

GLOSSARY OF THEORETICAL TERMS AND ABBREVIATIONS FOR THE CASCADE PROJECT

KEY DEFINITIONS FOR THE CASCADE PROJECT

Ecosystem: “an open ecological system that includes all the organisms that function together in a given area (ranging in scale from very small to the whole globe) interacting with the physical environment so that a flow of energy leads to clearly defined biotic structures and cycling of materials between living and non-living parts” (Odum, 1983).

Catastrophic shifts in ecosystems: An ecosystem may suddenly shift to a new state, characterized by a different structure, species composition and/or functioning. This phenomenon is referred to as a “**catastrophic shift**” in ecology. Such shifts to a degraded state (e.g. occurring in drylands) can lead to dramatic economic as well as ecological consequences. A catastrophic shift, according to the mathematician René Thom’s catastrophe theory, is an abrupt change in the state of a system, which suddenly shifts from one stable state to another stable state, separated by a **tipping point**.

Catastrophic shifts are usually associated with **hysteresis**. **Catastrophic shifts** may either have positive consequences (shifts to the “healthy” state) or negative consequences (shifts to the “degraded” state) for the ecosystem functioning and related services. In physics **catastrophic shifts** are known as first-order phase transitions, and in mathematics they are subcritical bifurcations.

Ecological threshold: Limit or amount of external pressure/change at which there is an abrupt change in an ecosystem property, or phenomenon. At this point small changes in one or more external conditions produce large and persistent responses in an ecosystem. A threshold is not necessarily associated with a tipping point, and thresholds can be passed without feedback or hysteresis.

Critical transition: large and persistent response in an ecosystem corresponding to a change in ecosystem property/state occurring because an ecological threshold has been reached and because **positive feedbacks**, or nonlinear instabilities in the system cause changes to propagate in a CASCADE-like fashion that is potentially irreversible. Once such a critical transition has occurred, the ecosystem in question is not likely to spontaneously return to its previous state.

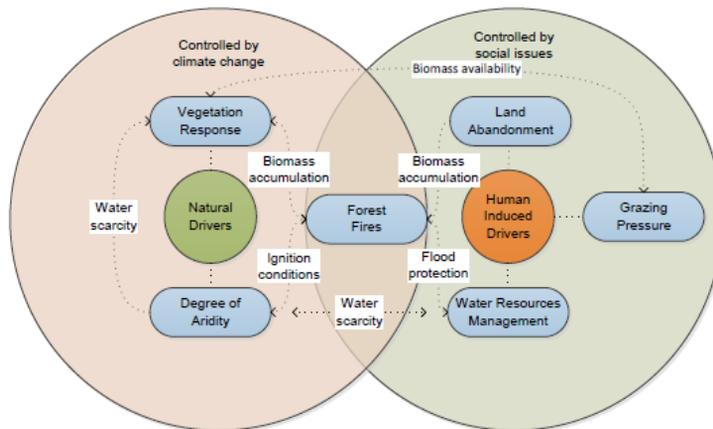
Early warning signals: characteristics of the system that change in a predictable way as a system approaches a critical point (see Scheffer 2009 for a review of such characteristics.)

Hysteresis: characterizes the different paths followed by the system during degradation and recovery. Hysteresis makes the recovery of degraded ecosystem difficult (from Kéfi 2008, Ph.D. Thesis, p.15).

Positive feedback: the process by which a state variable (e.g. vegetation composition) modifies the environment in a way that is beneficial for itself. (From Kéfi 2008, Ph.D. Thesis, p.15.) If a system includes a feedback, a series of mechanisms that form a loop is observed. The feedback is positive when a change in a state variable leads to another change of the same sign, as a consequence of the loop (i.e. a variable increase leads to a further increase). In drylands, for example, it has been observed that vegetation can modify the environment in a way that is beneficial for itself.

Resilience: Original definition from Holling (1973, p. 17): “Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist.” Since then, two concepts have emerged (see Gunderson 2000 for a review): (a) **Ecological resilience:** The magnitude of the disturbance that a system can experience without undergoing a regime shift, i.e. before it goes into the basin of attraction of another stable state. It corresponds to the size of the basin of attraction in ecosystems with alternative stable states. Ecosystems with low resilience may easily shift into an alternative basin of attraction after a disturbance. (b) **Engineering resilience:** The time required for a system to return to equilibrium following a perturbation (from Kéfi 2008, Ph.D. Thesis, p. 15).

Driver of Change: any environmental or human induced stimulus that can significantly alter the state or perceived characteristics of a system.



Explanation of Drivers of Change from Deliverable 2.2, Figure 1: Conceptual framework of natural and human induced drivers affecting land degradation in the Mediterranean.

Degraded systems: systems resulting from reduced or loss of resilience in one or more aspects.

Desertification (1): land degradation in arid, semi-arid and dry sub-humid areas resulting mainly from adverse human impact.

Desertification (2): Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNCCD 1994)

Dryland ecosystems: Ecosystems in arid, semi-arid and subhumid areas, characterised by water scarcity and harsh climatic conditions. Disturbances in these fragile ecosystems can easily result in widespread and severe land degradation and thus desertification. (from Schwilch 2012, Ph.D. Thesis, p.3)

Drylands (1): arid, semi-arid, and dry subhumid areas (UNCCD)

Drylands (2): include all the terrestrial regions where water scarcity limits the production of crops, forage, wood and other ecosystem provisioning services, i.e. where the aridity index (AI), defined as the long-term ratio of mean annual precipitation to mean annual evaporation demand (expressed as potential evaporation), is less than 0.65 (Millennium Ecosystem Assessment). Formally, the definition encompasses all lands where the climate is classified as dry subhumid ($0.5 < AI < 0.65$), semiarid ($0.2 < AI < 0.5$), arid ($0.05 < AI < 0.2$) or hyper-arid (< 0.05). Precipitations in drylands are characterised by their high variability and unpredictability. (from Kéfi 2008, Ph.D. Thesis, p.9)

OTHER DEFINITIONS, LISTED ALPHABETICALLY

Adaptability: The capacity of the actors in a system to manage (improve or retain) resilience.

Adaptive capacity: The ability of a social-ecological system to cope with novel situations without losing options for the future (Folke et al. 2002)

Agenda 2000: reform of the CAP that became effective in 2000.

Agro-ecosystem: an ecological system that results from agricultural activities.

Anthropogenic activities: human actions

Aquifer: a geological formation of water-bearing rock with sufficient porosity and permeability to yield economic supplies of groundwater.

Benefit-cost ratio: the ratio of the present value of benefits to the present value of the costs.

Biodiversity: the variety of all life forms - it includes 'genetic diversity', which reflects the diversity within each species; 'species diversity', which is the variety of species; and 'ecosystem diversity', which is the diversity of different communities formed by living organisms and the relations between them. It is sometimes considered at the landscape diversity level.

Catena: a repeated sequence of soil profiles that is geographically related to and associated with relief features.

Climate scenarios: internally consistent pictures of a plausible future climate, not predictions of future climate.

Common Agricultural Policy (CAP): agricultural policy of the European Union.

Compaction: the development of a dense, compact surface soil layer (e.g. due to cultivation with heavy machinery, overgrazing), characterised by a much lower permeability so impeding the movement of water and air, and the growth of plant roots.

Complex adaptive system: A dynamic network of many agents (e.g. cells, species, individuals, firms, nations) acting in parallel, constantly acting and reacting to what the other agents are doing (cited in Waldrop 1992).

Cost-effective measures: a favourable relationship of benefits over monetary and non-monetary costs of establishing and maintaining the measure.

Crusting: development of a surface layer on soils ranging in thickness from a few millimetres to a few centimetres, which is more compact, hard and brittle when dry than the material immediately beneath it (see also compaction).

Dehesa: oak savanna in Spain, with cork oaks (*Quercus suber*) or holm oaks (*Quercus rotundifolia*) and cultivated fields or, most typically, grasslands.

Discounting: the procedure to arrive at the sum of either the costs or benefits over the lifetime of a project using a discount rate to scale down future benefits and costs. The effect of using a discount rate is to reduce the value of projected future costs and benefits to their value as seen from the present day (the main justification being individual time preference). It is often of an order of 6%.

Ecological Indicator: a characteristic of an ecosystem that is related to, or derived from, a measure of biotic or abiotic variable, that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability.

Ecological restoration: the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. <https://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration#3>

Ecological succession: the gradual and orderly process of change in an ecosystem brought about by the progressive replacement of one community by another until a stable climax is established.

Ecosystem approach: An integrated approach to the study of human-environment interactions; recognizes that people are an integral part of their ecosystems and the mutual dependence of one's upon the other's welfare (UNEP/CBD/COP5 2000).

Ecosystem services: the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth (MEA 2005).

Environmentally sensitive area (1): (ESA) (DESERTLINKS) Areas distinguished or mapped by using certain key indicators for assessing the land capability to withstand further degradation, or the land suitability for supporting specific types of land use (Kosmas et al., 1999).

Environmentally Sensitive Area (2): (ESA) (MedAction) areas in which EU subsidies are paid to encourage landowners to follow land uses sympathetic to an environmental or landscape objective.

Erodibility: the ease with which natural materials break down when they are attacked by agents of denudation (whose capacity is called erosivity, especially for rainfall events of short duration and high intensity). Erodibility is dependent on susceptibility to removal and transportation, and the term is often used in the context of potential of a soil or sediment to gully or rill formation (Whittow, 1984).

Evapotranspiration: the loss of water from a given area and during a specified period of time, due to evaporation from the soil surface and to transpiration from plants. In arid conditions most of the precipitation returns to the atmosphere after some time, and does not participate in the deep soil water recharge. Potential evaporation (or evapotranspiration) is the amount of evapotranspiration that would occur from a certain area if there were no restriction on water availability.

Focal Point: Each country party to the Convention to Combat Desertification names a representative to serve as a focal point to the Convention, to liaise with the secretariat and to assist in intersessional work.

Governance: A continuous process of managing the economic, social, environmental and political affairs of society. State and non-state actors, at various levels, interact in the process of setting societal (collective) goals and deciding how to intervene, through specific mechanisms and structures of coordination, to steer society towards achieving them (Briassoulis, 2008).

Habitat: the place where an organism (plant or animal) or a community lives (survives and reproduces), i.e. where its environmental requirements (ecological niche) are fully or partially met.

Indicator: see Ecological indicator

LAI: leaf area index. The area of leaves above a given area of ground (expressed as the area of leaves above one square metre of soil).

Land abandonment: land that has been converted from any form of agricultural production or from areas which have been heavily grazed and then left and allowed to revegetate naturally.

Land cover: the observed physical cover including the vegetation (natural or planted) and human constructions which cover the earth's surface. Water, ice, bare rock or sand surfaces count as land cover.

Land degradation: The reduction in the capacity of the land to provide ecosystem goods and services and to assure its functions over a period of time for its beneficiaries. (LADA, 2009)

Land degradation in drylands: Reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns. (UNCCD 1994).

Land degradation (3): 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)

Less Favoured Area (LFA): areas with a special status in Europe. Farmers are encouraged to cultivate these lands in an environmentally friendly way.

Livelihood: comprises the capabilities, assets (stores, resources, claims, access) and activities required for a means of living. (Chambers and Conway, 1992).

Macchia mediterranea: bushy vegetation made up of shrubs and low trees (Italian). See also **matorral, maquis**, Mediterranean scrubland.

Maquis: a vegetation type of the Mediterranean area, mainly composed of evergreen broadleaved shrubs, less than about 5m high (French).

Matorral: type of shrubby vegetation cover as found in Spain, comparable to the French maquis and garrigue and macchia mediterranea.

Mediterranean scrubland: Mediterranean scrublands have resulted from the interaction between natural factors and very ancient human disturbance. The main control on the ecosystem is the annual summer drought. This intense hydric stress imposes a set of adaptations (such as sclerophyllous leaves) and characteristic structures of the plants.

Mesocosm: an experimental tool that brings a part of the natural environment under controlled conditions. In this way mesocosms provide a link between observational field studies that take place in natural environments, but without replication, and controlled laboratory experiments that may take place under somewhat unnatural conditions.

Montado: oak savanna in Portugal, with cork oaks (*Quercus suber*) or holm oaks *Quercus rotundifolia* and cultivated fields, or, most typically, grasslands.

Multiple stable states, or Alternative stable states: several stable states coexisting under a given range of conditions. Whether a system ends up in one or another depends on the history of the system (the initial conditions). (from Kéfi 2008, Ph.D. Thesis, p.14).

National Action Programme (NAP): one of the key instruments in the implementation of the convention to combat desertification. They are developed in the framework of a participative approach involving the local communities and they spell out practical steps and measures to be taken to combat desertification in specific ecosystems.

Net Present Value (NPV): the stream of all benefits net of all costs for each year of a project's life discounted back to the present date.

Phrygana: undershrubs or dwarf shrubs e.g. thyme, sage, the many species of broom, species of *Cistus* (rock roses) and *Phlomis*. Undershrubs are not potential trees; they reproduce by seed. Most species are unpalatable to herbivores.

Plant community: an assemblage of individuals of one or more species that influence one another and modify their environment (after Mueller-Dombois and Ellenberg, 1974).

Plant-soil feedbacks: can be negative e.g. when monocultures stimulate growth of soil borne pathogens and diseases; or positive e.g. when plants improve soil fertility in terms of organic matter content, water holding capacity and nutrient availability.

Policy: A purposeful course of action, comprising a long series of more-or-less related activities, which governments pursue to reach goals and objectives related to a problem or matter of concern and to produce certain results. A policy is not a single, discrete, unitary, disembodied phenomenon, but a series of decisions. It concerns what is actually done (or not done) as opposed to what is proposed or intended; policy implementation and enforcement complete the actual policy process. Essential constituent elements of a policy are its object, interested and/or involved actors, their goals, the resources and means available, the instruments used to achieve the goals set and the implementation mechanisms (Brassoulis 2005, 21-22).

Restoration: the assisted recuperation of a system to a previous non-degraded state.

Socio-economic drivers: social and economic structures and processes that can either singly or in combination lead to a particular change.

Soil erosion: the stripping of soil and weathered rock from landforms; creating sediment for transportation by water, wind or ice, and enabling formation of new sedimentary deposits.

Soil water-plant model: a model describing the dynamics of water over the land surface or/and in the soil, and of the plant system in a certain area. Generally, plant dynamics depends on, and at the same time influences, soil water availability.

Special Area of Conservation (SAC): an internationally important habitat designated under the EC Habitats Directive.

Sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs". (Brundtland Report, 1987)

Sustainable soil practices: managing soil and crop cultural practices so as not to degrade or impair environmental quality on or off site, and without eventually reducing yield potential as a result of the chosen practice through exhaustion of either on-site resources or non-renewable inputs.

Sustainable land management (SLM) (1): a knowledge-based combination of technologies, policies and practices that integrate land, water, biodiversity, and environmental concerns (including input and output externalities) to meet rising food and fibre demands while sustaining ecosystem services and livelihoods (United Nations 1987; Wood and Dumanski, 1994; World Bank, 2006).

Sustainable land management (SLM) (2): The use of land and water resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions. (WOCAT)

Vegetation dynamics: changes in vegetation (e.g. biomass, cover or composition).

Vulnerability: A function of the exposure and sensitivity of a system to hazards or hazardous conditions, and the ability of that system to withstand, adapt to or recover from the effects of those conditions (Smit and Wandel 2006).

Abbreviations

CAP: Common Agricultural Policy

COP-11: Eleventh conference of the parties to the UNCCD

CSD: Commission of Sustainable Development

CST: UNCCD Committee for Science and Technology

FAO: Food and Agriculture Organization

GIS: Geographical Information System

LFA: Less Favoured Area

NAP: National action programme, or plan

SAC: Special Area of Conservation

SPA: Special Protection Area

UNCCD: United Nations Convention to Combat Desertification

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