Regional aspects – Desertification in the Middle East and North Africa

Warning signs for a global future?

Desertification is nowhere more serious than in the Middle East and North Africa (MENA), stretching from Pakistan in the east to Morocco in the west, and from Ethiopia and Sudan in the south to Turkey in the north. Yet, many MENA countries have successfully rehabilitated large areas. Concerted efforts can indeed stop and even reverse desertification, though their long-term success will depend on how well they manage their limited water resources.

Photo: ICARDA

A number of countries in the drylands succeeded in rehabilitating large areas, like in Syria.

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Mesopotamia, now Iraq, is regarded as the cradle of Western civilization, but today significant areas are parched or degraded. Overgrazing, intensive farming, forestry and irrigation probably caused widespread deforestation, erosion and salinization through successive empires over seven thousand years (Juo and Wilding, 2001, *Response to Land Degradation;* Science Publishers). Climate change around the year 2200 B.C. may have also played a role, interacting with those human influences (Weiss et. al. 1993, Science 261: 995–1004). Governance and development policies during the Imperial Roman era may also have encouraged land degradation, because areas within the Middle East and North Africa (MENA) region were farmed intensively as the breadbasket for the Empire (Barker 2002, World Archaeology 33: 488–507).

MENA may be a window into the future of desertification for younger dryland civilizations elsewhere, especially as they face the coming onslaught of climate change.

Increasing pressure on overburdened drylands

In ancient times, rural people adopted the nomadic herding lifestyle to reduce risk. They shifted their animals to greener areas that happened to receive more rainfall in a given year. This gave a rest to other lands that were not favored by rainfall that year, allowing them to recover. As populations grew, however, land became insufficient to leave some idle. People expanded farming and grazing onto ever-poorer, drier, more sloping lands that degraded even more quickly. The productivity of the land decreased while the risk of damaging it increased.

In some areas, traditional social restrictions on over-grazing broke down as land pressures increased. A 'free-for-all' situation (sometimes called the «tragedy of the commons») is emerging in which individuals must extract as much as they can from the land before someone else does in order to survive, rather than leave some lands to rest for long-term sustainability of society.

Desertification in Middle East and North Africa – MENA

MENA as defined here is home to over 600 million people, or about one-third of the world's dryland population. Droughts, variable timing of rainfall, a short rainy season, extreme temperatures, cultivation on sloping lands subject to erosion, and shallow rocky soils (sometimes a result of their long history of use, causing erosion) all imply a need for careful management if the productivity of these lands is to be sustained (Nahal 1995, Desertification Control Bulletin 27: 53–57).

Definitions of desertification vary and data are scarce and uncertain, but Lal

(2002, Land Degradation and Development 13, 45–49) estimates that 45 percent of all the land in MENA is degraded to some extent, including about 68 percent of the rainfed agricultural land, one-third of the irrigated cropland, and 85 percent of the rangeland. These figures should be considered cautiously because they are substantially higher than estimates by others. For example the 45 percent figure well exceeds the global dryland degradation estimate of 10-20 percent by the Millennium Ecosystem Assessment (2005, download at http://tinyurl.com/p838a).
It is reasonable to speculate that degradation may be more extensive in MENA than in other parts of the world because of the long history of intensive land use. At the same time it should be noted that countries in the region have successfully rehabilitated large areas, such as the western side of the Nile Delta in Egypt, along the Euphrates River in Syria, in the central Arabian Peninsula, and recently in the marshlands of southern Iraq, among others (Nielsen and Adriansen 2005, Land Degradation & Development 16: 151–161). These success stories show that concerted efforts can indeed stop and even reverse desertification, though their future will depend on the sustainability of water resource management.

A quick regional tour

Within the MENA region, there are important sub-regional distinctions that influence the course of desertification, and solutions to it.
The flat plains and undulating hills of the countries surrounding the Mediterranean Sea are dependent on scant winter rainfall (200-350 mm per year) and short rainy seasons to cultivate low-yielding cereal, legume and tree crops, together with sheep and goat herding on fragile, low-productivity rangelands. Rangeland degradation from overgrazing, combined with increasing demand for meat and milk by growing urban populations have compelled herders to buy more and more of the feed and fodder that their animals need.
Nile River Valley agriculture, in contrast is based on intensively-managed irrigated systems. The enormous population pressure and lack of rainfall in this zone makes it heavily dependent on maximizing food production per unit of land, which increases risks of salinity buildup, water pollution, water shortages and ecological damage.
The Arabian Peninsula, one of the world's major arid zones, depends almost entirely on irrigation to grow its crops, but lacks major river systems like the Nile. Instead this area depends on groundwater raised through wells, but groundwater is being depleted faster than the scant rainfall can replenish it. Making matters even more difficult, the growing urban areas are taking priority for the scarce freshwater, leaving agriculture to use low-value brackish or salty water that can increase the risk of salinizing the soil. While some areas in the Peninsula are wealthy enough to afford the de-salinization of seawater, agriculture cannot afford this costly source.
Looking eastward towards Iran and Pakistan, aridity is complicated by rugged mountainous terrain and more extreme temperature variability, especially colder winters. Irrigation in inter-mountain basins often raises soil salinity because the salt-laden water does not easily drain out of these low-lying areas. Irrigation on steep land often scars the land with erosion gullies.
Highland areas in other parts of MENA face similar gulley erosion risks, such as in Ethiopia and in the Atlas Mountains of Morocco. In the mountainous areas of Oman and Yemen, farmers have used terracing to reduce erosion combined with water-harvesting techniques such as 'aflaj' and 'spate irrigation' to capture rainfall as it runs off from the slopes.

Climate Change

Climate change is an ominous threat to the future of MENA. Current predictions by the United Nations' Intergovernmental Panel on Climate Change, though far from certain, suggest that MENA may become drier and hotter over the next 100 years, which would increase desertification trends. Lower rainfall will reduce crop yields and increase the salinization of lands. As it becomes more difficult to live in MENA, migrations to other parts of the world will increase.

Tools in the fight against desertification

Improved knowledge. As the earlier discussion of the wide variation among estimates of desertification indicates, there is an urgent need to improve our knowledge of this phenomenon. Desertification is complicated by a range of definitions and a variety of causes and symptoms; different degrees of expression that are difficult to measure; and a shortage of practical tools and techniques for measuring how desertification is affected by different remedial practices. Without good information it is difficult to issue early warnings of impending drought and damage to lands. However, good progress is being made in improving tools and methods. The power and affordability of satellite remote sensing tools are improving rapidly. Satellite images of vegetation, soil surface condition and primary processes such as plant water use, taken over time can indicate trends over large areas. Ground-truthing and the consolidation and interpretation of these data is becoming increasingly practical through the use of information technologies such as global positioning systems and geographic information systems. Improved climate models are making more accurate predictions of the probability of drought events.
More rapid, affordable soil testing technologies such as infrared spectrometry are providing inexpensive, accurate measures of soil fertility on a large scale. Biometric methods aided by advances in computer science are giving a more incisive view of trends in biodiversity. Advances in molecular biology are yielding a better understanding of the genes that control plant adaptation to dryland conditions. And advances in animal health research are discovering ways to help livestock better cope with the stresses of drought and disease.

More land-conscious policies and governance. Many countries in MENA, as elsewhere in the world, originally attempted to combat land degradation by issuing central government directives that did not take into account the needs and priorities of those who actually lived on the land. As a result, such directives were often ignored, resisted or evaded.
Communities have the most at stake, and the best knowledge of their lands. In a major effort known as the Mashreq/Maghreb Project convened by the International Center for Agricultural Research in the Dry Areas (ICARDA), eight countries in the Middle East and North Africa empowered local land-users to co-manage their lands with the central government in ways that harmonized their livelihood needs with the desire to improve long-term sustainability.
Governments can sometimes be too helpful, providing assistance in the wrong ways.

The idea of a rainfall insurance

The International Food Policy Research Institute (IFPRI) suggests that regional governments consider the feasibility of 'rainfall insurance' (Hazell et al. 2001, IFPRI, http://tinyurl.com/ottgr). Farmers and herders would pay for the amount of insurance they feel they need, instead of being rescued by government relief aid for over-extending their crops and herds in ways that damage fragile dryland soils.

Photo: ICARDA

Instead of grazing livestock can be fed with waste products from the farm such as straw, rice bran or date pulp.

The provision of emergency aid to farmers and herders after droughts has unintentionally encouraged larger herds and cropped areas than the land can support. This is because these 'risk subsidies' protect land users from the consequences of overburdening the land. Wealthier land users benefit the most from such emergency aid, because payments were usually linked to herd size or the amount of land cropped.

Better water management. One reason water use is inefficient despite shortages in MENA is that water policies often treat it as a free or heavily subsidized good. The negative consequences of water abuse or over-use are borne by the environment and society in general, not by the users. Such policies need to be re-examined and altered to reward environmentally friendly management. Technologies are available and being developed that can improve water use efficiency. For example, the estimation of crop water requirements based on climatic conditions measured by automated weather stations can help farmers know when and how much irrigation will give the optimum payoff.

Brackish (slightly salty) water is widely available in MENA, and its use for irrigation can take pressure off the scarce supplies of fresh water. However, brackish water irrigation must be carefully researched and managed because it carries with it a risk of salinization if done improperly. It holds particular potential when combined with salt-tolerant wild species that animals are willing to eat. Brackish water can also be used to irrigate salt-tolerant landscaping plants in the expanding urban areas and highways of MENA.

More 'crop-per-drop'. Crops and cropping systems can also be engineered to become more water-efficient. One example is mentioned above – identifying salt-tolerant species for brackish-water irrigation. Plant breeding may also be able to modestly increase the salt and drought tolerance of some species used for human consumption in MENA, particularly cereal crops like barley and wheat.

Degraded rangelands can be rehabilitated by planting productive plant species that are nutritious and palatable to livestock. Spineless cactus (*Opuntia ficus-indica*), saltbushes (*Atriplex*), and wattles (*Acacia*) have been successfully introduced in Algeria and Tunisia; the higher water content of cactus appeals to sheep, and aids in their digestion. Research is needed to evaluate the risks to native biodiversity of introducing such 'alien species' on a large scale; but this risk should be balanced against the already-existing risk that overgrazing poses to that native biodiversity.

Supplementary feed sources for livestock. Hungry animals and land shortages lead to over-grazing. Meanwhile, agricultural waste products such as straw, rice bran, date pulp and others create a waste disposal problem at food and feed processing plants. A promising option is to recycle these cheap agricultural wastes as feed. The ICARDA-convened Mashreq & Maghreb project mentioned earlier devised ways to compact these wastes into nutritious, inexpensive 'feed blocks'. Now being tested in Iraq and Jordan, feed blocks improve sheep weight gain, fertility and lambing rates while taking pressure off the rangelands.

Diversifying to reduce risk, increase incomes and options. Instead of only producing low-value raw materials to be exported for processing in developed countries, MENA rural communities can band together to add value to their harvests through processing and marketing. For example they can create products such as couscous, pasta, and frikeh from their durum wheat. ICARDA is helping them identify market opportunities at the local, national and international levels, and build human and institutional capacities for the research and development that must underpin such diversification.

Diversification into higher-value crops also holds promise. The MENA region is a center of genetic diversity for many valuable species. Options include the cultivation of high-value herbal and aromatic crops such as Bigflower Rosy Onion (*Allium roseum*), Desert Wormwood (*Artemisia herba-alba)* and Rosemary (*Rosmarinus officinalis*) as well as medicinal plants and mountain products such as honey, walnut, olive oil, cheese, and goat meat. With national partners, ICARDA has coordinated the collection and conservation of many such species. Building on this initiative, the Government of Tunisia has prepared a national strategy for the production of medicinal, herbal and aromatic plants.

Correction of nutrient deficiency

In many parts of MENA, nutrient deficiencies in the soil weaken crop plants, making them more susceptible to drought and salinity. Correction of phosphorus deficiency, for example makes cereals more drought-hardy, higher-yielding and more efficient in water use. Excessive nitrogen fertilizer, on the other hand can make plants more susceptible to drought. Stronger efforts are needed to extend this knowledge and technology.

The years ahead

This brief overview mentions a few of the many options that are available for combating desertification. Rapidly growing human populations in MENA however keep raising the pressure on the land. Experiences in other parts of the world suggest that as poverty is reduced, birth rates will slow and land pressure will ease. Therefore, poverty reduction, especially through alternatives to agriculture, is important for combating desertification. The threat of climate change adds an even greater urgency to the need to find more water-efficient, drought-resilient agricultural technologies and management practices, as well as alternative livelihoods for the peoples of this region. Rural education will better equip the poor to leave the farm, if more open and competitive economic policies create more urban job opportunities in MENA.