ENJEUX SCIENCES

DESERTIFICATION AND CLIMATE CHANGE

ARE THEY PART OF THE SAME FIGHT?

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WHY SHOULD WE FOSTER COMPLEMENTARITY BETWEEN LOCAL, REGIONAL AND GLOBAL SCALES?

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According to the strict (cartographic) sense, the term "scale" in geography refers to the relationship between a real distance, measured in terrestrial space, and its representation on a map. The larger the scale, the smaller the area represented on a document (e.g. A4 size). This is why a map with a 1:1,000 scale (1 cm = 10 m) is at a larger scale than the 1:100,000 map (1 cm = 1,000 m) and shows a smaller area on the same A4 document. In other disciplines, scales measure the intensity of a phenomenon (e.g. the Richter scale for the magnitude of an earthquake, the Beaufort scale for wind speed). In interdisciplinary contexts, the term "scale" most often refers to the spatial level at which a phenomenon is analysed: scales may be local or regional in a subnational sense, national or regional in a supranational sense, continental or global, from the smallest (a field, village, municipality, etc.) to the largest (planet Earth) area being discussed.

Desertification (and efforts to combat it) is a phenomenon whose climatic and anthropogenic causes, land degradation (and rehabilitation) mechanisms and ecological and social consequences operate on different scales or apply to several scales (multiscale processes).

Wind erosion as a case in point

Fighting wind erosion is a perfect example to illustrate the importance of considering the different levels of scale involved and their interactions and complementarity in combating desertification. Wind erosion refers to the action of the wind on bare or sparsely vegetated surfaces in dryland areas resulting in the horizontal and vertical movement of part of the soil. The horizontal movement of this sediment leads to redistribution on a local scale, with areas of loss and areas of accumulation. The vertical flow of soil due to wind erosion transports desert dust over long distances (regional, continental and global scales). This loss of the finest, most fertile fraction of the soil degrades it (local scale). The African continent, for example, is depleted of fine particles exported in suspension by wind transport towards South America, Greenland and Europe. However, soil is also redistributed more regionally to the tropical rainforest of the Gulf of Guinea, which helps fertilize the forest soil (continental and global scales). The biophysical consequences of wind erosion are thus multiscale. They are also social, as evidenced by the problems wind erosion causes for the respiratory and cardiovascular systems of humans on a local, regional and continental scale.

The causes of this erosion may be local (e.g. unsuitable practices, tornadoes) or regional (e.g. geomorphological position of the eroded land, lack of policies to protect vulnerable land). To combat wind erosion, solutions can be sought at local scale (e.g. planting hedges, grouping fallow fields together under a village agreement) as well as at regional, national or continental scale (e.g. subsidies or training/awareness-raising to help farmers plant tree hedges and stabilize sand dunes; regional dissemination of effective practices identified at local scale). Finally, the ultimate purpose of interventions must be considered: why make changes in an area losing sediment that people do not use, when the area where it accumulates is – and benefits from – receiving the most fertile fraction of the eroded soil? Similarly, could potential tensions between land users in areas of loss and areas of accumulation be avoided (on a local as well as regional scale if necessary) by organizing consultations and collectively seeking compromises in terms of development linked to the effects of wind erosion? Wind erosion is a natural phenomenon people have long benefited from, such as by being able to farm the large fertile plains of sedimentary basins. Should we fight or slow down this phenomenon if the costs are reasonable, or let nature take its course and adapt to change? Of course, if the actions undertaken are too intense, too fast or unsuitable, they can accelerate natural dynamics that will need to be limited, especially if demographic pressure leads to new land being developed. Considering local actions within a global dynamic raises questions of a paradigm shift: should we consider the world as fixed and try to preserve the current equilibrium, and at what cost (economic and social)? Or should we adapt to the Earth's ever-changing dynamics?

Which innovative solutions should we draw from to do so without worsening inequality?

The degradation of woody plant species

The degradation of woody plants (trees and shrubs) in the Sahelian drylands is another illustrative example. The density and diversity of trees across much of this area (on a regional scale in the supranational sense) have declined sharply, particularly since the major droughts of the early 1970s and 1980s, with consequences on soil degradation (e.g. erosion, reduced fertility), biodiversity loss and less food for humans and animals. The consequences have also been social: for example, the loss of trees in fields (local scale) may have encouraged women who process non-timber forest products (fruit, leaves, bark, etc.) or men deprived of their extremely degraded land to change jobs and move to an urban area or another region, country or continent to make up for lost income (migration at regional to continental scale).

Some areas (local or regional scale in the subnational sense) in the Sahel have been regreening, starting in the 1990s and again from 2000. The vegetation (woody, grassy, etc.) and causes (climatic, anthropogenic) involved in this regreening are still being debated in the scientific world, but likely stem from multiple reasons, including improved rainfall in recent decades and regeneration practices, such as the assisted natural regeneration of trees in cultivated fields in Niger. Regreening linked to assisted natural regeneration in one or more village areas (local scale) can encourage locals in one or more regions to adopt this technique or to practise it again (regional-scale dissemination).

This type of practice is now being promoted at regional level in the Sahel as part of the Great Green Wall (GGW) initiative, which aims to coordinate efforts to restore and rehabilitate Sahelian ecosystems from Senegal to Ethiopia. This initiative addresses both local issues of participatory regeneration practices engaged in with local populations and the transnational harmonization of programmes, funding and legislation on the management of these ecosystems. Acting on these regional scales also means potentially being able to influence water cycles, 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