

RAINFED FARMING SYSTEMS OF THE NEAR EAST REGION

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### Abstract

Rainfed farming systems of the Mediterranean Basin share many features, and also resemble those of the Arabian Peninsula in some respects. In the region, agriculture plays an important role in employing and feeding much of the population. In general there is a duality in the distribution of farm lands; the majority of farms are small but large farms occupy much of the land. The latter are frequently under state control and may have different resources and priorities than the small farms. Subsistence production is relatively important on small farms, as is diversification among crop production, livestock and off-farm work; large farms are more specialized in crop production for sale. Thus different technologies and policies may be required to reach large and small farms.

Cereals are the main rainfed crops, followed by pulses and summer crops. Winter cereals are most commonly grown in rotation with a winter fallow; this may be left weedy to feed livestock, or cultivated to conserve moisture and nutrients while controlling weeds. Crop production is extensively mechanized but implements and practices vary considerably throughout the region. Small farms make use of mechanical techniques through custom services.

Livestock play an important role in the system, especially for small farms. They provide dairy products and meat both for consumption and for sale. They contribute a large proportion of farm income, and act as a buffer in years of low crop production. In large part they are fed by-products of food crop production, although in winter they must often be fed barley grain.

In large part the health of the agricultural sector depends on government policy. Recent years have seen an increase in support for agriculture, including the rainfed areas.

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## RAINFED FARMING SYSTEMS OF THE NEAR EAST REGION

The Near East is one of the original agricultural regions of the world, and the site of domestications of many major food crop and animal species. The western stereotype may be one of deserts and camels (and more recently oil wells), but these notions ignore the fact that sedentary agriculture has until recently been the mainstay of life for the vast majority of the people of the region. This paper attempts to draw out some of the features that are most common in the rainfed farming systems of the Near East region, and of greatest importance. The focus will be on field crops and livestock rather than tree crops, which have special characteristics not discussed here.

In looking across the region, the greatest similarity in rainfed farming systems is found among the countries of the Arab Mediterranean and Iraq. In these countries a common pattern of rainfall, both in time and space, combines with many shared aspects of history and policy. To a large extent, the climate and farming systems are similar to those found in Cyprus and Turkey, although there are differences. The farming systems of the Arabian peninsula are rather more distinct, being based on spring and summer rainfall and, to a large extent, different crops than the Mediterranean; therefore, the Yemens and Saudi Arabia are given less attention in this paper. Countries with extremely small rainfed areas, such as Egypt, Oman and Bahrain, are omitted.

Agriculture is an economically important, but secondary, sector in most countries of the Near East Region. Statistics are incomplete, but in most countries with substantial land resources, agriculture represents approximately 15-20% of GDP (Table 1). At 6%, Algeria is particularly low for a country with over 7 million hectares of arable land; this would seem to be a result of its heavy emphasis on industrialization and development of oil resources in recent decades. In general GDP figures underestimate the importance of agriculture, because they do not adequately value subsistence production or household labor. Approximately half of the population lives in rural areas, and

Table 1: Agriculture in the national economies

	<u>AGRICULTURAL</u>		<u>AGRICULTURAL %</u>		<u>URBAN POPULATION</u>		<u>FOOD PRODUCTION</u>	
	<u>% OF GDP</u>		<u>OF LABOR FORCE</u>		<u>AS % OF TOTAL</u>		<u>PER CAPITA</u>	
	1960	1981	1960	1980	1960	1982	80/82 AS % OF 69/71	
ALGERIA	16	6	67	25	30	45	75	
LIBYA		2	53	19	23	58	127	
MOROCCO	23	18	62	52	29	42	84	
TUNISIA	24	15	56	35	36	54	128	
IRAQ	17		53	42	43	70	87	
JORDAN		7	44	20	43	60	70	
LEBANON	11		38	11	40	77	134	
SYRIA		19	54	33	37	49	168	
TURKEY	41	21	79	54	30	44	115	
SAUDIA		1	71	61	30	69	9	
Y.A.R		26	83	75	3	14	93	
P.D.R.Y		12	70	45	28	38	92	

Source: World Bank 1984.

in most countries one-third to one-half of the work force is primarily engaged in agriculture. That agriculture provides employment and most of the food requirements for half of the population is obviously an important, if undercounted, contribution to the economy of the region.

In addition, it should be noted that a substantial proportion of the industrial sector is related to agriculture, either in the manufacture of inputs or the processing of outputs. Fertilizer plants, tractor factories, textile mills, and food processors all revolve around crop and livestock production. Similarly, a large part of the service sector is involved in the bulking, breaking and transporting of agricultural inputs and outputs. Therefore, the vitality of industrial and service sectors may depend in large part on agriculture.

The importance of agriculture has been recognized by many countries in the Middle East in recent decades, stimulated by sharp declines in their ability to feed their populations from their own resources. Turkey was the first country of the region to focus on this issue, and has now reached self-sufficiency in food (Hanson et al 1982). Over the last 15 years, self-sufficiency of the Arab countries, individually and as a group, has declined for a broad range of commodities, particularly cereals (AOAD 1983). In response, recent development plans from Algeria, Jordan, Libya, Morocco, Syria, Tunisia, and other countries show an increased emphasis on agriculture, and many countries have maintained or adopted policies which stimulate part or all of the agricultural sector. The potentials of rainfed areas as well as rangelands and irrigated areas are being considered with new appreciation. (Butter 1985; Europa Publications 1984:539,692; USDA 1985:13,26,32).

#### The location of rainfed farming areas

The Mediterranean climate has several well known characteristics. Rainfall comes in winter and early spring, and falls in greatest quantity near the sea. Rainfall decreases as one goes inland, and in all countries but Turkey and Cyprus the farmlands give way to large expanses of arid grazing lands or desert. In the Arabian peninsula,

most rainfed areas are in the southwestern highlands, and have spring and summer rainfall. Rainfed farming systems generally occur in areas with 200-600 mm mean annual rainfall. In the small areas with more than 600 mm, irrigated crops or tree crops usually predominate; on the other hand, with less than 200 mm crop production is rarely economically feasible. With the notable exception of Iraq, countries with sizable rainfed areas have irrigation on only 2 to 10 percent of their crop areas.

#### The social context of farming: holding size

Before discussing more technical aspects of the farming systems, it is useful to ask who the farmers are and to consider their circumstances. One of the most important factors in understanding farmer practices is the farm size. Holding size distributions are given in Table 2. The data do not distinguish land by productivity, rainfall group or irrigation, but they give a general idea of the patterns of land ownership.

In all countries of the region, the vast majority of farmers are cultivating areas of 10 hectares or less, often as little as one or two hectares. However, such farms frequently make up less than 25% of the arable land. At the other extreme, farms of 50 ha and over are a small percentage of the total number of farms, but occupy from 14 to 45% of the land in all but one of the countries in Table 2. Since most of these countries have carried out land reforms involving expropriation of large farms, these large holdings are usually found on land expropriated from urban landlords or foreign settlers. They are frequently under direct or indirect government administration, as collectives, cooperatives, or state farms, and occasionally as government land leased to commercial farmers. The land on the large farms is generally of higher quality and in the most favored areas. In some cases, such land is scheduled for eventual redistribution in small plots, but governments are often reluctant to release control of these resources.



Table 2: Distribution of land holdings

COUNTRY	YEAR	PERCENTAGE OF FARMS					PERCENTAGE OF LAND				
		(HECTARES)					(HECTARES)				
		0-5	5-10	10-50	50-100	>100	0-5	5-10	10-50	50-100	>100
ALGERIA	1973	61.6	17.6	18.9	1.4	0.5	14.2	15.7	47.0	11.8	11.4
LIBYA	1974	46.8	20.6	29.4	2.4	0.8	6.5	9.8	40.8	10.8	32.1
MOROCCO	1973	73.7	14.9	10.7	0.5	0.2	24.5	20.7	37.7	7.2	10.0
TUNISIA	1980	42.1	21.3	32.3	3.0	1.2	6.6	10.5	43.9	13.3	25.7
IRAQ*	1979	39.7	25.4	32.6	1.2	1.2	6.9	12.4	39.7	6.3	34.8
JORDAN	1975	63.5	17.0	17.4	1.4	0.7	13.6	14.6	41.9	11.6	18.3
LEBANON	1961	92	6	3	<.5	**	44	16	25	15	**
SYRIA*	1970	56.4	17.4	23.5	1.8	0.9	10.7	11.3	45.7	11.1	21.1
CYPRUS*	1980	89.8	7.8	2.2	0.3	**	37.0	20.0	18.0	24.9	**
TURKEY	1973	72.9	19.2	7.0	0.6	0.2	26.6	39.5	19.8	8.8	5.3
SAUDIA*	1979	75.4	11.1	12.1	1.0	0.8	14.3	10.4	31.5	8.7	35.0
Y.A.R	1982	88.5	7.4	4.0	0	0.1	43.5	22.5	29.4	1.2	3.3

\* Some figures estimated by interpolation from other groupings.

\*\* All holdings over 50 ha are reported together.

Source: AOAD 1984, except: Cyprus, Karouzis 1980 (sample survey of five regions); Lebanon, Saab 1973; Turkey, official statistics cited in Ulsan 1980:140.

In between these two extremes lie middle-sized farms of 10-50 ha; they form a substantial minority of farms and land area in all countries. Farmers in this category may have a similar orientation and background to those with small farms, but they get a greater share of their income from crop production, and may have more resources to call upon. For example, such farmers more often own tractors in Turkey (Arıcanlı and Somel 1979) and they have better access to credit and extension services in most countries.

Thus, there is a duality in the agricultural sector of most countries, between small (and very small) farms accounting for much of the rural population but little of the land, and big farms with few farmers. This point is essential to an understanding of the diverse farming practices which are discussed below. This duality often presents a difficult policy choice for governments and donors; whether to invest in greater crop production on the large, easily reached farms, or to focus on improving rural incomes for the largest number of people. Earlier projects, such as the Increase in Cereals Production Project in Morocco initiated in 1968, often chose to ignore the small farms in the belief that the economic returns of working with them were not worth the cost (Hogan et al 1984). Currently there is a greater appreciation of equity issues and the importance of increasing the security of rural life, and small farms are more often included in development programs.

Holding size is a simple measure that obscures other factors. Patterns of joint ownership, leasing, tenancy and sharecropping also affect the nature of land holdings. Large farms may be sharecropped by small farms, but small farms may also be leased on a cash or sharecropping basis to large operators. Those with small holdings may lease land from other small farms to bring the holding size to an acceptable level (Hogan and Hansen 1983; Hogan et al 1984; Johnson et al 1983:B11). Contract services may also be provided on a share basis. More research is needed on the effect of these structures on farm decisions, particularly decisions to adopt new technology. It is clear, however, that they may involve several parties with differing goals in the decision process, and may divide limited farm income into very small

amounts per party. Extension efforts need to be aware of local patterns of land access and design incentives accordingly.

Farmers with small holdings are sometimes considered an obstacle to change. However, they have shown themselves to be ready to adopt new practices when suitable technologies have been developed, and when both information and financing have been made available. Turkey's farmers, 73% of whom cultivate five hectares or less, are among the highest input users of the region; Syria's small-scale wheat farmers also show high rates of use of fertilizers, herbicides and improved seed; and other examples could be cited (Aricanli and Somel 1979; Rassam and Tully 1986a). The key requirements are to develop a technology which meets farmers' needs, and to make that technology available. There is no reason that improved seed, fertilizers, herbicides, and tillage practices cannot improve yields on small farms as well as large, if they are made available in a reasonable form.

#### The social context of farming: household strategies

Farm households are large, due both to large family sizes and the common occurrence of extended families, usually composed of married children and their parents. Mean household sizes of 10 or more are commonly reported. However, some observers have noted a growing number of nuclear family households, which may be related to increasing wage employment (Bates and Rassam 1983:147). In some countries, the young are emigrating from rural areas, leaving farming in the hands of the older generation (Papachristodoulou 1979; Snobar and Arabiat 1984; USDA 1985:27)

With large families on small farm areas, it is inevitable that subsistence production accounts for a considerable amount of farm output, and therefore has an important effect on the nutritional status of a large part of the population. Surveys have shown substantial on-farm consumption of farm produce (Arabiat et al 1983; D. Nygaard, unpublished data from Tunisia). The FAO food balance figures give an indication of food consumption patterns on a national basis (Table 3). Cereal consumption in this region is approximately 200 kg/year/person,

Table 3: Sources of nutrition										
	PERCENTAGE OF CALORIES					PERCENTAGE OF PROTEIN				
	CEREAL	PULSES	MEAT	MILK ETC		FAT & GHEE	CEREAL	PULSES	MEAT	MILK ETC
ALGERIA	56.8	2.0	2.0	6.0	2.0		66.5	5.3	6.3	12.5
LIBYA	40.3	1.5	6.0	6.2	2.2		45.4	4.1	21.1	12.9
MOROCCO	63.0	1.8	2.6	1.7	1.8		71.6	4.6	8.4	4.4
TUNISIA	55.8	2.6	2.7	3.7	1.3		60.8	6.0	8.4	8.5
SYRIA	50.4	3.3	4.0	4.6	3.9		51.0	6.9	9.6	12.8
TURKEY	53.7	2.3	3.5	3.8	2.3		55.9	5.1	10.3	10.4
SAUDIA	44.7	1.0	7.7	7.2	8.6		41.0	2.5	21.1	17.1
Y.A.R	67.3	4.7	4.3	4.0	1.4		62.6	9.8	10.4	8.3
P.D.R.Y.	60.3	0.3	2.9	4.5	5.6		60.5	0.7	7.5	13.1

Source: FAO 1984.

providing over half of both calories and protein in most cases. This is primarily made up of wheat, although considerable barley is consumed in Morocco and Algeria, imported rice in Saudi Arabia, and millet and sorghum in Yemen. Milk products, mostly produced on-farm, are the main source of high-quality protein; meat consumption is limited to 15-20 kg/person/year, except in the oil-rich countries. Rural people often consume less than these figures indicate, and it appears that deficiencies in nutritional levels and caloric intake are endemic in many rural areas (El Sherbini 1977; Fikry 1982; Miladi 1983; Mokbel 1985).

Large farms are usually focused on crop production, but small farms typically try to manage risk and increase income by diversifying out of crop production into livestock and off-farm employment (Hogan et al 1984). In addition to their valuable dietary contribution, livestock provide an income through the sale of lambs and dairy products, and they provide a hedge against bad crop years and poor prices. The role of livestock will be discussed in more detail below.

Off-farm employment has become increasingly available in the region, as a result of rapid development of industrial and service sectors in urban areas, as well as increased opportunities for international migration. Off-farm income has been estimated at 24-37% of household income in several studies in Syria (Rassam 1984; Rassam and Tully 1986; Somel et al 1984). In Cyprus the majority of farmers consider agriculture a secondary occupation (Papachristodoulou 1979), while in a Tunisian survey 67% of households with less than 10 ha had off-farm income (ICARDA 1985:58).

Off-farm employment adds stability to rural incomes, but it also has an effect on the availability of labor (Hogan and Hansen 1983). This has partly been offset by mechanization of the major agricultural tasks, as will be described below. The remaining non-mechanized tasks, such as weeding, animal care, and dairy activities, are carried out to a large extent by household labor on small farms. Women, who work off-farm much less frequently than men, represent an increasing proportion

of available household labor. Women have always worked in agriculture in the Near East, and their work load appears to be increasing in many areas (Hammam 1981; Youseff et al 1979).

When hired labor is needed for seasonal non-mechanized tasks, such as harvesting legumes or tree crops, there may be scarcity or high cost due to competition with urban employment. In Syria the proportion of males in the unskilled rural labor force is low due to competition with urban jobs (Rassam and Tully 1986b). As mechanization has increased the seasonal character of labor demand, rural workers have been unable to sustain themselves and have moved to cities (Bates and Rassam 1983:150, citing unpublished material from N. Hopkins). Thus the impetus to continue mechanization of agriculture is high.

### Crop production

The prevailing crops in areas of winter rainfall are cereals, primarily wheat and barley, with small areas of rye or oats in some countries. On the other hand, millet and sorghum are the dominant cereals of the Arabian peninsula. In Turkey, bread wheat predominates, but in the Arab countries most of the wheat is durum, which is the basis of the flat breads, bulgur and couscous that form the core of diets. Both durum and soft wheat are grown in wet areas as well as dry, with the wet areas more often using high yielding varieties (MAAR 1979). Durum is grown in large part for consumption by the farm household, but may be replaced by soft wheat on larger, surplus-oriented farms. In Algeria, for example, only 12% of private sector cereal area is soft wheat, compared to 43% in the socialist (government controlled) sector (Benzaghoul 1979; cf. ICARDA 1985:57 for Tunisia). Soft wheat is more often consumed in cities, often as a component of subsidized bread made with imported wheat.

Barley is grown primarily for livestock feed, but it is also a significant food crop in Morocco and Algeria. Grazing resources have been decreasing while demand from the urban population for animal products has grown; thus demand for barley to feed animals has been strong. In many countries barley area increased in the 1974-83 period

while wheat area decreased or remained stable (Table 4). Barley is often considered a crop for dry or infertile conditions. However, international statistics show that barley is not restricted to dry areas (MAAR 1979). Indeed, in Iraq 53% of the barley area is irrigated (Hermis and Hussain 1979), and in Turkey 41% (MAAR 1979). A survey in northwestern Syria showed no significant relationship between cereal choice and rainfall or soil type (author's unpublished data). Many other factors can affect farmers' decisions.

The next most important category after cereals is pulses. Although they only occupy 5 to 10% of the area planted to cereals, they largely meet local demand and are exported from Turkey, Syria, Tunisia and Morocco. The most important pulses are broad bean, chickpea and lentil in winter rainfall areas, and cowpea under summer rainfall. Broad bean is commonly irrigated or limited to the higher rainfall zones; chickpea and lentil may benefit from irrigation but can tolerate somewhat lower rainfall. These legumes are most commonly grown in rotation with cereals. They are usually not grown in areas of low rainfall or on poor soils, because yields are low and risky while costs remain high (Tully 1984). Local economic conditions would appear to determine how good yields have to be to make legume cultivation worthwhile. The current limit of legume cultivation in Syria is at approximately 300-350 mm mean annual rainfall. In Morocco 70% of legume area is found in areas with at least 400 mm of rainfall (Newburg et al 1982) and in Tunisia legumes are also limited to the wetter areas (Ketata et al 1979).

Expansion of legume area as a replacement for fallow is often put forward as a way to increase output. However most fallow is in the drier zones and includes large areas of shallow and stony soils with low moisture storing capacity. It must be kept in mind that legumes are generally sensitive to moisture stress at flowering. Increases in legume area will depend upon the development of techniques which increase the value of legume crops to acceptable levels under relatively poor conditions (Tully 1984).

Table 4: Use of land. (thousand hectares)

	ARABLE CROPS	PERMANENT CROPS	TOTAL CROPS	IRRIGATED AREA	RAINFED AREA	WHEAT AREA		BARLEY AREA		PULSES	
						1974-76	1981-83	1974-76	1981-83	1981-83	AREA 81-83
ALGERIA	6827	642	7469	310	7159	2240	1741	826	880	122	
LIBYA	1738	315	2053	200	1853	210	266	374	264	9	
MOROCCO	7269	430	7699	426	7273	1843	1770	2026	2142	347	
TUNISIA	3440	1420	4860	123	4737	967	809	367	490	144	
IRAQ	5100	187	5287	1572	3715	1513	1187	554	958	46	
JORDAN	357	34	391	36	355	158	104	57	52	16	
LEBANON	240	108	348	85	263	47	18	13	5	10	
SYRIA	5356	369	5725	547	5178	1607	1256	960	1485	201	
CYPRUS	365	67	432	94	338	64	14	56	50	6	
TURKEY	24977	2787	27764	1983	25781	9142	9040	2599	2951	909	
SAUDIA	1108	71	1179	382	797	73	173	9	7	4	
Y.A.R	2737	450	3187	230	2957	68	66	57	52	70	
P.D.R.Y	175	20	195	53	142	11	15	1	2		

Source: FAO 1984a.



Other crops are very diverse, and mostly fall in the category of summer crops suitable for rotation with winter cereals. These will usually be planted in spring after a winter fallow, and grow through summer on stored moisture. Such crops include watermelon, cantaloupe, maize, sesame, and sunflower. Irrigated crops may also be grown in rotation with rainfed wheat, possibly in a double-crop system. Rainfed potatoes and other vegetables are sometimes found in wetter areas. As shown in Table 5, tree crops are also a regular component of agriculture in this region, and include citrus and other fruits, olives, and nuts. Tree crops are important exports in several countries.

The most common crop rotation in the region is a two year sequence of cereal-fallow. However, the management of the fallow varies considerably throughout the region. In the central plateau of Turkey, wheat researchers in the 1960s and 70s developed a technique of shallow cultivations in the fallow year to reduce weeds and maximize moisture storage. This has allowed the high-yielding varieties to perform well, increasing output considerably (Guler et al 1979; Hanson et al 1982). A similar practice is used in the socialist sector of Algeria, although in this case moisture storage appears to be of minor importance compared to weed control (Benzaghou 1979). Presumably this is because higher temperatures encourage weed populations while making moisture storage more difficult. Cultivated fallows are also practiced in some areas of Tunisia, Syria, and other countries.

However, the more common practice, especially for small farms, is an uncultivated fallow. Particularly in North Africa, the weeds and volunteer crops on the fallow land are considered a valuable livestock feed in spring. This is the time when lambs are weaned, and also the time of greatest milk production by the ewes; thus a green fodder has a high value at this time. Farmers' adherence to the uncultivated fallow regime indicates a preference to maintain this livestock feed even at the cost of reduced cereal yields.

Table 5: Machinery and fertilizer use.

	<u>TRACTORS</u>		<u>COMBINES</u>		<u>FERTILIZER</u> <u>100G/HA</u>		<u>TONS N</u>	<u>TONS</u> <u>P2O5</u>
	1974/76	1982	1974/76	1982	1970	1981	80-83	80-83
ALGERIA	41533	45000	3850	4200	174	262	65985	90964
LIBYA	6767	16000			64	375	29435	42170
MOROCCO	19992	25100	2708	3400	130	239	99225	83250
TUNISIA	29000	36200	3267	3650	82	180	30300	38020
IRAQ	19741	29956	5028	5490	35	141	66109	18584
JORDAN	3736	4600	190	280	20	53	5549	5712
LEBANON	3000	3000	90	90	1279	1006	16050	12600
SYRIA	15548	35533	1901	2958	67	232	84435	47201
CYPRUS	9767	11000	300	420			9502	6045
TURKEY	241339	489813	11542	13477	166	454	788820	565711
SAUDIA	800	1400	277	480	44	602	35425	19159
Y.A.R	1010	2100			1	43	10530	763
P.D.R.Y	1190	1270	12	15		88	1622	176

Source: Tractors, combines:FAO 1984a; fertilizer per ha: World Bank 1984; tons fertilizer: FAO 1984b.

Finally, in some regions management of the fallow has little effect on weeds or moisture storage. In areas of Syria with less than 300 mm mean annual rainfall, for example, weed levels are low, and moisture storage under fallow is minimal (ICARDA 1983:41). Some farmers cultivate to prepare the seed bed in spring, some in autumn, while others merely sow on uncultivated land. (Some1 et al 1984). The latter is especially true on shallow and stony soils. In such cases, fallow cultivation is primarily determined by equipment cost and availability.

As mentioned earlier, rotations of legumes and other crops with cereals are less common than cereal/fallow systems. In part this reflects the value of a weedy fallow, but also the higher costs associated with non-cereal crops. ICARDA is working to develop erect,

non-shattering legume cultivars and appropriate mechanical harvesters for this region; if successful, the area sown to legumes can be expected to increase. Work is also under way at ICARDA to test the feasibility of self-regenerating and annually sown legumes as grazing crops in rotation with cereals (ICARDA 1985; cf. Haddad et al 1984 for a report of efforts at the University of Jordan.). Cyprus has had some success in encouraging rotations with forage legumes (Photiades 1979), and this strategy continues to attract interest throughout the region.

Three course rotations are less common. They may include one or two years of cereal, in rotation with fallow, legumes and/or summer crops. Continuous cereal cultivation is also found, and fertilizers may allow yields to be sustained for several years in this regime; however, productivity eventually declines (Cooper 1986).

Crop production is extensively mechanized in the Near East compared to many regions of the world. Tractors and other machinery were introduced by settlers, colonial agencies during the Second World War, and the Marshall Plan in Turkey. Agricultural machinery led to an expansion of crop areas in virtually the entire region, and fueled the movement of rural populations to cities and other countries. The pace of mechanization has varied from country to country, but at this stage it is possible to say that mechanized tillage is the norm in the region, with mechanization of other operations proceeding briskly. Animal tillage continues in some areas, most often in drier or mountainous regions and on small farms (Aricanli and Somel 1979; Campbell et al 1977; Parvin and Hic 1984; Snobar and Arabiat 1984).

Tillage practices are extremely diverse. As indicated, fallows may be cultivated or not, and seed beds may be prepared in autumn, in spring or not at all. A wide variety of implements is employed in tillage, including discs, mouldboard plows, chisel plows, and sweeps. Aside from the Turkish wheat project which focused on tillage, one finds little reported research on the relative merits of various cultivation regimes in the region. However, a constant theme in the expatriate development literature is the inappropriateness of deep cultivations in

these low rainfall areas (e.g. Carter 1975; Hogan et al 1984; Newburg et al 1982). Deep tillage is said to reduce moisture storage, encourage weeds, bury desirable pasture species, and increase erosion. It has been suggested that plows developed for high rainfall European conditions were introduced along with tractors, without proper consideration of the needs of the area. Nevertheless, deep tillage appears to be general in North Africa, Jordan and Iraq and is carried out on the majority of wheat fields in wetter areas of Syria.

Sowing is also highly variable. Where animal traction is used, seed may be covered with a shallow plow or a spike-tooth harrow (Campbell et al 1977). In North Africa and Jordan, the most common practice appears to be hand broadcasting followed by a disc harrow, which leads to a fairly erratic crop geometry and poor fertilizer placement (Arabiat et al 1983; Campbell et al 1977). Drilling is common in Iraq and Turkey, while in Syria a common practice is to broadcast over shallow ridges and cover the seed by splitting or flattening the ridges with a cultivator or bar. Again, it seems highly likely that practices are being determined by equipment availability rather than yield maximization (Hogan and Hansen 1983).

Thus, tillage and planting techniques are extremely varied, and there appears to be no good evidence that current techniques are the most advantageous in terms of yields or any other factors. This would appear to be a fertile field for research to devise better systems, and for policies to bring these systems to the farmers. The issue of equipment availability is vital; for example, shallow tillage practices recommended by the Jordan Wheat Research and Development Project (1967-75) could not be adopted by farmers because they could not get the necessary implements (Hogan and Furtick 1983).

Mechanical harvesting is a bit less general than mechanical tillage. Harvesting cereals by combine is fairly common in most countries but is limited by the lack of suitable machinery for stony or sloping fields, and by many farmers' desire to collect the maximum straw yield to provide winter feed by hand pulling or cutting. In Iraq 20% of

cereal is hand harvested (Hermis and Hussain 1979), while in the barley fields of northern Syria the figure is 31% (Somel et al 1984). In most cases where cereals are hand harvested, however, mechanical threshing is common. Legume harvesting is mechanized to some degree in Turkey, but because of inappropriate equipment it is largely a manual operation in the region; similarly, legume threshing is rarely done by machine. Summer crops and tree crops are generally harvested manually.

It is often assumed that mechanical operations are not feasible if farm sizes are small. However, the Near East has seen widespread adoption of custom services, in which farmers hire equipment operators as needed (Arabiat et al 1983; ICARDA 1985:59; Johnson et al 1983:B13-15). Rented and owned tractors were found to operate with equal technical and economic efficiency in Turkey (Somel 1979). The availability of custom tillage has led to a rapid spread of mechanization to poorer farms in Morocco, Tunisia, Turkey, Syria, and elsewhere.

In terms of other agricultural inputs, practices are also diverse. Fertilizer use is low to moderate by world standards, but clearly has been increasing in all countries (Table 5). Many of the countries have phosphate or oil resources which are utilized in fertilizer plants. Herbicide use on cereals is quite popular on small farms in Turkey and Syria, and on large farms everywhere, but it is not as common as fertilizer use on small farms in North Africa (ICARDA 1985:57). This may be related to the economic value of weeds as livestock feed. The use of high yielding varieties is also variable. Their use depends very much on access to the seed, which is often limited for small farms (Newburg et al 1982).

### Livestock

The importance of livestock has been indicated with respect to three central issues - nutrition, income, and crop rotations. At this stage let us focus on livestock themselves and consider more fully their place in the system.

Sheep, goats and cattle are the most important livestock species in the region (Table 6). Sheep and goats combined are about six times more numerous than cattle, but the latter are more important for dairy production than the small stock, and in some countries they contribute more red meat as well. The statistics are not disaggregated by location of stock, but in general one can say that a substantial number of the sheep are found in steppe areas, while many of the cattle are in dairies or irrigated areas. Of stock kept on farms, cattle tend to be more common in wetter areas and sheep in drier zones. Some of the cattle are draft animals, although this is becoming less common.

Livestock play a key role in the mixed farming areas, particularly for small farms in dry zones. Livestock contribute as much income as crops in drier areas of Morocco and Cyprus (Campbell et al 1977:84; Papachristodoulou 1979), and this is perhaps typical of the region. Nevertheless, they are often undernourished, and programs to support livestock production in mixed farming systems are rare.

Table 6: Livestock production

	<u>ANIMALS (1000) 81/83</u>			<u>MEAT 1000 TON 81/83</u>			<u>MILK 1000 TON 81/83</u>	
	<u>SHEEP</u>	<u>GOATS</u>	<u>CATTLE</u>	<u>SHEEP</u>	<u>GOATS</u>	<u>CATTLE</u>	<u>SHP,GT</u>	<u>COW</u>
ALGERIA	13730	2763	1389	68	13	43	316	530
LIBYA	4598	1412	175	53	2	29	54	64
MOROCCO	14913	6240	3047	59	23	116	50	790
TUNISIA	4980	875	572	24	3	34	30	226
IRAQ	11883	3767	3033	43	15	55	234	1075
JORDAN	1021	540	37	6	7	2	40	4
LEBANON	143	442	53	11	4	9	56	91
SYRIA	10969	1103	799	88	7	34	539	599
CYPRUS	518	360	43	6	4	4	64	51
TURKEY	49288	18727	17003	294	108	211	1865	3613
SAUDIA	3333	2200	450	102	8	22	164	252
Y.A.R	3150	7500	950	13	38	14	183	64
P.D.R.Y	997	1350	120	6	5	2	37	8

Source: FAO 1984a.

Feeding of livestock follows a yearly cycle. The rains begin in October or November, and fresh fodder is first available in winter or early spring, depending on temperatures. By spring, livestock feed is relatively abundant. Weedy fallow areas and grazing lands are at their most productive, supplemented by weeds pulled from crops; indeed, weeding may be delayed to increase the amount of fodder (Newburg et al 1982). Cereal crops may be grazed as well. Income from stock sales and dairy products is at a peak; this sustains many farmers until the crop harvest.

After harvesting in May and June, crop stubbles and aftermath become available. This consists of leftover weeds and a few inches of standing straw. The rest of the straw is frequently gathered up after combine harvesting to be stored for winter use. After hand harvesting, weeds are the only feed remaining on the field. Crop stubble and aftermath are enough in some areas to sustain small stock through the summer months. Standing crops of grain, mostly poor crops too short for combine harvesting, supplement the stubbles in other areas. Dairy cattle may require additional feed at this time, sometimes provided in the form of agro-industrial by-products.

Depending on the location, irrigated or summer crop residues may be available towards the end of summer, locally or at some distance. These tend to be fairly high in nutritive value, but are the last fresh fodder until the subsequent spring. With the beginning of the rains, livestock feeding is at its most difficult point. Depending on temperature, winter grazing may be good, but it is unreliable. In colder areas animals need to be fed conserved feeds for two to five months. This feed is largely composed of barley grain plus cereal straw; where available, legume straw is also highly valued. The potential of cereal straw should not be underestimated; in a Syrian mixed-farming area, it provided 30-43% of metabolizable energy and 16-24% of crude protein to farmers' flocks in the winter feeding period (Jaubert and Oglah 1985). In some countries with irrigated cotton or beet crops, agro-industrial by-products may also be available at reasonable cost.

Livestock based in steppe or semi-desert areas may also consume crop by-products. These flocks usually consume conserved feed and natural grazing through winter and spring, but in summer they are often moved to graze crop residues or standing crops in rainfed and irrigated crop lands. They may pay the land owner, but in some areas the pastoral nomads have the right to graze without payment. Changes in cropping patterns need to be evaluated for their indirect effects, both on the welfare of the nomadic population, and on their ability to provision the urban areas with meat and dairy products.

Thus in a normal year, livestock make use of cereal straw and stubble as well as some of the grain crop, graze associated fallows and failed crops, provide income and valuable nutrients before the harvest, and act as a repository of value. In a poor crop year, livestock act as a buffer. Pastures are poor in such a year, but the higher proportion of failed crops provides spring and summer feed for the livestock. Usually the value is less than the value of a good harvest but still sufficient to offset planting costs and provide a portion of the normal harvest income to farmers. This applies whether the farmer grazes the crop with his or her own animals, or sells the grazing rights. Crop grazing also allows livestock owners to reduce their herds gradually over several months, and permits officials responsible for livestock to prepare for a feed shortage in the subsequent winter rather than an immediate shortage at harvest time.

The value of manure is widely appreciated in subsaharan Africa, but it is not clear how great its importance is in the Near East. Certainly some organic matter is added to soils by grazing practices, and some farmers collect and apply manure to their fields. It would be useful to know how effective current practices are in this respect, and whether better management of manure could be used to improve the fertility of the land.

Some agricultural strategies call for a reduction in the role of livestock in mixed farming areas, or a decrease in their current feed resources. This is true of systems of cultivated fallow and, to some



extent, herbicide use. These technologies have been acceptable on large farms oriented to commercial cereal production. However, widespread adoption of such strategies could encounter several obstacles. First, how will the increasing demands for meat and dairy products by urban consumers and a growing population be met? Specialized meat and dairy operations will be hard pressed to compete with the opportunistic use of free or cheap feeds by mixed farming households. Second, the nutrition, income and risk aversion aspects of mixed farming are difficult to replace. Even where substantial cash from off-farm employment is available, the distribution system is not adequate in most countries of the region to provide consumers with fresh dairy products on a regular basis. With respect to risk, crop insurance or compensation programs are rare in the region (although they are available in Cyprus, according to Samios (1979)). Thus a crop production technology which operates to the detriment of livestock has high opportunity costs for both farmers and urban consumers, and may require substantial indirect support to be viable.

However, new systems which increase cereal production while also increasing the availability of spring and summer feed resources might avoid these problems. Rotations with legume pastures are, in theory, the most promising possibility; they will provide fodder and also allow a level of weed control. It remains to be seen whether farmers will judge them to be more economically attractive than weedy fallows.

#### Rainfed farming in the larger system

Rainfed crop and livestock production takes place in a larger context. The expansion of cultivated area, occurring almost universally in this region in the war and post-war years, has been fueled by urban investment in mechanization and urban demands for foods and exports. Policies for investment, pricing of goods, extension of new technologies, provision of agricultural inputs, and research priorities all affect the vitality of the farming sector. As mentioned earlier, there is a high awareness of the importance of agriculture by most governments in the region. Nevertheless, policies which are pro-

agriculture may still discourage development of parts of the sector. Policies have often been, officially or practically, structured to favor large farms over small, irrigated agriculture over rainfed, and high rainfall areas over low (Campbell et al 1977:56; Hogan et al 1984). This applies to the availability of inputs, credit and extension, as well as research.

While such an approach may maximize short-term food production for the market, it leaves a large part of the population, namely the poorest farmers, facing a declining standard of living. Furthermore, policies towards provision of services and construction in rural areas affect the quality of life and the desirability of continuing to live on farms. The overly rapid urban growth in the region, with associated housing, food and social problems, is in large part the cost of having neglected small-scale farming in the past.

These aspects are currently receiving greater consideration. In Tunisia, for example, the most recent development plan links agricultural policy to improvements in rural life rather than just increasing production, with the explicit goal of stemming rural depopulation (Europa Publications 1984:691). In Syria, the extension of rural roads and services, particularly in the 1970s, encouraged relatively slow urban growth while giving rural people access to new employment opportunities (Tully 1985). The activities of national research programs, collaborative efforts such as the highlands project in Jordan and the MIAC project in Morocco, and the creation of international centers (ACSAD and ICARDA) explicitly working on dry lands, are all evidence of a heightened interest in developing the low-productivity farm areas. This should help to establish a more secure basis for rural life, and benefit urban residents as well.

### Summary

Agriculture is a major sector of the economy of the Near East region, and approximately half of the population lives in rural areas. Nevertheless, agriculture's share in national economies has been shrinking, and in many countries food production per capita has been in decline. This has sparked a renewed interest in agriculture in the region, including rainfed crop production.

The Near East is marked by a duality between large farms, often state-run, and small private holdings. The large farms are usually involved in commercial crop production, while the small farms are more often subsistence oriented. Small farms invest more in livestock, which may contribute half of their incomes, and they also work off-farm. Small farms produce much of their crops for home consumption, particularly durum wheat, dairy products and pulses.

The most common crops are wheat, barley and pulses, usually grown in cereal-fallow or cereal-legume rotations. Weedy fallows are common on small farms because they provide livestock feed, but large farms often cultivate fallows to maximize moisture storage and thus cereal yield. Livestock graze crop lands after harvest and through the subsequent fallow year, and this provides the bulk of their feed intake.

Mechanization has been extensive, affecting both small and large farms. Small farms often hire custom services, especially for tillage and cereal harvesting. Machinery used for tillage and sowing is diverse, and could likely be improved.

Policy towards agriculture is a critical factor in determining production. Rainfed agriculture, particularly in dry lands, may be neglected relative to other crop production; similarly, small farms may be given less incentives than large. However, with encouragement the small farms and dry areas should be able to achieve substantial increases in productivity.

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