



Sustainable Soil Management in Drylands

Desertification is an especially severe form of land degradation, which involves gradual and significant loss of agricultural productivity and ecological health. By thus undermining food security and rural incomes, desertification imposes great hardship on dryland populations. According to the Secretariat of the International Convention to Combat Desertification (CCD), the problem threatens about 30 percent of the earth's total land area and already affects about 70 percent of its agricultural drylands, which are home to some 250 million people.

Desertification may be triggered by a range of causes, such as climate change, population growth and inappropriate policies. Under these pressures, rural people, especially the poorest, have little choice but to engage in destructive land management practices, including overgrazing, deforestation and excessive removal of crop residues. The loss of vegetation robs the soil of its natural protection, exposing it to erosion by wind and rain and to the loss of soil fertility. Sand dunes form through gradual accumulation of wind-blown soil.

Drought, by depleting vegetation and putting greater pressure on farm communities, contributes significantly to land degradation. But in some dryland areas, such as the African Sahel, declining soil fertility poses an even greater constraint than drought. To overcome this problem requires a combination of improved crops and prudent application of chemical fertilizers, together with the use of local sources of nutrients and organic matter.

To broaden the array of options available to farmers, scientists and development partners are working with farmers to devise appropriate technologies for accomplishing tasks such as reduction of wind erosion during the dry season and maintenance of soil fertility. A key challenge of this work is to promote diversified rural livelihoods, which can provide dryland populations with greater protection in the face of drought and other risks.

Selected Highlights from Research for Dryland Development

Fertilizer micro-dosing: A variety of new practices are better enabling farmers in Africa's Sahel region to raise soil fertility. Organic matter and nutrient content are generally low in this region, because growth of vegetation is limited and much of it is removed for feed, fuel and construction. There is ample evidence, though, that fertilizer can boost the productivity of dryland agriculture when rainfall is adequate. But applying normal doses of fertilizer is too expensive for most farmers in the Sahel and besides increases the risk of soil acidification. The use of organic matter, in the form of livestock manure and crop residues, is effective, but supplies of these materials are limited.

A safer and more economical alternative is to apply small quantities of inorganic fertilizers in the hole where seed is sown, a practice called "micro-dosing." Practiced by thousands of farmers in Burkina Faso, Mali, Niger and Zimbabwe, micro-dosing helps crops mature more rapidly and escape the worst effects of drought. This and other options are the focus of collaborative research involving the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT), the International Food Policy Research Institute (IFPRI) and their national partners. The research has demonstrated that, by practicing micro-dosing, farmers can significantly improve crop productivity and boost their profits.

This work has also shown that micro-dosing may be combined, to good effect, with other measures, such as mulching with crop residues and the placement of small amounts of mixed organic/inorganic fertilizer in soil mounds formed for planting. In Niger, farmers who have adopted these practices are obtaining cash for purchased inputs through an innovative agricultural credit program called “warrantage.” Introduced from Asia, the program is being promoted with hundreds of farmer organizations. Another innovation aimed at making fertilizer more accessible to small farmers involves the creation of links between them and large-scale fertilizer dealers. This new arrangement, which is being tried in southern Africa, could contribute importantly to reducing rural hunger.

Precision manuring: Livestock manure, like inorganic fertilizer, is important for raising soil fertility in the African drylands, and there is much scope for making its application more efficient. Toward this end the International Livestock Research Institute (ILRI), ICRISAT, and their national partners are helping agro-pastoralists find more efficient ways to integrate livestock and cropping.

Results indicate that farmers can better manage rates of manure application on cropped areas simply by rotating the night-time tethering sites of their animals. Through this strategy of “precision manuring,” they can concentrate manure application on the “bad spots” or “tired soils” that are most in need of transfusions of nutrients and organic matter. The practice is especially useful for poor farmers, since they don’t have enough land to simply ignore areas of declining soil fertility. Village-level management of precision manuring shows promise for enabling dryland communities to fine-tune the management of agro-pastoral systems across whole landscapes, resulting in higher and more sustainable yields.

Fertilizer trees: Another effective approach for restoring and maintaining soil fertility in drylands is the planting of leguminous “fertilizer trees,” which capture nitrogen from the atmosphere and make it available in the soil. Researchers at the World Agroforestry Centre have shown in the drylands of southern Africa that these trees, when grown with crops or in fallows, can boost maize yields dramatically. Moreover, once farmers have made the initial investment in establishing the trees, rural communities can handle seed multiplication and extension on their own. Since the late 1990s, when a few hundred farmers began testing the technology, it has spread rapidly and is now used by an estimated 200,000 maize farmers.

Cultivating cactus: This activity, promoted by the International Center for Agricultural Research in the Dry Areas (ICARDA) and its national partners, is gaining ground across North Africa and Central and West Asia. Production of spineless cactus (*Opuntia* spp.), a multipurpose plant, helps boost local supplies of animal feed, which translate into increased income for small farmers, while at the same time helping prevent wind erosion and stabilize sand dunes. Cactus is also a popular food, consumed fresh or processed into jelly, jam and juice. It has medicinal uses as well.

