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AGRICULTURAL MACHINERY IN NORTH AFRICA*

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* North Africa includes Algeria, Egypt, Libya, Morocco, Sudan, and Tunisia.

AGRICULTURAL MACHINERY IN NORTH AFRICA

1) The evolution of agricultural machinery in North Africa.

The mechanisation and motorisation of agriculture have a long history in North Africa. The first tractors were utilised in Tunisia and Algeria as early as 1912-1913, while combine harvesters were introduced in 1920. Present-day agriculture, however, is still characterised by the juxtaposition of two sectors: one which chose to rapidly mechanise and motorise, and another which continues to use animal traction and rudimentary techniques and instruments. As a result, the instruments used in present-day agriculture range from the simple to the complex, from the hoe to the tractor.

The statistical information on the composition of agricultural machinery in North Africa is quite scarce. The different concerns of each country in this area and their varying productive structures leads each country to produce very different information about the subject, severely limiting the possibilities of comparison among the six countries. Available statistics generally only cover the stock of "noble" equipment: tractors and harvest combines.

1.1. Tractors.

In the period 1961-1965, about 65,900 agricultural tractors were in service in North Africa. They accounted for less than 1% of the total world supply. Twenty years later, in 1982, the region was employing about 174,300 units (see Table 1). Although they were still less than 1% of the world total, the tractor park in North Africa grew substantially faster than it did worldwide (4.7% vs. 2.9%).

Table 1:
North Africa: Agricultural Tractors in Service
(units)

	MAROC	ALGERIE	TUNISIE	LIBYE	EGYPTE	SOUDAN	TOTAL	MONDE
61-65	8000A	27620C	11795	2834C	13607	2040C	65896	12418578
1966	8000A	39300C	16000C	3200C	15000C	2400A	83900	14306350
1967	9000C	39500C	18131	3350C	15400	3000A	88381	14989149
1968	10000C	39800C	19000C	3500C	15572	3500C	91372	15435875
1969	11000C	40000C	20000C	3700C	16962	4462	96124	15915259
1970	12000C	40200C	21000C	3900C	17300C	4842	99248	16246064
1971	13838	40500C	22000A	4000C	17566	5820	103724	16666296
1972	14606	40700C	23500A	4200C	18500C	7980	109486	17069930
1973	16102	41000C	27000A	4400C	20036	8000C	116538	17542003
1974	18477	41300C	28000C	4800C	20889	8500C	121966	18188927
1975	20000C	41500C	29000C	5500C	21500C	8800C	126300	18806431
1976	21500C	41800C	30000C	10000C	22000C	9000C	134300	19312422
1977	22000C	42000C	31000C	11000C	22468	9300C	137768	19885914
1978	23000C	42147	32000C	12000C	28300C	10000C	147447	20489181
1979	23800C	42500C	33000C	13000C	34189	10500C	156989	20942215
1980	24500C	43693	34000C	14000C	36000C	11000C	163193	21741730
1981	24800C	44000C	35500C	15000C	38000C	11600C	168900	22048260
1982	25100C	45000C	36200C	16000C	40000C	12000C	174300	22516593

A: Non official information
C: F.A.O. estimate

Of course, each of the countries experienced differing rates of equipment growth. Similarly, the regional stock is unequally divided among the different countries (Table 2).

Table 2:

North Africa: Evolution of Tractor Stock

	Regional Share		Growth Rate
	1966	1982	
Algeria	46.8	25.8	.8
Egypt	17.9	22.9	6.3
Libya	3.8	9.2	10.6
Morocco	9.5	14.4	7.4
Sudan	2.9	6.9	10.6
Tunisia	19.1	20.8	5.2
TOTAL	100.0	100.0	4.7
World	n.a	n.a	2.9

In 1966, almost 84% of the equipment was concentrated in three countries: Algeria, Egypt, and Tunisia. This proportion fell dramatically in the following years as the number of tractors in Algeria stagnated; in spite of this, however, the three remain the most important in the region, with 69% of the total in 1982.

When the tractor park is compared with the cultivated and irrigated land the intraregional disparities are even more evident. Sudan accounts for more than one-third of the arable and irrigated land but less than 7% of the tractors. Egypt, with a small proportion of the cultivated land but a large share of all irrigated area also uses a disproportionately large number of tractors. Algeria and Tunisia also stand out among those having a large tractor park relative to their cultivated area (Table 3). Morocco and Sudan are clearly poorly equipped by any standard when compared with their apparent needs as measured by cultivated land.

Table 3:

North Africa: Tractor Park in Relation to Cultivated Land, 1982

	Arable Land		Irrigated Land		Hectares/ Tractor
	has.	regional share	regional share	% irrig	
Algeria	6,875	19.8	6.3	5.0	62
Egypt	2,305	6.6	42.0	100.0	52
Libya	1,765	5.1	4.1	12.9	42
Morocco	7,930	22.8	9.7	6.7	466
Sudan	12,390	35.7	34.6	15.3	688
Tunisia	3,487	10.0	3.3	5.1	92
TOTAL	34,752	100.0	100.0	15.8	129

During the course of its growth, the types of tractors have also changed. Wheels have displaced caterpillars as the dominant form of traction because the former are easier to manipulate and less expensive to purchase. In Algeria, for example, 23% of the tractors had caterpillars while in 1983 this type of vehicle only accounted for 15.8% of the total. In Morocco, the change is even more notable as caterpillar-type vehicles fell from 44% to less than 5% at present (Table 4).

Table 4:

Morocco: Evolution of Tractors According to Type (%)

	1965	1969	1975	1980
Wheeled	56	74	94	96
Caterpillar	44	26	6	4

In general, there are a large number of suppliers of tractors and their origins are quite diverse. (In Morocco and Egypt, for example, one finds some fifteen different brands of tractors in each country.) In spite of this, a small number of them effectively control the market, thus vitiating any possible benefit that might result from the competition.

The diversity of brands and models makes it difficult to manage an adequate stock of spare parts. To respond to the demands, the suppliers must maintain a large inventory of pieces, some of which will only be required occasionally; without these parts, however, it is not possible to keep the machines operating efficiently.

The financial cost of machinery maintenance is very high, because the spare parts have become increasingly expensive. Furthermore, the European and American factories, where the farm machinery and parts are manufactured, operate on the basis of long-term planning. Their order backlogs often require lengthy delays -- delays which are frequently as great for the parts as for the vehicles themselves. Thus, in addition to the high cost of these inventories, the lead time for satisfying demands requires careful planning; unfortunately, such planning is not well developed in North African agriculture.

The North African market requires an especially large supply of spare parts. The farmers do not examine their machinery until it is to be used. Thus, it is only at that moment (soil preparation and harvesting) that the farmers discover the need for parts: at these times the demand is so great that it often exceeds the demand during the rest of the year. It would be difficult to change this behavioral pattern and therefore the only reasonable solution (at least in the short term) would be to improve inventory control and stocking practices among the farm machinery suppliers in order to better respond to predictable demand patterns.

To evaluate the development of tractor use, it is necessary to take into account not only the number of tractors but also the

quality of the stock as measured by its age, its condition, and its power. In general, quantitative estimates of tractors must be used with care; they should be qualified because of the lack of replacement and maintenance programs. In Morocco, for example, only 41% of the tractors are less than five years old, and the annual sales do not even cover the needs for replacing previously reconstructed equipment. In Tunisia, the agricultural machinery stock is aging rapidly, in spite of its generally satisfactory operational condition, which is the result of an adequate maintenance program. Algeria is undertaking a substantial program to rejuvenate its tractors, but at the present time only 49% of its machines are less than five years old; the aging is more evident in the caterpillar-type equipment, as is evident in Table 5.

Table 5:

Algeria: Age Structure of Tractor Stock by Type (%)

	Wheeled Tractors		Caterpillar Tractors	
	1963	1983	1963	1983
Less than 5 years	27.5	32.3	18.0	33.5
5 to 10 years old	39.0	29.0	13.5	43.1
More than 5 years	33.5	18.7	68.5	23.4
TOTAL	100.0	100.0	100.0	100.0

Any classification of the age structure is arbitrary since the maintenance is an important element in determining the quality of the available stock. Because of old age and poor maintenance, the tractor stock in Algeria suffers from a high rate of breakdowns. Excluding the 6.8% of rebuilt tractors, the rate of breakdown was 16.1% in 1983; this rate was higher for the caterpillar-type vehicles (28%) than for the wheeled ones (14%). The lack of operational equipment occasioned important delays in farm labours or the simple abandonment of the equipment.

One-half of the Egyptian stock (in 1972-1974) was permanently non-operational. This situation was caused by the lack of local supplies of spare parts. In Sudan, also, a substantial proportion of the tractors are immobilised -- in 1979, the figure was about 33%.

In spite of the general tendency towards the production and use of increasingly powerful tractors throughout the world, the most common models in use in North Africa continue to be of relatively low power. In Tunisia, they are in the 50-65 horsepower category; from 60-65 hp. in Egypt; from 61-70 hp. in Algeria; and from 65-75 hp. in Sudan.

1.2. Agricultural equipment.

Agricultural equipment generally includes the instruments for the following tasks:

- Soil preparation
- Seeding and fertilizing
- Crop treatment
- Harvesting
- Irrigation
- Transportation

Although the tractor is the basic factor of mechanisation, farm equipment must also be taken into consideration. The plows, cultivators, chisels, seeders, harvesters, balers, trailers, as well as other machinery, must logically be included.

1.2.1. Soil preparation equipment.

The farm equipment programs in Egypt have been designed to mechanise tasks which have traditionally be performed by animals (cultivation, leveling). In general, three types of tools are used for working the soil: hoes, animal-drawn plows, and tractors. Tractors are increasingly used, but are still not predominant: when they are used they replace animals rather than manual cultivation. They are especially used for the motorisation of threshers, as is evident in Table 6.

In Morocco, the complementary farm equipment is quite rudimentary. The trailer and the "cover crop" (pulvenser) are the most commonly purchased items; the plow is quite rare. There are as many cover crops and trailers as tractors, but only one plow for each four tractors. On the whole, this situation has not changed since 1974. In contrast, hand tools and instruments made in small workshops which were already important, became even more significant during the 1974-1980 period (Table 7).

Table 6:
Egypt: Mechanisation of Agricultural Operations - 1980 (%)

Operation	Rate of Mechanisation	Animal Traction	Manual Labor
Soil Preparation			
Labour	90	4	6
Leveling	60	10	30
Boundaries	56	10	34
Cultivation			
Irrigation	62	3	35
Harvesting	-	-	100
On-farm Transport	15	10	75
Threshing	80	5	15
Straw cutting	30	10	60

Table 7:

Morocco: Stock of Farm Equipment

	1974	1980
I. Motorised:		
Flows : disk	3 900	4 500
plowshare	1 100	1 500
Disk pulverisers	8 000	8 500
Tooth instruments	600	650
Harrowers	400	450
Cultivators	750	800
Seeders: drill	700	750
precision	900	1 000
Fertilizer spreaders	1 600	1 650
Trailers	3 500	3 700
Pulversers	2 000	2 100
Threshers	1 000	1 025
Pick-up balers	1 500	1 600
Mowers	1 500	1 600
II. Animal-drawn		
Scratch plows	700 000	750 000
Plows	200 000	250 000
Harrowes	40 000	42 000
Hoes	12 000	13 000
Seeders	500	525
Wagons	10 000	10 500
III. Hand tools:		
Scythes, small	150 000	155 000
Sickles	300 000	310 000
Matchets	500	750
Pulversers	50 000	55 000
Dusters	100 000	110 000
Scythes	3 000	3 300

In Egypt, tractors are equipped with cultivators and not with plowshares for soil preparation. They also pull a type of metallic *louata*, and are used for the transport of harvests, of manure, and for motorising threshers. Aside from locally produced *chisels* and trailers, the agricultural equipment industry is virtually non-existent.

In Sudan, the most important equipment is the "wide-level disk" with an incorporated seeder. Although used in dry-farming, it is greatly underutilised. On irrigated lands, the disk pulverisers and plows are the most common equipment.

In Tunisia, traditional farm equipment dominates the panorama. Animals are used for plowing and weeding especially on the small plots in the center and southern parts of the country.

In Algeria soil preparation involves the use of many different types of equipment:

- Flowshares. with 1-6 units, These range from light and vineyard plows to large balance plows utilised for land clearing.

- Disked equipment. Disk plows (2-6 disks) of from 66 to 80 cm. in diameter, with a double incline, are used for work of from 20 to 30 cm. deep. Disk tillers (6-14 disks) of 60 cm. diameter along a single axle are used for light work and stubble plowing. Cover-crops (14-18 disks) of 55 cm. diameter on two axels in the shape of a "V" and pulvensers (24-28 disks) of 45 to 50 cm. diameter along two axels are used for surface tasks.

- Toothed equipment, in various configurations, depending on the brand. Heavy equipment with rigid teeth, like chisels with springs, is used for labours that do not require turning. Medium equipment with rigid teeth on springs of "tiller" type (teeth in squared sections) or with semi-rigid teeth with spirals giving flexibility of the "queue de Cochon" type (teeth in squared sections). Light equipment with flexible teeth of the "Canadian" type (teeth with flat sections).

- Rollers, croskill rollers, cultipakers: used for soil preparation prior to seeding, for those crops which require a very fine seed bed with 3-4 cm. of soil (forrage crops). They are usually used after seeding, generally alone or with the seeder.

Table 8 documents the importance of equipment for surface tasks. Considering the number of instruments used for land clearing, it must be concluded that there is a marked lack of instruments for deep soil preparation work. 45% of the equipment is single-purpose while 40 % is cultivation equipment.

Among the cultivation equipment, the disk plows only account for 37%, in spite of their importance. The disk plows are more resistant to breakage when compared to plowshares, but are less available than the latter.

The number of instruments for surface tasks appears to be sufficient to satisfy the country's needs. However, the rate of breakdown is quite high and probably limits their availability. This is especially true for those which are used most intensively, like the cover-crops and the disk tillers.

Judging by the availability of surface work equipment, it can be inferred that this type of land preparation is practically unknown in Algeria.

On the whole, the distribution of farm equipment displays serious imbalances. It appears to respond to the market rather than to a systematisation of work tasks.

Table 8:

Algeria: Principal Soil Preparation Equipment (1983)

	Number	Breakdown Rate
Land Clearing		
Balanced plows	635	11
Sub-Soiling	159	11
Cultivation		
Flowshares	13 722	11
Disk plows	8 442	18
Vineyard plows	1 112	12
Surface plowing		
Disk tillers	3 067	19
Cultivators	3 215	11
Chisel cult.	206	14
Cover-crops	15 967	18
Rotary cult.	220	12
Stiff-tooth cult.	1 393	9
Surface Work		
Harrowes	4 114	9
Rollers	769	13
Maintenance		
Weeders	397	11
Ridgers	44	4

1.2.2. Seeding and Spreading Equipment

Seeders and fertilizer spreaders are part of the same family of farm machinery. Both are built with one part to receive the material and others to distribute it. Three types of seeders are used:

- Centrifugal broadcasters are simply fertilizers used as seeders. This equipment is commonly used in Morocco.

- Seed drills are also multi-use equipment and for this reason are quite popular. In Algeria, for example, they accounted for 65% of the seeders in 1966, rising to 94% in 1983.

- Precision (single seed) seeders are less common and are used for beet-sugar and maize.

In general, the availability of this type of equipment is still insufficient both in qualitative and quantitative terms. In spite of great efforts in recent years to increase the use of these machines, centrifugal seeding still remains a very common practice. In addition to the shortage of equipment, its utilisation rate is also low. In Algeria, for example, the breakdown rate was 21.5% in 1983 (see Table 9). As a result, mechanical seeding is not common.

Table 9:

Algeria: Seeding Equipment by Type and Condition - 1983

Condition/Type	Seed Drills	Single Seed	Combined	Total
Operational	3 238	70	168	3 476
In repair	1 379	18	35	1 132
TOTAL	4 317	88	203	4 608
Rebuilt	622	9	33	664

Fertilizer spreaders are quite unproductive. The most common types are the least productive simple spreaders. They are even less available than the seeders and generally fertilisation is done by hand. In Algeria, for example, there were only 3 065 spreaders in 1983, distributed as follows:

- 1 942 simple spreaders
- 1 077 centrifugal spreaders
- 46 localised fertilizers

In spite of the quantitative growth of these machines (there were only 885 in 1966), the breakdown rate was quite high (18%), thereby further reducing their effective availability.

1.2.3. Crop treatment equipment.

This equipment is of three types:

- manual pulverisers sometimes adapted to motorised use
- manual dusters sometimes driven by motors
- atomisers carried on backpacks, by animals, or tractors

In general, sufficient motorised equipment is available, especially since it is complemented by a broad distribution of backpack atomisers. This is certainly the case in Morocco (see Table 7). In Algeria, in spite of the fact that motorised spreaders are more widely available, manual equipment is still relatively important (45% of the total in 1983). However, mechanical failures have put 21% of the mechanised equipment and 17% of the backpacks out of service.

Table 10:

Algeria: Crop Treatment Equipment by Type and Condition (1983)

Condition/Type	Pulverisers		Dusters		Atomisers (Motor)
	Motorised	Backpack	Motorised	Backpack	
Operational	2 294	2 598	741	1 313	1 576
In Repair	519	616	189	210	517
TOTAL	2 813	3 214	910	1 523	2 093
Rebuilt	245	330	104	113	938

1.2.4. Harvesting equipment.

The forrage collection machinery is gaining in importance among farm equipment as milk and meat production increases the demand for large areas of forrage crops. The machines are of three types: mowers (animal or machine drawn), combine side-rakes and tedders, and the pick-up balers which are often attached to the pneumatic silo loaders (ensilers) (especially in Algeria).

This equipment is limited and unfamiliar to farmers in the region, in spite of the ratchet-like growth of forrage crops. On the average, one piece of equipment is available per parcel. In 1983, there were 8 517 mowers, 5 372 combine side-rakes and tedders, 6 290 pick-up balers, and 144 ensilers. This is equivalent to 1.48 apparatuses per farm and 0.62 per tractor.

1.2.5. Irrigation equipment.

The availability of irrigation equipment is clearly the most significant determinant of agricultural yields in North Africa. In this regard, the private sector in Algeria does not appear to have improved its position since 1976. In contrast, the production and utilisation of hydraulic equipment has increased notably in the state sectors, especially in Tunisia and Morocco. In Tunisia, even on small private farms, the increase in irrigation has been substantial in recent years. It should be added, however, that irrigated farming is relatively unimportant in these three countries, accounting for less than 10% of the total farm land.

A similar situation is also observable in the other countries in the region but to a much lesser degree. In Egypt, virtually all land is reported to be irrigated; in private agriculture, rudimentary manual devices for irrigation are in general use. Electric and diesel pumps are still rare because of their high cost and frequently are only cost-effective if used to service several different farmers. In Egypt in 1978 there were 2 160 electric and 24 830 diesel or gasoline irrigation pumps.

An important limitation of the use of more irrigation pumps is the lack of rural electrification at the farm level in much of the region. Furthermore, in Egypt the pumps are frequently acquired by merchants in rural towns (98% of the total) who then rent them to the peasants when their own irrigation systems are not operational.

*not
members
a much
lower share
of the crop
production*

Table 11:
Algeria: Farm Equipment - By Year of Acquisition, 1970-1978

	Pre-1970	1971-1974	1975-1978	1978 Stock
Harvest Equipment				
Mowers	4 220	2 732	4 514	11 466
Siderake/tedder	3 518	1 938	3 344	8 700
Pick-up balers		2 073	3 127	5 100
Ensilens		79	305	382
Plowing Equipment				
Plowshares	6 043	4 613	5 736	16 392
Disk plows	8 063	5 420	5 311	18 794
Disk tillers	800	1 422	1 715	3 937
Pulversers	2 000	7 365	7 635	18 000
Toothed equip.	8 000	2 900	4 200	15 000
Transport Equipment				
Trucks		1 296	2 086	3 282
Trailers	6 000	7 442	9 291	23 733

Table 12:
Morocco: Sales of Farm Equipment - 1982-1983

	1982	1983
Balers	774	254
Mowers	391	185
Siderake/tedder	434	212
Cover-crops	538	1 004
Plows	676	509
Fertilizer spreaders	238	217
Seeders	134	95

Table 13:
Algeria: Sales of Farm Equipment - 1978 - 1980

	1978	1979	1980
Trucks	372	349	133
Trailers	1 359	1 500	1 519
Water tanks (cisterns)	901	1 090	1 735
Plowshares	1 725	2 482	3 457
Disk plows	587	1 296	819
Soil preparation equip.	1 200	1 241	1 959
Seeders and fertilizers	970	804	1 103
Crop treatment equip.	3 403	1 686	7 202
Harvesting equipment	2 915	1 682	2 578
Pulversers (cover-crop)	2 712	3 270	2 578
Equipment carriers	100	26	13

1.2.6. Transport equipment.

Agricultural transport equipment is of four types:

- Heavy trucks providing farm needs, which can be substituted by a tractor pulling a trailer. In Algeria, the stock of trucks has varied from 4 015 units in 1966, to 3 282 in 1978, and 3 640 in 1983: the shortage of trucks is compounded by the large numbers which are out of service (27%).

- Trailers, both two- and four-wheel types, are more frequently used than trucks. Pulled by tractors, the trailer transports farm inputs, the harvest, and often the workers. It is quite common to see trailers full of peasants being pulled to the souks (markets) by tractors. The tractor and trailer are generally underutilised: in Egypt, for example, it is estimated that the tractor is used for more than 45% of the work time for transporting mud bricks. In Algeria, the stock of trailers has stagnated at about 18,000 units since 1966. This is the equipment which has the highest rate of servicability. In Morocco, there were only 3,700 units in 1980.

- Cisterns are quite heavily used for transporting water for weed and pest control devices, for watering young plants in dry farming, and especially for supplying family needs for drinking water. In Algeria, there were only 348 of these reported in 1983, while in Morocco this equipment is in great demand and the annual sales are as high as 1,500 units.

- Horse-drawn carriages are widely used but any quantitative estimate of the stock of these vehicles is difficult. They are locally made in a large number of artisan workshops. In Morocco alone, it is estimated that there were 10,500 of them in 1980.

1.3. Harvesting equipment.

Because of the predominance of grains in the North African countries, harvesting equipment is of particular importance. During the 1961-1965 periods, about 11,942 harvest combines were in service in the region (about 0.5% of the world total), of which 41% was in Algeria. Twenty years later (1982) the region had about 14,650 of these machines, a slightly smaller proportion of the global total (0.4%). According to FAO statistics, Libya is the only country which does not use this equipment. Algeria remains the largest user, although the rate of growth in the other four countries is greater.

Table 14:

North Africa: Harvest Combines in Service, 1961 - 1982

	MAROC	ALGERIE	TUNISIE	LIBYE	EGYPTE	SOUDAN	TOTAL	MONDE
61-65	2825	4870A	2727	*	1400A	120A	11942	2259264
1966	2500A	3400A	2850A	*	1500A	150C	10400	2415609
1967	2500A	3450A	2900A	*	1550A	150C	10550	2473766
1968	2500A	3500A	2900A	*	1600A	200A	10700	2502977
1969	2500A	3550A	2950A	*	1650A	230	10880	2544018
1970	2500A	3500A	3000A	*	1700A	300	11100	2592307
1971	2500A	3650A	3000A	*	1750A	490	11390	2625276
1972	2420	3700A	3100A	*	1800A	646	11666	2676830
1973	2501	3750A	3100A	*	1838	750A	11939	2751927
1974	2624	3800A	3200A	*	1880A	850A	12354	2896565
1975	2700A	3850A	3250A	*	1900A	900A	12600	2973015
1976	2800A	3900A	3350A	*	2000A	950A	13000	3075869
1977	2900A	3950A	3400A	*	2145	1000A	13395	3214849
1978	3000A	4000	3450A	*	2120A	1050A	13620	3246888
1979	3100A	4050A	3500A	*	2107	1100A	13857	3384444
1980	3200A	4100A	3550A	*	2110A	1150A	14110	3532048
1981	3300A	4150A	3600A	*	2130A	1200A	14380	3597837
1982	3400A	4200A	3650A	*	2150A	1250A	14650	3691886

A: F.A.O. Estimates

C: Unofficial data

Table 15:

Distribution of Harvest Combines in North Africa
1961-1965, 1982 (%)

	1961-1965	1982
Algeria	40.8	28.7
Egypt	11.7	14.7
Morocco	23.7	23.2
Sudan	1.0	8.5
Tunisia	22.8	24.9
TOTAL	100.0	100.0

The scarcity of harvest combines in Egypt is notable. Among farm tasks, the harvest is the least mechanised. Threshing and the winnowing are mechanised by connecting equipment to the power train of the tractors. In Egypt, about 80% of the threshers are mechanised, while the winnowing is much less mechanised; the two operations are rarely combined. Besides the harvest combines, in 1974, farm machinery in Egypt for harvest consisted of:

- 8 000 mechanical threshers
- 6 700 mechanical winnowers
- 500 thresher-winnowers

Policy & Instruments

The stock of farm machinery in North Africa has experienced substantial growth in recent years. This trend is directly linked to the process of agricultural modernisation, especially within the more highly organised farm sectors, and to the direct encouragement of mechanisation by state policies. Two different policy approaches can be identified:

- A technical approach which focuses on introducing new cultivation processes, especially for soil preparation.

- A production approach which focuses on increasing the volume of the harvest so that it can respond to demands created by population growth.

To reach these objectives the following instruments have been used:

- Farm equipment has been supplied to organised units, creating machinery centres which are placed at the disposition of farmers through workplaces (in Morocco) or service cooperatives (Algeria, Egypt, and Tunisia).

- Financial instruments have been created to facilitate the acquisition of farm equipment. Subsidies are often offered to extend these credit systems and encourage (or oblige) local savings institutions to finance the purchase. In Tunisia, for example, in addition to credit, the State provides a preferential price for diesel fuel used for agricultural machinery, as well as for fertilizers; it also exempts the importation of this equipment from customs taxes.

The weakness of the North African farm machinery market is a problem which government policy is deliberately trying to reverse. This weakness is evident from even the scarce set of statistics provided in this first part of the analysis. The tendency towards the expansion of mechanised production is evident, but still not as pronounced as in other regions. The needs are great, especially in the traditional sectors, which dominate agriculture in the region.

2. The Market for Agricultural Machinery.

The North African market for agricultural machinery is characterised by the weakness of the domestic production capacity. As a result, it is dominated by imports; the vagaries of the international market and political alliances have contributed to its instability.

2.1. The production of agricultural machinery.

An evaluation of local production is difficult because the factories and workshops that produce agricultural machinery are very diverse. There are both large and small units producing plows, harrowers, equipment for crop treatment and pulverisation, etc. There are also corporations which combine the sale of imported equipment and local assembly with the production of parts.

Local production is generally limited to hand tools and small wagons, plowshares and disks for tractor-driven plows, deep tilling plows, cover-crops, harrowers, seeders, fertilizer spreaders, pulverisers, backpacks, and trailers. The assembly of imported parts for tractors and combines is also common.

2.1.1. The Egyptian case.

Virtually all the equipment and instruments sold commercially are manufactured locally, principally in small workshops. These include: covers, hoes, pick-axes, forks, harvest knives, plows, chisels, and trailers. A few factories of larger size make more modern agricultural machinery. These include irrigation pumps and a limited number of small diesel motors. But most of the motors and other agricultural machinery available for sale is imported.

Most national producers operate on the basis of firm orders. The factories are really nothing more than large workshops and few have modern equipment for manufacturing.

Local production of agricultural tractors began in 1962. The tractors -Nasr- were produced under a Yugoslav license. The productive capacity of the factory was 3 000 tractors per year, but production varied greatly from year to year. To better adapt itself to local conditions, the enterprise --in cooperation with the Ministry of Agriculture-- introduced several modifications into the original design, increasing the tractors' weight as well as its power to 60 hp. During the period of cooperation with Yugoslavia (which lasted until 1970), local production developed to account for 30% of the total price of the tractor. Cooperation was abruptly suspended for 4 years because Yugoslavia was demanding payment in foreign currency, but subsequently was resumed. ? ?

After terminating all cooperation with Yugoslavia, the firm signed a contract with Rumania in 1971 for tractor assembly. This activity began in 1972. The marketing of these tractors was difficult because of their heavy weight and high consumption of oil and fuel; these difficulties were overcome and assembly of these models continues. They are sold locally at very attractive prices, and are popular with farmers in Egypt.

During the course of 1962-1980, these two brands (IMR and ITB) accounted for 86.6% of all the tractors assembled in Egypt: 47.3% Yugoslav and 39.3% Rumanian. The remainder of the market was divided among 2 brands and 3 licenses (see Table 16): 2% for a Fiat tractor assembled between 1974 and 1976; 1% for a British license of Massey-Ferguson (M-F) which began to be sold in 1977; and 10% for an American license of M-F which also appeared in 1977 to compete with the other tractors already on the market; both of these were 65 hp. models.

At the present time, a project for the assembly of tractors with a German partner (Deutz) is under consideration. The initial capacity of the plant is projected to be 6,000 units per year, far greater than the total production of all other models together.

Table 16:

Egypt: Tractor Production by NASCO, 1962-1980

License:	IMR-Yugoslavia		ITB-Rumania		Fiat-Italy		Massey-Ferguson		TOTAL
	55hp	60hp	65hp	3-cylinders	65hp (Brit)	65hp (U.S.)			
1962	426								426
1963	533								533
1964	537								537
1965	788								788
1966	1078								1078
1967	751								751
1968	564								564
1969	76	474							550
1970		1176							1176
1971		950							950
1972		251	976						1127
1973		133	1010						1143
1974			1201	58					1259
1975		194	795	446					1435
1976		561	1132	1					1694
1977		436	1830		242	253			2761
1978		1019	713		5	1188			2925
1979		879	1190		54	660			2783
1980		453	532			280			1265
TOTAL	4753	6526	9379	505	301	2381			23845

2.1.2. The Tunisian case.

Agricultural machinery production in Tunisia can be divided into four categories:

- SOFOMECA, located in Megune (southern suburb of Tunis), manufactures plows with 3 disks, agricultural trailer axels, shears.
- The Society of Diversified Industries at Sfax: shovel plows.
- The Sahael Mechanical Workshops: small hand tools.
- Numerous artisan workshops.

Besides these firms there are also the African Industrial Society (SAI) and the Mechanical Complex of Tunisia (CMT).

Located at Ben Arous (a southern suburb of Tunis), the SAI was formed in 1975 and began activities on 1 January 1977, with a capital of 150 000 Tunisian Dinars. Besides manufacturing equipment for public works (cement molds, cranes, etc.) the firm produces six types of irrigation pumps. In 1979, it produced 2 000 pumps with a rate of domestic integration of 95%. At that time, the national demand was about 4-5 000 units. Thus, the coverage of the domestic market was about 50%.

Following an agreement with CMT, the German firm Klockner Humbolt Deutz (KHD) is expected to provide technical assistance for the construction of a complex to produce agricultural machinery and various other types of equipment. The project is jointly financed by several banks and Tunisian firms (65%) and KHD (35%). Established at Mateur, some 60 km. northwest of Tunis, this industrial combine is to be constructed in four stages over a seven-year period, from 1981 to 1988. Some 1 000 jobs are to be created. The projected production for 1985 was to be 1 450 tractors, 50 harvest combines, 50 mowers, 50 side-delivery rakes (windrowers), and 100 balers. According to a representative of KHD, 1 500 knocked-down-kits (CKD) were delivered to the complex.

2.1.3. The Algerian case.

Production of agricultural tractors began in 1969 in Algeria. At that time a complex for the production of tractor motors was built in Constantine. In 1972, another complex for agricultural machinery was established in Sidi Bel-Abbes. These two units began production in 1974 and 1975, respectively.

The tractor motor plant was built under license from KHD. It required 535 million Algerian Dinars. It builds motors, tractors, and does some sub-contracting. The rate of domestic intergration is about 62%. Its installed capacity is: 8,300 diesel motors of 2 to 6 cylinders; 1 200 diesel motors of 6 to 8 cylinders; 4 000 wheeled tractors (license KHD); and 1 000 caterpillar-type tractors. At the present time, the nominal capacity of the complex is 10 000 motors and 6 000 wheeled tractors. It produces three models of tractors: 4006 with 40 hp.; 6006 with 60 hp.; and 6806 with 68 hp. (a model not contemplated in the original project).

Table 17:

Algeria: Tractor Production at Constantine

	1976	1977	1978	1979	1980	1981	1982
Number	1,834	2,839	3,724	4,883	4,206	4,379	4,500

These tractors are all wheeled models. The complex had originally planned to produce caterpillar models also, but in the face of difficulties with the KHD license, it sought another license from Fiat but eventually renounced its efforts in this direction.

The manufacture of motors is designed to equip cars, tractors, trucks, and harvest combines. The production of motors for agricultural equipment grew rapidly (Table 18). Between 1976 and 1977, motor production was operating at 68% of capacity. Combine motors are manufactured under subcontract from the complex at Sidi Bel-Abbes.

Table 18:

Algeria: Production of Motors for Agricultural Machinery

End Use	1976	1977	1978	1979
Tractors	2 205	2 755	4 090	4 678
Combines	104	100	100	100

The agricultural machinery complex at Sidi Bel-Abbes was undertaken with licenses from West German firms: CLAAS for the combines, Busatis for harvesting machinery. The investment was 335 million Algerian Dinars. Its installed capacity was: 500 harvest combines, 2 000 pick-up balers, crop treatment equipment, including 500 pulverisers and 500 atomisers of 1 000 litres; reapers, including 2 600 combine side-rakes and tedders, and 2 200 mowers; 1 300 seeders and fertilizers.

This complex has experienced serious difficulties during the course of its first few years of operation. By 1979, the situation was normalised and its rate of capacity utilisation had risen from 15% to 60%. The rate of domestic integration varies from 70% to 100% depending on the product; for the combines it is 90%. Because of the difficulties in producing a wide range of products and the high degree of national integration, they have recently decided to limit the number of products to combines, reapers, and crop treatment equipment.

Table 19:

Algeria: Principal Equipment Produced at Sidi Bel-Abbes

	1978	1979	1980	1981
Harvest combines	106	371	400	550
Plowing equipment (tons)	2 568	3 750	4 883	n.a.

In general, the demand for agricultural machinery and equipment has grown substantially more rapidly than production. In 1980, tractor production rose to 4 206 units while demand was estimated at 12 000 (10 000 in 1979). This can be tied directly to short-term factors resulting from inadequate supplies in the past, lack of spare parts for repairs, and poor maintenance. The question posed by this situation is whether local production can meet these demands or will additional machinery have to be imported? The question has yet to be answered definitively.

Other equipment is constructed in various self-managed and private enterprises: CAFMA (self-managed); Ben-Radis (self-managed); SACRA which combines the assembly of tractors (until 1970) and the manufacture of equipment; Bouderon at Annana; Dahnoun; construction of emboutissage in Algiers; etc. These units supply the totality of national demand for agricultural trailers and water cisterns, and 80% of plowing equipment.

2.1.4. The Moroccan case.

In 1966, Massey Ferguson created an assembly line for tractors in Morocco. Other lines have also survived: Ford.

created in 1967, and Fiat, in 1968. The local legal regime initially allowed the knocked-down kits (CKD) to enter the country without paying duty, and to benefit from a protective tariff of 25% on imported tractors. But since the domestic supply was insufficient to meet local needs, in 1973 import duties were reduced to 10%, which heavily effected the local assembly lines because they could not compete with the European and American imports.

At the present time, Morocco's needs for agricultural machinery are met primarily by imports. Local production accounts for about 20% of the market. It is composed of small equipment and pulvencers. It attends to demands for cover-crops, plows, cultivators, harrowers, trailers, and high-pressure pulvencers. This equipment is made by four firms; the two largest are: Les Ateliers Marocains in Rabat and Richard Continental Maroc in Casablanca. The artisan workshops dedicated to the production and repair of some equipment has virtually disappeared.

2.2. Imports.

2.2.1. The North African market.

The growth of the North African market for agricultural machinery has been rapid: 155 to 286 millions of U.S. dollars between 1976 and 1980. Libya and Algeria account for almost one-half of this total. Between 1976 and 1979, Libyan imports of agricultural machinery grew 2.6 times, although in 1980 they fell below the levels of the previous two years. Although Algeria is one of the principal importers in the region, it is an irregular client.

Moroccan imports are about the same as those of Egypt but much more unstable. Tunisian imports have not grown as fast as those of the region as a whole, but their growth has been quite stable. Sudan's market is the smallest and weakest of the six countries.

Between 1976 and 1980 the most important part of the import market was for tractors in both Egypt and Morocco. In contrast, the Sudan dedicates about 52% of its imports to harvest equipment. Algeria is in second place in this regard with 31% of the value of its imports.

2.2.2. The cost and composition of imports.

In the period 1961-1965, North Africa imported 4 788 tractors, or 1.3% of the world total. In 1982, the region acquired 24 100 tractors, climbing to 3.3% of world imports. This demand has experienced sharp variations from one year to the next, and from one country to another. For this reason it would be hazardous to attempt to discern any clear tendency in these data. Libya is a good case in point: from 1970 to 1975 its imports rose from 524 to 21 177 tractors, representing 5.7% and 65.4% respectively of the regional total.

Table 20:

North Africa: Tractor Imports, 1961-1982

I: Number of Units

	MAROC	ALGERIE	TUNISIE	LIBYE	EGYPTE	SOUDAN	TOTAL	MONDE
61-65	571	1436	850	701	912	318	4788	36548
1966	1096	1744A	479	1253	642	657	5871	428564
1967	1219	2370A	49	1018	204	683	5543	439016
1968	2398	3287	595	2417	16	285	8998	463E18
1969	2354	2761	0	1999	17	234	7365	480940
1970	1724	4745	392	524	0	1763	9148	470130
1971	2342	1329	1330C	1000C	16	263	6280	454744
1972	1100C	2787	2380A	2086	26	1000C	9379	474215
1973	1845	3555	1300C	2465	2	898	10065	560935
1974	2872	3203	2293	3894	10C	885	13157	638840
1975	3326	2093	3361	21177	396	1556	31909	779242
1976	2317	450C	2453	2291	1849	1804	11164	773196
1977	3163	2565	1895	2737	3498	985	14843	836261
1978	2543	4323	1781	5643	6000C	1033	21323	815035
1979	2524	755	1437	4700C	2850	533	12799	829323
1980	1600C	2000C	3214	3023	5282	833	15952	778580
1981	1370C	4780C	3948	4040	13009	2183	29330	756712
1982	1650C	6000C	3950C	3850C	6400C	2250C	24100	729902

A: Unofficial data
C: FAO estimate

II: Values in U.S. Dollars (000)

	MAROC	ALGERIE	TUNISIE	LIBYE	EGYPTE	SOUDAN	TOTAL	MONDE
61-65	2312	6388	2702	1690	3354	1356	17802	844421
1966	3905	6000A	2411	3647	3788	2031	21782	1072484
1967	3650	8200A	408	3344	1897	1809	19308	1045490
1968	6738	9204	1674	6302	164	804	24886	1074460
1969	8176	7491	1267	9039	175	909	27057	1117499
1970	5236	22534	1354	1470	225	5282	36101	1237815
1971	6002	4654	4664	4000C	69	1211	20600	1375478
1972	4451	16779	6141	7916	311	4535	40133	1625174
1973	7457	18045	7287	11705	9	2121	46624	2066733
1974	14534	27857	15215	20662	51	3306	81625	2747070
1975	21531	22771	19045	27325	11158	10000	111830	3991043
1976	19046	5015	15976	16713	12184	12444	81378	4273410
1977	22725	22384	14192	21530	31245	3655	115731	4769486
1978	20588	48808	14903	46438	54486	5482	190705	5186051
1979	21371	12405	13758	40000C	17911	4237	109682	5692783
1980	14534	33981	30246	26808	27828	7388	140785	6109091
1981	13009	83641	34397	41207	83111	16178	271543	5990926
1982	17000C	110000C	38000C	41725	44682	18000C	269407	5874971

A: Unofficial data
C: FAO estimate

The costs of tractor imports have risen more rapidly than the number of units. This is a reflection of the rising prices of the units and probably the growing power of the imported machines. Between 1977 and 1982, for example, these imports rose an annual average of 18.4% in value while the volume increased by only 10.2%. The classification of the six countries according to their imports by value and volume differ quite significantly and have changed during the past twenty years (see Table 21).

Table 21:
North Africa: Structure of Tractor Imports, Volume and Value

	Volume		Value	
	1961-65	1982	1961-65	1982
Algeria	30.0	24.9	35.9	40.8
Egypt	19.1	26.6	18.8	16.6
Libya	14.6	16.0	9.5	15.5
Morocco	11.9	6.8	13.0	6.3
Sudan	6.6	9.3	7.6	6.7
Tunisia	17.8	16.4	15.2	14.1

The comparison of the imports highlights two tendencies:

- For Morocco, Tunisia, and Libya, the relative importance of values and volumes evolve in the same direction.

- For the other three countries the variations are just the opposite. In Egypt, the variation suggests structural changes in its share of regional imports, with a probable bias towards smaller machines and less expensive models. In contrast, the growing unit value of tractors in Algeria suggests a trend towards larger, more powerful equipment.

An examination of the Egyptian case demonstrates that its turn toward supplies from the COMECON countries may have been instrumental in reducing the costs of tractor imports. At the present time about 88% of its tractor stock is based on designs from, or was directly imported from, that area. These tractors are clearly less expensive than similar models from the West (Table 22). These tendencies may change now that Egypt has opened its market to tractors from the OECD countries as a result of policy changes; this is in large measure the result of conditional aid from the U.S.

Table 22:
Egypt: Indicative Prices of 45hp or More Tractors, by Brands
(Egyptian pounds)

Origin:	Price
COMECON:	
IMR	3 500-4 200
Zetor 5011	5 000
UTB	4 600
AutoBella Russe (60-80hp)	5 000-5 200
IMT	4 800-5 000
Fordhit	6 000
OECD:	
Deutz 80 hp	9 000-10 000
Renault 80 hp	12 000
Massey-Ferguson	12 000

2.2.3. Suppliers by country.

Taken as a whole, the number of countries participating in the North African market is quite high. If these countries were divided in three blocs, **western market economies, eastern planned economies, and developing countries**, it becomes clear that the **first group** plays a dominant role in the region. The details about individual countries and equipment are interesting:

- In tractors, the **United Kingdom** controls most sales in Morocco (60-70%), **Italy** sells 15%. The **U.S.A.** presently dominates about 60% of the Egyptian market, and is slowly displacing **Italy, Japan, Spain** and the U.K. In Algeria, the U.S.A. and the U.K. account for about 60% of the imports; Japanese imports account for 10 to 50%, depending on the year. In Tunisia; **French** imports account for about 60% of the total, while **Germany (West)** and **Italy** cover another 15 to 20%.

- In soil preparation equipment, **France** supplies about 80% of the Algerian and 60% of the Tunisian imports. In Morocco, **France** and the U.K. both sell about 40% of total imports. In Egypt, **Italy, U.S.A., and U.K.** share about 80% of the market.

- In harvesting equipment the situation is more diverse. Moroccan imports come from **Germany (60%) and France (20%)**. These two also supply Tunisia with 60 to 70% of its purchases, along with the U.K. (10%). Egypt turns to **U.S.A. and Germany**, while Algeria depends in large measure (80%) on the U.S.A.

- Agricultural equipment from the **COMECON** countries goes principally to **Algeria and Egypt**.

- The developing countries supply very little agricultural equipment to North Africa. Some equipment from **Brazil and India** is delivered to Egypt.

2.2.4. Company participation.

An analysis of brands of tractors in the region shows no clear pattern. In Morocco, **Massey Ferguson** and **Ford** are dominant (45-60%); **International Harvester** follows (12-15%), along with **John Deere (8-10%), Fiat (10%), and Deutz (10%)**. Isolated imports of **EBRO** and **FURSUS** have only created short-term instabilities in the market. The closing of the **Massey Ferguson** assembly plant has opened new opportunities for **Renault**, which has joined with **Berliet Maroc** to gain a foothold in this market.

Massey Ferguson has also gained a dominant position (50%) in the Sudan. In contrast, in Tunisia and Algeria, the construction of an assembly plant by **Deutz** is leading to the displacement of **Massey Ferguson**. **Deutz** is also encountering competition from **Steyr** in Tunisia and **Fendt** in both Tunisia and Algeria.

In harvesting equipment, **International Harvester (IH)** is the principal seller in Algeria, Tunisia, and Egypt. However, its

position in the Algerian market is now threatened by CLAAS which has opened its assembly plant. Tunisia will probably also move in the same direction as the CLAAS assembly operation moves into full operation. The unstable market in Libya is dominated by MF.

The harvest combines imported into the region are principally from CLAAS: between 1973 and 1981 75% of the Sudan's imports were from that firm. In Morocco CLAAS and FAHR controlled about 60% of the market between 1977 and 1980.

2.3. Agricultural machinery exports.

The region's exports are insignificant. There is virtually no agricultural machinery industry in North Africa. That which exists is basically an assembly operation for imported parts. Although Algeria does have an industrial structure which could produce a broad range of products, it is not even able to supply its own needs.

Morocco exported 40 tractors between 1961 and 1982, while Algeria sold 81 and Tunisia 2. The GATT reports that Egypt exports small quantities of agricultural machines and equipment. These go principally to Yemen, Saudi Arabia, and the Sudan (Table 23).

Table 23:
North Africa: Number of Tractors Exported, 1961-1982

	MAROC	ALGERIE	TUNISIE	TOTAL	MONDE
61-65	8	34	*	42	388247
1966	0	0	0	0	412292
1967	0	0	0	0	409018
1968	0	0	0	0	420983
1969	0	0	0	0	435314
1970	31	5	0	36	473019
1971	0	24	0	24	437315
1972	0	13	0	13	495716
1973	0	5	0	5	586351
1974	0	0	0	0	691450
1975	0	0	0	0	768218
1976	0	0	0	0	853896
1977	0	0	0	0	897493
1978	1	0	0	1	803505
1979	0	0	2	2	833493
1980	0	0	0	0	821767
1981	0	0	0	0	805094
1982	0	0	0	0	714394

3. Future trends.

Agricultural activity in North Africa is severely handicapped by its low productivity. This is not the place to examine the many causes of this problem. But it is clear that the development and modernisation of agricultural machinery and equipment is an indispensable requisite for improving the agricultural situation.

In North Africa, there is a great deal to be gained by increasing and improving the use of agricultural machinery. The relation of land per tractor is still very high. From about 1

tractor per 40-50 hectares in Egypt and Libya, it rises to about 60 in Algeria and 90 in Tunisia in 1982. The under-equipment of Morocco and Sudan is evident (466 and 688 has. respectively per tractor in 1982) (see Table 3). In contrast, the developed countries use 1 tractor for less than 20 has.; in France, the ratio is 1:12 has.

This numerical scarcity of tractors is compounded by old age, lack of spare parts, and inadequate maintenance, which means that a large percentage of the available machines is not operational at any given time. The situation is equally critical for auxiliary equipment.

The potential demand for machinery and equipment is very great. The mechanisation effort is likely to continue, and new efforts will be made to increase local production and integration rates: this is likely to be particularly important in Algeria. But in the short and medium term, the demands of diversification and modernisation are such as to require growing imports. Mechanisation itself, however, will depend on other macroeconomic adjustment policies which make agricultural production itself attractive and provide purchasing power for local consumers.

In this context, it is likely that on a world-wide scale there will be ever-heightened competition among machinery builders for access to the North African market. It seems clear that these producers will have to develop strategies which will permit a larger proportion of the total value of this equipment to be built locally, generating employment and saving foreign exchange. The particular nature of this competitive struggle has already become evident, with the recent incursion of German firms and the privileged position of some COMECON countries. It seems clear, however, that other producers will continue to attempt to challenge these moves. Perhaps it might be possible for the countries in North Africa to take advantage of this situation to improve their own bargaining position in the process of expanding local production and better adapting it to local conditions.