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TREES AND DESERTIFICATION IN THE MEDITERRANEAN

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Fig. 1 – A isolated tree is often the last vegetal trace in a barren landscape. Its roots may reach nutrients and ground water under the degraded soil surface layer © F. Peter.

Desertification is officially defined as a degradation of the quality of land (see Box 1). Soils are no longer suitable to feed people, either directly through edible vegetable species (extensive or intensive agriculture, irrigated or not) or indirectly through travelling livestock farming.

The image of '**desert progression**' has been for long mistaking about desertification mechanisms. This plague should rather be compared with a severe skin illness of the Earth, which stretches step by step from some local places and can be locally cured.

The causes of desertification intricate natural evolutions and anthropic pressures in a systemic, non linear way. Choke and change points bookmark irreversible trajectories in the ecosystem evolution.

Some main **natural causes** of desertification have to be highlighted. Intense drought dry up the soil surface, bringing ground wetness deeper and deeper. Frequent extreme rainfall episodes may cause severe water erosion in vulnerable downstream areas. Wind erosion may affect both the area where it occurs and remote areas where sandy infertile deposits are carried out. Some of these sandy winds may blow across the Mediterranean (see fig. 2). Projected climate change in semi-arid Mediterranean regions is a hindering factor: the overall trends are rainfall decrease, temperature increase and greater occurrence of extreme events.

The many **anthropic causes** of desertification are as complex as human behaviour can be. The basic phenomenon is a set of additive pressures upon ecosystems, which exceeds their resilience capacity. Some of them have to be highlighted. An excessive use of poor soils removes their nutrients. Joint irrigation and excessive use of fertilizers and pesticides leads to both soil and water table salinization – which in turn, when pumped out in other places, can bring geographical extension of soil salinization on the long run. Cooking, building, commercial use of wood can lead to overlogging. Bush, shrubs and trees slash and burn practices are supposed to bring new nutrient but may cause desertification too – with forest fires too often uncontrolled. If fallow period is too short, overgrazing, overexploitation and deforestation makes bare soils, which are exposed to wind erosion (linked salinized particles may be blown off and spread out in large areas).

Some local desertification phenomena closely mix independent natural and anthropic causes. So, sea level rise in coastal zones can lead to ground water table salinization, especially in large deltas (Nile, Ebro, Rhone) while irrational use of pesticides and fertilizers can worsen this phenomenon and add more toxic products. But most often intricate coupling effects are at work. Among many examples, overgrazing makes bare ground quite vulnerable to erosion. After slash and burn, the specific Mediterranean rainfall regime may wash out the fertile ashes that were expected to regenerate soils.

Woody vegetation form an important part of most ecosystems, from boreal and humid and temperate to arid and semi-arid zones. Within Mediterranean ecosystems, they interact with other vegetal and animal species in quite complex and specific ways. They strengthen the ecosystems resilience and greatly contribute to the services that they offer. Breaking off these interactions can cause irreversible degradation by leading these ecosystems out of their resilience domain. When addressing desertification phenomena in the Mediterranean, one must take into account both high economic value trees, more usual economic value trees (cedars, oaks, pines, cypresses) and more "modest" vegetal species: not just trees, but also shrubs, bushes and scrublands of various species which associate various plant species as well as herbaceous species of steppes in which no trees can be found. Their covering properties play a crucial role in many Mediterranean regions. Interactions between all these species and desertification processes are very numerous and diverse. Therefore, a perfect knowledge and understanding of these man-made ecosystems and the services that they offer is needed.

Identifying the most important relevant interactions within these ecosystems can tentatively be made.

- When trees can develop deep roots, they can collect underground soil humidity and nutrients while superficial layers become drier and poorer. So they can produce biomass necessary to men and animals while crops and other natural vegetation cover suffer or disappear. The same happens for soil salinization when it affects only superficial soils layers and does not reach underground water tables. When coping with the very specific Mediterranean rainfall regime, trees can contribute to keep up water from erratic rainfall and even limit erosion processes (see above)
- These ecosystems efficiently cover the surface of the soil and/or make an 'umbrella' over it, protecting it from water and wind erosion. This can be either a direct, mechanical effect since the soil is protected from erosion agents, or an indirect effect, since roots efficiently contribute to soil

stabilization, avoiding such phenomena as soil collapses and landslides – especially in hilly and mountainous regions which make most of the Mediterranean landscapes.

- Oasis are quite specific and vulnerable ecosystems, endangered by population increase and climate change impacts. Among other species, palm trees play a key role in ensuring the resilience of these man made ecosystems. In addition to their ecological role, they are an additional source of income for local population. Many organizations pay the utmost attention to oasis ecosystems (national and international administrations, NGO's, local trade-unions, scientists). The same economic considerations apply to such species as fruit and olive trees, and in a more local way such species as argan trees in Morocco: derived high value products are under large control of local economic agents, including women associations.
- Some smaller trees and grasses play also an important **economic role**. Regrettably, some 80% of **alfa** disappeared from Algerian steppes due desertification and overexploitation pressures. **Jatropha curcas**, a drought resistant source of liquid biofuels, is a very specific case. Planted scarcely as a complement to other species, it could increase ecosystems biodiversity and above all improve local economic conditions. But its intensive industrial culture has indeed negative impacts on food security, through mechanisms that are beyond the scope of this short note. Although poorly used in the Mediterranean basin, the direct seeding mulch-based cropping systems are linked to the covering effect of trees. The basic idea is to avoid any soil disturbance. A dead or living cover is permanently kept up under trees, which allows adequate seeding.
- A very important role of trees, especially in the Mediterranean region (see fig.2) is to **reduce the strong sandy winds** (windbreaks and helter belts). They act by decreasing wind energy and blocking off a part of transported sand. Hedges are often planted to protect cultures and infrastructures from sand invasion.
- Trees are often used as **sources of wood** for heating and cooling, for building and for trading purposes. Such uses has to be carefully managed considering the major role of trees in consolidating the resilience of these fragile ecosystems. Any alternative solution is welcomed.
- Forest, bush, shrubs and scrubland **fires** are a permanent threat in the Mediterranean basin. monitoring show that some species are especially resistant to fires, while ecosystems that grow again in burnt areas include sometimes less valuable invasive species on these burnt areas – if ashes are not washed up by violent rainfall.

So, **trees, bushes, shrubs, scrubland and steppes** are **key contributors** to the equilibrium and resilience of arid and semi-arid Mediterranean man made ecosystems. They contribute globally and through specific environmental and economic features to the services rendered by these ecosystems'. They are too often the last vegetal living trace in landscapes on their final way to desertification.

They have to be protected from mankind ignorance and cupidity.



Fig. 2 – Satellite observation of winds carrying on huge amounts of desert sand towards more fertile areas in the North of Morocco and. © NASA.

Box 1 : A few definitions according to « **United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa** »

(a) "desertification" means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities;

(b) "combating desertification" includes activities which are part of the integrated development of land in arid, semi-arid and dry sub-humid areas for sustainable development which are aimed at:

- (i) prevention and/or reduction of land degradation;
- (ii) rehabilitation of partly degraded land; and
- (iii) reclamation of desertified land;

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(d) "mitigating the effects of drought" means activities related to the prediction of drought and intended to reduce the vulnerability of society and natural systems to drought as it relates to combating desertification;

(e) "land" means the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system;

((f) "land degradation" means 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, such as:

- (i) soil erosion caused by wind and/or water;
- (ii) deterioration of the physical, chemical and biological or economic properties of soil; and
- (iii) long-term loss of natural vegetation.