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MANAGING DROUGHTS IN THE LOW-RAINFALL AREAS OF THE MIDDLE EAST AND NORTH AFRICA

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ABSTRACT

Drought is a recurrent and often devastating threat to the welfare of countries in the Middle East and North Africa (MENA) where three-quarters of the arable land has less than 400 mm of annual rainfall, and the natural grazings, which support a majority of the 290 million ruminant livestock, have less than 200 mm. Its impact has been exacerbated in the last half century by the human population increasing yearly at over 3%, while livestock numbers have risen by 50% over the quinquennium.

Virtually no scope exists for further expansion of rainfed farming and very little for irrigation, hence there is competition between mechanized cereal production and grazing in the low rainfall areas, and traditional nomadic systems of drought management through mobility are becoming difficult to maintain. Moreover droughts seem to be increasing in frequency, and their high social, economic, and environmental costs have led governments to intervene with various forms of assistance to farmers and herders, including distribution of subsidized animal feed, rescheduling of loans, investments in water development, and in animal health.

In this paper we examine the nature and significance of these measures, both with respect to their immediate benefits and costs to the recipients and to governments, and to their longer term impact on poverty and the environment. We conclude that while they have been valuable in reducing catastrophic losses of livestock and thus alleviating poverty, especially in the low rainfall areas where they are the predominant source of income, continued dependence on these programs has sent inappropriate signals to farmers and herders, leading to moral hazards, unsustainable farming practices, and environmental degradation, while generally benefiting the affluent recipients most.

Moreover, they have tended to escalate and become an administrative and financial burden to their governments.

Alternative approaches to drought management need to be explored, and possibilities discussed here include area-based rainfall insurance against catastrophic droughts, and the development of more accurate timely, and accessible early warning drought forecasts. While we envisage the insurance as an unsubsidized private sector initiative with a number of attractive features, it would require strong support from the government in its formative stages. Improved weather forecasts are likely to remain a government responsibility in the immediate future and would help administrators and relief agencies position themselves for more efficient drought interventions, as well as farmers to adjust their plans to rainfall outcomes.

KEYWORDS: Drought management, Dryland agriculture, Middle East and North Africa.

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1. DROUGHT PROBLEMS FACING LIVESTOCK MANAGEMENT IN THE MENA REGION

Drought is not a phenomenon confined to dry areas of the world. In 1999, it caused unprecedented water shortages, bans on washing cars and watering lawns, and disputes over policy for water use between neighboring states in the Washington, D.C. area of the United States--certainly not an arid or even a semi-arid climatic region! However, in ecoregions where the prevailing rainfall regime is semi-arid and/or arid, and temperatures are high during a significant portion of the year, frequent visitations of drought compound the problems of resource management for agriculture, seriously threaten human and animal welfare, and jeopardize economic development.

This is the case in the countries of the Middle East and North Africa (MENA) where a high proportion of the total land is located in ecozones which are classified in terms of precipitation as semi-arid, arid, or hyper-arid and where drought is no stranger. (Table 1).

[1] In this context 'livestock' refers to ruminant animals (cattle, camels, sheep, and goats), but not pigs or poultry.
[2] This paper deals primarily with eight countries of the Mashreq and Maghreb regions of the Middle East and North Africa : Iraq, Lebanon, Jordan, Syria, Algeria, Libya, Morocco and Tunisia.

Table 1--Classification of Mediterranean Bioclimatic Zones in Middle East by Precipitation

Zone type	Annual rainfall (mm)	Percent of arable area
Super-arid	< 200	0
Semi-arid 1	200-400	74
Semi-arid 2	400-600	14
Sub-humid	600-800	10
Humid	800-1200	1
Super-humid	> 1200	1

Drought has long been a significant factor in this region, particularly for the low-rainfall crop-livestock systems and for herders in the vast grazing areas of the steppe. The problems were severe even in biblical times, but over the centuries, the total magnitude of the economic costs caused by droughts has increased, at least in proportion to the increases in human and livestock populations.

Unfortunately, the level of wealth accumulated in these agro-pastoral societies is inadequate to provide full protection from severe droughts, and the economic and human losses in drought periods can be severe. The problem has worsened with population growth, as more and more people seek to earn a livelihood from the meager resources available in these areas. It may also have been aggravated by more frequent and prolonged droughts associated with global warming. The high cost and the increasing vulnerability of agro-pastoral societies has led many governments in the region to intervene with various forms of drought assistance.

However, many of these interventions are encouraging farming practices that could increase both the extent of future drought losses and the dependence of local people on government assistance. They are also costly to governments, and use resources that could otherwise be spent for development purposes. It is important to know if the net benefits from existing types of drought relief programs justify their costs, particularly when their long-term impacts on poverty and the environment are assessed. It is also important to know if drought relief programs can be designed better to achieve their immediate objectives, but without distorting economic incentives for more sustainable management of natural resources. This paper addresses these issues.

2. LAND AND WATER AVAILABILITY AND USE IN THE MIDDLE EAST AND NORTH AFRICA

Agricultural land in this region is extremely limited. Arable land and permanent crops comprise only about 7 percent of the total land area, 25 percent is classified as pasture – mainly in ecozones with under 200mm mean annual precipitation (m.a.p.), and 7 percent is forest and woodland (often in poor condition due to grazing and fuel gathering). About 61 percent is identified as 'other' and is unsuited to agricultural use. This is mostly desert but there is some extensive grazing (Food & Agricultural Organization [FAO] 1995). The majority of the region has a Mediterranean climate with cool to cold winters and hot dry summers. Most of the rainfall is in the winter, but it is highly erratic in space and time, making agriculture a risky business.

In the Middle East about three quarters of the arable area is in the semi-arid rainfall zone with 200-400 mm of m.a.p. and a growing season of 75-120 days: only 12 percent is defined as humid or sub-humid with over 600mm m.a.p. Below 400 mm, the scope for crop diversification on rainfed land is limited: farm surveys in several countries show a sharp decline in the share of legumes, oilseeds, and vegetables, and an increasing dominance of cereals—especially barley (grown mainly for animal feed) with decreasing rainfall down to 150 mm, where the area of fallow declines and barley competes increasingly at the margin with the natural grazings.

Irrigation makes an important contribution to agricultural production, value added, and employment in most MENA countries, especially in the Middle East, where it represents almost 30 percent of the cultivated area overall. In North Africa (excluding Egypt where nearly all cropland is irrigated) it accounts for about 11 percent of the cultivated area. However, problems of soil and water pollution from agricultural uses and urban and industrial wastes, overpumping of ground water aquifers, salinization, and competition from other users are becoming major constraints, while the prospects for further significant expansion of the irrigated area are very limited.

While cattle are predominant in irrigated areas, in Syria, for example, there is increasing seasonal migration of sheep flocks to those areas to access crop residues and by-products (ICARDA 1992). However, most of the 250 million head of small ruminants in MENA are based on farms and rangelands in the lowland semi-arid and arid zones under extensive systems of management.[3] There is also a considerable but less well-documented ruminant population in the higher altitude plateau, mountain regions and forest grazings of Algeria, Iran, Iraq, Morocco, and Turkey.

Livestock are both a principal component of agricultural incomes and the main source of family wealth in these low rainfall and upland areas. In most MENA countries they contribute around 30 percent of agricultural GDP. Numbers of sheep have increased in the Middle East from 96 million in 1961-65 to about 135 million in the mid-1990's and from 22 million to 49 million over the same period in North Africa (Table 2).

[3] ICARDA has documented seasonal migratory movements of flocks to higher rainfall arable and irrigated land. These can cover distances of up to 100 km from their bases, and may involve some cash and kind payments to the land owners. (Wacholtz et al, 1993).

Table 2--Livestock Population in the Middle East and North Africa 1961-65 to 1996-98[1]

	Numbers of Stock – '000 head				Change in numbers 1961-65 = 100		
	1961-65	1979-81	1989-91	1996-98	1979-89	1989-91	1996-98
Sheep							
Middle East	96,292	125,556	137,125	133,110	130.3	142.4	138.2
North Africa	21,791	39,727	45,174	49,121	182.3	207.3	225.4
WANA total	118,083	165,283	182,299	182,231	140.2	154.4	154.9
Goats							
Middle East	56,589	44,716	50,323	53,549	179.0	188.9	94.6
North Africa	10,825	12,334	16,279	18,283	116.7	150.4	168.9
WANA total	67,414	57,050	66,602	71,832	84.6	98.7	106.6
Cattle							
Middle East	25,041	27,338	24,749	25,679	109.2	98.8	102.5
North Africa	6,502	7,520	8,285	7,718	115.7	127.4	118.7
WANA total	31,543	34,858	33,034	33,397	110.5	104.7	105.9
Camels							
Middle East	1,413	954	1,279	1,391	67.5	90.5	98.4
North Africa	984	776	586	643	78.9	59.5	65.3
WANA total	2,397	1,730	1,865	2,034	72.2	77.8	84.8

Recent FAO data indicate some stabilization of small ruminant numbers in MENA since 1989, Iran and Morocco being the exceptions. In Turkey the size of flocks has diminished due to erosion of grazings and reduced feed supplies (ICARDA 1991). The goat population has declined by about 3 million head to 53 million (5.4 percent) since 1961-65 in the Middle East, but their numbers have increased by 69 percent to 18 million in North Africa. Camel numbers declined slightly to 1.4 million in the Middle East, but more sharply by 35 percent to 643,000 in North Africa. This probably reflects their displacement by motor vehicles as a source of mobility for movements of stock and people, and also the decline of nomadic livestock systems either by choice or under duress from governments, as a consequence of nationalization of rangelands and settlement programs. (Blench 1998)

Human population growth is high, currently around 3.3 percent per annum for the MENA region as a whole: the projected gap between domestic production and consumption of grain is 75 million metric tonnes (mmt) in 2020, compared to about 33 mmt in 1990 (El Beltagy 1997).[4] Another estimate indicates that a considerable proportion of that increased grain consumption would be related to an increase in ruminant livestock numbers paralleled by a significant decline in the contribution of pastures to their overall feed supply (Nordblom and Shomo 1995).

While drought has long been a plague in the MENA countries, those countries are increasingly vulnerable to its ravages, due to the rising pressures of people and domestic animals on a dwindling land and water resource base.

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[4] This is probably a conservative estimate; it assumes zero growth of per capita incomes and of p.c. grain consumption, and a constant 2 percent growth of grain production to 2020.

3. THE IMPACT OF DROUGHTS IN THE REGION

Given the erratic precipitation in the MENA region, there are many years when annual rainfall falls below normal. But drought, at least as perceived in this paper, is associated with catastrophic rainfall shortages. What is a critical rainfall outcome? Pratt, Le Gall and de Haan (1997) suggest that a drought can be said to occur in a year when rainfall falls below half the long-term average, or when rainfall in two or more successive years is below 75 percent of that average. Rainfall failure stunts pastures, desiccates water points, greatly reduces crop yield, and kills livestock. It can lead to the liquidation of a significant part of the total flock in the absence of other sources of feed. Moreover, since the main commercial output of pastoral systems is meat, meat prices tend to be negatively correlated with drought (more animals are available for sale in drought years), and while this benefits urban consumers, it accentuates income shortfalls of producers. As human populations grow, so do animal stocking rates — the number of animals kept on a given land area. Thus, pastures are put under increasing stress, which in turn increases their vulnerability to drought. What used to be a manageable rainfall outcome may now be considered a serious drought that leads to significant economic and social costs.

Oram (1998) provides a review of some of the more recent consequences of drought for livestock production in the region. In the 1945 Moroccan drought, 25 percent of the cattle and 39 percent of the sheep either died or were sold prematurely on a glutted market (Iovanna 1996). In a major drought between 1958 and 1962, at least 70 percent of the then considerable camel herd in Jordan died, leading to the virtual demise of camels as an economic element of livestock production there. More recently about 30 percent of the national sheep flock was lost or slaughtered prematurely in the 1997 drought there. In Syria some 3 million sheep (about 25 percent of the national flock) had to be slaughtered during the 1983-84 drought due to a shortage of feed. (Oram and de Haan 1995). Feed shortages for livestock are due not only to the effects of drought on the natural grazings, but also to their impact on cereal yields; in the 1995 Moroccan drought, cereal production fell to 1.8 mmt from 9.6 mmt in 1994 (El Mourid and Moussaoui 1998). Yields of barley, the staple cereal of the low rainfall areas, have not improved greatly in several countries over the long term, and with the exception of the Lebanon--the least drought-prone country, show high inter-annual variability due to rainfall deficits (Table 3).

Table 3--Yield Trends of Barley in the Middle East and North Africa (Kg/ha)

	1961/65	1969/71	1979/81	1989/91	1993	1994	1995	1996	1997	1998	1999	1993/9
North Africa												
Algeria	587	608	782	892	625	648	540	1404	721	745	753	776
Libya	248	326	356	497	500	497	493	729	675	714	714	715
Morocco	808	1093	785	1172	477	1440	385	1577	663	812	815	617
Tunisia	286	378	626	909	933	592	328	1186	516	1165	1079	828
West Asia												
Iraq	925	190	838	759	675	614	720	788	663	708	574	697
Jordan	689	481	365	739	1165	561	588	857	860	851	75	708
Lebanon	968	859	1025	1705	1750	1667	1654	2526	2527	2534	2534	2170
Syria	877	631	904	271	716	782	877	1067	625	553	386	715

4. HOW HERDERS TRADITIONALLY MANAGE DROUGHTS IN MENA

Agro-pastoral societies have developed their own strategies for coping with drought. These include:

- Mobile or transhumant grazing practices that reduce risks of having insufficient forage in any one location.
- Reciprocal grazing arrangements with more distant communities for access to their resources in drought years.
- Adjustment of flock sizes and stocking rates as the rainy reason unfolds, to best match available grazing resources.
- Keeping extra animals that can be easily liquidated in a drought, either for food or cash.
- Investment in water availability — wells, cisterns, water harvesting.
- Diversification into crops and livestock (agropastoralism) especially in proximity to settlements, and storage of surplus grain, straw, and forage as a reserve in good rainfall years.
- Diversification among animal species (sheep, goats, cattle, camels, donkeys), and different breeds within species. Sheep and goats are most numerous on the low rainfall rangelands of MENA. Cattle are more commonly maintained on farms, or on grazings in higher rainfall areas.
- Income diversification into non-agricultural occupations, particularly seasonal migration for off-farm employment.

Traditional risk management strategies have proven effective in managing drought and have enabled pastoral societies to survive harsh environments for many centuries. The interplay between drought and traditional management systems has also helped to keep total flock sizes in equilibrium with the inherent productivity of the pastures, avoiding the long-term degradation of grazing areas. Stocking rates would trend upwards between droughts as herders bred more animals, but then would fall when the next drought occurred, fluctuations in herd size closely followed rainfall patterns, and peak stocking rates rarely reached unsustainable levels.

But despite their advantages, traditional drought management strategies can have associated opportunity costs. It is useful to think in terms of two types of such costs: those arising from inefficient use of resources within existing agro-pastoral systems, and opportunity costs arising from failure to exploit more productive agricultural development pathways.

Examples of the first type of opportunity cost are as follows: by liquidating animals during droughts, herders may end up with too few animals in the immediate post drought period, and hence miss out on important short-term production opportunities. On the other hand, given a sufficient respite between droughts, herders may build up excessive flock sizes in order to have a liquid asset as a hedge against the next drought. This can lead to overgrazing and the degradation of pasture, with reduced productivity. Herders also prefer to keep traditional breeds that are more drought tolerant, but which might be less productive than exotics under more favorable management, and are often reluctant to use or invest in modern inputs (feed, veterinary treatments, etc.) that could increase average profitability but which might lead to loss of capital investment if rainfall is unfavorable. There is a dearth of quantitative information about these costs.

The second type of opportunity costs are more speculative. If mobility and transhumant grazing practices remain the primary strategy for managing drought risk, then communities must retain large areas of land as common properties, and make reciprocal grazing arrangements with other communities for use in drought years. This necessarily restrains the enclosure and privatization of land, which in turn can impede investment in land improvements and the development of more intensive and settled farming systems in areas where rainfall, soils, and topography make settlement a rational goal.

Without a shift to such intensification strategies, it is not clear how rural communities can or should continue to absorb increases in their populations (Boserup 1981; Pingali et al. 1987). One alternative is that common property grazing areas be managed more effectively by local communities, with collective investment in land improvements, as is the case in Turkey and parts of Jordan, Morocco, and Tunisia (Oram and de Haan 1995). But the absence of many successful examples suggests that such local management is extremely difficult to organize, manage and sustain, particularly in the context of rapid population growth, uncertain property rights, and the increasing commercialization of agriculture which make cropping increasingly attractive in the less drought-prone areas.

The lack of quantitative information about the opportunity costs of traditional risk management strategies in agro-pastoral systems is an obstacle to the design of good drought management policies, because those costs should be justified on the basis of the increases in productivity and incomes that they generate. More research is needed to determine just how elastic the productivity of pastoral systems is to changes in risk management opportunities, and whether there exist important options for increasing production that could be exploited if drought risk could be better managed. Research on these and other issues affecting mainly the low rainfall areas has unfortunately been given relatively low priority by MENA governments especially compared to crop management in higher rainfall and irrigated areas.

5. ECONOMIC ASPECTS OF PUBLIC INTERVENTIONS FOR DROUGHT MANAGEMENT

Why Intervene?

If traditional drought management practices are constraining growth, then it is relevant to ask if there are more efficient ways to manage the problem. This is equivalent to asking if there are market failures that the government can correct. How might such market failures arise? We suggest two possibilities.

First, the covariate nature of drought risk makes more efficient risk spreading difficult within pastoral societies. Everybody suffers when drought occurs, and local sources of credit dry up just at a time when they are most needed. Also, livestock prices plummet during droughts when everybody is trying to sell (destock), and then rise rapidly afterwards when everybody is trying to buy to rebuild their flocks (restock). Credit and insurance markets for diffusing this covariate risk are weak in the rural areas of the MENA region. These problems, and the poor transportation and market infrastructure for livestock products in the pastoral regions are major obstacles to implementation of more orderly destocking and restocking of rangelands, as a solution to managing drought and preventing resource degradation (Behnke and Scoones 1993). Reviewing IFAD's project experiences in pastoral systems of Africa, Sidahmed (1993) concludes that the destocking/restocking approach requires high investment (building market infrastructure, rural financial services, technical support and education), which is only possible in favorable ecological and climatic environments.

A recent evaluation of destocking issues (Heffernan and Rushton 199*8*), shows that although it can assist successful rehabilitation of destitute pastoralists, many aspects of restocking are controversial, and the benefits are not easily quantified. Thus they suggest that restocking should be run in conjunction with other humanitarian assistance — water resources, supplementary feed and credit for repurchase of stock, for example. Hence, restocking becomes a component of a comprehensive development program rather than a panacea for pastoral rehabilitation. Decision support tools are needed to assess the environmental, economic, and cultural effects of restocking.

Second, property rights problems over the ownership of crop and rangeland may prevent the spread of management practices and investments that lead to more efficient drought management strategies. Without adequate property rights, population growth can lead to excessive stocking rates, and to encroachment of cultivation into traditional rangeland areas.[5] These changes in turn can induce degradation of range vegetation and soils, and by restricting the spatial mobility of flocks, increase herders' exposure to drought risk. However, the inability to protect sown pastures, community managed grazings, private shrub plantations, and forests from wandering flocks, shows that unrestricted grazing can also be damaging.

These kinds of market failures can provide a rationale for public intervention. However, governments might also be motivated to intervene with drought management policies for other social and environmental reasons. These include:

- Government has an obligation to alleviate human misery in drought years and to help protect the stock of breeding animals for the future. Drought relief measures may be seen as cheaper than safety net programs.
- Herders and farmers may default on loans in drought years, causing difficult problems for lending institutions.

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[5] Recent experience indicates that some barley planting on rangelands is done by or with the knowledge and consent of the herders, specifically to provide feed, which could be grain, straw, and stubble in a good year, and biomass in situ for grazing in an unfavorable year.

- Overgrazing of pastures that are already drought stressed, and soil compaction in areas around water holes, may contribute to wind erosion and local climate change that have negative externality costs for a country. Falling water tables can also have far reaching effects within a country.

Principles of Intervention

While humanitarian objectives are often the initial reason for government and donor drought relief interventions, they can prove economically expensive in the long term. This is particularly true if they are not designed to overcome more fundamental problems — such as market failure — which prevent more efficient and productive use of resources in agro-pastoral systems. Moreover, simply being able to fix an underlying problem is not sufficient to ensure that it is economically worthwhile. It also needs to be shown that the problem can be fixed at a cost that is less than the benefits, and in ways that give a reasonable rate of return on public funds. Both the short- and longer-term implications of alternative approaches to drought management must be examined, since ad hoc approaches have caused awkward problems for governments.

Where drought relief is required as a result of market failures (e.g., inappropriate property rights systems, or a poorly developed financial market), it may be more cost effective to fix the underlying problem (e.g., reform property rights, strengthen rural financial markets) rather than to incur the repeated costs of drought relief. Similarly, public investment opportunities to reduce drought losses (e.g., water catchment areas and wells) may also be more cost effective over time than drought relief. Unfortunately, these kinds of opportunities are typically quite limited in many drought-prone areas, and there may be little alternative in the near-term to public drought relief programs.

The cost of public drought management interventions is relatively easy to determine, but the benefits are much harder to assess. One-time interventions can provide significant humanitarian relief. But once drought management policies become institutionalized so that farmers and herders begin to take them for granted, they can lead to important changes in farming practices which impact on productivity. Well-designed and implemented drought management policies can contribute to greater productivity, and thereby justify their costs. But poorly designed interventions may lead to small productivity gains, or may even be counterproductive.

Any good risk management aid should enable farmers and herders to take greater risks in their quest for higher average returns. If farmers are risk averse, then they trade off some level of expected income for lower risk (e.g., through diversification strategies). The amount of expected income foregone to reduce risk can be viewed as a risk premium paid, or a production cost (Sandmo 1971; Robison and Barry 1987). If this cost can be reduced by the introduction of an improved risk management aid, then the farmer may be able to change strategy (e.g., specialize more in the most profitable activities) and obtain a higher average income for the same amount of risk. This change not only improves expected farm incomes, but can also lead to spillover benefits to consumers at an aggregate level through lower prices as the supply function shifts downwards by the amount of the reduction in the risk premium per unit of output. This effect is very similar to the effect of a new cost-reducing technology, and providing the new risk management aid is not subsidized, then there is always a net gain in social welfare. But if the new risk management aid is subsidized, then the effect is similar to a subsidy on any other farm input (e.g., fertilizer or credit). The reduction in unit costs is partly paid for by the subsidy, and the dead weight loss of the subsidy is always greater than sum of the additional producer and consumer welfare that it generates (Siamwalla and Valdes 1986).

What does this mean in practice? That subsidized drought management interventions can reduce risk costs to farmers to below their true social value, leading to excessive risk taking and increased exposure to future drought losses. Not only is there a built in dependence on future drought assistance from the government, but also the net social return to that assistance can be small or even negative. The bottom line is that wherever possible, public interventions should be limited to drought management interventions that farmers pay for themselves, although it might be necessary for governments to devise arrangements which allow deferred payment in installments.

Another potential problem with poorly designed drought management policies is that they can lead to moral hazards. This is a well-known problem in the insurance literature, and refers to the incentive problems that arise when an insurer underwrites risks whose outcomes can be influenced by the insured's behavior. For example, if an insurance company contracts to compensate a farmer for yield losses against pest and disease damage, then the farmer will have reduced incentive to be diligent in protecting or treating his/her crop once he/she realizes that the insurance will compensate for losses anyway. Moral hazards lead to greater losses than necessary, it increases the risk exposure of the insurer, and it makes actuarial calculations of those risks almost impossible. Similar problems can arise if a government indiscriminately compensates for drought losses that could have been reduced or avoided by herders. Unless appropriately targeted, feed subsidy programs could, for example, lead to reduced incentive to exploit remaining grazing opportunities, particularly in more remote areas that require greater time and expense to reach. Debt forgiveness in drought years can also generate moral hazard problems. Once farmers' know that their debt will be forgiven, then they have increased incentive to borrow more than is prudent, and reduced incentive to minimize their costs during droughts. Such behavior leads to greater losses than necessary, and makes feed subsidies and credit programs more expensive than they need to be.

6. PAST EXPERIENCE WITH DROUGHT INTERVENTION POLICIES IN MENA

Governments throughout the MENA region have intervened to help manage drought losses, but usually on the basis of crisis relief once the drought has set in (e.g., distribution of subsidized feeds for livestock, well drilling, and debt forgiveness). Since the primary motive is typically humanitarian assistance, not much thought may be given to the longer-term impacts of drought interventions on farming practices and productivity.

The result is often an inappropriate set of economic signals to farmers and herders, leading to unsustainable farming practices in drought prone areas that increase both future drought losses and farmers' dependence on government assistance, and to moral hazard problems that further add to the government's cost of providing drought compensation. A good analogy is the experience with hurricane disaster assistance in the USA. By routinely stepping in to compensate homeowners for their losses after a hurricane, the government encourages home construction in vulnerable coastal areas where prudent investors would not otherwise build, and encourages fraudulent practices within the home repair and construction industry. These problems add enormously to the cost of government assistance over time. Since this paper is concerned with drought management policies as an aid to more efficient risk management in agro-pastoral systems, we will focus on their long-term impacts on resource management and productivity. We turn now to look at two of the most common drought management policies used in the MENA region.

Feed subsidies

To reduce drought losses for farmers and herders, governments throughout the region have introduced extensive drought management policies during recent decades. These interventions have focused on providing supplementary feeds to safeguard livestock, with the predominant expenditure going for subsidies towards the costs and distribution (usually by parastatals) of concentrates and other feeds, especially barley, as well as investments in water development, and animal disease prevention. Feed imports are also relaxed in drought years, while imports of livestock and livestock products are constrained to maintain domestic prices, and cross-border movements of animals and meat exports may be prohibited.

These programs have been quite successful in protecting livestock numbers and production during droughts. Although the 1995 Moroccan drought was devastating, with total cereal production falling to only 17 percent of that in 1994, the ruminant livestock sector was only slightly affected (Laamari and El Mourid 1998; Oram 1997). Boughanmi (1996) states that because of drought relief measures, sheep numbers in Tunisia rose consistently during the droughts of the early 1990s, while the World Bank estimates that in the absence of such relief measures, producer prices would have dropped by approximately 40 percent during the 1988-89 drought. According to the World Bank, potential losses to producers during 1988 and 1989 could have been 119.7 million dinars (US$ 133 million), or 11.3 percent of agricultural value added but this was prevented by a program that cost 74 million dinars ($82 million), or 6.9 percent of agricultural value added. By preventing the large-scale loss of livestock, the interventions also eliminated potential livestock production losses in subsequent years, but these are not included in the Bank's calculation. In fact the direct effects of recent droughts seem to have been more severe on crops than livestock, especially in North Africa, although this compounds the feed supply problems for livestock.

Although they have helped limit production losses caused by drought, the drought management programs have also had negative impacts. These include the following:

They have probably accelerated rangeland degradation in the long term by undermining the traditional process of adjusting flock size to inter-annual climatic variations. Herd sizes have increased sharply in recent years, and grazing practices have changed so that many of the animals no longer leave the rangeland areas during the dry season but have their feed and water trucked in. This practice leads to overgrazing during the dry season, reduces the natural seeding of annual pasture species, disturbs the soil, and contributes to wind erosion, particularly in areas near water and feed supply points. User fees have been suggested as an economic signal of the scarcity and value of the rangelands (Kassas et al. 1991); whether this approach would be a viable option in these large and often remote areas remains to be tested.

High government procurement prices for barley have encouraged the mechanized encroachment of barley cultivation on to rangeland areas where it cannot be sustained. An additional motive in some countries is that cultivation allows its perpetrators to claim user rights to the land. The Syrian government, for example, has banned barley production in zones where annual rainfall is under 250 mm (Cooper and Bailey 1990).

Feed subsidies have added to the fiscal burden on governments. During the 1994 drought, for example, some 500,000 tons of heavily subsidized concentrate were fed to livestock under the program in Tunisia. In Morocco, it is estimated that 420,000 tons of feed were distributed during the 1992 drought at a cost to the government of about US$30 million (Laamari and El

Mourid 1998) (0.8 percent of agricultural value added). The same program cost the government about $28 million during the 1995 drought.

In Jordan, cumulative feed subsidy costs between 1991-96 were 168.4 million JD (US$116 million), and $55 million of this was incurred in the 1996-97 drought alone, representing about 26% of agricultural value added. (Salem 1998). The program created numerous distortions, including poor farm efficiency, little attention to fodder crop production or to care for conservation of range resources. The latter was due partly to the increased numbers of animals made possible by the subsidized feed, partly to incentives to mechanized cultivation of rangelands and partly to ambiguous property rights. Although the subsidies contained an element of welfare, the 15 percent of the flock owners who possessed 62 percent of the national flock were the main benefactors.

Subsidies tend to become permanent and they have proved difficult to target, with the lion's share of the subsidized concentrates going to large herders and to commercial farms. Indeed, during the Moroccan drought of 1992, many farmers claimed that they received only small amounts of subsidized feed (about 1 percent of total feed needs) (Laamari and El Mourid 1998).

In spite of these problems several MENA countries have moved to permanent feed subsidy systems, expending considerable public resources on the distribution of heavily subsidized concentrates every year (Pratt et al. 1997).

However even well-planned measures can misfire with far-reaching ramifications, as was the case with the livestock development project in Syria, implemented with World Bank support in 1978, which resembles in several ways the campaigns in Jordan and North Africa. This project had several components including:

- the improvement of feed availability;
- the provision of special credits for livestock development, and for supplementary feed at subsidized prices;
- the improvement of veterinary services, and the control of major animal health problems, especially sheep pox and parasites; and,
- support to various types of cooperatives for animal breeding, fattening, and range improvement.

In the short run this project was technically very successful, with numbers of sheep increasing from 5.8 million in 1975 to 13.4 million in 1983, an average annual rate of growth of about 10 percent. Eradication of sheep pox—a major case of loss, was an outstanding achievement. However, in the long term the failure to establish the feed reserve foreseen in the plan to support the expanded national flock proved to be its Achilles heel. (Oram and de Haan 1995).

Drought struck in 1983 and 1985, with devastating effect, and although Syria had a barley surplus of 555,627 metric tons in 1982 the government was forced to import 299,314 metric tons of feed in 1984 despite a shortage of foreign exchange. This had serious repercussions on the fast-growing private sector poultry industry which received lower priority for feed than state and cooperative enterprises, driving up costs of poultry production at a time when the meat market was glutted with sheep meat as a result of drought-induced slaughtering. The national sheep flock declined by 2.5 million (almost 20 percent from 1983 to 1985). Demand for poultry meat fell below cost, and because storage was inadequate, a number of producers were driven out of production (USDA Foreign Agricultural Service 1985).

Capital accumulation by flock owners as a result of credit and cheap feed fueled the rapid and ultimately disastrous build-up of sheep numbers during this period. A contributory factor was increased grazing pressure on the rangelands whose estimated contribution to total feed supply declined from 65 percent to 33 percent, due partly to plowing of previously uncultivated land for barley production, as well as to the increasing number of animals during the course of the project. Concurrently concentrate feed rose from 6 percent to 26 percent of total feed consumption, with local cooperatives as a main instrument of government for their distribution and sale; while the contribution of crop residues to feed supply increased from 25 to 30 percent.

Experience in Syria shows that judging the success of feed subsidies and other measures to alleviate droughts in low rainfall areas requires a long time horizon. Syria has made considerable progress since the 1980's, but still faces the challenge of a new two-to-three year drought.

The high budgetary costs and negative environmental impacts of subsidies have led some countries to reconsider their drought management programs. Jordan recently abolished its feed subsidy program as part of its structural adjustment program, and this has led to a very sizeable reduction in the national flock of sheep and goats (perhaps by as much as 30 percent in two years).[6] Syria, on the other hand, maintains its feed subsidy program, but has now banned the cultivation of barley in many of the steppe areas. This is a controversial decision because it appears that much of the barley planted there was used by local herders for grazing green as well as for grain and straw. Even if grain production in drought years was negligible, stubble and straw could still have been used for grazing.

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[6] However, this has also led to livestock owners using the rangelands for longer periods, raising concerns about overgrazing. Taimeh. 2000.

Credit support and drought

Systematic rescheduling of credit for farmers during drought years has also been an important policy approach to drought management. However, while providing some short-term relief to herders and small farmers, this approach has proved of greatest benefit to larger farms, and has contributed to the chronically poor debt collection performance of the region's agricultural development banks.

In Tunisia, for example, debt was rescheduled during the 1994/95 drought at a cost to the government of 30.8 million dinars (US$30 million), 1.5 percent of agricultural value added. The loss was due primarily to lost interest payments (Zekri et al. 1997). The program benefited a mere 2850 farmers, and because of the nature of transaction costs involved in the process and the initial collateral required by the banks, the main beneficiaries were large rather than small farms. Moreover, credit rescheduling favored farmers in the higher potential zones with cattle operations rather than sheep owners who tend to have a more extensive production system primarily based in the lower rainfall zones (e.g. in the Center and southern regions of Tunisia). This support for the more intensive cattle operations is reflected by the relatively steady increase in milk production in Tunisia in the period from 1987 to 1995 despite the incidence of two drought years (Boughanmi 1996).

In Syria, Shibani (1997) reports the same type of impact from credit rescheduling in drought years. The Feed Fund provides credit for farmer associations and cooperatives at subsidized rates (5.5% for 8 months) and covers up to 80% of the total value of feed to be purchased. On average over four agricultural campaigns (1986 to 1989), 150 farmer cooperatives benefited from subsidized feed credits. The credits distributed to these associations over these four campaigns totaled 588 M SL (US$14 million). However, the program was shut down after 1990 because of a high default rate. The Ministry of Agriculture submitted the Feed Fund case to the Higher Agricultural Council. The latter has agreed to cover the continuing operation of this fund from the Agricultural Bank's budget. In Syria livestock associations have been the main beneficiaries of credit rescheduling and subsidized credit for feed purchases. As in Tunisia and Morocco, this raises equity considerations with respect to the impact of public drought relief operations on the smaller flock owners who are often not organized within an association.

7. NEW POSSIBILITIES FOR IMPROVED DROUGHT MANAGEMENT

A limitation of most drought management interventions is that they inadvertently subsidize inappropriate farming practices and encourage moral hazard problems. They also represent a recurring fiscal burden to governments, which can become institutionalized, and are hard to sustain over the years. Two newly emerging approaches can avoid these problems by providing farmers and herders with the means to better manage drought risks themselves with a minimum of government intervention.

Rainfall Insurance

Agricultural insurance has often appealed to policy makers as an instrument of choice for helping farmers and agricultural banks manage climate risks like drought, and indeed many billions of dollars of public money are spent each year on agricultural insurance around the world. But the experience has generally not been favorable (Hazell et al. 1986). Publicly provided crop insurance has without exception depended on massive subsidies from government, and even then its performance has been plagued by the moral hazard problems associated with many sources of yield loss, by high administration costs, by political interference (especially of compensation payments in election years!), and by the difficulties of maintaining the managerial and financial integrity of the insurer when government underwrites all losses (Hazell 1992).

Livestock insurance that compensates for loss of animals or reduced productivity because of drought has rarely been offered, and seemingly not at all for herders in traditional pastoral systems. There are good reasons for this: the incidence of drought losses is usually too high to make the insurance affordable, opportunities for fraud and moral hazard are too great, and there is little opportunity for on-farm inspection of management practices or loss assessments, particularly when the animals are on the move.

But given the frequent occurrence of drought and the widespread damage that it causes, there clearly is a need for some form of insurance against drought losses. Indeed, if such insurance could be successfully designed, it might well displace the need for public drought management policies.

What is needed is a form of insurance that is affordable; accessible to all kinds of people; compensates for total income losses; is practical to implement given the limited kinds of data available; and can be provided by the private sector without the need for government subsidies.

Area-based rainfall insurance offers a promising new alternative that in principle can meet all the requirements listed above (Skees et al. 1999). In this approach, rainfall insurance contracts are written against specific rainfall outcomes (e.g. drought or flood) at a local weather station. The rainfall events should be defined at catastrophic levels, and they should be highly correlated with the value of regional agricultural production or income. For example, an insured event might be that rainfall during the most critical month of the growing season falls 70 percent below normal. In years when the insured event occurs, all the people who purchased the insurance would receive the same payment per unit of insurance. In all other years, no payments would be made.

Insurance is sold in standard units (e.g. $10 or $100), with a standard contract for each unit purchased called a Standard Unit Contract (SUC). Purchasers decide how many SUCs to buy. The insurance is sold on a full-cost basis, and the price of the SUC is the premium. The insurance must be sold before season-specific information about the insured risk becomes available. This requires a purchasing deadline (such as a month before the normal arrival of the rainy season), after which new SUCs are not sold.

Area-based rainfall insurance has a number of attractive features:

- It avoids the moral hazard and adverse selection problems that plague crop insurance programs;
- it could be very inexpensive to administer;
- it uses only rainfall data, which is now available in most countries for long periods of time;
- the insurance can be sold to anyone, including agricultural traders and processors, farm input suppliers, banks, shopkeepers, and agricultural workers. There is no need to be a farmer, or to keep livestock;
- it would be easy for the private sector to run;
- as long as the insurance is voluntary and unsubsidized, it will only be purchased when it is a less expensive or more effective alternative to existing risk management strategies.
- a secondary market for insurance certificates could emerge which would enable people to cash in the tradable value of a SUC at any time.

In designing an area-based rainfall insurance scheme, a number of difficulties need to be overcome, including:

- The insurer faces high risk because of the covariate nature of the insured risk. When a payment is due, then all those who have purchased insurance against the same weather station must be paid at the same time. Moreover, if the insured risks at different rainfall stations are highly correlated, then the insurer faces the possibility of having to make huge payments in the same year. To hedge against this risk, the insurer can either diversify regionally by selecting weather stations and risks that are not highly (positively) correlated, or seek reinsurance in the international financial markets.
- Rainfall stations must be protected to prevent possible tampering of rainfall measurements. Possible approaches include a) more secure, tamper proof stations and instruments, b) triangulation of readings from neighboring weather stations, and c) verification of low soil moisture by remote satellite sensing.
- The actuarial soundness of the insurance could be undermined by El Nino weather cycles that change the probability of the insured events. It may be necessary to adjust the cost of the insurance whenever an El Nino event is confirmed.
- The volume of insurance sold could be too small to be profitable. The insurance will only appeal to people whose economic losses are highly correlated with the insured rainfall event. If the basis risk (the uninsured part of a person's risk) is high, then the insurance will not sell. Also, if the probability of the insured risk is high, then the cost of the insurance could be prohibitive. To overcome these problems, the insurance should be limited to truly catastrophic droughts that significantly affect agricultural production in a region.

The private sector might be expected to take the initiative in developing rainfall insurance, but several setup problems might require government intervention to jump start activity in developing countries. These include paying the research costs of identifying key catastrophic rainfall events that correlate strongly with agricultural production and income; educating rural people about the value of rainfall insurance; ensuring secure rainfall stations; establishing an appropriate legal and regulatory framework for rainfall insurance; and underwriting the insurance in some way (perhaps through contingent loans) until a sufficient volume of business has been established that international reinsurers or banks are willing to come in and assume the underwriting role. These roles need not be costly, but could prove crucial in launching rainfall insurance. But it is also important not to launch the insurance on a subsidized basis, so as not to distort incentives for private insurers or farmers and herders. Drought insurance of the kind proposed here is being seriously considered in Morocco and Tunisia, with the active interest of private international insurers.

Early Warning Drought Forecasts

In principle, the ability to provide early warning drought forecasts could be a powerful tool for avoiding many of the economic costs associated with the misallocation of resources that arise because farmers, herders and other decision makers have to commit resources each year before key rainfall outcomes are known. For example, decisions about planting crops (date of planting, seeding rate, initial fertilizer treatment, etc) often have to be made at the beginning of the wet season before knowledge about rainfall outcomes is available. The economic value of season specific forecasts really depends on the degree to which farmers can adjust their plans as the season's rainfall unfolds. Of course, the reliability of the forecasts and the ability of the farmers to adjust their initial decisions in response to this information is also critical. If decisions about planting and cultivation practices, and the feeding, culling and seasonal movement of livestock can be sequenced, with key decisions being postponed until essential rainfall data are available, then forecast information will be less valuable. But if most decisions have to be made up front each season, then the scope for mistakes will be much larger and the potential economic gains from reliable forecast information will be greater. Stewart (1991) examines how the date of onset of the rainy season can provide a pretty reliable forecast of the ensuing seasonal rainfall pattern for Niamey, Niger, and shows how this information could be used to more optimally adjust planting and input decisions for the season (his “response” farming approach). Barbier and Hazell (1998) use a stochastic programming model to show how many of the decisions in a typical agro-pastoral community in Niger can be optimally adjusted to rainfall outcomes.

Reliable drought forecasts could also enable governments and relief agencies to position themselves each year for more effective and cost efficient drought interventions. This possibility has already been realized, and there are now several early warning drought systems already in place in Africa, which have proved successful in giving advance notice of emerging drought situations. But these programs are really monitoring systems that track emerging rainfall patterns within a season rather than true weather forecasting systems that predict rainfall outcomes before they even begin.

Reliable multi-year rainfall forecasts are not yet possible, but seasonal (from 3 to 6 months out) forecasts have become more reliable, particularly where an important part of the year to year variation in seasonal rainfall can be attributed to the Pacific El Nino Southern Oscillation (ENSO) weather patterns. As the ability to model these phenomena at the global and regional levels improves, it seems plausible to expect that more reliable seasonal forecasts will be available at local levels (Gibberd et al. 1995). This may prove to be one of the most exciting developments for drought management in the next few years. It seems likely that private weather forecasting services will expand and become more available to developing countries. But this is also an area where government could play a catalytic role, and even subsidize many of the development costs without having to worry that this would distort resource management incentives at the farm level.

8. CONCLUSIONS

The need to improve methods for managing drought risks in the low-rainfall areas of MENA has increased in recent decades as population growth and climate change have contributed to greater demands on the resource base and accentuated both the incidence and severity of drought losses. Government interventions have typically been initiated on an ad hoc basis in response to crisis situations, and little thought is usually given to their long term impacts on the way farmers and herders manage resources and the productivity of agro-pastoral systems. There is now accumulating evidence to show that once drought management interventions are institutionalized, they lead to changes in the way resources are managed, including the increased cropping and privatization of rangeland resources, and to more settled patterns of livestock production. These changes can contribute to greater productivity and improved livelihoods. However, if drought management interventions are subsidized, they can also lead to the adoption of excessively risky farm management practices, with increased losses in drought years and a growing dependence on government assistance. Many drought management programs also contribute to moral hazard problems because they reduce incentives for prudent management by farmers and herders. Drought management interventions need to be designed so that they assist farmers and herders to better manage risk and to improve their productivity and incomes, but without distorting incentives in inappropriate ways. The experience with feed subsidy and credit programs in the MENA region has had mixed results, and while they have helped protect incomes and food security in drought years, they have had negative impacts on the way resources are managed. Better alternatives could be area-based rainfall insurance, particularly if offered by the private sector, and the development of more accurate and accessible drought forecasting information.

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