ENJEUX SCIENCES

DESERTIFICATION AND CLIMATE CHANGE

ARE THEY PART OF THE SAME FIGHT?

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erosion phenomena and the heat contexts that affect desertification processes on a local, regional and continental scale.

The causes and consequences of these desertification phenomena are thus multiscale (global/local climate, regulations, regional and local practices). The mechanisms differ from one context to another depending on the homogeneity or heterogeneity of the biophysical and social conditions (contexts can be highly localized, where regional heterogeneity is significant, or regionalized, where there is considerable regional homogeneity). Acting at all levels to ensure that actions are complementary rather than contradictory is the best way to implement sustainable, equitable and fair actions.

HOW DOES ADAPTING TO CLIMATE AND ENVIRONMENTAL VARIATIONS HELP COMBAT DESERTIFICATION?

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Despite major water constraints, people have been able to develop extremely resilient livelihood systems that are adapted to the ecosystems of arid, semi-arid and dry sub-humid areas through specific agroecological practices, the diversification of crop and livestock species and activities, and the mobility of goods and people. These systems revolve around crop and animal species that thrive in the local bioclimatic conditions, with farmers selecting those that best meet their needs and environmental changes.

Crops and animals suited to the climate

These crop species have a phenology adapted to a rainfall regime that is generally seasonal with high inter-annual variability and a temperature regime characterized by very high peaks in the middle of the day, particularly at the end of the dry season. Along the north–south, Saharan–Sahelian–Sudanese gradient, C3 photosynthetic plants (which produce sugars with three carbon atoms) account for the greatest number of species. There are fewer C4 photosynthetic species (which produce acids with four carbon atoms). They include cultivated cereals, which are diet staples for the local populations (millet, sorghum, maize). CAM (crassulacean acid metabolism) plants are also well suited to these

specific conditions, but there are not so many of these species; unlike in other dry regions, succulent plants are uncommon in the Sahel. These various ways that plants adapt to the climate could play a role in climate change. In addition to seasonality, there is considerable spatial heterogeneity related to rainfall or its redistribution via surface or subsurface run-off, which affects the spatial distribution and availability of vegetation.

Animal species, both wild and domesticated, are also characterized by their ability to withstand heat, drink sporadically and feed opportunistically, while easily drawing from their body reserves during difficult periods.

The "3M" model: mobility, multi-enterprise farming and multifunctional space

Adapting subsistence systems to the environmental variability of resources is based on the species and varietal diversity (long or short cycles) of cultivated plants to make the most of the edaphic heterogeneity, the practice of fallowing, and the complementarity between less fertile areas that get little water and areas with more resources (e.g. oases, flood plains and rice paddies, manure-fertilized and watered gardens). With regard to livestock farming, animal breeds have been selected over millenniums, and mobility – daily and local pastoral mobility as well as seasonal and regional – remains the main mode of adaptation. This mobility is combined with community or public land tenure, which enables adaptive management of an area according to the inter- and intra-annual resource availability based on negotiated rights of access for specific uses: watering of animals, grazing, gathering, felling of wood.

These practices tend to renew soil fertility and mitigate land degradation processes, sometimes even encouraging regeneration, mainly due to the extensive nature of the resulting resource use. Soil nutrient exports drop along with falling crop yields. Pastoral mobility lowers the forage harvest at one place and in one season by grazing that is always selective and opportunistic. Fruit and wood gathering is also partial, as it is selective. Fallowing, the management of livestock effluents via composting and manure pits, and the spreading of manure and household

waste all contribute directly to restoring soil fertility. This is also the case for agroforestry practices, which include the establishment and maintenance of agroforestry parklands and hedgerows. Diversifying their activities and moving to less densely populated areas with more favourable agroclimatic conditions or near urban centres are among the strategies adopted by farmers in areas where land is saturated. These strategies help strengthen regional complementarities to increase food security and reduce human pressure on local natural resources.

An uncertain balance

Global change (which encompasses climate change, population growth, urbanization and globalization) is having a major impact on rural areas in arid, semi-arid and dry sub-humid zones. Rising anthropogenic pressure, resource extraction and the reduction or elimination of fallow periods are degrading the soil. Until now, farmers have been able to adapt by planting new species and varieties of seeds, sometimes from far away and which they source through markets or the movement of people (e.g. replacing long-cycle varieties with short-cycle varieties during periods of drought). They have also diversified their crops and activities to ensure their own food security and supply local towns. However, the extent of climate change means that farming adaptations (photoperiodic varieties, field management, agricultural extension services) must go well beyond previous adaptations and require support. Rising livestock numbers adds to the pressure on natural resources. The speed and pattern of urbanization also play a major role in land degradation due to the ensuing sharp increase in demand for food, energy and building materials.

In this context, certain long-standing practices, depending on their nature and intensity, can degrade the vegetation cover or soil, such as fires used to clear Sahelian annual plants or tree felling, which affects species prized for their timber (e.g. *Prosopis africana*, *Dalbergia melanoxylon*, *Sclerocarya birrea*, *Hyphaene thebaica* in the Sahel, and *Pterocarpus erinaceus*, *Khaya senegalensis* and *Borassus aethiopum* farther south). New practices, such as collecting cereal stubble from the field and raking straw from rangelands, are becoming increasingly common. Because they

reduce the organic matter and minerals returned to the soil, they worsen the slow decline in soil fertility and hence desertification. Fallowing is only effective if done for a long enough time. The number of years depends on the intrinsic soil properties (at least three to five years in the Sahel), but this leaves a large part of the landscape unusable, which is often incompatible with the rising need for agricultural land. Similarly, sources of animal manure may be sufficient to maintain soil fertility on a cultivated field, but they are often not enough to maintain the fertility of agricultural soils on a village or territorial scale.

The limitations of technical solutions and the need for a new model

Development projects offer a range of practices to tackle these soil degradation processes, with varying degrees of success. Anti-erosion measures such as terraces, filter dykes and semi-circular bunds to control surface run-off and limit water erosion are widely recommended and supported by international funding to rehabilitate land damaged by water erosion. The same applies to techniques for stabilizing dunes and bare loose sands by building dead hedges in a chequerboard pattern. Forestry-type afforestation projects, where seedlings are planted in rows in fields protected from any other use, are recommended to combat desertification (such as in the Great Green Wall initiative). Along with the use of mineral fertilizers to boost cropland productivity and increase yields, all these new practices are aimed at rehabilitating degraded land. However, farmers do not use them as strategies for adapting to climate variations and climate change. Rather, they reflect a desire to increase soil productivity, which can be seen as an indirect means of adapting to climate change by making better use of scarce water resources. The use of supplements to improve livestock feeding during the leanest periods at the end of the dry season and the beginning of the rainy season is an indirect adaptation by livestock farmers to keep their livestock in better condition to deal with the climate and related changes.

As a result, the solutions proposed by development projects are out of step with ancestral resource and ecosystem management practices when it comes to adapting to seasonal and interannual

variations in resources in these heterogeneous environments that vary over time. While traditional practices place limited pressure on ecosystems over time through adaptive domesticated species, seasonality and mobility, development projects offer technical solutions. These solutions are based on agricultural intensification and increasing soil productivity along with land management (anti-erosion systems, reforestation, soil rehabilitation) and are limited to technical approaches. These field-centred solutions are not innovative in any way. Given the scale of the changes to come and the multiple crises affecting food security and governance systems at different levels, new practices are needed. Such practices will depend on the development of services (crop and livestock insurance, medical and social insurance), agroecological intensification and the creation of appropriate supply chains to improve the social, environmental and economic sustainability of these social ecosystems while also combating desertification.

WHAT ARE THE DIFFERENT TECHNIQUES FOR REHABILITATING LAND AFFECTED BY DESERTIFICATION?

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Combating land degradation is a major challenge in dryland areas for the development of vast territories whose economies mainly revolve around renewable natural resources. The productive capacity of these areas depends on the ongoing interaction between seasonal work and transhumance movements, which free up agricultural areas for the growing season.

Reducing land degradation means:

- Combating water and wind erosion;
- Expanding the woody and grassy cover of grazing areas and crop fields;
- Increasing the stock of soil organic matter for the long-term intensification of existing agricultural land;
- Managing flows and exchanges between ecosystem compartments and between regions;