunisia, Zeuss Koutine	Mediterranean to Saharan type (150-240 mm annual P in mountains, to <100 mm bordering the desert)	Cultivated dryland	Soil erosion, biodiversity loss
Russia, Dzhanybek and Novy	Continental climate (Novy), P: 391 to 435 mm per year, dry steppe climate (Dzhanybek), Mean annual precipitation is about 150-300 mm	Cropland, specifically annual and perennial (non-woody) cropping (Novy) and grassland (Dzhanybek)	Soil erosion, salinization (Dzhanybek), Soil salinization, water logging (Novy)
China, Loess plateau	Arid and semi-arid	Dry land farming	Soil erosion by water and wind, vegetation degradation
Boteti area, Botswana	Semi-arid climate, average rainfall is 350mm/yr with 38% variability	Floodplain arable farming, communal grazing, game farming	Extreme human induced wind erosion
Mexico	Temperate, sub-	Agriculture on	Soil erosion by

	humid, with heavy rains in summer (average rainfall 700 to 900 mm/year	forest margins with grazing on fallows	water
Secano Interior, Chile	Mediterranean with 250 – 1200 mm of mean annual rainfall, and 7 – 4 months of drought	(natural) pasture land and forest plantations cover 86% of the 1M ha of the study site, 9% field and tree crops	Soil erosion, Water quality and quantity decline, Vegetation degradation
Cape Verde, Ribeira Seca	Arid to humid	Subsistence Rainfed farming	Soil erosion, vegetation degradation

Source: Compiled from study site descriptions and information from study site coordinators.

4.2 Drivers of desertification

This chapter is a summary of the reports from all study sites on the drivers of desertification and on the policies that can have an impact on desertification, both positive and negative.

The main environmental factors influencing desertification in the Mediterranean region are the Mediterranean climate, characterized by dry summer with intense autumn rainfalls, tectonic uplift, deforestation, loss of natural vegetation cover after wildfires, overgrazing, erosion-inducing management of agricultural land, and low soil stability.

Table 2 summarizes the results of a survey, using questionnaires, for drivers of desertification and their impacts in DESIRE study sites. It lists those factors with the highest frequency in the DESIRE study sites. It is not a ranking of severity of importance of each driver. The full list of drivers, policies, pressures, responses and their impacts are provided in Table 3 and Table 4 (Appendix 1). See Appendix 3 for a diagram of processes and drivers and their interrelations.

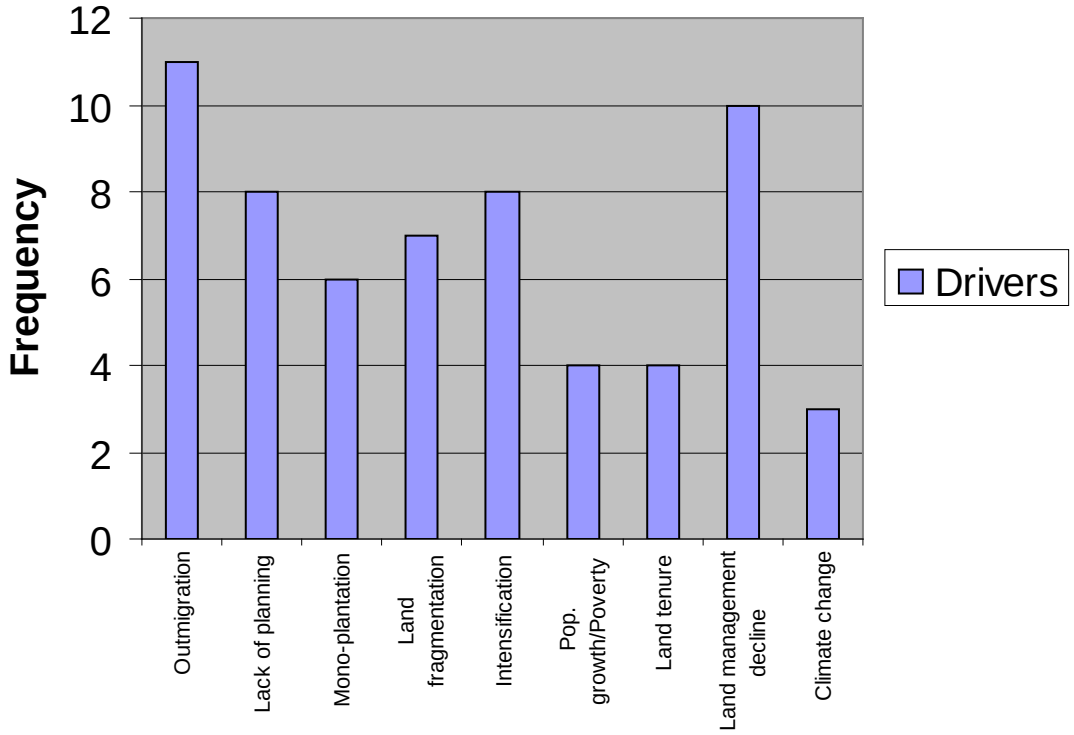

Figure 4: Frequency diagram for major drivers of desertification in the DESIRE study sites.

Figure 4 shows the frequency of reported drivers for desertification/ degradation in the 16 DESIRE study sites.

Outmigration is a key driver of desertification mentioned in eleven sites and ten countries of the DESIRE project study sites. It is indicative of a global trend of increasing urban population and declining rural population. It is estimated that around 2007 for the first time more people live in cities that in rural areas (see Figure 5). In the Mediterranean countries outmigration causes neglect of existing soil and water conservation structures that collapse as a consequence and with accelerated erosion as a result. Also, as in Spain, the disappearance of the mosaic landscape pattern contributes to the increased land degradation at the catchment level. The depopulation of the rural area is (positively) related to land abandonment, land use intensity[1] and land fragmentation. Land abandonment can have positive or negative

[1] Land use intensity may refer to all types of land use and was assessed based on MEDALUS III methodology. Land use intensity in cropland areas is related to input level; the degree to which cultivation of the land is mechanized, the application of fertilizers and pesticides, and the use of irrigation. In forested areas land use intensity is related to yields in wood extraction compared to sustainable wood extraction. Recreation areas can be subjected to high number of visitors in certain periods affecting the soil surface through e.g. destruction of annual vegetation, disturbance of soil aggregates, formation of pathways in which runoff water can concentrate and cause e.g. gully erosion. In mining areas soils are usually disturbed with the bedrock or waste materials exposed at the surface. Such areas require rehabilitation by transporting and spreading soil for allowing the native vegetation to grow.

impacts on conservation of natural resources depending on the physical environmental conditions at the time of abandonment and the land management characteristics after abandonment (AUA 2010). In a study of desertification in the DESIRE study sites using indicators (AUA, 2010) found for instance that grazing intensity increased in (recently) abandoned areas further deteriorating already degraded lands. On the other hand the rate of land abandonment was negatively related to forest fires in that study. Forest fires occurred more in areas with a low rate of land abandonment. The exodus of rural people to the towns is a global trend and is caused by land use changes (e.g. in Europe and Morocco) where agriculture has intensified and there is a lower need for labour and traditional dry land farming is disappearing because of falling prices. Other countries (outside Europe) suffer from the falling prices too and decreased profitability of (smallholder) farming. In developing countries farm efficiency and profitability decline due to decreasing productivity, the decreasing farm size due to inheritance systems, and the claim on high quality agricultural lands for urban development. The loss of rural population leads to skewed age distribution of remaining population and depopulation of rural villages. Service provision and labour requirement, and therewith opportunity for work, in the rural area declines. The exodus of young people from rural areas means a loss of labour and social capital and the land use change and decline of traditional dry land farming causes a loss of knowledge of sustainable practices in these fragile environments. In the desertification indicator study in the DESIRE field sites (AUA, 2010) soil erosion control measures were negatively related to social indicators such as old age index, and population growth rate. These were two opposite trends related to the social characteristics of the study field sites. In one case, old aged people do not care so much for applying measures for soil erosion control, in the other case, high population growth rates lead to over-exploitation of the land. It seems that the optimal social conditions related to these indicators are somewhere in the middle, that means moderate population growth rate and old age indices.

The reverse case also occurs where desertification is the driver for outmigration as it leads to a decline of the quality of the environment.

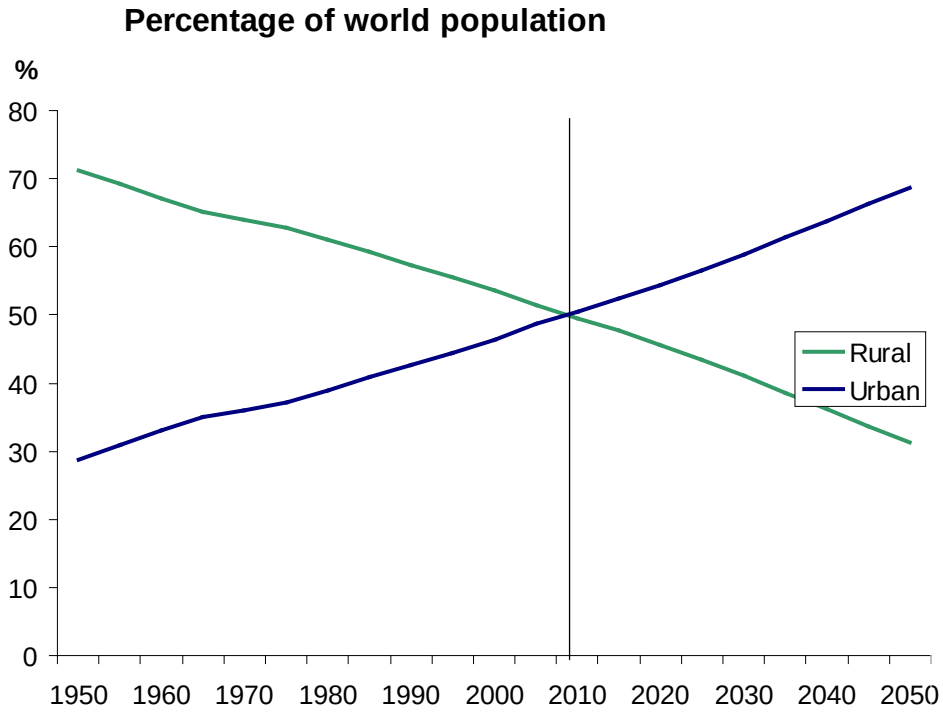

Figure 5: Percentages of rural and urban population over time. Based on data from: UN 2007.

In eight sites and six countries of the DESIRE focal areas, *lack of integrated planning and implementation of policies* is considered to contribute to desertification. Desertification is typically a multidisciplinary and multi-thematic problem and is therefore related to various sectors in policy, such as agriculture, environment, water, forest, urban and rural development, spatial planning, and trade. Mono-sectoral development activities, planned and imposed from the central government, are not fully effective on integrated themes such as desertification as they do not reflect the cross-sectoral issues and its consequences to the affected people. For achieving impact of desertification policies, there is a need for cross-sectoral planning and interdepartmental collaboration, which often proves to be difficult to realise. Lack of cross-sectoral planning is an issue in several DESIRE study sites. An example is that in fire prone areas, the rate of the burned area increased where the policy enforcement was lower (AUA 2010).

The *introduction of monoculture tree plantations* is mentioned in six countries and five study sites (some countries have multiple study sites) as an issue that contributes to desertification. Eucalyptus and Pinus species, as planted in Morocco, are large water consumers and have little undergrowth that protects the soil. In Crete, olives plantations replace natural vegetation

in some sloping areas and part of that land is ploughed, leading to soil erosion.

In Tunisia the traditional agro-pasture practices are abandoned for large scale mono-culture agriculture plantations (olives) that are a cause of erosion. In some sites agro-forestry practices are abandoned for large scale mono-culture forest plantations and exotic tree species (Pinus pinaster, Eucalyptus globulus) are introduced leading to less soil protection and higher risk (Chile) and incidence (Portugal) of forest fires. The Chilean government subsidises exotic monoculture tree plantations. In Chile water availability for human consumption and for agricultural use markedly decrease in areas where Eucalyptus dominates.

Land fragmentation is mentioned in seven countries and six DESIRE study sites as a driver. Fragmentation of land leads to increased land abandonment, less managed forest and vegetation, less land care in general. This in turn is a cause of increased risk of forest fires, lowered production and incomes, soil erosion and nutrient depletion. Another, opposite effect, is the negative effect of land fragmentation on grazing intensity (highly fragmented lands are not easily overgrazed).

Shift of traditional land management to capital intense, large scale managed farms was reported in eight study sites/countries as a driver/issue. Large scale managed farms are not always a cause for degradation. A large scale operation can provide means for sustainable management if production, and therewith return, is high and land investments are used to ensure a continued production of high volume and quality. Yet, the intensive nature of large scale farms can create a high water demand in dryland areas (such as the case in Tunisia, Spain, Turkey-Karapinar,) and cause lowered groundwater levels (Karapinar), or cause low water recharge (e.g. Greece-Crete). For the establishment of large scale managed farms land leveling is sometimes practiced, such as in the case of horticulture farms in the Guadalentin, Spain. This form of land disturbance is a direct cause of soil degradation. In some of the sites overexploitation of traditional land uses has led to overgrazing (Morocco, Russia) and to reduction of fallows that causes more overland flow and soil erosion.
Land use intensity affects water stress and desertification risk through a series of actions related to overexploitation of natural resources. Land use intensity was associated with several indicators in the study field sites related to the physical environment, land management, and social and economic characteristics (AUA, 2010). Together with specific land management techniques (tillage) and policy enforcement, the desertification

risk due to soil erosion in agricultural areas was predominately related to land use intensity in the DESIRE study sites (AUA, 2010).

Population growth and poverty were reported for four of the study sites although two of the sites (Turkey-Karapinar, and Cape Verde) indicated that poverty is the actual underlying driver, directly related to the overpopulation issue. Overexploitation of natural resources such as forest resources (fire wood) or ground water lead to depletion and degradation of the resource. Extension of agricultural land into marginal (sloping) areas leads to over-use and inappropriate management methods, causing degradation (Yanhe River Basin, China). The Grain for Green policy, that forbids to cultivate steep slopes, is very successful in combating erosion. Erosion is now mainly taking place the more lower and gentle slopes. In Botswana (Boteti), expansion of dryland farming into rangelands, the increased use of fencing in communal areas, the increase of livestock, and wildlife sanctuaries leads to a decline of conservation areas and of habitat for wildlife species. The pressure on the communal areas increases as private ranges and farmers fences their land and people maintain the same number of cattle on the communal grazing lands that have decreased in area.

Lack of land tenure and security is considered a driver in four study sites/countries. Land that is rented or of which land tenure is insecure are less cared for, which may lead to soil erosion and production decline (Cape Verde), soil fertility decline and soil erosion (Sehoul, Morocco), increased forest fire and associated biodiversity loss and soil erosion (Crete). When communal lands are claimed for individual use, such as in Zeuss-Koutine, Tunisia, grazing pressure is higher on the remaining communal grazing area. On agricultural lands, management methods are not always appropriate for the specific lands (e.g. use of inappropriate ploughing techniques), causing degradation. Fire (burned area) is higher in tenant or state-farmed field sites than in owner or shared-farmed field sites (AUA, 2010).

Land management decline/poor land management is considered a driver in ten study sites and in nine countries. The processes and associated pathways to desertification may vary considerably. Land use change may for instance be related to land abandonment where there is a lower level of management and care for the land, which in the case for the Macao and Goìs sites in Portugal, leading to biodiversity loss and soil erosion. Land use change may also implicate a transition between land use and management types, such as the abandonment of traditional agro-pasture practices for large scale mono-culture agriculture plantations (olives), such as in Tunisia, related to increased soil erosion, or for large scale pastures (Dzhanybek- Russia) that has led to increased water erosion. The increase of irrigated area has led in

some sites to soil salinization (Nestos-Greece and Russia, Novy). In Novy, more people get primary income from work in town. The irrigated area has decreased but inappropriate methods are used for irrigation. Mechanized land management practices cause soil erosion, compaction and salinization. In Cointzio, Mexico, free grazing is the main cause of increased soil erosion. In Sehoul, Morocco, a series of partly interrelated changes of land use occur, such as urbanization, land abandonment and the conversion of pastures to agricultural lands. As a consequence, pastures shift to the degraded lands as a consequence which leads to further degradation. In the desertification indicator study, field sites located in areas with low measures of soil erosion control, low percentage of terracing, and low actions for storage of runoff water were mainly subjected to high land use intensity (AUA, 2010).

Climate change was mentioned as a driver for desertification in three study sites. In other sites severe droughts were mentioned as an environmental factor, but not as climate change. Since droughts and climate variability are an inherent characteristic of drylands, only those sites where climate change was mentioned specifically were counted in the score for drivers.

Global trade regimes and linked government policies influence food production and consumption patterns significantly and affect directly or indirectly the resilience of dryland ecosystems (MEA 2005). Studies have shown that trade liberalization, macroeconomic reforms, and a focus on raising production for exports can lead to desertification. Trade, or broader, globalization may either contribute to or help prevent desertification. It creates stronger links between local, national, sub-regional, regional, and global factors related to desertification (MEA 2005). Several of the major drivers in the study sites, such as outmigration and land use change, can be influenced by globalization and trade.

Table 2: Selected drivers of desertication in DESIRE SSs and their impacts.

Driver / Issue	Study Site	Primary impact	Secondary impact
Outmigration / low population / Ageing	Portugal (2)	Land use change/land abandonment, negligence of SWC structures, loss of (traditional) knowledge	Forest fires, soil erosion
	Spain	Land abandonment, loss of traditional knowledge. Mosaic landscape is lost, SWC structures damaged	Soil erosion
	Tunisia	Land use change (degradation of SWC structures)	Soil erosion
	Greece, Crete	Less land care	Soil erosion
	Mexico	Lack of investment in land. Low prices for	Soil erosion

		agricultural commodities	
Population change	Russia (Dzhanybek)	Introduction of mechanization	Soil erosion, salinization
	Cape Verde	Land abandonment lead to invasive species	Biodiversity and soil quality decline
	Chili	Poor agricultural and livestock practices	Soil erosion
	Italy	Poor land care	Soil erosion, Mass movement, soil slip
	Morroco, Sehoel	Indirect effect: lack of labour for rotational cropping	Soil mining
Lack of integrated planning and implementation of policies	Portugal (2)	Poor agricultural and forestry practices	Forest fires
	Spain	Coordination of effective policy is extremely difficult as there are multiple sectors and many administrative levels. Policies are therefore ineffective or sometimes have contradictory effects	Soil erosion
	Turkey, Karapinar	Main limitation in implementation of existing legislation is in the coordination of various institutions and structure related to land use and soil protection	Wind erosion
	Botswana	Lack of coordination and implementation capacity resulting in low impact of policies. National policies do not always fit local conditions that sometimes cause negative side-effects	Low environmental protection, degradation
	Greece, (2)	Lack of coordinated planning is a limitation for multi-sectoral issues and limits policy implementation impact	Soil erosion, sea water intrusion into aquifer, biodiversity decline
	Cape Verde	Weak coordination between implementation projects on environmental issues	Duplication and less impact of efforts
Monoculture tree plantations	Portugal (2)	Less forest management	Forest fires, soil erosion
	Tunisia	Decreased soil cover (olive trees)	Increase soil erosion, and nutrient depletion
	Chili	Increased fire risk, soil erosion	

	Greece, Crete	Low water recharge due to high evapo-transpiratation	Overexploitation of ground water
	Morocco	Planting of fast growing trees such as Eucalyptus species	High overland flow causing soil erosion, low water recharge due to high evapotranspiration
Land fragmentation	Portugal (2)	Increased land abandonment, less managed forest and vegetation	Increased forest fires risk
	Turkey, Eskişehir	Lowered income, less investment in land	Soil excavation, soil erosion by water
	Tunisia	Poor land management practices, lower production and income	Soil erosion, nutrient depletion
	Greece, Crete	Less land care	Soil erosion
	Chile	lower production and income, high dependence on off-farm income and subsidies	Soil erosion, nutrient depletion
	Cape Verde	Less land care	Soil erosion
Shift of traditional land management to capital intense, large scale managed farms	Spain	Increase of irrigated agriculture, land levelling for preparation of large scale farms	Effects yet unclear, water consumption increase, land disturbance
	Tunisia	Large scale mono-culture agriculture plantations (olives) at the expense of traditional dryland farming and grazing lands	Decreased plant cover, increased runoff processes, decreased water quality, increased soil loss, decreased biomass, economic losses, loss of plant biodiversity
	Turkey, Karapinar	Expansion of irrigated agriculture at the cost of dryland farming	Lowering groundwater levels
	Morocco	Intensification of traditional land uses with corresponding reduction of fallow periods; overgrazing in natural areas	Increase of overland flow and erosion
	Greece, Crete	Ploughing in olive groves (in 26% of the area) and vineyards, Irrigation and increase of horticulture	Soil erosion, low water recharge
	Russia, Dzhanybek	Abandonment of traditional rainfed agriculture for large scale pastures (without proper knowledge/ experience); overgrazing, increase of irrigated vegetable	Soil erosion by water, soil salinization

		cultivation (subsidy on water pumps)	
	Greece, Nestos	Increase of irrigated agriculture	Soil salinization, soil degradation
	Mexico	Land cover change (Conversion of agricultural fields to Avocado plantations)	Soil erosion and overexploitation of ground water
Population growth and poverty	Cape Verde, (more poverty related)	Overexploitation of natural resources such as wood cutting leading to vegetation degradation (lower soil cover and biodiversity decline)	Overexploitation of x`groundwater, intensive cultivation of inappropriate slopes
	Botswana, Boteti area	Overexploitation of natural resources (e.g. firewood collection)	Decreasing ranging area because of private cattle ranches (tribal grazing land policy-tglp) Expansion of dryland (arable) farming into rangelands and wildelife retreats
	China, Yanhe River Basin	Inappropriate land management (agriculture on gentle slopes), grass cutting in apple orchards	Soil erosion, vegetation degradation
	Turkey, Karapinar (more poverty related)	Sustained overgrazing	Degradation of meadow
Insecure/lack of land tenure	Morocco	People leave for urban areas and sub- rent their agricultural land to others	Land is less cared for which leads to soil fertility decline and soil erosion
	Cape Verde	Inappropriate land management	Soil erosion increase and productivity decline
	Greece, Crete	Rented lands are less well managed and more degraded	Forest fires leading to biodiversity decline, soil erosion
	Tunisia	Communal lands are increasingly being claimed by individual land owners, rangelands are cultivated (using inappropriate ploughing techniques) and natural vegetation is removed, increased grazing pressure	Soil erosion, biodiversity decline
Land management	Portugal (2)	Abandonment of land, lower level of	Soil erosion, biodiversity loss, lower

decline / poor management		management	water quality, \diminished wood production
	Tunisia	Wood cutting and overgrazing, poor land management practices	Soil erosion, Biodiversity loss
	Morocco	Urbanization, land abandonment, conversion of pastures to agricultural lands, degraded lands are used for pasture which leads to further degradation, fencing leads to decreased access to grazing lands, free grazing land is gradually disappearing which impacts on smallholder traditional farming. Overgrazing is the result	Soil erosion
	Russia, Novy	Decrease of irrigated area but use of inappropriate methods for irrigation	Soil salinization, water logging
	Chili, Secano Interior	Land fragmentation through inheritance system, leading to land use intensification, field crops on hill slopes	Soil erosion, nutrient depletion
	Spain, Guadalentin	Decline of traditional knowledge	changes in water availability and quality
	Italy, Rendina	Poor farming practices, destruction of drainage systems through heavy machinery	Soil erosion, mass movement, drainage system degradation
	Greece, Nestos	Poor irrigation practices	Soil salinization,
	Mexico	Land abandonment and reduced land care due to low prices and off-farm income	Soil erosion
Climate change	Russia, Dzhanybek	Water scarcity	Vegetation degradation, soil salinization
	Crete, Chania	Decreasing rainfall	Water deficit
	Italy, Rendina	Overuse of water resources	Decreased water availability

4.3 Policies and desertification

Land use changes are often the long term results of political and economic factors, related to national and international policies. These policies induce

changes that have a space and time expression in the different phases and rhythms of transformation of rural landscapes, that do not always follow the intended policy directions (Casimiro and Roxo 2006). Policies that aim to control land degradation often focus on vegetation cover management, such as reforestation, crop rotations and fallow periods, and specific land management practices and land use changes through subsidies and laws. Land use changes in Europe are largely driven by agricultural and environmental policies, market adjustments from EU enlargement and international trade agreements (Polet 2009). Examples are the CAP, the Water Framework Directive, the Nitrate Directive (Council Directive 91/676/EEC), and the agro-environmental programs under the Rural Development policy 2000–2006.In areas with high percentage of arable land, policy enforcement has been mainly characterized as low (AUA, 2010).

Policies formulated with other objectives than controlling land degradation and managing land are often as influential or sometimes even more influential. Export-related policies or investments in private sector development are examples of such policies. The study site area in Eskisehir, Turkey, became part of the urban expansion of the city of Eskisehir, which resulted in land use conflicts between villagers and people from the city. Land owned by people living in the city, who do not actively manage the land, is sometimes sub-rented or the land is sold to a brick factory that removes the top 3 metres of the soil for brick making. Legislation is generally more favourable to urban (economic) interests than for rural development.

Many of the DESIRE study site teams report on national laws and regulations as a response of the government related to the management of the natural resources. These policies put restrictions or stimulate specific practices such as forest management, land and water use, conservation or rehabilitation. Scenario analyses as performed in WB5, will provide information for policy formulation with regard to the significance of land use for erosion and the effects of climate change on erosion (risk). Countries have tried to put bans on “degrading activities” and have implemented public reforestation projects. China’s Sloping Land Conversion Program, also known as “Grain for Green” with a target area of almost one million hectares and a budget of $US 40 billion, is the world’s largest and most ambitious land conservation program. Its 2010 target is an increase in China’s forested area by 10-20% and an 11% decrease in cultivated area. The current program, however, lacks “voluntarism” in participation, and therefore suffers from low cost-effectiveness and high cost of performance monitoring and evaluation (Xu *et al.* 2006). In the Chinese study site Grain for Green has been very successful in combating erosion. As trees are planted on the steeper slopes, erosion is now mainly taking place on the lower and gentle slopes in the study area.

A study (Uchida *et al.* 2005) on the cost-effectiveness and sustainability of the set-aside in the Grain for Green policy found that although more than half of the sown area of the participating households was set-aside, only a marginal drop in crop production was found. This may be explained by the fact that typically the lowest yielding land is set-aside. In addition, although this was not verified with data, farmers will probably have reallocated their freed-up household labour to the remaining plots and intensified the production. The long term sustainability of the land set aside will depend on whether the government will stop or continue with the program after the foreseen program end. Concerns are that when set-aside subsidies through Grain for Green will stop, farmers will reconvert their set-aside land back into cultivation(Uchida *et al.* 2005).

Sectors and administrative levels in policy formulation and implementation
Desertification is a multidisciplinary and multi-thematic issue and is therefore related to various sectors in policy and government. Apart from the sectoral differentiation in design and implementation of strategies, there are many policy and government levels. There are local level policies, at municipal level for instance, sub-national/regional (e.g. autonomous regions or provinces), national, international (supra-national) and global. The Guadalentin basin in the Spanish study site, for example, is divided over two provinces, the provinces of Murcia and Almería, and therewith over two of Spain's autonomous regions (i.e. Murcia and Andalucía). Fifteen municipalities form part of the basin. As a consequence, many soil erosion and conservation issues are administered by different institutions within the Ministry of the Environment (Dirección General para la Conservación de la Naturaleza, DGCONA), at national and regional level, and by the basin authority of the river Segura (Confederación Hidrográfica del Segura, CHS) (De Vente and Sole 2007).

Thousands of multilateral and bilateral conventions and agreements relevant to drylands have been developed, both at global and regional levels. Not only at different levels but also with different objectives, from the UNCCD and the Kyoto Protocol to co-operative regional agreements between three or four States and specific national laws and decrees. In the following paragraphs an overview is provided of the international, national and local policy processes and frameworks that were mentioned by the study sites as relevant[2]. Next some policies are discussed that were not mentioned but that nevertheless

[2] For a more extensive review of all kind of relevant international policy agreements, see "International Conventions and Multilateral Agreements relevant for CSOs working in drylands", 2009, Both ENDS and Drynet partners, which can be found on the publications section of www.dry-net.org.

will have an impact on the mitigation and remediation scenarios at the study sites.

The international policy agreements and national contributions to them mentioned by the study sites:

- the United Nations Convention to Combat Desertification, and its National Action Plans (7 sites)
- Agenda 21 and environmental action plans and protection laws (7 sites)
- Common Agricultural Policy (in Europe) (3 sites)
- National Strategy for Poverty Reduction (1 site)
- Natura 2000 (1 site)
- Convention on Biological Diversity, and national plans and regulations (1 site)
- European Water Framework Directive (1 site)

The national and local agreements mentioned:

- Subsidy schemes, regulations, laws on irrigation, water management, waste and flood control (9 sites)
- Forestry laws and forest management regulations (5 sites)
- agricultural laws and regulations, such as national policy on agricultural development (5 sites)
- laws and national strategies on soil conservation and prevention and control of desertification (3 sites)
- bonus programme on rehabilitation of degraded lands (1 site)
- regional development plan (1 site)
- official establishments of protected areas and national parks (1 site)
- national strategy for rangeland improvement (1 site)
- land management law (1 site) and grassland law (1 site)
- Community Based Natural Resource Management Policy (1 site)
- Tourism policies (1 site)
- Emigration policies (1 site)
- National plan for rural biogas development (1 site)
- Revised National Policy on Education (1 site)
- Order in council on protection of air (1 site)
- Order in council on norms related to construction projects for entertainment building

UNCCD - United Nations Convention to Combat Desertification

All 13 countries in which the 16 study sites of the DESIRE project are located are UNCCD signatories that have ratified the UNCCD convention, and have developed National Actions Plans (NAPs) for combating desertification (see:

http://www.unccd.int/convention/ratif/doeif.php?sortby=name). In addition to the NAPs, there are Sub-Regional Action Programmes (SRAPs) and Regional Action Programmes (RAPs). Examples of SRAPs are the 'Sub-regional Action Programme to combat desertification in Southern Africa' and the 'Programme d'Action Sous-Régional de Lutte contre la Désertification au Maghreb'.

Adeel *et al.* (2009) argue that the UNCCD national action plans have often been weak and ineffective. They state that the national action plans were hurriedly prepared with the assumption that funds would flow into environment and development with soft conditionality, which proved not to be the case. According to the authors, the quality of the NAPs is variable and often poor and they do not address real policy priorities but rather presented shopping lists of projects for funding; they were not part of core national development strategies but drawn up by ministries of environment or, occasionally, agriculture. The agreement of a Ten Year Strategic Plan for the Convention and the continued effort by the Global Mechanism in supporting the development of integrated financing strategies and comprehensive investment frameworks is an opportunity to enhance implementation of the Convention at country level (Adeel *et al.* 2009). Furthermore, there is an ongoing global trend to "mainstream" desertification issues and the National Action Plans into development processes in the countries in order to be more effective. The Convention integrates environmental concerns on the loss of ecosystems and biodiversity, with social elements such as the recognition of poverty, poor health, malnutrition, and food security, and its objectives are therefore relevant for and linkable with development policies and processes.
Though Action Plans might be weak, this particular Convention is strong on its participatory aspects. National reports by governments on the status of the implementation of the Action Plans have to be developed with the participation of non governmental stakeholders. This means scientists, NGOs and other stakeholders can in theory liaise with the National Focal Point for the UNCCD.

Agenda 21 and environmental action plans
Agenda 21 is a plan of action designed to promote sustainable development. It consists of a comprehensive blueprint of action to be taken globally, nationally and locally by UN organizations, governments, and major groups in areas where humans impact the environment. Agenda 21, along with the Rio Declaration on Environment and Development and the Statement of principles for the Sustainable Management of Forests, was adopted by 179 Parties during the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. The Commission on Sustainable Development (CSD) was created in 1992 and is responsible for reviewing

progress in the implementation of Agenda 21. The CSD operates in two year cycles with each cycle focusing on specific thematic issues. The Commission on Sustainable Development (CSD) was created in 1992 and is responsible for reviewing progress in the implementation of Agenda 21. The CSD operates in two year cycles with each cycle focusing on specific thematic issues.

Chapter 28 of Agenda 21 identifies local authorities as being the closest form of governance to people and calls upon them to consult, develop and implement local plans with communities that are sustainable. This has led to Local Agenda 21 (LA21) programmes which should provide both a forum and eventually a framework for sustainable development at the local level. Likewise Chapter 8 of Agenda 21 requires countries to adopt national strategies for sustainable development under the name National Agenda 21 – National governments should present a National Action Plan for sustainable development that includes integrating environment and development in policy, planning and management, along with providing an effective legal and regulatory framework.

Common Agricultural Policy (CAP)

Since its inception in 1963, the CAP has been one of the most important Pan-European policies that represented a large proportion of the overall EU budget and expenditure. The initial objectives of the CAP were economic (stabilize markets and fair standard of living) and securing food supply at reasonable prices, specified in the Treaty of Rome in 1957 (EC 1957). The latter implied productivity increase through technical measures and optimal of production factors, labour in particular. From the 1980's, the EU began its systematic reform to deal with overproduction, negative impacts on the environment, and dumping (Delayen 2007). Since 2003, a reform of the CAP is implemented ("health check") in which the focus shifts from support for volume of production ("decoupling") towards greater producer flexibility to respond to markets and more focus on sustainable production and rural development ("cross-compliance"). In cross-compliance, payments are linked to environmental, food safety, animal and plant health and animal welfare standards, as well as the requirement to keep all farmland in good agricultural and environmental condition.

In most study sites the exchange between stakeholders and local and national policy representatives is limited, such as in Turkey for example. In the Northern Mediterranean countries that are part of the EU, farmers are all directly influenced by the CAP and the regional and national policies that are derived from this through the subsidy system. Obviously, the link between agricultural and regional development policies is greater in those countries,

with both positive and negative (opposite) impacts. The impact of the CAP regulation is not the same everywhere either, given the local differences in control and law enforcement (e.g. case of the Basilicata region, Box 1).

The study sites in the European Community are a special case as they have a common supranational policy framework in addition to national and local (regional, provincial, municipal) policies. Although policy decisions in European countries are often taken at many different levels, most of the decisions and policies at these levels are constrained or initiated through regulations provided by the CAP. Since joining the European Community (EC), the Spanish agricultural policy for example, has been dominated by the CAP, which priority is the development of sustainable and ecologically-sound agriculture. However, CAP implementation in southern Mediterranean European countries such as Spain, Italy, and Greece, has had negative environmental effects on soil erosion (Boellstorff and Benito 2005; Borselli *et al.* 2009; Rojo Serrano 2004) where EU policies have had a contradictory two-fold role

With the focus on productivity increase, before 2003, the CAP resulted in land use changes, including the expansion of irrigated farming in dryland areas and the expansion and intensification of dryland agriculture in the hills (García-Ruiz 2010; Kosmas *et al.* 2009). As a consequence, erosion-derived problems are emphasized since subsidies did not take the production systems and environmental aspects into account (de Graaff and Eppink 1999).

The set-aside policy was introduced as an EU political measure under the Common Agricultural Policy (CAP) that was introduced in 1988 to: (1) help reduce the large and costly surpluses, such as the 'grain mountain' produced in Europe under the guaranteed price system of the Common Agricultural Policy (CAP); and (2) to compensate for the significant negative environmental effects of the intensification of agriculture on agricultural ecosystems and wildlife. The set-aside policy has resulted in a strong increase in the extent of bare soils vulnerable to erosion. In Spain, the set-aside policy has resulted, in combination with reduced profitability, in the abandonment of land. The resulting reduced land cover and decline of the mosaic landscape has lead to increased soil erosion.

In Italy (Basilicata region) the CAP has led to unsustainable practices because 1) of lower (municipal) level policies that provide farmers with dispensation for CAP land management restrictions (burning of residue in the field) while maintaining the subsidies - which implies lack of national government enforcement, and 2) farmers opt for the maximum cultivated

area to receive the CAP subsidy and thereby are reluctant to practice soil and water conservation measures, such as contour grass strips, as they reduce the total cultivated area and therewith the subsidy. See Box 2, for further explanation of the impact of CAP in the Basilicata region.

In general, there is a need for greater complementarity between agricultural policy measures and policies for broader regional development focused on the specific conditions of the different regions (ESPON 2004).

CAP reforms, in the context of Agenda 2000, signified a new era of integrated development of rural areas, including soil protection and erosion control. The CAP reform of 2003 ('health check') has abolished the arable set-aside in the new policies.

The European Agricultural Guidance and Guarantee Fund (EAGGF) was set up on the financing of the Common Agricultural Policy and consumed a large part of the general budget of the European Union. The EAGGF was replaced by the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD) on 1 January, 2007.

Others

Updated every three years with annual progress reports, Poverty Reduction Strategy Papers describe the country's macroeconomic, structural and social policies and programs over a three year or longer horizon to promote broad-based growth and reduce poverty, as well as associated external financing needs and major sources of financing. They are overseen by the World Bank and IMF. The National Strategy for Poverty Reduction in Botswana is an example of this, the study site team seeing the links between poverty and land degradation.

Natura 2000 and the Convention on Biological Diversity (CBD) both concern biodiversity issues. The CBD agreement covers ecosystems, species, and genetic resources and explicitly sets out to link traditional conservation efforts to the economic goal of using biological resources in a sustainable manner. The CBD obliges Parties to organize national strategies, along with plans and programmes for the conservation and sustainable use of biodiversity. Parties must also adapt existing programs and plans to such concerns and these strategies must be developed under a participatory framework. The CBD is arguable the Convention that has clashed the most with WTO rules and issues of (agricultural) production and export, protecting ecosystems and species over farming and economic interests. As such, it is no wonder that ecosystems and species often loose in this competition.

Natura 2000 is an EU-wide network of nature protection areas established under the 1992 Habitats Directive.

Adopted in 2000, The European Water Framework Directive establishes a legal framework to protect and restore clean water across Europe and ensure its long-term and sustainable use.

As listed, there are a number of national and local specific laws and policies that stakeholders have indicated to be of relevance.

Some agreements that were not mentioned

As for climate change, only one stakeholder workshop in the DESIRE study sites identified it as threat. This is surprising considering that the whole political world is talking about and working on climate change issues at the moment. Governments are drawing up national policies like never before, do these agreements, negotiations, action plans and such not have any effect yet at the local level, or are they not known about in the study sites? As almost every public or political figure claims a direct relationship between a changing climate and worsening conditions for example in drylands (more extremes such as droughts and floods), it would be interesting to see how this is perceived in the study sites and if the available data show this linkage or not.

While international environmental agreements are important, it is trade and investment flows that couple the individual economies of the various countries to one another. Governments apply various measures related to trade and investment to protect and stimulate their national economies and to meet other policy objectives. For example, countries try to regulate the in- and out-flow of goods by import and export restrictions or the application of import and export taxes. In particular developing countries are interested in attracting foreign investment in the hope that this will support national policy objectives such as economic growth, increased employment, technology transfer and increased government revenues.

In practice, trade and investment agreements often take precedence over environmental and development agreements. These agreements often impact not only on land use practices but also on national policy and legislation. For instance, an increase of export-driven agriculture can result in changes in national land and water use practice. This can have severe impacts on drylands as is the case with intensive cotton production of the planting of biofuel crops.

Furthermore, these agreements might even include provisions that limit how governments can implement the commitments they have made in the various environmental and development agreements to which they are Parties.

Trade agreements are established at international, regional or bilateral levels, depending on the specific goal[3]. At the international level, the World Trade Organisation (WTO) is the primary organizing institution. The WTO has set rules and regulations such as:

- *The TRIMs agreement* - Trade Related Investment Measures. This agreement limits the possibility to call for certain performance requirements for foreign investors.
- *Trade in Agricultural products* - The liberalization of markets for agricultural products could have direct implications on land use practices. For example, if the production of certain agricultural products in a certain country becomes unviable because of cheaper imports from abroad, this will impact negatively on sustainable land use practices. Conversely, market opportunities for agricultural products abroad might lead to an intensification of the production in this sector (for example, soya exports to Europe), which could impact on sustainable land management.
- *Trade in non agricultural goods* - The related negotiations of further liberations in non agricultural products are taking place under the so called NAMA negotiations (Non Agricultural Market Access). This does not only include industrial goods such as textiles and leather but also mineral resources and water. Forest products such as timber or non-food biofuels as well as fish fall under the NAMA regulations.
- *Trade in services* - Trade in services is currently regulated under the General Agreement on the Trade in Services (GATS). Issues covered under GATS include environmental services, and public services like electricity and water.
- *TRIPs agreement* - The agreement on Trade Relates Intellectual Property rights has become well known in relation to the controversy about the patents of seeds, GMOs and other limitations to using and sharing seeds. It also might limit the access of developing countries to technology.

This is accompanied by various regional and bilateral trade and investment agreements, and a variety of International Institutions that deal with trade and investment issues:

[3] Again, for more information, see "International Conventions and Multilateral Agreements relevant for CSOs working in drylands", 2009, Both ENDS and Drynet partners.

- United Nations Conference on Trade and Development (UNCTAD) - a UN institution which was established in 1964 with the aim of promoting development-friendly integration of developing countries into the world economy.
- The Cotonou Agreement and Economic Partnership Agreements - The Cotonou Agreement is the current principal framework for co-operation between the European Union and the 77 countries in the African, Caribbean and Pacific (AGP group). The component of the Agreement dealing with trade ended in 2007, and is being replaced by Economic Partnership Agreements (EPAs). This new system should set in place trade relations that conform to WTO rules.
- Mercado Comun del Sur (Mercosul/Mercosur) Agreements - regional trade agreements between some of the Latin american countries.
- BITs - Bilateral Investment Treaties. BITs are agreements between two countries that encourage reciprocal promotion and protection of investments in their respective territories by companies based in either country.
- Bilateral and regional trade agreements - Such as Free Trade Agreements and ECOWAS. Countries are free to add provisions in Free Trade Agreements [FTAs] which are not included in WTO law (such as social and environmental clauses or provisions which go beyond the existing WTO rules on investment and intellectual property rights).[4]

Trade and investment regulations can be of substantial influence on land use, as a current trend of companies buying up huge areas of land for export production clearly shows. The chances of producers to use the land, to grow their product, to sell it, to sustain their right to using or farming the land, all influence their willingness to invest in measures and technologies to prevent and reverse land degradation. Therefore, looking at policy aspects driving desertification processes remains crucial for understanding desertification and how to control it.

[4] An overview of EU agreements can be found here: http://ec.europa.eu/trade/issues/bilateral/regions/index_en.htm. An overview of US agreements can be found here: http://tcc.export.gov/Trade_Agreements/All_Trade_Agreements/index.asp
The website www.bilaterals.org monitors ongoing negations: http://www.bilaterals.org
An analysis of the challenges of EU-FTAs can be found here:
http://www.oxfam.org.uk/resources/policy/trade/euftamanuals.html

Box 2: The impact of CAP in the Rendina basin Italy

The reference rules for application of CAP inside region Basilicata are the application rules produced European, National and by Regione Basilicata:

- Regolamento (CE) n. 1698/05 (EU),
- DM n. 12541/2006(Italian Government)
- D.G.R. n. 2214 del 29.12.2008 (Regione Basilicata)

The latter contains the regulation to apply the CAP for 2009. The CAP has a malicious effect on the environmental degradation processes in the Rendina Basin. On the one hand we have the direct payments to farmers, at the condition of application of a set of best management practices such as: measures against concentrated erosion and against the loss of soil fertility and organic matter.

Regione Basilicata produced rules to apply the EU directives for CAP (see above) but at the same time produced, each year , a set of dispensation "deroghe" (Italian) that allows, under given conditions, the farmer not to apply the same ruled best management practices. For example the burning of residues is forbidden by EU directive and national rules to prevent the loss of organic matter, but each year a dispensation rule is produced that allows that, including special rules how to perform the burning of residues in August-September. Similar contrasting rules and dispensations are published in the official Bulletin of Regione Basilicata each year (BUR n. 3 del 26.01.2009). Also important is the control of the implementation of CAP by national authorities.

Left: Wildfire in rangeland produced by residue burning activity – close to rendina Reservoir (sept. 2008). Right: Recent burned area (dark upper part of the slope) close to the Rendina reservoir (sept. 2008)

The control of farmers' declarations for CAP subsidies is done year by year by the national agencies. These controls are accurate but these kinds of controls prevent the application of regional rules for best management and for erosion prevention. For example to prevent erosion the establishment of contour grass strip inside the cereals field is suggested. But the farmer can't declare the presence of these strips (until 8% of entire surface in steep lands) in the declaration for CAP subsidies, and hence the reduced surface sown, because there is the risk of being accused of a false declaration for CAP subsidies, with the consequence of rejection of the annual subsidy. The presence of some additional basic conservation measure cannot be included in the calculation of sown surfaces to obtain the CAP subsidies.

Source: DESIRE study site description, Rendina Basin, Italy (Borselli *et al.* 2009)

http://www.desire-his.eu/wimba/CG SSD Rendina, Italy/page_22.htm

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APPENDICES

Appendix 1 Desertification drivers, pressures, responses, polices and impacts of DESIRE Study Sites

Table 3: Desertification drivers, pressures and impacts in DESIRE SSs.

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Study site: Mação and Góis, Portugal				
Repetitive wild fires	Outmigration of active population, ageing population, land use change, negligence and failure to clean up forests	Introduction of exotic tree species, litter removal, severe drought periods	Increased runoff and sediment production, decreased soil organic matter and soil cover, increased invasive alien species, increased water repellency of soil, decreased water quality	Soil erosion, biodiversity loss, lower water quality, diminished wood production
Poor agricultural and forestry practices	Outmigration of active population, land use change, ageing population, lack of integrated planning, negligence and failure to clean up forests, abandonment of traditional agro-forestry practices for large scale mono-culture forest plantations, land fragmentation through inheritance system	Introduction of exotic tree species (Pinus pinaster, Eucalyptus globulus), litter removal, severe drought periods, soil sensitivity to erosion, landslides	Decreased crop production, decreased farm income, decreased farm product diversity	Soil erosion, soil nutrient depletion
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Study site: Guadalentin Basin, Murcia, Spain				
Land abandonment	Aging farming population (traditionally dry land farmers), farming only part-time activity. Commercial, irrigated farms have developed at the cost of traditional dryland agriculture. Policy developed and implemented at many different levels within ministries and governments. Cross-sectoral cooperation and planning is extremely complex and difficult to implement.	Natural conditions such as topography, climate and lithology and active tectonic uplift favor overland flow and erosion.	Changes in soil quality, soil organic matter content and increased vegetation cover	Soil erosion (+)
Common Agricultural Policy (CAP)	Low profitability of agriculture calls for government intervention to provide incentives	The threatened mosaic landscape is crucial for SWC purposes	Changes in soil quality, soil organic matter content and increased vegetation cover	Soil erosion (+)

Intensive tillage	Tillage under almonds is traditionally done 3-5 times a year	Soils are easily crusted without tillage which reduces infiltration capacity	Higher organic matter content, less runoff and erosion	Soil erosion (-)
Irrigated horticulture and illegal pumping of groundwater for irrigation	Irrigated horticulture is the most profitable land use type in the region	Land leveling is often practiced for irrigated agriculture	Changes in groundwater availability and quality	Ground water (quality+ quantity) decline
Intensive pig farming	Intensive pig farming has a lower land demand	High demand for pork and ham	Changes in water and soil quality	Soil and groundwater contamination
Decline of traditional knowledge	Land abandonment, due to out-migration to cities, has lead to increased soil erosion, causing damage to existing SWC structures such as terraces and water harvesting structures.	Long dry periods and intermittent rivers require structures to maintain water that is available during rainfall events throughout dry periods.	Changes in water availability and quality	Water stress
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Zeuss-Koutine, Tunisia				
Wood cutting and overgrazing	Outmigration of active population, ageing population, land use change	Soil fertility decline, Insecure rainfall	Increased runoff processes and sediment production, decreased soil organic matter, increased unpalatable species, increased soil water repellency	Soil erosion, biodiversity loss
Wood cutting, overgrazing,and cultivation	Outmigration of active population, land use change, ageing population, solutions focused on the forest sector, livelihood diversification.	Decrease of organic matter in the soil, severe drought periods	Decreased plant cover, increased runoff processes, decreased water quality, increased soil loss, decreased biomass, economic losses, loss of plant biodiversity	Vegetation degradation
Inadequate agricultural and forestry practices	abandonment of traditional agro-pasture practices for large scale mono-culture agriculture plantations (olives), land fragmentation through inheritance system, insecure land tenure	Soils sensitive to erosion, instable slopes	Decreased crop production, decreased farm income, decreased product diversification	Soil erosion, soil nutrient depletion

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Karapinar, Turkey				
Low vegetative cover	Low institutional capacity Lack of cross-sectoral cooperation Poor links between different levels of policy bodies and their laws and regulations Poor extension services Traditional farming system no longer economically rewarding Low adoption of government funded alternative practices as people value traditional systems Surplus money is invested in consumption goods and is not invested back in farming, affecting the sustainability and productivity of the farming method Rural poverty; household of the study site farmers is mostly very low. More than 50 % of the population survives below the hunger limits Low prices Only 10% adopted drip irrigation Fatalism towards environmental changes (Acts of God)	Arid climate, very weak soil structure, persistent strong winds, agricultural practices Cereal farming and sheep farming are traditional systems	Loss of topsoil	Wind erosion
Irrigated agriculture, market demand for agricultural produce			Changes in groundwater availability and quality	Ground water depletion
Groundwater depletion			Decreased crop production, soil quality change	Secondary salinization
Torrential summer and autumn rains, low vegetative cover			Increased runoff and sediment production, changes in soil quality	Water erosion
Sustained overgrazing			Decreased plant cover, increased runoff processes, increased soil loss, decreased biomass, loss of plant biodiversity	Degradation of meadows

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact

Eskişehir, Turkey				
Low vegetative cover	Low institutional capacity Cooperation Poor extension services, access to market difficult (also for purchase of management inputs) Low level of organization among farmers Low level of contact between stakeholders Large difference between farm gate price and market price: role of middle men Urban priorities dominate the rural region because of tourism (city to rural areas), soil excavation for bricks (urban construction)	Low vegetative cover Arid climate Agricultural practices Dominant land use is unirrigated cereals, meadows, irrigated sugarbeet and sunflower and fruit cultivation Deforestation Torrential summer and autumn rains Low vegetative cover Inappropriate tillage overgrazing	Arid climate, inadequate agricultural practices	Wind erosion
Groundwater depletion			Decreased crop production, soil quality change	Secondary salinization
Inappropriate tillage			Increased runoff and sediment production, changes in soil quality	Water erosion, Soil fertility decline
Soil excavation				Urbanization
				Biodiversity decline in meadows
Urbanization	Construction of holiday houses in the rural areas (city people build houses and expect a clean and quiet environment causing conflict of interests)		Lowered rate of infiltration	Sealing of the soil
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Rendina, Italy				
Poor agricultural practices	Attitude of farmers' unions towards land degradation in general is uncooperative	There is degradation rather then desertification Wheat cultivation includes	High sediment load of rivers and lakes	Soil erosion
Land levelling			High sediment load of water ways and siltation of lakes	Mass movement, soil slip

Destruction of drainage systems due to use of heavy machinery	Low tourism intensity For economic considerations, local regulations related to drainage system mainantance are not respected	burning of residues before deep tillage operations and sowing, land levelling		Drainage system degradation
Overuse of water resources	Water is exploited for sale of bottled water Low institutional capacity Common Agricultural Policy (CAP) Outmigration of people from the area Ageing population	Mount Vulutre is a volcano that is (partly) located in the Rendina basin		Decreased water availability
Climate change		Climate change is believed to have a significant impact on the vegetation and stability of the slopes of Mount Vulture. Leading to increased degradation and risk for disasters (mud and debris flows)	Vegetation changes, decreased slope stability	Increased environmental risks
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Sehoul, Morocco				
Irrigation, drinking water extraction			Changes in groundwater availability and quality	Ground water depletion
Inadequate land Management	Lack of soil and water conservation, Reduction of fallows, increased animal load, commercial farming concentrates on the good soils of the plateau, pushing local communities to the sloping and marginal lands and into the forest and grazing areas	Very weak soil structure, torrential autumn rains, pasture degradation,		Land productivity decline

Land use change	Urbanization, outmigration, land abandonment, conversion of pastures to agricultural lands, degraded lands are used for pasture which leads to further degradation, free grazing land is gradually disappearing which impacts on smallholder traditional farming, land abandonment, land ownership; those who manage land are often not the owner but rent the land	Fragile soils, mechanization, deforestation, land cover change (cork oak to Eucalyptus and irrigated agriculture), cultivation of marginal and sloping lands, overgrazing, ploughing in slope direction, increased pressure on marginal lands	Overland flow, crust formation, compaction	Soil water erosion
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Chania and Messara Valley, Crete, Greece				
Inadequate land management	Due to introduction of mechanization, part of the of the steeper mountain slopes have been abandoned for use, low profitability due to low market prices, high land fragmentation leads to less land care, ageing population in rural areas, tourism is an important sector and attracts labor at the cost of agriculture (young people), about a quarter of the population is working in the primary sector (agriculture/ fisheries), farmers' income is decreasing and people depend on subsidies (CAP) and community funds	Ploughing in olive groves (in 26% of the area) and vineyards, soil erodibility is highly dependant on soil parent material, natural vegetation is replaced in the upper hilly areas by intense cultivation of olives, land uses with erosive effects (decreasing effect): vine> eucalyptus> wheat> shrubland>olive, vine cultivation declined due to phylloxera infestation, olive is highly adapted to Mediterranean conditions, high desertification risk co-determined by topography, climate, and poor vegetative cover	Land abandonment on the steep slopes due to low productivity	soil erosion

Land access with heavy equipment	Due to requirement for CAP fund access, farmers sometimes apply practices where conditions are not suitable, leading to desertification			Soil compaction
Overexploitation of groundwater	Irrigation and consumption in tourist season, urban development - especially in the coastal area, increasing horticulture, drip irrigation is applied in olive and citrus groves and avocado plantations, increasing urban area into agricultural land	Low water recharge due to high evapotranspiration,	Rainfall decreasing in Chania area creating water deficit, rainfall is characterized by uneven spatial and temporal distribution	Intrusion of sea water into aquifer system in Messara valley
Overgrazing	There is a lack of enforcement of regulations	Number of goats and sheep have doubled over past 30 years while number of cows was stable, pasture systems exist with highly specific spatial and temporal patterns related	Decrease in lower vegetation species, soil wash through rills	Soil erosion
Forest fires	Forests are mainly publicly owned, fire is provoked to clear forest for pasture or cultivation land, relatively low population density except for large cities, land ownership is an important factor; rented lands are less well managed and more degraded			Biodiversity decline, soil erosion,
Lack of enforcement of existing laws	Lack of coordinated planning is a limitation for multi-sectoral issues and limits policy implementation impact		Overgrazing, rangeland degradation	Soil erosion
Lack of enforcement of existing laws	Forest protections law exist but are not adequately enforced at municipal level		Forest are not restored after burning but used for property development	Soil erosion, soil sealing, biodiversity decline

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Nestos river basin, (Maggana) Greece				
Irrigation with saline water due to seawater intrusion	Land use change	Ecosystem changes, introduction of potential new species	Flood-controlling engineering works have been built in Nestos River Delta plain which have disturbed the ecological balance and have changed the groundwater-recharging regime, this has lead to: ecosystem changes, decreased water, quality economic losses, decreased crop production	Salinisation, soil degradation
Poor agricultural practices	Farmers annual income decrease, lowering revenue from farming	Expansion of desertified areas		Soil fertility loss, vegetation degradation
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Dzhanybek, Russia				
Regional climate pattern change		Change of plant and soil cover	Increased water stress of plants and crops	Water scarcity, vegetation degradation
Saline groundwater rise	Outmigration of people from the rural area, land use change, use of micro-depressions for vegetable irrigation cultivation, demand for growing vegetables with irrigation, high price for energy needed for water pumping	Severe drought periods, rise of saline ground water	Regional economic change, fresh water scarcity, increased infiltration of snow melt water, decreased harvesting of snow melt water, considerably decreased delivery of fresh water by water supply canals from Volga River, decreased crop production	Soil salinization
Overgrazing	Abandonment of traditional rainfed agriculture for large scale pastures, regional economic situation change	Soils are sensitivity to erosion, decreased bio-diversity	Decreased crop production, increase of sediment loads to local water ways	Water erosion

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Novy, Russia				
Excessive irrigation	Weak institutional support, lack of credit facilities, subsistence farming	Poor vegetation growing, change of plant and land cover	Ground water level rise, increased loss of water due to deep percolation, hazard of ground water pollution, crop yield decline	Soil salinization, water logging
Poor irrigation practices	Land use change		Increased sediment load into local water ways	Runoff, soil loss
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Yanhe River Basin, China				
Easily eroded soil	Low revenues from farming, people on marginal lands most affected by degradation	Crop yields are low and insecure, decreased vegetation cover	Increased runoff and sediment production, changes in soil quality, non-point pollution, decreased yields	Soil erosion
Inappropriate land management (agriculture on steep slopes)				
Excavations from engineering works (e.g. road construction)	Inappropriate excavation works lead to soil and slope disturbance		Slope instability	Soil erosion
Droughts		Low rainfall	Decreased soil moisture availability, lower soil cover, soil organic matter decline, increased soil erosion	Vegetation degradation
Poor vegetation management				
Overgrazing				
Climate change		Drier and warmer trends	Droughts, greater evaporation from soil surface, yield decline	Water loss and shortage of soil water

Intensive rainfall storms		Rainfall distribution is concentrated in storms of extreme rainfall with high erodibility	Increased runoff and sediment production, changes in soil quality, non-point pollution, decreased yields	Soil erosion. shortage of soil water
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Boteti area, Botswana				
Policy failure	Lack of coordination between legislation and lack of cross-sectoral cooperation, lack of capacity to successfully implement legislation and policies, poverty, human migration,	Environmental change, drying of Boteti river	Declining community resource base, production decline	Land degradation
Resource use pressure	Water wastage, depletion of groundwater, firewood is the principle source for cooking and domestic energy	Overstocking, excessive wood collection, soil erosion through trampling, mining, cutting of grasses before seed production	Vegetation decline, soil erosion, soil quality decline, crop production decline, biodiversity decline, extinction of wild fruit species, ground water decline, drying up of groundwater recharge areas,	Soil erosion (wind), Biodiversity decline, ground water depletion
Environmental stress	Increasing population (annual growth rate 1.9%, 1991-2001), increase in number of livestock, introduction of fences in communal grazing areas, increased human impact in areas of wildlife retreat, poverty, expansion of dry-land cultivation into rangelands, market constraints, not easy to sell cattle and low prices, poor management of communal rangelands	Prevailing drought conditions, which affect the vegetation vigour, drying up of Boteti wetland system, wildlife retreat to protected areas, increased wood collection for fences, reduced communal grazing land, extended droughts, uncontrollable winds, Veldt fires, natural or man induced,	Lower rainfall, high mortality of livestock, air pollution (due to dust), ozone layer depletion, human diseases related to dust, erosive rains (thunder showers), plant pests	Drought, lowered carrying capacity for livestock, wind erosion

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Secano Interior, Chili				
Long-term poor agricultural and livestock practices	Outmigration of active population, ageing population, land use change poverty risks, land fragmentation through inheritance system, low education level of land users, high dependence on off-farm income and subsidies	Soil sensitivity to erosion, topsoil erosion, compacted soils with high runoff levels, rainfall concentrated in short growing season, field crops on hill slopes causes erosion	increased runoff and sediment production, soil organic matter decline, loss of soil resilience, increased soil water repellency, water storage reduction, crop production decline, decreased farm income, declining product diversification	Soil erosion by water, nutrient depletion
Wood exploitation		Introduction of exotic tree species (Pinus radiata, Eucalyptus globulus) in large scale plantations		
Long-term poor agricultural and livestock practices	Outmigration of active population, land use change, ageing population, poverty risks, decreased opportunities for diversity in farm production	Soil sensitivity to erosion, topsoil erosion, loss of soil resilience, water storage reduction	Decreased soil cover, increased runoff, decreased water quality, increased soil loss, decreased wood production, economic losses	Vegetation degradation
Wood exploitation		Introduction of exotic tree species (Pinus radiata, Eucalyptus globulus) in large scale plantations		

Drivers	Socio economic drivers	Environmental drivers	Pressures	Impact
Ribeira Seca, Cape Verde				
Intense and irregular rainfall	Poor access to financial support for agricultural activities, insecure land tenure (land users are not landowner), high level of unemployment due to the decline of rural economic activities (agriculture, livestock), rural poverty, excessive parceling of lands through inheritance, lack of access to information on natural resources management, main economic activities are in the primary sector, which still employees a substantial portion of the active labor force, high trade deficit financed by foreign aid and remittances from emigrants (remittances supplement GDP by more than 20% - CIA factbook), insufficient research on local processes and drivers. Weak coordination between implementation projects on environmental issues	Poor natural resource base, including serious water shortages exacerbated by cycles of long-term drought, steep and instable slopes, low organic matter content, low productivity of soils Duplication that leads to less impact of efforts	Low infiltration; high overland flow, increased runoff, loss of top soil	Soil erosion by water, soil nutrient depletion
Inadequate practices in rainfed agriculture (excessive weeding)	Fuelwood is the main source of energy in rural areas, low education level of land users, rural poverty, lack of land, insecure land tenure	Lack fuel woods and pasture, shortage of agriculture land resulting in intense soil use, high pressure on vegetation (fuel wood and pasture), consecutive droughts, lack of soil cover (bare soils), high evaporation, low soil organic matter, low rainfall, shallow soils	Increased sediment yield, organic matter decline, soil cover reduction, decrease of biodiversity and increase in invasive alien species, bare soils, increased evaporation in arid, semi arid and sub humid zones	Vegetation degradation

Overexploitation of groundwater	Rural exodus (emigration, and selling of lands), increase in irrigated land areas	Sea water intrusion into aquifer system due to overexploitation of groundwater (soil and water salinity)	Decrease of crop yield, decrease of soil and water quality, reduction of farmers income and increase of their vulnerability, lands abandonment	Soil salinisation
Land fragmentation	Less land care	Lands are less intensively managed	Increased sediment yield, organic matter decline, soil cover reduction, decrease of biodiversity and increase in invasive alien species, bare soils, increased evaporation in arid, semi arid and sub humid zones	Soil erosion
Drivers	**Socio economic drivers**	**Environmental drivers**	**Pressures**	**Impact**
Cointzio, Mexico				
		Arid climate		Soil erosion
Overgrazing	Animals are the bank for the majority of farmers. Involved the poorests famers to control and changes their agro systems is difficult in economic and sociologic terms.	Low vegetative cover before the first rains	River bank erosion	
		Soil vulnerability (compaction, weak soil structure)		
Outmigration/lack of land investment	Out migration of young people; ageing population	Poor land management practices (cultivation of sloping marginal lands, ploughing in slope direction)		
	Low agricultural prices, off-farm income more important			
		Uncontrolled road drainage	Flash floods	

		Land management intensification and land use change (irrigated avocado plantation+urbanization)	Decreased water availability	Decline of ground water resources
Forest fires		No forest or shrub management		Soil erosion
		Poor access		
		Low availability of human resources and mechanisation		
		Lack of water reservoirs for fire control		
Ground water contamination	Lack of information, lack of control, corruption	Hot spot contamination (Trout and chicken farming , human settlements)		Decline of water quality

Table 4: Desertification drivers, impacts, responses, and policies in DESIRE SSs and countries.

Drivers	Impact	Responses	Policies
Mação and Góis, Portugal			
Repetitive wild fires	Soil erosion, biodiversity loss, lower water quality, diminished wood production	Contour-felled logs (log erosion barriers, log terraces, ...), mulching (potential), prescribed fire, reforestation, seeding, preventive forestry (fuel load management through mosaic landscape planning)	Many laws and regulations have been formulated after the catastrophic forest fires in 2003 and 2005 additional to the existing forest management and planning laws and programmes
Poor agricultural and forestry practices	soil erosion, soil nutrient depletion	Terracing	Programmes were implemented focused on rural livelihoods and reforestation
Drivers	**Impact**	**Responses**	**Policies**
Guadalentin Basin, Murcia, Spain			
Land abandonment	Soil erosion (+)	Construction of terraces and check dams, reduced tillage, increased fallow periods, reforestation	Policies and regulations that focus on vegetation cover management, such as reforestation, crop rotations and fallow periods
Common Agricultural Policy (CAP)	Soil erosion (+)	Construction of terraces and check dams, reduced tillage, increased fallow periods, reforestation	National Action Programme to Combat Desertification (NAPD), European Agricultural Guidance and Guarantee Fund (EAGGF), and the Regional development programmes
Intensive tillage	Soil erosion (-)	Reduced- and contour tillage	Regional development programme
Irrigated horticulture and illegal pumping of groundwater for irrigation	Ground water (quality+ quantity) decline	Drip irrigation and plastic covers to reduce evaporation losses	Policy enforcement by the water authorities, water transfers, subsidies for irrigation infrastructure, European Agricultural Guidance and Guarantee Fund (EAGGF)), and the Regional development programmes (every 5 or 6 years).
Intensive pig farming	Soil and groundwater contamination	Controlled use of sludge for fertilization purposes	Regulations on waste treatment, storage and use of pig sludge

Decline of traditional knowledge	Water stress	Construction of terraces and water harvesting structures	Regional development programme
Drivers	**Impact**	**Responses**	**Policies**
Zeuss-Koutine, Tunisia			
Wood cutting and overgrazing	Soil erosion, biodiversity loss	Water harvesting and soil conservation, such as erosion barriers, terraces, Jessours, tabias)-> actual response	National strategy for range land improvement and rehabilitation (1990 - 2009) National action plan to combat desertification National strategy for soil and water conservation (2001-2011) National strategy for water resources mobilization (2001 - 2011) National environment agenda (21-21) National inventory of forestry and range lands
Wood cutting, overgrazing, and cultivation	Vegetation degradation		
Inadequate agricultural and forestry practices	Soil erosion, soil nutrient depletion	Sustainable forest management practices (state controlled lands), grazing limited to specific periods	
Drivers	**Impact**	**Responses**	**Policies**
Karapinar, Turkey			
Low vegetative cover	Wind erosion	Reforestation (attempts are made but results are insecure, more research is done on how to apply successful reforestation under these dry and saline conditions) Drip irrigation (actual)	Law 5403 on soil preservation and land use Law 5403 on soil preservation and land use Subsidies for drip-irrigation
Irrigated agriculture, market demand for agricultural produce	Ground water depletion		
Groundwater depletion	Secondary salinization		

Torrential summer and autumn rains, low vegetative cover	Water erosion		
Sustained overgrazing	Degradation of meadows		
Drivers	**Impact**	**Responses**	**Policies**
Eskişehir, Turkey			
Low vegetative cover	Wind erosion	Reforestation	law 5403 on soil preservation and land use
Groundwater depletion	Secondary salinization		
Inappropriate tillage	Water erosion, Soil fertility decline		
	Urbanization		law 5403 on soil preservation and land use
	Biodiversity decline in meadows		
Soil excavation	Soil degradation		Urban priorities (construction) and local economic gain overrule local environmental concerns (and law 5403)
Drivers	**Impact**	**Responses**	**Policies**
Rendina, Italy			
Poor agricultural practices	Soil erosion		Common Agricultural Policy (CAP) CAP derived regional law and rules
Land leveling	Mass movement, soil slip		
Destruction of drainage systems due to use of heavy machinery	Drainage system degradation		

Overuse of water resources	Decreased water availability, water pollution	irrigation water storage	
Climate change	Increased environmental risks		
Drivers	**Impact**	**Responses**	**Policies**
Sehoul, Morocco			
Irrigation, drinking water extraction	Ground water depletion		Several local laws exist, both customary and formal, but lack integration National programme for desertification control (PANLCD) Water laws: Code d' l'eau (10/1995)
Inadequate land management	Land productivity decline	Fencing	
Land use change	Soil water erosion	Afforestation	
Drivers	**Impact**	**Responses**	**Policies**
Chania and Messara Valley, Crete			
Inadequate land management	Soil erosion		regulation 24/1975 (protection of natural resources) regulation 117/1975 (restoration of burned forest) regulation 92/43/EU NATURA 2000 (establishment of protected areas) Common Agricultural Policy (CAP) Structural Funds (SF) Cohesion funds (CF) Tourism policies
Land access with heavy equipment	Soil compaction		
Overexploitation of groundwater	Intrusion of sea water into aquifer system	Drip irrigation	
Overgrazing	Soil erosion		
Forest fires	Biodiversity decline, soil erosion,		

			Greek National Committee for Combating Desertification (GNCCS) Law 2486, ratification of UNCCD National action plan for combating desertification Adaptation of GNAP, 2001, decision 99605/3719 that orders ministries to incorporate GNAP measures into their planning establishment of a central water authority to coordinate water policies establishment of a working group for connectivity of policy on water and CAP. It aims to define measure for implementation of the Water framework directive Law 2742/1999 on 'Planning and sustainable development', ministers' decision (100949/2478) for Codes of Good Agricultural Practices containing general obligations to farmers ministers' decision (85167/820) for Codes of Good Practice for the protection of Ground Water by Nitrogen Pollution of Agricultural Origin Investment in capacity for extension services (law 3377, off. Gazette 255/17/ 4/2005 - A') through which 650 new staff positions were created

Drivers	Impact	Responses	Policies
Nestos basin, Maggana, Greece			
Irrigation with saline water due to seawater intrusion	Salinisation, soil degradation	Potential: Construction of drainage ditches, applied but limited extent: irrigation with fresh water, improvement of soil quality (eg. application of gypsum). There are plans to bring fresh water from the Nestos river to this area (East Nestos river basin) for irrigation through canals	Land reclamation works during the decades of '50 and '60 Construction of -only one- irrigation network (Thalassia – Kremasti), which transfers water through concrete ditches for 31.000km2 of eastern Delta region (2008) Prefect's decision about water use and restrictions: prohibition of drilling of new wells (2002) Greek Law: Protection and management of water resources, Greek Government Gazette, No 3199 (2003) Greek Law: Environmental impact studies, Joint Ministerial Decision No 69269 (2003)
Poor agricultural practices	Soil fertility loss, vegetation degradation	Cultivations of alternative crops	
Drivers	**Impact**	**Responses**	**Policies**
Dzhanybek, Russia			
Regional climate pattern change	Water scarcity, vegetation degradation	Soil water conservation Soil water harvesting` (potential responses)	1. Code of land laws of Russian Federation, 25 October 2001 №136-FZ (with changes in 2003 and 2007)
Saline groundwater rise	Soil salinization	Use of pocket of fresh ground water under micro-depressions Use of additional sources of fresh water for irrigation Change of irrigation technique from	2. Federal Law "About Melioration", 10 January 1996 4FZ (changes in 2003) 3. Code of water laws of Russian Federation, 03 June .2006 № 74- FZ 4. Federal Law "About Land Management",

		sprinkler irrigation to drip irrigation	18 June 2001 № 78-FZ 5. Federal Law " About protection of environment", 10 January 2002 №7-FZ
Overgrazing	Water erosion	Land rotation management	
Drivers	**Impact**	**Responses**	**Policies**
Novy, Russia			
Excessive irrigation	Soil salinization, water logging	Introducing of soil and water friendly irrigation techniques (potential)	1. Code of land laws of Russian Federation, 25 October 2001 №136-FZ (with changes in 2003 and 2007) 2. Federal Law "About Melioration", 10 January 1996 4FZ (changes in 2003) 3. Code of water laws of Russian Federation, 03 June .2006 № 74- FZ 4. Federal Law "About Land Management", 18 June 2001 № 78-FZ 5. Federal Law " About protection of environment", 10 January 2002 №7-FZ
Poor irrigation practices	Runoff, soil loss		
Drivers	**Impact**	**Responses**	**Policies**
Yanhe River Basin, China			
Easily eroded soil	Soil erosion	(actual) Revegatation, reforestation, terracing, reduction of local population	Regulations on the Protection of Basic Farmland (1998-12-27), Regulations on Conversion of Farmland to Forests (2003-1-20)
Inappropriate land management (agriculture on steep slopes)		Prohibit planting slopes steeper than 25 degree and impose a fine on actions that provoke erosion	Flood Control of The People's Republic of China (1998-1-1), Law of the People's Republic of China on Prevention and Control of Desertification (2002-1-1)
Excavations from engineering works (e.g. for road construction)	Soil erosion	Excavation for engineering projects must be accompanied by plans for SWC (obligatory)	Environmental Protection Law of the People's Republic of China (1989-12-26), Forest Law of The People's Republic of China (1985-1-1),

			Law of The People's Republic of China on Water and Soil Conservation (1982-6-30), Emigration policy from mountain region (2004-1-1), Policy for stimulation of emigration for farmers to other areas (2005-1-1)
Droughts	Vegetation degradation	Mulching	Regulations on Conversion of Farmland to Forests (1999) -> " Grain for green"
Poor vegetation management		Decrease the density of trees, planting local trees	Law of the People's Republic of China on Prevention and Control of Desertification (2002-1-1)
Overgrazing		Planting local trees	Environmental Protection Law of the People's Republic of China (1989-12-26), Forest Law of The People's Republic of China (1985-1-1), Law of The People's Republic of China on Water and Soil Conservation (1982-6-30), Grassland Law of the People's Republic of China (1985-10-1), National Plan for Rural Biogas Development (2004~2010)
Climate change	Water loss and shortage of soil water	Mulching	Law of the People's Republic of China on Prevention and Control of Desertification (2002-1-1)
		Terrace	Law of The People's Republic of China on Water and Soil Conservation (1982-6-30)
		Infiltration ditch and fish-scale pits	emigrant workers of local farmers to other place (2005-1-1)
Drivers	**Impact**	**Responses**	**Policies**
Boteti area, Botswana			
Lack of cross-sectoral planning, lack of implementation capacity (policy	Desertification		National Action Plan to Combat Desertification, National Conservation Strategy, Environmental Impact Act, National Policy on Agricultural Development,

failure)			Revised National Policy for Rural Development, Revised National Policy on Education, National Strategy for Poverty Reduction
Resource use pressure	Soil erosion, Biodiversity decline, ground water depletion		Community Based Natural Resource Management Policy (CBNRM) (2006), Tribal Grazing Land Policy (1975) Services to Livestock Owners in Communal Areas (SLOCA-1970) Livestock Water Development Programme (1988) National Biodiversity Strategy and Action Plan
Environmental stress	Droughtness, lowered carrying capacity for livestock		Arable Lands Development Programme
Drivers	**Impact**	**Responses**	**Policies**
Secano Interior, Chili			
Long-term poor agricultural and livestock practices	Soil erosion by water, nutrient depletion	Contour-felled logs (log erosion barriers, log terraces, ...), forest plantations, no-till farming pastures establishment, fertilizer applications	D.L. 701 Bonus program for forest plantation and forest management Technical assistance for forest plantation and management Bonus program for native forest management DFL 235 (1999) Bonus Programme for rehabilitation of degraded soils and its regulation (DS 83, 118 and 35) Government Institutions supporting Programs for farmers: 1. National Commission for Irrigation (CNR) Law 18450. Program for investment in
Wood exploitation	Vegetation degradation	Improvement of degraded Pastures, fertilizer applications, introduction of exotic legume plants and shrubland	

			irrigation and drainage infrastructure. Program for evaluation studies. Program for training with emphasis in poor communities 2. National Institute for Agricultural and Livestock Development (INDAP). Supporting programs for medium and small farms Technical assistance. Program for Investment development. Irrigation program for farmers associations. Collaborative programs with political administrative sectors. 3. Agrarian Innovative Funding (FIA). Funds for new and original projects (initiatives supported by farmers, government institutions and universities)
Drivers	**Impact**	**Responses (potential)**	**Policies**
Secano Interior, Chili			
Intense and irregular rainfall	Soil erosion by water	Implementation of SWC infrastructures (afforestation, contour ridges, green contour ridges, contour stone, walls, contour stone walls combined with several species, terraces, micro catchment, check dams, Reservoirs), Creation of income generating activities for the vulnerable families, capacity building for different level of stakeholders, improvement of breeds to increase animals production, undertake research on erosion processes	There is lack of institutional mechanisms to implement and monitor policies affecting their impact Law nº 86/IV/93, of 26 July, defining the Baselines of the Environmental Policy Order in Council n.º 14/97, of July 1, developing the Baselines of the Environmental Policy Order in Council nº 29/2006, establishing the juridical regime of the validation of the Environmental Impact of public or private Projects susceptible to bring effects on the environment
Inadequate practices in rainfed agriculture	Vegetation degradation	Creation of protected green areas and forest perimeters, accessibility to improved planting material,	

(excessive weeding)		reconversion of rainfed to irrigated lands, increase the accessibility of drip irrigation system to land users	Law n.º 102/III/90, of December 29, establishing the Bases of the Natural and Cultural patrimonies Order in Council n.º 3/2003, of February 24, establishing the Juridical Regime of Protected Areas Order in Council n.º 40/2003, of September 27, establishing the juridical regime of the natural reserve of Santa Luzia Island Order in Council n.º 5/2003, of March 31, defining the National System for the protection of air Order in Council n.º 31/ 2003 of September 1, establishing the essential requirements for the elimination of solid urban residues, industrial and others and a respective control Order in Council n.º 6/2003, of March 31, establishing the juridical regime of licensing and exploitation of quarries Law nº 48/V/98, of April 6, establishing the protection of the tree and the forestry Order in Council n.º 2/2002, of January 21, prohibiting the extraction and exploitation of sand hill from Beaches, Rivers, Costal and the territorial sea Order in Council nº 81/2005 of December 5, establishing the Environmental Information System and the Juridical Regime
Overexploitation of groundwater	Soil salinisation	Facilitate accessibility of land users to drip irrigation system and subvention of infrastructures to collect water for irrigation, roof collection of rain water is an existing practice	

			Order in Council n.º 22/98, of May 25, approving minimum norms related to the elaboration and approval of construction projects for entertainment buildings
Drivers	**Impact**	**Responses (potential)**	**Policies**
Cape Verde			**Law nº 86/IV/93**, of 26, July which defines the Baselines of the Environmental Policy
Intense and irregular rainfall	Soil erosion		Order in Council n.º 14/97, of 1 of July that develops the Baselines of the Environmental Policy
			Order in Council nº 29/2006, establishes the juridical regime of the validation of the Environmental Impact of public or private Projects susceptible to bring effects on the environment.
Inadequate practices in rainfed agriculture (excessive weeding)	Soil erosion, soil fertility decline		**Law n.º 102/III/90**, 29 of December, establishes the Bases of the Natural and Cultural patrimonies
			Order in Council n.º 3/2003, 24 of February, establishes the Juridical Regime of the Protected Areas
Overexploitation of groundwater	Soil salinity (intrusion of sea water into aquifer system)		**Order in Council n.º 40/2003**, 27 of September, establishes the juridical regime of the natural reserve of Santa Luzia Island
			Order in Council n.º 5/2003, 31 of March, defines the National System for the protection of air.
Land fragmentation			**Order in Council n.º 31/ 2003** of 1 September, establishes the essential requirements to be considered in the elimination of solid urban residues, industrial and others and a respective control, in order to protect the environment and human health **Order in Council n.º 6/2003**, of 31 March, establishes the juridical regime of licensing

			and exploitation of quarries.
			Order in Council n.º 2/2002, of 21 January that prohibits the extraction and exploitation of sand hill from Beaches, Rivers, Costal and the territorial sea.
			Order in Council nº 81/2005 of 5 December, that establishes the Environmental Information System and the Juridical Regime
			Order in Council n.º 22/98, of 25 May that approves minimum norms related to the elaboration and approval of constructive projects, the invoicing and conditions of security of diurnal use of an entertaining building
Drivers	**Impact**	**Responses (potential)**	**Policies**
Cointzio, Mexico			
Overgrazing	Soil erosion	Control of n° of animals/use of grazing cultures/areas protected…	Human settlements and environmental protection and natural resources of the country: Article 27, Paragraph Three of the Constitution of the United Mexican States
		Minimum tillage/changes of cultures/use of mulch	Definition of respective jurisdictions between Federation, states and municipalities: Article 73, sections C and XXIX-XXIX-G of the Constitution of the United Mexican States
Outmigration/lack of land investment			Federation: Political constitution of the United Mexican States
			Federation: General law of human settlements
			Michoacán state: Political constitution of the

			free and sovereign state of Michoacan de Ocampo
			Michoacán state: Urban development code
			Municipalities: Municipal government edict
			Municipalities: Urban development code
			Federation: General law of ecological equilibrium and environmental protection
			Michoacán state: Environmental law and natural heritage protection
			Municipalities: Environmental protection regulation
			Federation: General law of wildlife
			Michoacán state: Environmental law and natural heritage protection
		Caterpillar+tractor to create new soils and terraces	Municipalities: Environmental protection regulation
Forest fires	Forest fires		Federation: General Law on sustainable forest development
			Michoacán state: Sustainable forest development law
			Municipalities: Green areas regulation
Decreased ground water resources			Integral Management Plan of Natural Resources of the Cuitzeo Lake Basin (which

			include Cointzio) MARCH 2009
Water pollution	Decline of water quality		Federation: National waters law (2004)
			Watershed Organism: Watershed laws and regulations

Appendix 2 Reporting format Study Site descriptions

Below is a format for general study site descriptions to be included on the DESIRE Website (under Project Information/Research Sites). We would like you to include at least the information requested below under "Headings to be addressed" as much as possible and wherever relevant. Any other relevant information can of course be added.

NB: *These study site descriptions aim to provide a brief but inclusive overview for each site. Much of the information is asked for in other questionnaires (e.g. WOCAT) that will be applied to the study sites either at field level or site level. We do not want to duplicate efforts, hence we recommend you to use the information from the other sources to compile this brief general report wherever possible.*

1. Responsible IP partner:

2. General information

Headings to be addressed:

- Location (coordinates) + map / Google Earth kml-file (placemark or map overlay)
- Size (km^2)
- Main reasons for selecting this site/region
- Participating local partner institutions
- Photos or other figures (NB: can be added anywhere in the text)
- Main language(s)

3. Bio-physical description

Headings to be addressed:

- Major natural resources available in the study site area? (e.g. geology, soils & terrain, climate, vegetation, etc.)
- Existing practices on land and resource uses? (e.g. slash-and-burn, arable farming, cash crops)
- Existing practices on water resources? (e.g. irrigation, domestic use, industrial use, fisheries, navigation)
- Existing uses of Forest resources? (e.g. protection, production, recreational)
- Strengths of existing land use practices(e.g. environmentally friendly, socially friendly, ease of use, economically rewarding, etc)?
- Weaknesses of existing land use practices (e.g. unsustainable, uneconomic, causing degradation)?
- Major degradation issues due to the use of natural resources? (e.g. erosion, soil fertility decline, salinisation, pollution, water quality or quantity decline, biodiversity)

4. Socio-economic description

Headings to be addressed:

- Population density, as well as structure (by age, by sex ratio)
- Level of education

- Level and source(s) of income main stakeholder groups (income from the resource base vs. income from off-farm labour or from family members in city or abroad)
- Major livelihood supports available from the resource base listed above (e.g. food crops, cash crops, fodder, firewood, timber, settlement)?
- Impacts of land degradation on the livelihood of people and what groups are most affected?(e.g. poverty, productivity, income, social unrest)?
- Major challenges of existing land resource management? (e.g. environmental degradation, low economic return, increase of social unrest, GO-NGOs relationship)?
- Major drivers of main land degradation processes (e.g. weak institutional support, lack of information, insecure land tenure, poor access to financial support)
- Other relevant socio-economic indicators

5. Institutional and political setting

Headings to be addressed:

- Existing institutions involved in natural resource management and desertification
- Existing civil societies (CS), and traditional organisations
- Existing laws and policies for land and water resource management (both customary and formal)?
- Extension and training (availability and adequacy)

6. Relevant end-users / stakeholder groups (at all levels)

Headings to be addressed (NB: not all may be relevant for each study site):

- Govt./Project staff
  - National
  - Local
- Public administration
  - agriculture
  - forestry
  - land
  - water
  - livestock
  - environment
- Research Centres and Universities
- NGOs / Community based organizations
- Companies
- Media (journalists)
- Schools
- Land users
- ….

7. Past and on-going projects

Each of the study sites were asked to provide the following information:

Degradation type, and for each those the:

Drivers

Policies

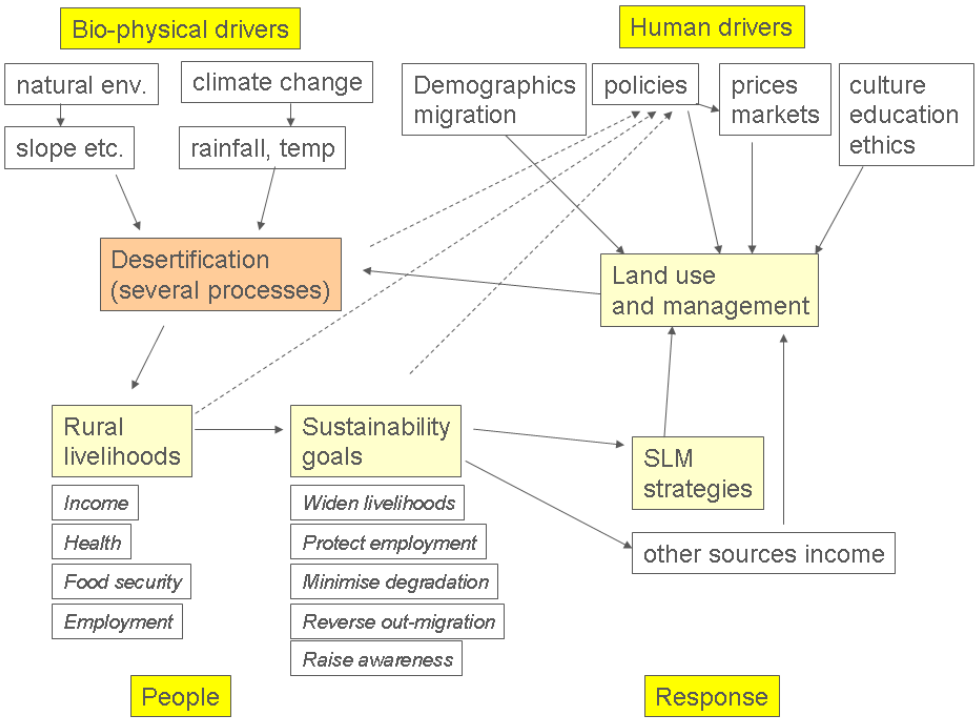
Impact

Responses

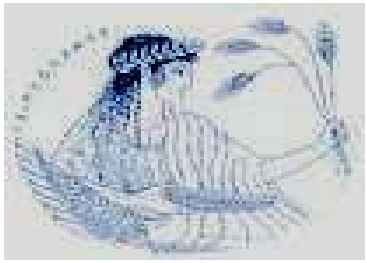
Socio economic factors

Environmental factors

Appendix 3 Diagram of processes and drivers and interrelations



Appendix 4: Detailed reports on drivers of land degradation, law and policy from Greece, Tunisia and Botswana



DESERTIFICATION MITIGATION AND REMEDIATION OF LAND – A GLOBAL APPROACH FOR LOCAL SOLUTIONS

Contract No. 037046

WP 1.3

Drivers and Policy Context

Deliverable 1.3.1

Identified drivers of land degradation with specific reference to the study areas at field, local and policy level

Contractor: Agricultural University of Athens
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Drivers of land degradation and desertification in Crete study site

1. Introduction

As early as the Neolithic age, Crete was inhabited by a scattered population living partly in caves some distance from the coast but also concentrated at Knossos, in one of the largest settlements of that period in the eastern Mediterranean. Crete's population was reinforced at the beginning of the Bronze Age, i.e. shortly after *ca.* 3,000 B.C. with the arrival of new settlers perhaps from Asia Minor (Angelakis and Spyridakis 1996a). Crete have been progressed especially in the Middle Bronze Age *(ca.* 2,100-1,600 B.C.) when the island's population in its central and south regions increased, towns developed, the first palaces were built and Crete achieved a prosperous and uniform culture. By the end of this period, both manufacturing and the arts flourished and the islanders engaged in extensive trade with Egypt, the Aegean Archipelago and the Near East. In the early phases of the Late Bronze Age *(ca.* 1,600-1,400 B.C.), Crete appears to have prospered even more, as the larger houses and more luxurious palaces of this period indicate (History of the Greek Nation, 1970). The geological catastrophe through the eruption of the Santorini volcano in 1450 B.C. halted the Minoan civilization (Angelakis and Spyridakis 1996b). After the destruction of the Minoan civilization, new horizons of development were initiated in the island by shipping commerce and trade with other peoples such as the Phoenicians, the Syrians, and the Egyptians. With the invasion of the Achaeans and the Dorians in the island, the new cities of Lato and Aptera were founded. Lato became the most important city on Crete (7th century B.C.), until the Roman occupation *(ca.* 69-330A.D). The most distinguished centre in those days was Gortis in the Messara valley.

During the Byzantine era, the wealth of Crete was shown off in the mosaic floors of its basilicas and half the churches of Greece. Crete was occupied by Arabs in 824 A.D. for one and a half centuries. Handak, the city of Heraklion, was founded during that time. Then, in 1204 A.D., the island passed to the Venetians. They fortified the old castles at Handak and built mew ones at Gramvoussa, Spinalonga, Frangokastello, lerapetra, and Paleochora. In 1645 A.D. the island was conquered by the Muslims that entered it for the first time and in 1669 it was occupied by the Turks to be free again after the revolution and was united with Greece in 1913.

The population of Crete suffer great variations throughout the centuries due to catastrophic events occurring such as deluges, earthquakes, as well as invasions of different conquerors, mainly Arabs, Venetians and Turks. It is estimated that during the Homer time, the population of Crete was more than one million, to drop dramatically then. The population, however, followed great fluctuation depending on the prosperity of the island, the level of civilization and the frequency of invasions from the crusaders. After the invasion of the Turks, the population of the island reached the lowest density of 53,753. Today's population of Crete is 578,251, with an average population density of 65 persons per km^2.

Pressure on the land probably explains why so many hillsides are terraced. Some of the terraces are Minoan, some Roman, some are later. Despite the controversial discussion about the extent of forests in Crete during the last thousands of years and the deforestation in ancient times (Grove *et al*., 1990, Papanastasis *et al*., 1990) there must have been some remnants of forests during all time. The human impact fluctuated between the successive prehistoric and historic periods according to the population changes dictated by various factors including local and regional

conflicts and invasions. In the meantime, a man-maintained equilibrium between dependent and controlling factors was established in the natural ecosystems over the centuries. In the last few decades, however, this equilibrium is being threatened. Such threats are more pronounced in hilly and mountainous areas where long term established conservation practices have been abandoned in favor of new developmental driving policies, such as subsidies to livestock husbandry by the European Union (Lyrintzis *et al*., 1998). Drivers of land degradation and desertification in Crete are related to social, political, economic, demographic, cultural and physical environment conditions. Such driving forces impose changes in production, life styles and consumption. The principal driving forces are population growth, the common agricultural policies of European Union and the national policies. Of course adverse climatic and topographic conditions have contribute to land degradation and desertification. The objective of this WP is to identify and evaluate land degradation drivers and the policy context in the Crete study site.

2. Grazing land

2.1 Land characterisitcs

Pastures are the most widely expanded in Crete with great ecological and economical importance for the production of low cost and good quality of animal products. Even though pastures present serious problems related to the land productivity and the environment, they contribute significantly in the local economy. They are extended in a wide range of altitudes from low to alpine zones and they can be distinguished in the three following zones based on altitude: (a) pastures of low zone (altitude 0-600 m), (b) pastures of middle zone (altitude 600-800 m), and (c) pastures of upper zone (altitude >800 m) (Sarlis, 1998). The upper zone covers 50% of the total area of pastures producing 53% of the total palatable biomass. The middle and low zones cover 32% and 18% of the total pasture land, respectively, producing 33% and 18% of the total biomass. As Fig. 1 shows pastures in Crete cover 166,404 hectares or 20,1% of the total area.

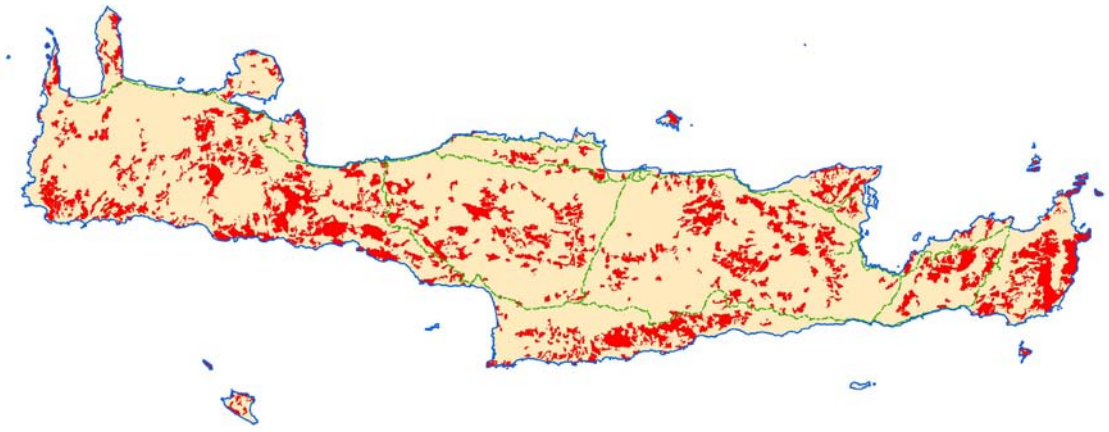

Fig. 1. Geographical distribution of natural pastures in Crete according to the CORINE 2000 (pastures in red colour)

Pastures are found in all climatic conditions existing in Crete which can not be characterized as favourable for high grass production. The long duration of drought in summer and the low temperatures prevailing during winter restricts plant

growth. Therefore, natural pastures can be used for grazing a short period during winter, spring or fall but never during the whole year. Pastures are found in most parts of the island of Crete especially in hilly and mountainous areas (Fig 2).

Fig. 2. Grazing land in the lower altittude (<600 m, left) and upper altittude (>800 m right) in Messara subjected to overgarzing

Growing domestic livestock in various places in Crete has begun since the Neolithic times, about 10,000 years BP. Actions for range management of pastures are limited. Except for the pastures of the upper zone which are used only during the summer period, all the others are used during the whole year. Overgrazing is very common resulting in high erosion rates and disappearance of various plant species and expansion of plant species which are not eaten by the animals. Furthermore, pastures in the upper zone receive large numbers of animals during the summer period or these pastures are undergrazed due to lack of infrastructure (roads and drinking water for the animals). Pastures in the lower zone covering plain and hilly areas (altitude lower to 600 m) are used mainly during the winter period or most of the year. Due to relatively favorable air temperatures, grass growth is mainly dependent on the amount of rainfall. Grass production is greater in spring than in fall but due to lack of water plants are getting dry quickly and animals are moving to upper elevations. Pastures in the middle zone (600-800 m) are grazed mainly by goats during the whole year. Grass production in the middle zone is especially high during spring, while grazing can be limited for some period during winter due to the presence of snow. Pastures of the upper zone are used for few months during summer. This zone is better protected from overgrazing and soil erosion.

2.1 Drivers of land degradation

Drivers of land degradation and desertification are realted to the social economic and political characteristics such as land ownership, farm size, CAP policies. ***Land ownership*** had greatly affected desertification risk. Due to population migration especially during the period 1950-1965, land has been abandoned or rented to farmers remaining in the area. Furthemore, part of the land especially the upper mountaneous areas, is controlled by the Ministry of Agriculture (Department of Forestry and Natural Resources). Under such conditions the main concern of the land user is the overexploitation of the natural vegetation without applying any erosion control

measures. In some cases farmers deliberately put fire to burn perennial shrubs and to generate palatable annual grass for the animals favoring high erosion rates. Once the land was bare of its vegetative cover and the soil was loosened, the torrential rains of autumn and winter began to wash away the topsoil. In the last fifteen years, there is a significant increase in the frequency and magnitude of forest fires in the area. Controlled grazing is a major management issue for reducing desertification risk. In some cases, land is fenced and animals are moved from one place to the other avoiding overgrazing.

Another important driver of desertification is the ***farm size and land fragmentation.*** As farm size decreases and land fragmentation increases the sensitivity of the land to desertification increases. The farm size usually ranges from 10-50 ha while the dominant fragmentation is 2-8 parcels. Small farm size with high land fragmentation leads to overgrazing since shepherd has to keep a large number of animals in small piece of land or to move from one parcel to the other favoring overgrazing and soil erosion. In addition under small farm size the farmer can not applied measures on soil erosion control since can not feed the large number of animals.

The Common Agricultural Policy (CAP) through its structural policies support an adequate income to farmers, contributing to the development of regional economies and the maintenance of landscapes, especially in less favoured areas. In addition, subsidies allocated under the CAP as an economical driver accelerates the intensification and specialisation process in agriculture. Higher farm prices under the CAP encourage farmers to keep larger number of animals in degraded areas. As figure 3 shows, The number of sheep and goats in the island have almost doubled or even more in the last three decades due to allocated subsidies, while the number of cows has decreased. Under extreme conditions, overgrazing can actually affect the health and the plant community, even changing species composition.

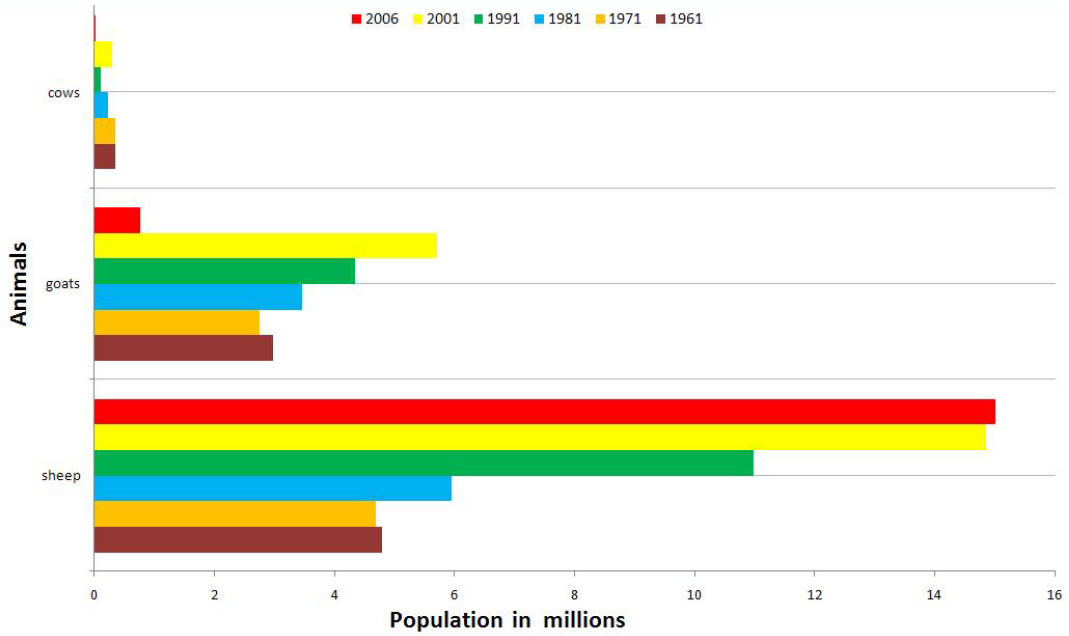

Fig. 3. Changes in the grazing animal population in Crete during the last four decades (Agric. Statitstical Service)

The EU production subsidies are highly important, sometimes become even more important than agricultural prices. This is because without these subsidies

farmers would not be able to carry on with their activity. Income determines the capacity of the farmer to invest in infrastructures and labour (including conservation practices) in the farm. Farmers try to maximise their farm income, so their decision on land resources management is directed to those number of animals that can assure higher income. But high animal density is a crucial factor of land degradation leading to vegetation degradation and, in turn, to soil compaction and erosion. Overgrazing by thousands of sheep and goats is contributory factor to the desertification of mountainous areas of Crete. It has been known for years that there are far more sheep and goats in Crete that the island can support. It is estimated that 1,500,000 sheep and goats graze on 55% of Cretan land, eliminating all edible vegetation in their desperate struggle to find food.

3. Agricultural land

3.1 Land characteristics

The agricultural land, including arable land and permanent crops, covers 407,440 hectares (Greek National Statistical Service) the agricultural areas including farmland and pastures cover 594,740 ha or 39.4 % of the total area. Olive and vine plantations are the main perennial crops covering a great part of lowlands and the hilly areas, but also parts of the uplands (Fig 4). Orange trees and avocado are mainly located in the lowland of Chania and Messara valley. Olive groves have been expanded in the last 4 decades after eliminating the maquis and shrub vegetation. Vine plantations have greatly declined the last decades due to the destruction by the insect phylloxera. New plantations, more resistance to phylloxera appear in the area the last decade (Fig. 5).

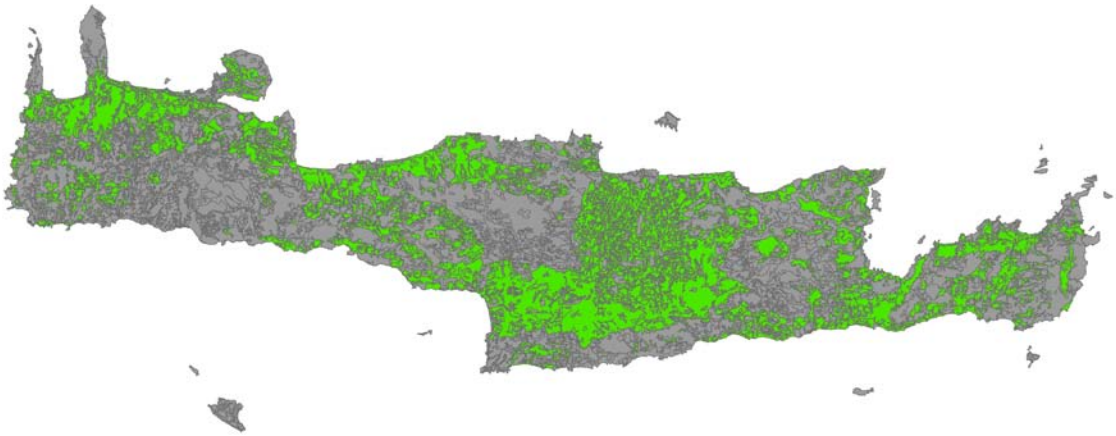

Fig. 4. Distribution of agricultural land in the island of Crete (green color) (CORINE 2000)

The soils characteristics in which agricultural land is found varies depending on topography and parent material. Deep alluvial soils of various textures, rich in carbonates were formed in the bottomlands (Xerofluents, and Chromoxererts). Deep soils of various textures free of carbonates with a cambic or an argillic horrizon and various degrees of erosion were formed on alluvial terraces of Quaternary age (Haploxeraf, Rhodoxeraf, Xerochrepts). Soils formed in hilly areas are characterized by their advanced degree of erosion with the parent material exposed on the soil surfaces in several cases (Xerochrepts, Xerorthents, and Lithosols). These soils are mainly formed of shale, marl, and conglomerate deposits. The most productive soils

are those formed on shale parent material followed by marl and conglomerate deposits.

3.2 Drivers of land degradation

Drivers of land degradation and desertification are related to social, economical and environmental conditions such as higher profitability of irrigated farming, low prices and of agricultural products, land fragmentation, tourist development, and climatic conditions. ***The higher profitability of irrigating farming*** and the low profitability of dry farming due to the climatic conditions (mainly due to low rainfall) has greatly affected farmer's decision in expanding arable land and changing land management practices. The expansion of irrigation in upper hilly areas cultivated with olives or vines has greatly affected water availability and water quality. It is estimated that water consumption in Crete is increased more than 4 % per year. The increased demand of water, either for urban or agricultural use, cannot be always met despite adequate precipitation. Water imbalance is often experienced, due to temporal and spatial variations of the precipitation, the increased water demand during the summer months, and the difficulty of transporting water due to the mountainous terrain.

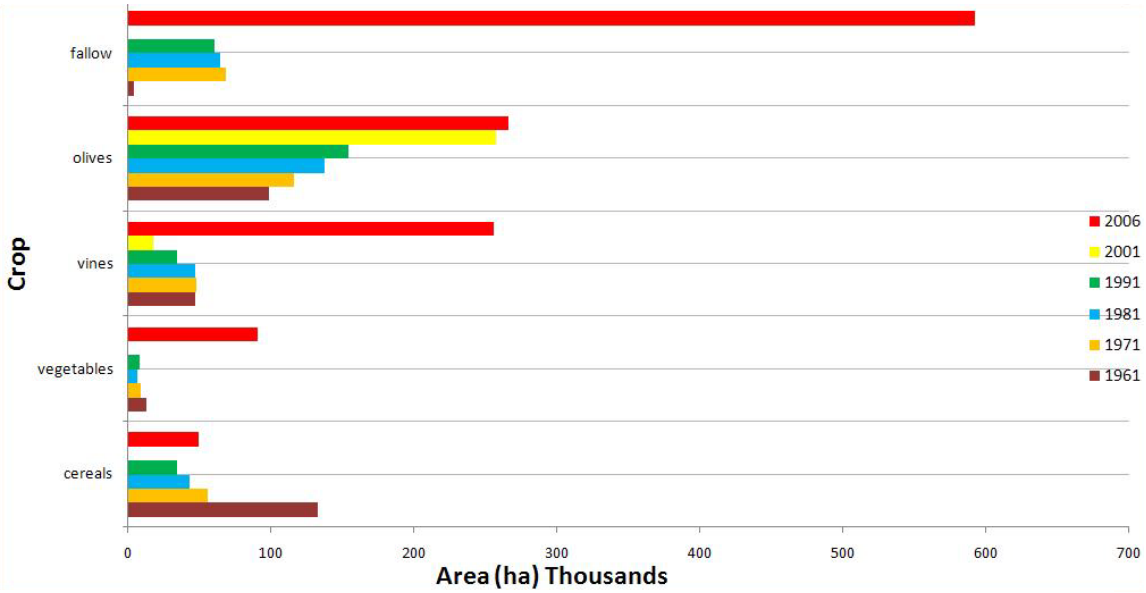

Fig 5. Changes in agricultural land uses in Crete in the last decades (Agricultural Statistical Service)

The major water use in Crete is for irrigation which corresponds to 82 % of the total consumption. Total water consumption for 1980 was 225 million m^3 of water. It has increased to 375 million m^3 in 1991. Today water consumption has increased more than 30 % compared to the previous two decades with an amount of 439 million m^3 required for irrigation. The irrigated land cover an area of 107,909 ha or 42.2% of the cultivated land. The overexploitation of the a aquifers especially in the Messara valley has favoured seawater intrusion in Tymbaki area (Messara valley) with adverse consequences on land productivity. Salinisation is one of the key process that could lead to land desertification. It is a growing problem in the lowlands of Crete. Agriculture plays a major role in driving the process of soil salinization by causing high water consumption and water chemical degradation but at the same time is the economic sectors that is facing the strongest impacts. Effects of salinisation for

farmers could be dramatic in economic and social terms. Moreover current climate change scenario with the foreseen increasing air temperatures and sea level rise could significantly increase salinity and cause the expansion of the affected areas.

Most of the small dry farms are still worked only by older traditional farmers with low income. These farms are often abandoned when farmers are retired. Young people from rural areas are much more attracted by the increasing tourist activity of the coastal areas than by farming and especially dry farming. Land abandonment is a major issue of areas in which land degradation has proceeded in large extent. The abandonment of the land can have great impacts on the environment and the economy of local communities. The effects of land abandonment on the environment or more specific on land quality may be positive or negative depending on the soils and climatic conditions of the area.

The low prices of agricultural products and high competition from other countries especially for the olive oil and orange fruits has greatly decreased farmer's adequate incomes. Farmers then adopt different cultivation methods in order to obtain public subsidies or change to more profitable crops, even though the soil conditions may not be suitable. They might also decide to clear natural vegetation and to grow olives or vines in order to increase their income (Fig 6) with adverse impacts on land degradation and desertification.

Fig. 6. Land clearing of natural vegetation and planting olive groves in Chania area (spring 2007)

An analysis of land use change from natural vegetation to agricultural crops in the area of Chania for the period 1960-1997 has shown a dramatic change in these land uses. Olive groves have been expanded in the area by 29.9% (Table 1) or in an area of 19,369 ha. The expansion of olive groves was mainly achieved by clearing the natural vegetation. Natural areas have been converted to agricultural areas (including olives, annuals, vines, etc) in an area of 19,719 ha or 30.5% of the total study area. The major changes have been occurred in the upper hilly areas mainly with steep slopes. A relatively small part of the agricultural area (3.6% or 2356 ha) was abandoned and natural vegetation allowed to be grown. Such changes occurred mainly in sloping land highly degraded. Urban areas have been expanded along the coast into agricultural or natural areas in 1321 ha (Table 1 and Fig. 7). Of course, no land use occurred in the major part of the study area covering 41379 ha or 63.9% of the total area. In most of the cases olive groves did not replaced with other type of land use except in the zone along

the coast in which the value of land is assessed more than twice for tourist purposes than for agriculture.

Table 1. Major land use changes in the area of Chania between the period from 1960 to 1997 (IMAGE project- INTERREG IIIB ARCHMED)

Land use change from	Area	
	Hectares	%
Agricultural to natural areas	2356	3.6
Natural to agricultural areas	19719	30.5
Agricultural and natural areas to urban	1321	2.0
No land use change	41379	63.9

The analysis of the various environmental factors affecting land use change from natural vegetation to agricultural crops has showed that the most important are: soil water storage capacity, distance from the nearest sea-shore, and altitude. The probability of land use change increased as the distance form the sea-shore and the altitude increased, and soil water storage capacity decreased. It seems that land use change have mainly occurred far from the seashore in higher altitudes and in moderately deep soils or shallower (soil depth less than 60 cm) moderately degraded. The main driver of expansion of the agricultural land to natural areas is related to the EU subsidies allocated for the olive oil production under the ***CAP policies.***

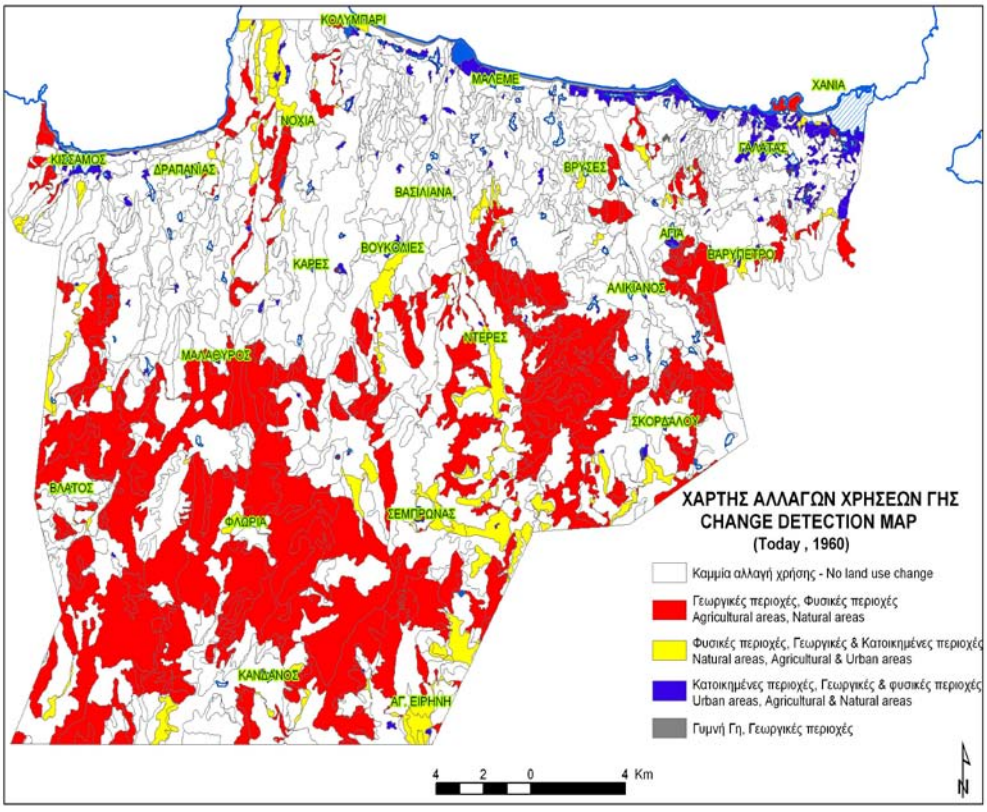

Fig. 7. Changes in land use observed during the period from 1960 to 1997 in the area of Chania (red colour = change from natural vegetation to agricultural crops)

Four CAP-related policies stand out with regard to their specific influence on land use change in Crete. These include structural policy measures like Less Favoured Areas (LFA) payments, special policies for aiding small islands in the Aegean, and policy measures for the modernisation of holdings.LFA policies are the key component of CAP structural measures implemented in the area. Member states are asked to provide special subsidies to farmers so that farming activities in disadvantaged areas are stimulated, and living standards of rural communities improved. All rural communities in Crete have been classified as 'less favoured'.

Land Fragmentation *le*ads to less profitability, as land parcels become increasingly divided they provide less and less income to the farmers causing the farming activity to become secondary. This way farming is more likely to be abandoned. Land mismanagement in Crete is connected with the high fragmentation of the agricultural farms (viz. 1.8 hectares on average). In addition, new farmers generations are more likely to sell the land than their parents, since they sometimes feel less linked to the land, or just work somewhere else for a living, often far from rural areas. Furthermore, new generations often move for education in urban areas and other more profitable opportunities apart from farming are available for them so they remain in urban areas in other economical sectors. As a result, farmers get older and finally, when they cannot carry on farming, land is abandoned. ***Parallel employment in tourist*** business assures some incomes for the farmer but also affects land management, since less time and effort is available for farming activities. On the other hand, the change in economic conditions due to tourist industry put more pressure on the land resources.

Tourist development in the last few decades has led the landscape of Crete in a dramatic explosion of new activities, such as mass tourism, growing urbanization and intensive irrigated agriculture, extensive single cropping, all leading to a progressive decline in traditional agriculture. The tourist arriving in Crete were 2 million in the year 2006. The number of beds has increased by 53% during the period 1986-1991. In some dry areas, farmers sell their land for building new tourist infrastructures. The low incomes from farming activities, and the high prices offered for tourist activities motivates farmers to change land use, reshaping landscape and altering resources. Furthermore, urbanization and intensive tourist development requires large amounts of water to cover the needs of local residents and visitors, a problem evident in the city of Heraklion and the tourist resorts of Heraklion Prefecture, where water needs increase exponentially every summer. Increased water requirements in urban and tourist areas are currently met through boring new wells. In periods of low rainfall, however, these result in a fall in the water table, salination of coastal areas and drying-out of wetlands, threatening local ecosystems and their biodiversity.

Climatic conditions are one of the most important determining factors affecting agriculture, in Crete. Under irregular rainfall with long dry period and high summer temperatures, farmers plans cultivation practices in order to store more much rainfall into the soil or reduce soil water evaporation by tillage. Such practices in hilly areas greatly contributes to high erosion rates due to surface water runoff and tillage operations. Farmers consider that the understory vegetation competes with their crops for rain water, so they remove it by chemicals or by cultivating the soil.

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DESIRE Project

Deliverable 2.1.2 :
Analysis of the main drivers of desertification (law and policy) and the impact of desertification on social, economic and natural capital and on the ecological and economic functions

Study site: Zeuss-Koutine, Tunisia

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Introduction

Tunisia has extensive arid zones that are extremely sensitive to various forms of land degradation and a number of development programs and studies to combat desertification are executed in the country. Arid bioclimates cover over 63,000 km2, of which 11.8 % has been assessed to be very degraded, 36.6% to be moderately degraded and 17% to be slightly degraded There has been no significant climatic changes since the end of the last century, so the authors state that the present signs of desertification cannot be attributed to an increasing dryness of the climate. Instead, they are caused by human and animal pressure on fragile ecosystems. The stresses are listed as follows (Mtimet et al., 2002):

- inappropriate use of soils, through extending arboriculture and cereal crops into zones that should be used as rangelands only;
- use of inappropriate equipment for the preparation of soils (e.g. the use of polydisc ploughs in sandy soils sensitive to wind erosion);
- increasing numbers of livestock in conjunction with a decrease in the area of rangeland, resulting in overgrazing, a deterioration of soils and a decrease in plant species suitable for grazing;
- removal of wood for domestic use, which is one of the main causes of the decline of tree and shrub species;
- use of high salinity water for irrigation, contributing to the salinization of soils and the decline of their fertility; and
- urbanization, particularly in coastal areas and around ancient cities and towns, resulting in land, often the most fertile areas, taken out of production.

These pressures work as causes of degradation, as their effects include water and wind erosion, deterioration of the vegetation cover, and degradation due to hydromorphy and salinization.

In the Jeffara region, more specifically the Zeuss-Koutine site (study site), which served for a very long period of the history as a large open grazing lands and nomads movement routes from south to the centre or vice versa, has known profound and very rapid mutations since the beginning of the last century. In fact, it is nowadays considered as crossroad of intensive exchanges and human movement whereby very strong ties have been built either with neighboring regions and countries (Libya) or more far regions such as Tunis capital and Europe (Paris) (Genin et al., 2006).

Certainly and as it is the case of other similar regions in the Mediterranean basin, the biophysical and socio-economic drivers and impacts are tightly interconnected. In fact, many authors (Turner et al., 1995; Puigdefábregas, 1998; Geist and Lambin, 2004) agree that there is not one single factor that causes desertification or land degradation. Both biophysical and socioeconomic factors should be considered, even jointly, as they interact and reinforce each other to induce transition trigger events (Turner et al, 1995; Puigdefábregas, 1998). Related to this is the issue that it is often difficult or even impossible to separate natural from human-induced degradation. In many cases, climate or climatic change acts as a boundary condition, but without human actions this would not necessarily lead to degradation

Main biophysical drivers

The climate of southern Tunisia, as defined by Houérou (1959), is subjected to two completely opposite climatic centers of action: the first, located at the west-south, is the place of a dry and hot subtropical climate, and the second, located at the east of the gulf of Gabes, is under the influence of a relatively moderate Mediterranean climate (Despois, 1955).
Southern Tunisia is thus impregnated by the Gulf of Gabes in north and the North-East and the presence of the mountainous chain and the great oriental erg from the other directions. The hot and dry summer lasts 4 to 5 months; the winter is moderate with soft and irregularly rainy, the autumn and spring present very variable climatic conditions. The climate of the area is characterized by an extreme irregularity, whose essential features are as follows (Floret and Pontanier, 1982):
- A low and very variable rains occurring during the cold period, and a quasi-absolute dryness between May and September.
- A much contrasted temperature pattern with moderated winters and very hot summers.
- A high evaporation.
- Strong wind especially during spring and drought periods.

Except, some local deposition of quaternary deposits (loess formations), the soils are distinguished by very low rate of pedogenesis, coarse to medium texture, very low organic matter content and water storage capacity.

The surface water resources are almost negligible but the wadis can bring very strong flows after heavy and intense rainfall events.

The groundwater aquifers, which represent the main water supply source in the region, are characterized by low renewable rates (as rainfall and runoff are low) and relatively high levels of salinity.

Outside the remote mountain areas and the saline depressions, the plant cover is sparse and subject to continuous degradation.

Main drivers of desertification (law and policy)

The management of the land use was always among the major preoccupations of the central power (Government) and the population in Tunisia. Many policies have been realised to palliate to the main problems related to the access and the use of the land.

The major problem met by the Tunisian Government is related to difficulties of access to the land and the different natural resources (soil, water and vegetation) and productive resources (agricultural production mainly). Indeed, the Government inherited of the colonial period a land situation marked by the importance of collective lands witch constituted a real brake to the development. Therefore, the land was a common property between all members of the tribe that possess only the ancestral use right witch defines rules of access and uses of the land (Sghaier and Fetoui, 2006). This situation drove, on one hand, to the blockage of lands and therefore to the reduction of their agricultural enhancement and the weakness of the production level, and on the other hand, to the tribal conflicts concerning natural

resource management and finally drove to the overuse of natural resources (pastoral and forest) and the deterioration of lands (erosion, loss of fertility, etc.).

To resolve this problem, the Tunisian Government started implementing policies and lows, just after the independence, concerning land promotion, through a progressive suppression of the collective lands regime (Ministry of agriculture, 2006). The year 1964 is considered as a turn in the evolution of the land use politics in Tunisia and in particular in the Southeast. At this date, the first operations of privatization of some collective lands have been started (Sghaier and Fetoui, 2006). This privatization, fast evolved at the last three decades, generated a structural change of the use of lands and the production systems (Nasr and Bouhaouach, 1998). Indeed, among objectives of privatization is the integration of the private lands in the economic circuit by their agricultural enhancement. So that the privatization permits to farmers to benefit from credits and subsidies of the Government in order to develop their agriculture by improving production and productivity. This strategy of privatization, holding by farmer on one hand and by the Government on the other, is characterised by an access to the land valorised by transformations in the use of the space. In the Southeast of Tunisia, characterised by a periodic and sharp drought and an irregular rainfall in the time and in the space, we can see this agriculture development based on the extension of arboriculture and the installation of important water and soils conservation techniques to combat desertification and water scarcity. Arboriculture and crops become more and more the privileged productive choices by farmers following the new possibilities of the access to the land. So, these land use politics had as consequences a local development marked by an expansion of the agricultural production of the region and a fixing of an old nomadic population on their new private lands.

2. Impact of desertification on social, economic and natural capital and on the economic functions

These policies of privatization generated mutations of production systems and the natural resource management, which took place in a climatic aridity, rarity of the natural resources and changes in socio-economic politics contexts. This situation generated an artificialisation of the fragile systems of the study area, coupled to the demographic growth, a high exploitation of natural resources (overgrazing), marginalization of pasture areas, low fodder production, and risks of land degradation and desertification. These problems allow taking care about viability of the rural populations and their environment. Indeed, the policies of privatization had also negative impacts related to the abandon of the private lands because of drought and difficulties to support an agricultural sustainable development (Sghaier *and al*, 2003).

The Tunisian Government conferred to environmental dimension a place of choice in the orientations concerning development, through the elaboration of protective strategies and management of the environment and the setting up of preservation programs of the natural resources, farming development and combat against the desertification (leading plans of water (1975-1990), the water and soils conservation strategies, the water codes (1975), the forest codes, etc). The majority of these programs is integrated and strengthened by the National Action Plan to combat desertification, which is an integral part of the sustainable development national

program (Agenda 21). This is done after the ratification, by Tunisia, of the international conventions to combat desertification (UNCCD, etc.).

The following table summarize the main drivers of desertification (law and policy) and the impact of desertification on social, economic and natural capital and on the economic functions in the Southeast of Tunisia.

Drivers	**Underlying drivers**	**Pressure**	**State**	**Impact**	**Response**
- Privatization of land to engage in the market drives a change in pastoral breeding to intensive agriculture and sedentarized lives. - Immigration of people - Rural development policy - Environmental policy - The development of the most disadvantaged zones and the reduction of the differences between the areas	- New demands for livelihood emerged in the population. - Technology development - Population growth - Economic growth. - Climate change	- Water consumption, and low irrigation efficiency. - Intensified agriculture. Subdivision of lands, overgrazing. - Production systems changes	- Disrupted water resources, quantity and quality. - Loss of vegetation cover, - Reduced forest cover. - Eroded lands, loss of soil, Saline, alkalized soils.	Environmental: - Land degradation, - Desertification, - Loss of biodiversity. Economic: -Low agricultural productivity, temporary and weak. - Marginalization of pasture areas, low fodder production. Social: - Marginalized pastoralists Reduction of extensive breeding	- Sustainable development policies; - Water and soil conservation strategies; - Saving water and irrigation encouragement policy. - Environmental policies – Regional and national and global level;

Source: Sghaier *et. al*, 2008

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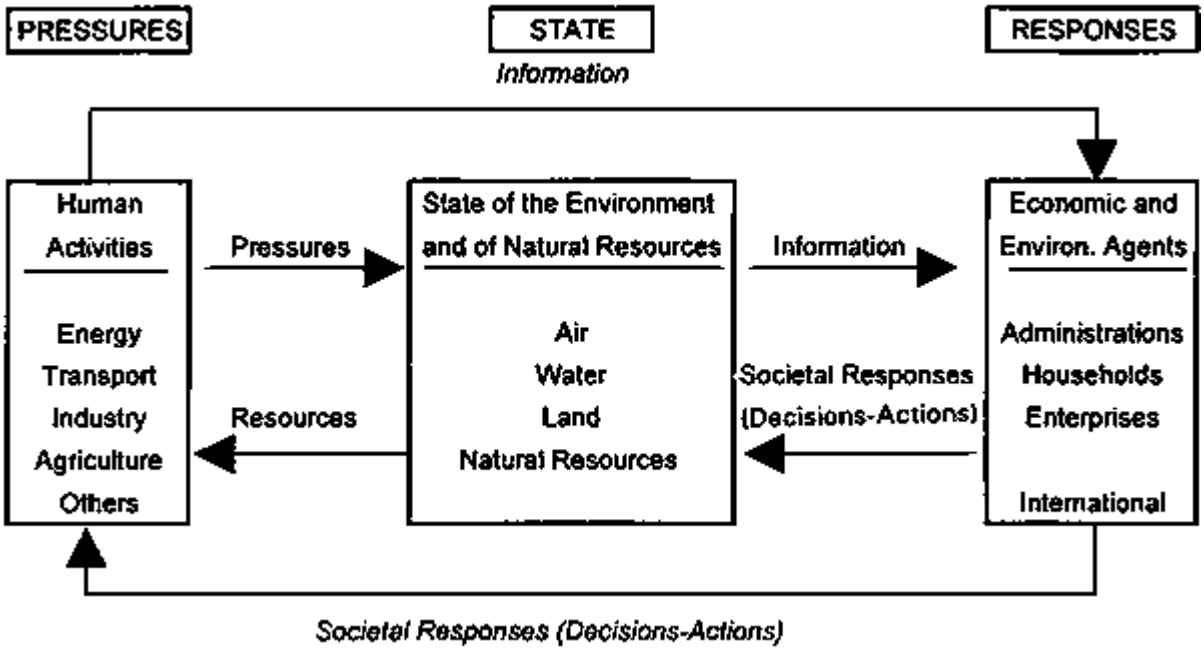
WP1.3 – Drivers and policy context of land degradation in the Boteti area, Botswana

1.3.0 Introduction:

Essential background information on the Boteti site (geographical location, etc) is to be found in the site description prepared and submitted separately under this Work Block (WB1). This report focuses on the drivers of land (environmental) degradation and their policy context. In doing this, the OECD and World Bank endorsed pressure-state-response (PSR) framework (Figure 1) was used to structure the presentation, seeing the drivers as being largely socio-economic and emanating from both human activities and societal management response to the pressures exerted on a drought-prone operational environment.

Figure 1: The Pressure-State-Response framework for discussing land degradation drivers



Source: After Dumanski, J. and Pieri, C. (URL: http:/www.fao.org/docrep/w4745e/w4745e08.htm; p.6). Downloaded on 06/04/2009.

1.3.1 The State of the Boteti environment

The key features of the Boteti environment in its current state are as follows (details can be found in the site description):

- Semi-aridity (annual rainfall average = c350 mm with an evapotranspiration rate approximating 2000 mm).
- Drought proneness, with a recurrence interval of 10-18 years. Time series analysis of rainfall data from stations in the region does not suggest any desiccation of the climate (Ministry of Agriculture, 1994).
- High dry season winds averaging 7-8 km/hr, with individual gusts reaching up to 40 km/hr.
- Wetlands that have been dry for over 20 years. These include Lake Xau (Dow) and the Boteti River itself which was the major locational factor for all the settlements strung out along it. When in flood, the river's floodplain supports

flood recession agriculture and fishing. Lake Xau, west of Mopipi village, supported a thriving fishing industry in the 1970s and early 1980s (Zuffreys, 1983). However, these long dry cycles are not unusual for the Boteti river system (e.g. Table 2)

- A multiplicity of land degradation (desertification) indicators, which include the following:
    - Large areas of bare ground, especially in the Luvisol-covered lacustrine areas (plains and pan-dominated zones) which are a major source of wind-blown dust (Plate 1).
    - Sand dunes formed behind obstructions such bushes and fences (Plate 2 a & b)
    - Loss of biodiversity (woody, herbaceous and wildlife)
    - Declining groundwater table
    - Increasing salinity of wells
    - Increasing water stress

Table 2: Historical Boteti River flow record at Rakops, 1849-present

Year	Flow status
1991-present	Dry
1989-1990	Flow
1987-1988	Dry
1984-1986	Flow
1983	Dry
1974-1982	Flow
1973	Dry
1966-1972	Good flow
1965	Poor flow
1961-1964	Good flow
1960	Poor flow
1952-1959	Good flow
1948-1951	Low flow
1941-1947	Dry
1940	Poor flow
1929-1939	Dry
1901-1928	Flow
1900	Dry
1849-1899	Flow

Source: VanderPost & McFarlane (2007), p.4 of article in press

Plate 1: Large areas of bare ground are major source of dust pollution in Boteti (Photo: Atlhopheng, August 2008)

Plate 2: a) Sand dune formation due to wind erosion from bare lacustrine ground and **b)** exposed tree roots (Photo: Chanda, May 2009)

a) **b)**

- Nutrient-rich Fluvisols along the Boteti River system which formerly supported flood recession (molapo) farming, but which are still seasonally cultivated for mixed cropping.
- Nutrient-poor Arenosols in the dryland, non-lacustrine areas where dryland farming is practiced seasonally (Plate 3)
- Woodlands dominated by *Mopane spp* from about 10 km west and east to Mopipi and Mokoboxane villages (Plate 4)

Plate 3: Maize cultivated on the Boteti valley soils
(Photo: R. Chanda, May February 2007)

Plate 4: Mopane woodland about 10 km south west of Mopipi village
(Photo: R. Chanda, May 2009)

1.3.2 Drivers (pressures) of land degradation in the Boteti area

The main drivers of land degradation in Boteti are the drought-wet cycles interacting with a mix of socio-economic or human agents. Perhaps the greatest pressure on land has been generated by an expanding human population against a correspondingly shrinking operational environment and resource base. For instance,

over the intercensal period 1991 to 2001, Boteti's population grew by 20 percent, from about 35,500 to about 42,700. This represents an average annual growth rate of 1.9 percent. While lower than the national growth rate of 2.4 percent, it is markedly higher than the rural average of 1.0 percent. In the meantime, the communal rangeland has been boxed in by fences for wildlife, livestock disease control and leasehold livestock ranches (Figure 2). The drying up of the Boteti wetland system and the virtual depletion or retreat of wildlife to the protected areas nearby has exacerbated human pressure on dryland resources (especially through dryland farming) and on non-riverine veldproducts (e.g. fencing material to substitute for reeds that disappeared with the floods). Thus, although the livestock population seems to have remained stable since 2000 (CAR, 2006) (Table 1), this must be seen within the context of a much reduced communal rangeland environment subjected to frequent droughts and an aquatic ecosystem that is no longer as productive as a source of forage and water.

The interplay between the physical setting and human activities came through strongly from a series of workshops organized and facilitated by the DESIRE team during which land users identified a number of drivers of land degradation (Table 2). It is evident from Table 2 that the principal drivers are linked to biogeography, climate, agropastoralism and veldproduct utilization, i.e. to people's livelihood activities and the physical environmental background. Poverty also emerged as a major driving force, which land users sitiuated in a positive feedback loop with environmental degradation. It is noteworthy that veld (bush) fires do not feature in Table 2. This is perhaps a reflection of the absence of an herbaceous fuel load due to overgrazing (e.g. Plate 5). Indeed, the DESIRE team did not see much evidence of fires on the ground when it went out to the study site to survey for degradation indicators (May 2009).

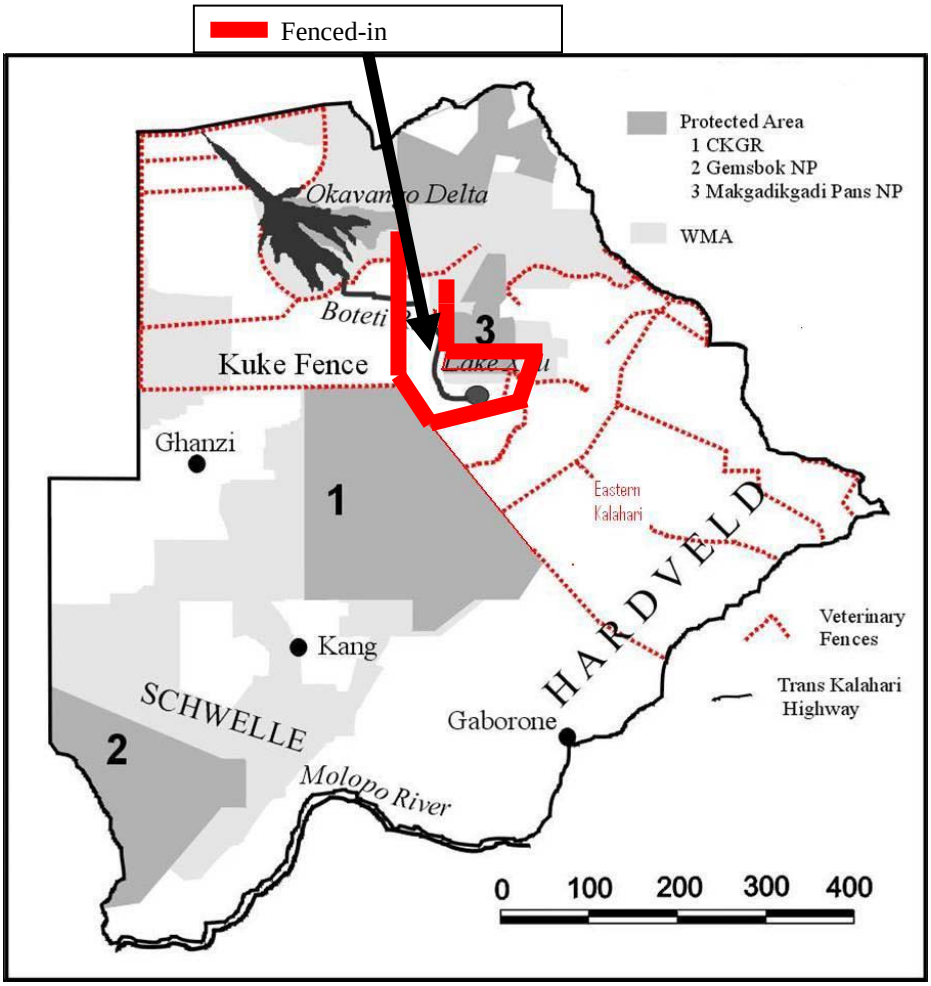
Table 2: Land user identified drivers of land degradation in Boteti:

PERCEIVED DRIVER	NATURE OF DRIVER: PHYSICAL/HUMAN
Low rainfall.	Physical
Overstocking.	Human
Cutting down of trees (tree depletion).	Human
Erosion caused by movement of livestock (trampling).	Human
Too many modern buildings reflect the heat.	Human
Certain cultural practices (keeping too many cattle for prestige reasons)	Human
Loss of vegetation.	Human/physical
Sloping ground.	Physical
Developments (e.g. mining).	Human
Drought.	Physical
Water wastage.	Human
Depletion of underground water.	Human/physical
High mortality rate of livestock.	Physical/human
Uncontrollable winds.	Physical
Air pollution.	Physical/human
Ozone layer depletion.	Human
Poor soil conditions.	Physical
Low plant production.	Physical
Poverty.	Human
Lack of nutrients.	Physical
Loss of grazing.	Human/physical
Extinction of wild fruits.	Human/physical
Diseases (dust related: e.g tuberculosis, blindness, and lung	Physical

diseases).	
Drying up of groundwater recharge lines.	Human/physical
Erosive rainfall (thunder showers).	Physical
Pests (eat plants and seeds).	Physical
Cutting of grasses before producing seeds (before they mature).	Human

Source: WOCAT workshops (2007 and 2008)

Figure 2: Boteti boxed-in by fences



Source: Adapted from Perkins (2007)

Plate 5: An overgrazed cattlepost area west of Mokoboxane
(Photo: R. Chanda, May 2009)

1.3.3 The policy context of land degradation in Boteti

Botswana has a fairly large body of policies, legislation and institutions concerned with, or with a bearing on, environmental protection. These policies, legislation and institutions have not had the expected impact, largely because of lack of coordinated action and implementation capacity. The National Focal Point for the CCD is in the Ministry of Environment, Wildlife and Tourism, which is also charged with the implementation of the National Action Programme to Combat Desertification. The Government of Botswana has taken steps in the direction of coordinated action by adopting the National Policy on Natural Resources Conservation and Development (popularly known as the National Conservation Strategy) under which two institutions were created, namely, a 17-member National Conservation Strategy Advisory Board and the Department of Environmental Affairs (DEA) (formerly the National Conservation Strategy Coordinating Agency). Through these institutions the Ministry of Environment, Wildlife and Tourism is expected to coordinate the activities of the various environment and natural resources institutions of the government. An Environmental Impact Assessment Act was enacted by parliament recently and an overarching environmental management Act is in the process of enactment. With these legal instruments the coordinating functions of the Ministry will be legitimized by the force of law.

Other policies, as well as programmes, strategies and plans relevant to land (resource) management and protection in Boteti include the following (relevant legislation is covered under WP2.1.2): *Community Based Natural Resource Management Policy (CBNRM) (2006); 1975 Tribal Grazing Land Policy, National Policy on Agricultural Development; Services to Livestock Owners in Communal Areas (SLOCA-1970); Livestock Water Development Programme (1988*); *Revised National Policy for Rural Development*; *Arable Lands Development Programme;* the *Revised National Policy on Education; National Strategy for Poverty Reduction;* and *National Biodiversity Strategy and Action Plan.* These are briefly outlined below.

The *Community-based Natural Resource Management (CBNRM)* Policy was adopted as a development approach that incorporates conservation of natural resources i.e. management and protection of the natural resource base and cultural resources. The objective of the policy is to create a foundation for conservation-based development, in which the need to protect biodiversity is balanced with the need to improve rural livelihoods and reduce poverty. The people of Mopipi and Mokoboxane have formed a CBNRM Trust and developed an environmental management plan to take advantage of the provisions of this policy. The plan has, however, not been implemented due to lack of funds and the absence of a viable wildlife resource (wildlife-based tourism has been the basis of most successful CBNRM projects).

The *Community Based Strategy for Rural Development (CBSRD):* The CBSRD aims to expand rural economic activities and reduce poverty through the full participation of potential beneficiaries so that they could own the activities. By targeting poverty, the strategy is indirectly promoting long-term environmental protection.

The objectives of the *1975 Tribal Grazing Land Policy* (TGLP) were:

- Increase output and productivity of livestock;
- Curb overgrazing and conserve range resources upon which the livestock sub-sector depends;
- Spread the benefits of the livestock industry to as many people as possible especially the resource poor farmers; and
- Upgrade rural livelihoods by improving cattle farmer incomes.

This policy resulted in the creation fenced leasehold ranches for individuals or groups of individuals (syndicates) in communal rangelands of the country. In 1991, a provision in the *National Policy on Agricultural Development (NPAD)* extended the opportunity to own leasehold ranches to areas not covered by the TGLP. The study area has leasehold ranches demarcated under NPAD. However, countrywide reviews of TGLP ranches have not revealed significant improvements in range management or livestock productivity or incomes (e.g. Tsimako, 1991) Indeed, during the indicator data campaign by the DESIRE Team in May 2009, several leasehold ranches remained unfenced and unpaddocked and were operating as traditional cattleposts (Plate 6).

Plate 6: An unfenced bush encroached leasehold ranch in Area 4B west of Mokoboxane, Boteti

The *Services to Livestock Owners in Communal Areas (SLOCA)* instrument was adopted to offer small grants (less than P 15 000) to farmers in communal areas to

enable them to develop their livestock support assets. Areas of support include: dipping facilities, drift fences, water sources, firebreaks, fodder production and cattle crushes/kraals. Furthermore, demonstration facilities show farmers how to improve livestock management. Fodder and vaccinations are also included in the scheme. SLOCA mostly benefits those with fewer than forty heads of cattle, and therefore impacts mostly on poorer livestock farmers. Their richer counterparts are provided for under the *Livestock Water Development Programme (1988)* which gives significant financial support for drilling or equipping of boreholes in selected areas for individual farmers or syndicates with herds of 60 to 500 animals.

The *Revised National Policy for Rural Development*'s primary goal is to enhance the quality of life of all people who live in rural Botswana through an integrated implementation of policies and strategies that will "optimise people's social and economic well being and strengthen their ability to live in dignity and food security" (DEA, 2006). The policy's link to environmental protection would come through its poverty alleviation impact and its sensitivity to sustainable development.

The *Arable Lands Development Programme (ALDEP)* recently been replaced by a similar but more comprehensive subsidy programme for the arable. However, while it lasted, ALDEP's goal was to raise arable production among small-holder farmers through providing subsidies for draft power, seeds, agricultural implements and fencing material. The extension of arable production to the dryland Arenosol zone of Boteti was greatly aided by this programme. It could probably be blamed for opening up marginal areas to the low-productivity arable farming of the area, potentially exposing them to agents of erosion (especially wind) when crops fail.

The relevance of the *Revised National Policy on Education* to environmental protection lies in its provision to infuse environmental education into school curricula with a view to growing environmental awareness among the future generation so that could become an "influential force in promoting environmental awareness" among the public (DEA, 2006).

The Government of Botswana adopted the *National Strategy for Poverty Reduction (NSPR)* in 2003 to provide a framework for tackling poverty by all sectors of the Botswana society. The aim of the NSPR is to enable the poor to "achieve sustainable livelihoods by improving access to resources and provision of social safety nets to protect their welfare" (Ibid).

The *National Biodiversity Strategy and Action Plan* was adopted to promote ecosystem health through biodiversity conservation and preservation while ensuring equitable access to the benefits deriving from biological resources so conserved or preserved (e.g. through the CBNRM strategy). Environmental degradation is clearly an enemy of biodiversity conservation.

1.3.4 Conclusion

Land degradation in the Boteti area takes place against a background of climate adversity (not change at the moment) and a declining communal resource base, on the one hand, and an expanding agropastoral population which must eke living out of the commons and which may becoming increasingly poor, on the other. The rich environmental governance instruments have so far been ineffective due to lack of

coordination and implementation failure. Therefore, the drivers of land degradation are a composite of policy failure (even conflict), resource use pressure and environmental stress, as outlined above.

1.3.5 References

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WP2.1.2 Drivers of Desertification in the Boteti area of Botswana: Law and Policy

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2.1.2.0 Introduction

As noted in the report for WP1.3 (Drivers and policy context), Botswana has a rich body of policies and legislation related to environmental governance. These policies, legislation and institutions have not had the expected impact, largely because of lack of coordinated action and implementation capacity. However, The Government of Botswana has taken steps towards coordinated environmental protection action by adopting the National Policy on Natural Resources Conservation and Development (popularly known as the National Conservation Strategy) under which two institutions were created, namely, a 17-member National Conservation Strategy Advisory Board and the Department of Environmental Affairs (DEA) (formerly the National Conservation Strategy Coordinating Agency). Through these institutions the Ministry of Environment, Wildlife and Tourism was expected to coordinate the activities of the various environment and natural resources institutions of the government. An Environmental Impact Assessment Act was enacted by parliament recently and an overarching environmental management Act is in the process of enactment. With these legal instruments the coordinating functions of the Ministry will be legitimized by the force of law. At the moment, the National Focal Point for the Convention to Combat Desertification is in the Ministry of Environment, Wildlife and Tourism, which is also charged with the implementation of the National Action Programme to Combat Desertification adopted in 2006 and launched in 2007. Thus, the point to make at this stage is that environmental degradation in Botswana in general and Boteti in particular has continued not because of inadequate legislation and policies, but because of policy and legislative failure arising from lack of coordination and implementation capacity. The reader will appreciate this point better after reviewing the following sub-sections which outline the various legislative instruments and policies with a direct or indirect bearing on abating or the prevention of desertification. The reader is also encouraged to read our report on Drivers and Policy Context submitted under WB1 to which this report has a very close relationship.

2.1.2.1 Legislation

i. Agricultural Resources (Conservation) Act (Cap.35:06 of 1973): Provides for the conservation of Botswana's agricultural resources. The Act defines agricultural resources as animals, birds, plants, waters, soils, vegetation and vegetation products, fish, insects, etc. Sections 16 and 18 of the Act explicitly provides for the protection of the physical environment including the protection of slopes, protection of land against erosion, preservation of vegetation, prevention of silting of dams, preservation of the soil and its fertility and controls the use of insecticides, fertilizers, or any type

of chemical compound in, or over land and the drainage of land (construction, maintenance, or repair of artificial or natural drains, gullies, contour banks).

ii. Forest Act (CAP.38:04 of 1976): The Act provides for the protection of the forests and forest produce for the purposes of preserving the forest ecosystem and valuable species of trees. The Forest Act regulates the use of forestry resources and under this Act; areas can be designated as forest areas. The Act prescribes the procedures for utilisation of forestry products, highlights rights and privileges granted to local communities, and identifies those species to be granted protected status on state, tribal and private land.

iii. Herbage Preservation (Prevention of Fires) (CAP.38:02 of 1978): All persons require permission from the Herbage Preservation Committee to set fire to any vegetation on land of which one is not the owner or lawful occupier. This is an act to prevent and control bush and other fires. In order to preserve existing vegetation on land that the Act defines as growing or standing vegetation which includes any tree or part thereof and any bush, shrub, brushwood, undergrowth, grass, crops or stubble, Section 4(1) of the act prohibits, without permission, any person from setting fire to any vegetation on land which he is not the owner or in lawful occupation.

iv. Tourism Act (Act No. 22 of 1992): Regulates the tourism industry and allows for the establishment of a Tourist Industry Licensing Board. The act provides for tourism concession areas wherein exclusive tourism rights are acquired by firms or communities. If communities are granted such rights, they may sub-let (part of) these rights or develop a joint venture with a tourism firm. This Act is a very good legislative instrument for the implementation of the Community Based Natural Resource Management (CBNRM) Policy outlined later.

v. Wildlife Conservation and National Parks Act (Act No.28 of 1992): the act aims at protecting and conserving the country's wildlife resources. The act enables gazettement of national parks and game reserves which are protected areas for wildlife conservation. The act also establishes wildlife management areas (wildlife conservation and utilization areas) outside the national parks and game reserves. Within these wildlife management areas (WMAs), wildlife utilization takes priority over other forms of land use. Lastly, the act establishes Controlled Hunting Areas (CHAs in which hunting is regulated. Again, this Act facilitates the implementation of the CBNRM Policy in WMAs and CHAs.

vi. Tribal Land Act (Cap.32:02 of 1970): In areas of tribal land, the act controls land use rights and makes provision for the imposition of restrictions. This Act provides for the establishment of tribal land boards, to vest tribal land in such boards, and to define powers and duties of such boards. It also provides for the determination of land use zones. Land allocations must not conflict with the zoned land use. Land Boards may determine plans for use and development of the zones. This Act usurped land administration and management from tribal authorities, effectively ending a common property resource management regime that seemed to have worked well in protecting rangeland resources in Botswana (Chanda and Darkoh, 2007). Due to a weak implementation capacity, the Act literally created an open access regime which may be partly responsible for the overgrazing and forms of land degradation observed on communal rangelands today (Chanda and Darkoh, 2007).

vii. Water Act, Chapter 34:01 (1968)

The Act establishes a Water Apportionment Board and a Water Registrar. It declares all water as public, and makes the pollution of public water an offence. Anyone wishing to discharge into public water would need to do so with permission from the Water Registrar. In addition, it introduces the issuing of water rights for use of public water other than for watering stock; drinking, washing and cooking; or use in a vehicle. Tampering or diversion of public streams or rivers by individuals also becomes an offence, unless granted permission through the issuing of a water permit. Part IV section 17 (1, iii) prohibits the pollution of water used in these activities to an extent that it causes injury, directly or indirectly to public health, animal and plant lives.

2.1.2.2 Policies

i. National Policy on Natural Resources Conservation and Development of 1990

This is Government Paper No.1 and approved in 1990 and is the policy referred to in the introductory paragraph of this report. The primary goal of the policy is to increase the effectiveness with which natural resources are used and managed so that beneficial interactions are optimised and harmful environmental side effects are minimized and **to integrate** the work of the many sectoral ministries and interest groups in Botswana, therefore improving the development of natural resources through conservation.

The policy identified two key areas of environmental concern, which requires solutions. These are:

- Growing pressure on water resources from increased population, urbanization, and development
- Pollution of air, water, soil and vegetation resources.

The solutions provided by the policy for the identified problems above include the following:

- Improved planning and administrative measures in the interest of both protecting water resources against pollution and improving multi-purpose use.
- Recycling of treated effluent
- Inter-regional water transfer schemes
- Incentives to encourage recycling

ii. Tribal Grazing Land Policy (TGLP) of 1975

The objectives of this policy were to increase income of large and small cattle owners, to increase productivity and improve range management. It also aimed at safeguarding the interest of small cattle owners and non-livestock owners. Large herds would move out of communal areas into ranches, creating more space for small herds. Ranch owners would receive exclusive land rights for 50 years with limited transferability and pay an annual land rental. Groups of small cattle owners would receive priority during ranch allocations. Reserves would be set-aside for future cattle owners. In

communal areas, Land Boards would control cattle numbers, and could set a ceiling for the number of livestock to be held per person. Land Boards could specify the number of land holdings and the total area held by one individual. Water points would not be individually owned. In commercial areas, displaced cattle owners would be compensated and reserves would serve the future interest of the poor and be available for non-livestock users. However, many reviewers (e.g. Chanda and Darkoh, 2007; Ntseme, 2007; CAR, 2006; Tsimako, 1991) have observed that many leasehold ranches suffer from absentee or remote control management by their owners and that they are operated like cattleposts. Indeed, instead of removing their herds completely from communal land, the ranch owners enjoyed what has been termed as "dual grazing rights", whereby they could release their animals onto the commons while enjoying exclusive rights to the ranches. Their argument being that, as *bona fide* tribesmen, owning a ranch did not cause them to lose their rights to use resources on the commons.

iii. National Policy on Agricultural Development (NPAD) of 1991

The policies objective was to increase production without or with minimal adverse environmental consequences. Employment and income creation, agricultural diversification and resource conservation were some of the specific objectives. For the livestock sector the following measures were mentioned: breeding with artificial insemination, veterinary services, increased milk production and tsetse eradication. In addition, fencing of certain areas would be allowed, and exclusive rights would be granted to individuals, groups or communities. Borehole owners would automatically be granted exclusive land rights. Ranches would be allocated after land use plans had been prepared and were approved by the Land Boards. Then the Ministry of Agriculture would demarcate ranches and the Land Boards would start the allocation process. The implications of the fencing component of this policy to rangeland management are the same as those of the TGLP.

iv. Community Based Natural Resource Management Policy of 2007

This policy aims to provide a stimulating environment for the growing number of CBNRM projects, most of which deal with wildlife resources. It also aims to establish common property regimes for biological resources that are now threatened by open access and ineffective management. Moreover, the policy aims to link resource conservation and rural development by strengthening local resource management and by increasing local benefits. The policy therefore promotes both resource conservation and poverty alleviation.

2.1.2.3 Plans

In the introduction section, we alluded to the Botswana National Action Programme to Combat Desertification, which an instrument designed to directly tackle desertification in the country. However, the implementation of this programme has to be within the context of national and regional development plans within which budgetary provisions are made for programmes and projects. In Botswana, these provisions are made, firstly, in 7-year national development plans and, secondly, in district (regional/provincial) development plans of the same period. Only programmes or projects budgeted for in these plans are implemented. As can be seen below,

environmental protection and poverty alleviation feature as key issues to be addressed at both planning levels:

i. National Development Plan 9 2003/4 – 2008/9

The national challenges outlined in NDP9 include:

- Rapid urbanisation
- Scarcity of water resources
- HIV/AIDS pandemic
- High poverty levels

The major policy thrust of NDP9 in addressing the above problems include:

- Economic diversification
- Employment creation and poverty reduction
- Environmental protection
- Human resource development including the fight against HIV/AIDS

NB: National Development Plan 9 has come to an end and National Development Plan 10 will soon be implemented.

ii. District Development Plan

The study area is within the Central District. The Central District Development Plan 6: 2003 – 2009 outlines the following as major challenges:

- High unemployment
- High poverty levels
- Environmental degradation
- Human resource development including the fight against HIV/AIDS

The major policy thrust of Central District Development Plan 6 in addressing the above problems include:

- Economic diversification
- Employment creation and poverty reduction
- Environmental protection
- Human resource development including the fight against HIV/AIDS

2.1.2.4 Conclusion

As noted earlier, Botswana has enough legislative and policy instruments to prevent and/or reverse environmental degradation. What is required is an integrated, coordinated approach to their implementation, backed by sufficient budgetary provision and grassroots support. The CBNRM approach of aligning environmental protection with socio-economic upliftment has much to commend it.

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