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AN ANALYSIS OF SPARE PARTS SUPPLY AND REPAIR-MAINTENANCE PROBLEMS OF AGRICULTURAL MECHANIZATION IN LESSER DEVELOPED COUNTRIES - AN EGYPTIAN CASE STUDY 1/

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AN ASSESSMENT OF SPARE PARTS SUPPLY AND REPAIR-MAINTENANCE PROBLEMS OF AGRICULTURAL MECHANIZATION IN LESSER DEVELOPED COUNTRIES - AN EGYPTIAN CASE STUDY

Compiled by

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I. INTRODUCTION

The situation described and analyzed in the following case study is factual; it was synthesized from the findings of a comprehensive inquiry into the feasibility of "Further Mechanization of Egyptian Agriculture", 2/ undertaken in 1978. While the overall study primarily addressed the larger issue of the possibilities for and advisability of increasing the present level of Egyptian agricultural mechanization, including the identification and assessment of various strategy options open to the United Arab Republic Government in so doing, it also examined in considerable detail the overall nature and extent of current mechanization within the country's agricultural sector, as well as, assessing (to some degree) the associated spare-parts and repair-maintenance situation that exists. It is upon these latter aspects that this case study is (for the most part) focused, even though some time will be spent in reviewing the broader setting and historical framework within which this narrower area of concern is embodied, including the construction of a national, farm-equipment/mechanization profile and its analysis relative to this spare-parts repair-maintenance problems.

Also, in constructing this case study, it is fully recognized that regardless of the (high) degree of authenticity of the data upon which it is based, the resulting study depicts a country-specific situation, with the insight and references to be derived from its analysis having yet-to-be determined relevance to other lesser-developed countries (LDCs). Nonetheless, despite this limitation, it does provide a considerably more-detailed examination and assessment of overall spare-parts/repair-maintenance services and supply difficulties within an LDC than has commonly been available to date. Thus, it can usefully serve to exemplify the general magnitude and seriousness of these problems throughout the developing world; and, it is with this latter purpose in mind that this case study has been developed.

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II. BACKGROUND AND SETTING

Prior to the land reforms of 1952 and 1961, the overall level of mechanization in Egypt was very low. Advanced mechanization of any type was limited almost exclusively to the larger farms; and mechanization development progressed only at the rate larger land-holders found its adaption advantageous. However, because as much as 20% of the total cultivated-area (at that time) was farmed in units of 50 feddans or more, even restricting mechanization development to the larger farms still resulted in bringing a reasonable measure of technological improvement to a sizeable portion of the agriculture sector. Nonetheless, it affected only about one percent of the farmers and resulted in a very skewed benefit-distribution pattern, which did more than a little violence to the concept of social justice. The subsequent reforms were therefore in response to a much needed adjustment in the ownership and production/operation pattern of Egyptian agriculture; however, the implementation of these reforms also had a disruptive effect on agricultural production, as well as the rate of mechanization development.

A. Earlier Mechanization Policies and Programs

Consequently, in the early 1960's Egypt found itself at a very cruicial juncture in its agricultural development. It faced not only the task of repairing a disrupted production system, brought on by land reform, but also the urgent need to greatly expand agricultural production to feed a rapidly growing population and to maintain a high level of exports, especially cotton, needed to generate foreign exchange. An accelerated pace of mechanization development/improvement was required, including making mechanization available to the smaller units that had proliferated as a result of these recent changes in land ownership. Fortunately, the Government responded effectively with an innovative approach that was geared to both the needs and circumstances of the times.

1. Mechanization Development During the 1960's

Recognizing that Egypt's very small farms could not individually mechanize economically, the Government was able to induce a dramatic increase in mechanization through the establishment and promotion of cooperative-based custom tractor-services, which blended the goals of technological improvement and social justice. From a pilot experiment in two governorates in 1965, this innovative system spread rapidly to bring the benefits of mechanization within reach of even the smallest farms. However, while successful initially, this cooperative-operated system, with its limited built-in capacity for growth, could not keep pace with the effective demand for custom services; nor, has it in recent years served all farmers equally well. In addition, the system developed early-on administrative difficulties characteristic of such centrally controlled enterprises.

Noting these difficulties, however, takes nothing away from the vital role played by these cooperatives in pioneering an approach to agricultural mechanization that has been uniquely adapted to the structure of Egypt's agricultural economy. Actually, that it succeeded as well as it did, no doubt resulted in large measure from its consonance with the traditional practice among Egyptian farmers to share the use of work animals, water lifting equipment and other machine y and activities through joint ownership or other arrangements.1/ This point is discussed in more detail later on (Part III).

In any case, after an initial, several-fold increase in the level of tractor imports, starting in the latter-half of the 1960's the number of tractors being imported dropped off drastically, mostly for reasons external to agriculture; the result was that very little change occured in the size of national tractor fleet over the next several years. This situation continued until the early 1970's, marking a period of substantial disinvestment in tractor capital. However, despite this turn of events, the government-initiated launching of cooperative-based tractor services did build a viable market for custom operations; and, as that market developed, private custom-operators entered the field in rapidly increasing numbers, particularly during this 1965-73 period, utilizing rehabilitated machines imported earlier in the decade. However, despite this development, the availability of custom-services still lagged effective demand in the early 1970's.

2. Re-Expansion in the 1970's

1973 saw the end of the above stagnation period, with regard to mechanization development and expansion. It started with the adoption of an 'Open-Door Policy' that freed-up the importation of tractors and brought in its wake the makings of another era of rapid agricultural mechanization. With the removal of constraints to the importation of agricultural machinery of all types, including tractors, private dealers aggressively pursued the Egyptian farm machinery market; tractor imports jumped from the 1965-73 plateau of about 1200 per year to 6000 in 1977.

The effect was to make obsolete the cooperatively-based (custom) tractor service system, as an instrument of government initiative for fostering agricultural mechanization. More correctly stated, perhaps, success of the co-op system in pioneering custom service operations, together with the "Open-Door Policy', which gave private operators access to the equipment needed for expanding their operation, rendered obsolete the originally conceived purpose of engaging co-ops in the supply of custom tractor-services. Subsequently, the government has implicitly recognized the changed role of cooperatives, by essentially

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1/ Those concerned with mechanization policy in LDC's would also do well to build upon the strengths of existing traditional procedures and practices.

putting them on their own with respect to the financing replacement machines. Today, each co-op wishing to replace a worn-out tractor must have the necessary financing in hand - either from custom revenues or local borrowing on its own account - before ordering new machines. The only advantage they receive in terms of price or other conditions is that resulting from pooled import procurement by government-managed tenders. Considering the time inevitably required by the pooling and tendering process, some cooperatives no doubt would argue they pay a dear price for the relatively small savings gained by large-scale procurement. That, however, is but a part of a much larger question, that of the optimal role of government vis-a-vis cooperative-supplied custom machinery services; this question and debate will not however be taken up in this study.

3. The Challenge of Today

As in the early 1960's, Egypt (today) again stands at the cross-roads of mechanization policy. And, it is because of the recognition of this need to once more take decisive action that the Government has undertaken the overall feasibility study (referred to in Part I),from which this case study has been extracted. However, as noted above, it is not the purpose of this paper to discuss the role of the Egyptian government in guiding agricultural mechanization development over the years ahead or to identify/access the strategy options available to it, as it was in the feasibility study itself. Nonetheless, a few observations will be made while proceeding to describe briefly the general agricultural situation in Egypt, relative to its mechanization and, subsequently to examine in detail (Part III) the state of agricultural mechanization within the country. Finally, Part IV discusses parts and maintenance/repair problems that are the real focus of this case study, with Part V outlining the overall study's recommendations, relative to addressing this latter problem-situation.

B. Present Level and Structure of Agricultural Mechanization

As mentioned previously, following a decade of low-plateau imports of farm tractors and components for local assembly, starting about 1973, the number of tractors and the availability of custom tractor-services expanded dramatically; and, while the level of mechanization that has resulted is relatively high, it has not occured without its problems. Custom operators and farmer-users alike plunged into tractor farming with little experience to guide them. Even now, the accounting base used by cooperatives for setting custom rates typically disregards depreciation, leaving no profit margin to cover the cost of replacements, and tractor operators achieve only about 45 hp of performance from the commonly-used 60-65 hp machines. The Agricultural Extension Service has no program in machinery management;

research on tillage methods and other aspects of mechanization is meager in volume and seriously deficient in depth; and machinery dealers appear little-concerned with providing prompt, efficient after-sales service. In total, the ancillary services and facilities that typically support progressive farm mechanization are presently incapable of meeting the needs of even the present number of machines,much less the more-complex requirements that further mechanization of Egyptian agriculture would entail. However, before directly addressing this latter problem further (see Part IV for a more detailed discussion of this topic) let us first examine the present (general) level, structurae and operational-efficiency of mechanization within Egypt's agriculture.

1. Nature of Egyptian Mechanization

Not only has the before-mentioned custom of sharing agricultural equipment influenced the degree of agricultural mechanization but it has also dictated the structure which it has taken on. The spread and popularity of custom tractor services has enabled many small and medium sized operators to become tractor owners. As their own small acreages require only a fraction of a tractor's time, custom work has almost become a separate occupation for many small farmers and, in turn, a major source of family income.

Until 1977, to ensure that the limited number of tractors imported were fully utilized for agricultural purposes, only farmers who owned at least 20 feddans of land could obtain a license to import a tractor. This same philosophy and criterion was also generally applied by the Agricultural Credit Bank, other credit sources and dealers who imported tractors in bulk for sale to farmers. The freeing of imports by the Open-Door Policy of 1973 and recognition of the importance of custom services to agricultural production prompted abandonment in 1977 of both the licensing requirement and the 20-feddan criterion. That many small farm operators have taken advantage of this widened opportunity to buy tractors is evident from the number of one to three year old tractors owned by farmers with less than 5 feddans of cultivated land.

Joint use of sakias and other irrigation devices has been common practice in Egypt for generations. "Rights" to participate in the joint ownership and use of such equipment typically have been passed on from generation to generation. In fact the strong hold of tradition upon the size and composition of sakia-rings may well be the strongest single deterrent to modernizing irrigation water lifting. Those using irrigation water from a given sakia typically are joint owners of the equipment. Where motor-driven pumps have come in, users typically "rent" the pumpset; that is, they pay the pump-set owner a user charge. There is no evidence, however, that farmers have any more aversion to custom-hire usage of water lifting equipment than they do in the case

of tractors. In either instance they may complain about high custom rates, as did many of those interviewed in a survey of attitudes towards mechanization, but Egyptian farmers readily accept the custom-services system as a traditional and necessary way of gaining the benefits of farm mechanization.

2. Degree and Type of Mechanization

Relative to most LDCs, Egypt is fairly highly mechanized. That Egypt has reached its present degree of farm mechanization is due predominantly to the time-honored custom of shared-use of equipment, draft animals, and human labor. Only through a system of joint-use, based on custom services could tractor power have become available to the majority of Egypt's typically small farmers. Recent surveys indicate that about as high a percentage of farms of only 1-2 feddans use tractors for plowing and threshing as do units of 10-20 feddans. Today, only 23 percent of total tractor-hours are used by private owners of their own farms; few farms are large enough to fully utilize an economical-sized tractor. Privately owned machines are bought mainly for custom operations and this practice is so firmly established, that Egyptian credit institutions make tractor loans on the strength of borrowers' prospective custom operations. This combination of circumstances has not only greatly increased the extent of tractorization but has enabled a very widespread sharing of the benefits of mechanization throughout the country.

a) Tillage: In Egypt today, farm mechanization is limited largely to tractorization of primary tillage and the threshing of wheat and rice, as about eighty percent of all farmers still depend upon animal-powered sakias or man-powered tambours for lifting irrigation water. Even primary tillage and threshing operations are far from fully mechanized. Although about 70 percent of all farmers use custom-hire tractors for some plowing, there are only enough operable tractors available to cover 40 percent of the total area plowed each year. Consequently, even farmers who use custom-tractor service necessarily depend upon animal drawn baladi plows, drags and hand methods for seed-bed preparation and other tillage operations beyond initial plowing. Indications are that, with the general shortage of draft power and high farm wage rates, some farmers are foregoing the typical second plowing and others are skimping on seed bed preparation. Some larger operators appear to even forego planting of a second crop. Any of these means of economizing available power and labor obviously takes a toll of national farm production. It also follows that, until substantially more tractors are available, little progress can be expected toward yield-increasing mechanization of additional tillage operations.

b) Threshing: As for threshing, mechanization is similarly "partial", in both kind and degree. Country-wide, about half of all farm operators are reported to use tractor-powered drum threshers; another 10 - 40 percent, depending upon the kind of crop, use a tractor-drawn variant of the traditional animal-drawn norag. Drum threshers are used much more extensively for wheat and tractor-drawn sledges for rice. Reasons given are that rice threshes more easily and is much more subject to being cracked by drum threshing; also, wheat straw has to be pulverized for cattle feed, while rice straw is generally not fed to animals. These grain-threshing methods involve only partial mechanization, since winnowing remains to be done by hand. Using tractors for threshing reduces the already short supply of tractor power available for plowing and other seed-bed preparation operations. Although modification of the IRRI-type self-powered thresher-winnower to fit Egyptian farm conditions has been under way for four years, and a few prototypes were field tested on grain sorgum in the fall of 1978, no thresher-winnowers are in general usage.

c) Water Lifting: With respect to water lifting, the slow rate at which motor-driven pumpsets are replacing the traditional sakias and tambours appears to result from a combination of organizational and economic constraints. Even at today's relatively high milk and meat prices, there is little economic incentive for the five to ten farmers using a sakia cooperatively to shift to a motor-driven pump. Economical use of even the smallest diesel motor size would require that two or three present "sakia rings" join forces in an irrigation unit of 30-45 feddans. Neither the Agricultural Extension Department nor any other unit of government presently is engaged in encouraging and assisting farmers to take such steps. Even those who might take the initiative on their own are discouraged by the terms on which the agricultural credit system makes intermediate-term loan funds available.

3. Efficiency of Present Mechanization System

A combination of low tractor density and poor understanding of how best to utilize tractor power to increase production are chiefly responsible for the existing suboptimal mechanization of tillage operations. Currently, Egypt has only one operable farm tractor for each 475 feddans of cropped area. This translates into roughly .20 HP per feddan of cultivated land area, less than half the level already achieved by the more advanced developing countries. In many areas, notably Upper Egypt, current tractor density is well below the national average. A significant consequence of low tractor density is the farmers' apparent willingness to wait for custom tractor plowing even at the expense of getting their crops, particularly maize, planted late with resulting lowered yields. That customs tractor

plowing is both cheaper and faster than preparing land entirely with animal-drawn equipment and hand labor no doubt weighs heavily in such decisions. So, too, is the general scarcity of labor and power during the summer peak period when harvest, land preparation, and crop cultivation all require attention at the same time.

Lack of repair facilities and a chronic shortage of spare parts for the many makes and models of tractors in Egypt take heavy toll of the already small and aging farm tractor stock. Moreover, the low state of repair services severely limits the investment Egypt should make in additional machines unless the investments are accompanied by significant improvement in such facilities, spare-parts availability and machinery management in general. Today, farm machinery repair facilities range from mediocre to non-existent. More than a fifth of all tractors owned by cooperatives are inoperable; on State Farms developing the New Lands, more than half are reportably out of service. While no data are available on down-time, widespread reports of long waits for repair parts suggests they are quite substantial (See Part IV for a further discussion of these problems).

III. PROFILE OF AGRICULTURAL MECHANIZATION AND SCOPE FOR IMPROVEMENT

In terms of type and amount, Table 1 provides a current (1978) inventory of Egypt's national farm-machinery stock, broken down by number and percentage of equipment items owned privately and cooperatively. However, while briefly examining and discussing the country's overall equipment/mechanization profile, the main focus will be on tractors; the latter being not only the most important component of mechanization but also the one most affected by the spare-parts/repair maintenance problem, which is the principle concern of this case study. Regarding the latter, several aspects of the spare-parts problem, as well as the factors affecting it, are identified and discussed in this section, as they arise relative to analyzing the current state and condition of the Egyptian tractor stock. However, the full assessment of the magnitude of this problem and its impact on overall agricultural growth and performance is deferred to the following section (Part IV) of this paper.

A. Examining the National Farm Tractor Profile

While Ministry of Agriculture (MOA) provided some information on farm equipment, this was supplemented by a two-part semi-detailed farm machinery survey conducted to obtain information about the number of tractors, their use, condition and other characteristics. The survey was conducted by agricultural graduate students of the University of Alexandria. Two types of questionaires were used. One type was sent to half of the approximately 4000 village-level MOA representatives and another type to the other half. Nearly 2500 completed questionaires were returned, roughly the same proportion by type that was sent out. Together, the two parts of the survey yielded information on

nearly 7000 individual tractors and overall data from more than one-half the villages in Egypt.

Table 2 provides a summary of the findings of this farm machinery survey, supplemented with available secondary data from MOA and other sources. 1/

1. Tractor Numbers, Size and Trends

Based on results of the farm machinery survey, as well as other statistics, it is estimated that there are nearly 30,000 tractors on farms in Egypt today (1978), including those on State Farms as well as those privately and cooperatively owned. Table 2 provides a breakdown by Governorate and ownership category. As may be seen, essentially two-thirds are privately owned, with the remaining split fairly evenly between cooperative ownership and state farms.

With regard to size Table 3 provides a breakdown by size (and age), in terms of percentage based on findings of the farm machinery survey. The 46-50 HP size represents the largest single category (overall) for cooperatively owned tractors, whereas for the private sector the 61-15 HP category is the largest. However, in terms of the total percentage in the over 50 HP class, they are about the same in both groups, with the private sector having an overall greater total horsepower. This is particularly true if only the new models (year old or less) are considered.

Table 4 presents estimates of total tractor numbers and total horsepower for both the past, present and future, based on a feasibility study conducted for Massey-Ferguson and NASCO tractor manufacturing facility. These figures for the present estimate a smaller fleet than that derived from MOA numbers and the farm machinery survey. However, in any case it serves to illustrate the trend in numbers and in size as represented by total horsepower estimates.

Table 4 also serves to provide further evidence of this increased use of more and larger tractors, as does Table 5, which shows tractor shipments over a ten-year period (1968-1979). Without a doubt, these figures reflect a definite trend toward larger tractors.

1/ The overall feasibility study also included a farm management survey and a farmer's attitude survey, which yield information/ data relevent to the construction of a national farm equipment profile.

TABLE I - FARM MACHINERY INVENTORY, BY TYPE (1978)*

Item	Estimated Total No.	Owned Privately	Owned Cooperatively
	No.	Percent	Percent
Tractors	24,680	83	17
Tractor Plows	19,900	86	14
Subsoiler/ditcher excavator	125	88	12
Harrows	8,820	86	14
Planters	6,430	95	5
Irrigation Pumps:			
Electric powered	2,160	98	2
Diesel or gasoline powered	24,830	98	2
All motor-driven pump sets	26,990	98	4
Threshers and winnowers**	3,580	89	11
Dusters:			
Manual	2,580	98	2
Motor operated	960	8	92
Sprayers:			
Motor operated	160	38	62
Other	2,640	20	80
Spraying equipment:			
Motor operated & car carried	4,730	10	90
Motor operated & back carried	1,940	55	45
Manual and back carried	50,600	23	77

* Based on 2-part farm machinery survey, 1978 with cross-check reference to Ministry of Agriculture data supplied by respective Governorates. In addition to above numbers of implements MOA 1978 indicate the following are on the state farms reclaiming new lands: Chisel plows 2270; trailers 1704; drum threshers 631; mobile irrigation pumps with motors 1696; stationary irrigation pumps with motors 2588; and snapsack sprayers 600.

** Drum threshers and hand winnowers. Responses were unclear as to how the numbers reported are divided between the two pieces of equipment or whether the numbers given were intended to refer to each type. Indications are that Egypt currently has in operation some 3-4000 drum threshers.

TABLE 2 - ESTIMATED NUMBER OF FARM TRACTORS, BY GOVERNORATE, 1978*

Governorate	Co-op Owned	Privately Owned Number	State** Farms	Total	Cultivated Area per Tractor in Feddans
Alexamdria	10	216		226	297
Beheira	421	1917		2338	296
Gharbia	353	2000		2353	186
Dakahlia	141	3555		3696	167
Kafr El Sheikh	463	2112		2575	191
Danuetta	46	382		428	220
Menoufia	320	1072		1392	246
Kalubyia	158	673		831	246
Sharkia	606	2420		3026	223
Ismailia	17	104		121	356
Suez	8	11		19	200
Giza	112	450		562	302
Beni Suef	379	1022		1401	201
Fayoum	240	849		1089	280
Minyeh	409	1051		1460	329
Assiut	158	895		1053	341
Sohag	167	949		1116	287
Kena	142	571		714	490
Aswan	42	241		283	361
Total	4190	20,490	5336	30,016	249

* Based on 2-part Farm Machinery Survey, 1978 with cross-check reference to Ministry of Agriculture data supplied by respective Governorates.

** In addition to above tractors serving private farmers (both privately and cooperatively owned), MOA 1978 data indicate an additional 5,336 are on the state farms reclaiming New Lands. Of these only 55 percent were reported to be in operating condition.

TABLE 3 - SIZE OF TRACTORS ACCORDING TO AGE AND OWNERSHIP
(Farm Machinery Survey, 1978)

Co-operatively Owned

Age	Horsepower							Total
	40 & Under	41-45	46-50	51-55	56-60	61-65	66 & Over	
	Percent							
1	.6	-	6.2	6.2	18.8	17.2	50.0	100.0
2	-	1.2	1.2	4.8	3.6	13.3	75.9	100.0
3	-	-	3.3	36.7	3.3	36.7	20.0	100.0
4	-	3.2	3.2	3.2	-	51.6	38.8	100.0
5	2.7	-	2.7	5.4	6.8	67.5	14.9	100.0
6	-	-	2.7	-	8.1	75.7	13.5	100.0
7	-	2.9	14.7	-	35.3	41.2	5.9	100.0
8	-	-	15.0	15.0	17.6	50.0	2.5	100.0
9	-	-	26.3	-	36.9	31.5	5.3	100.0
10-15	-	6.3	47.4	27.5	4.5	11.0	3.3	100.0
15-20	-	6.7	46.6	40.0	1.7	3.3	1.7	100.0
20 & Over	4.2	25.0	20.8	33.3	-	16.7	-	100.0
Unspecified	3.0	3.0	32.8	20.9	4.4	29.9	6.0	100.0
Total	.5	4.7	32.6	21.2	6.8	21.4	12.8	100.0

Privately Owned

Age	Horsepower							Total
	40 & Under	41-45	46-50	51-55	56-60	61-65	66 & Over	
	Percent							
1	.5	2.0	6.7	5.1	20.0	42.3	23.4	100.0
2	1.1	4.7	9.5	3.3	20.2	46.2	15.0	100.0
3	1.2	7.8	17.3	9.9	16.1	36.4	11.3	100.0
4	2.9	6.6	14.7	10.3	19.9	37.5	8.1	100.0
5	2.7	8.4	17.6	8.7	20.3	38.4	3.9	100.0
6	4.0	9.9	17.0	12.9	15.8	35.1	5.3	100.0
7	2.1	7.7	25.9	15.4	23.7	21.8	3.4	100.0
8	4.1	13.8	28.7	13.2	22.4	15.8	2.0	100.0
9	-	15.8	31.6	15.8	19.3	17.5	-	100.0
10-15	6.2	19.9	37.8	15.1	10.5	8.8	1.7	100.0
15-20	14.2	32.6	30.9	11.4	4.6	5.8	.5	100.0
20 & Over	40.0	28.4	14.1	10.2	3.9	2.4	1.0	100.0
Unspecified	12.1	12.1	28.0	4.4	8.3	25.5	9.6	100.0
Total	5.8	12.9	21.7	10.0	15.2	26.2	8.2	100.0

TABLE 4 - TRACTOR PROJECTIONS

Year	Tractor Units	Average HP	1000 HP
1961 - 65 average	13607	45	612
1969	16962	45	763
1970	17500	48	840
1974	18597	55	1023
1977	21000	58	1218
1980	28700	60	1722
1985	37000	65	2405

Source: Adapted from feasibility report for Massey-Ferguson/NASCO tractor manufacturing facility.

The overall feasibility study indicates that 60,000 tractors plus associated implements could essentially replace all animal power currently used in Egyptian agriculture. The study further estimates that Egypt, practically, could reach a total tractor population of about 35,000 by 1985. Further, estimating a replacement rate of 2,500 units per year, an average sales of 4,000 new tractors per year between 1980-84 would be needed to reach this density. The latter was felt by the study-teams to be a realistic level of demand. However, the future demand for farm tractors, like that during the recent years of rapidly increasing numbers, will in the end be determined by the rates farmers are willing to pay for custom tractor-services.

In this regard very few farm operators can afford a tractor without using it extensively for custom work; and, even with today's expanding availability of custom tractor services, many farmers appear to have to wait for custom plowing and threshing services. This indicates a strong demand and custom rates that are acceptable to farmers in general. However, increasing tractor density, will heighten competition among custom operators, hence tending to keep service rates at fair and equitable prices to farmers.

TABLE 5 - TRACTOR SHIPMENTS, 1968 - 1977

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Units TOTAL	3719	3182	1901	1632	1670	1500	1952	2850	3398	6061
Less than 40 HP	--	--	600	--	--	--	1	3	3	65
41 - 50 HP	3749	2858	124	121	10	26	4	73	235	4
51 - 60 HP	--	174	1027	1153	604	335	562	1639	1353	1777
61 - 70 HP	--	150	150	150	986	1089	1273	961	1691	4201
71 - 80 HP	--	--	--	--	--	--	110	141	40	4
81 - 100 HP	--	--	--	3	--	--	2	3	--	3
Over 100 HP	--	--	--	--	--	--	--	--	15	4
Crawlers	--	--	--	205	70	50	--	30	61	3
Percent TOTAL	100	100	100	100	100	100	100	100	100	100
Less than 40 HP	--	--	31.6	--	--	--	--	0.1	0.1	1.1
41 - 50 HP	100	89.8	6.5	7.4	0.6	1.7	0.2	2.6	6.9	0.1
51 - 60 HP	--	5.5	54.0	70.6	36.2	22.3	28.9	57.5	39.8	29.3
61 - 70 HP	--	4.7	7.9	9.2	59.0	72.6	65.2	33.7	49.8	69.2
71 - 80 HP	--	--	--	--	--	--	5.6	4.9	1.2	0.1
81 - 100 HP	--	--	--	0.2	--	--	0.1	0.1	--	0.1
Over 100 HP	--	--	--	--	--	--	--	--	0.4	0.1
Crawlers	--	--	--	12.6	4.2	3.4	--	1.1	1.8	--

Source: Feasibility report for Massey-Ferguson/NASCO tractor manufacturing facility.

2. Other Characteristics of the National Tractor Fleet

The farm machinery survey provided detailed information on many characteristics of the Egyptian tractor stock, about which little had been known previously. Presented below is summary information on make, size, age and condition of the national tractor fleet:

a) Make and Ownership: Egypt's current tractor fleet is composed of at least 15 different makes, each ranging from perhaps 100 to several thousand in number. Table 6 provides further a breakdown of current tractor numbers by country of manufacture and/or make; Table 7 gives some indication of this mix over time - in terms of tractor sales by make and size.

TABLE 6 - TRACTOR PROFILE BY MAKE
AND/OR COUNTRY OF MANUFACTURE 1/

Make or Country of Manufacture	Reported from Farm Machinery Survey		
	Privately owned	Coop-owned	Total
Yugoslavian	1693	1662	3355
Rumanian	714	198	912
Russian	307	120	427
Letar	420	65	485
Fiat	84	16	100
Ebro	121	1	122
David Brown	94	67	161
Mony-Ferguson	86	1	87
IHC	121	16	137
Other	1051	123	1174
Total	4691	1269	5960

1/Survey covered 2500 villages and accounts for an estimated 20% of total national tractor fleet.

The purpose of the above information is to indicate the variety of tractor makes which complicate the spare-parts problem and contributes to the difficulty of maintaining a high percentage of the overall national fleet in working condition.

In this respect, Yugoslavian and Rumanian models make up about half of the present total, both assembled by NASCO. 1/ Most of the Russian-made Belaros Tractors, which were imported in the late 1960's, are getting old and informed sources say spares are next to impossible to come by. The same is generally true of the minor makes. The large number listed as 'others' has little significance other than indicating the difficulty of servicing such a variety of different makes.

Table 8 provides information on local manufacture (assembly) by make. Table 9,which is primarily structured to illustrate the age and condition profile of the National tractor fleet, also exhibits further evidence of the declining role of cooperatives as suppliers of custom tractor services. Tractor purchases by private owners have apparently far outstripped those of cooperatives, as evidenced by the significantly higher ratio of 1-3 years old tractors to older models within the private sector. In fact, it appears that co-ops, in general, are not even replacing their worn out machines; and, hence, are reducing their tractors numbers.

TABLE 7 - TRACTOR SALES (PUBLIC & PRIVATE)

Description HP / Make		1967	1968	1969	1970	1971	1972	1973	1974	1975	1975	TOTAL
		Y E A R S										
50	IMR Assm.	--	500	500	500	500	500	500	500	500	--	4000
60	IMR "	--	300	500	500	500	500	500	500	500	500	4300
65	Univ (Rom)	--	--	--	--	500	500	1500	1000	1000	1500	6000
54	Fiat "	--	--	--	--	--	--	--	--	504	--	504
60	IMR Imp.	--	--	--	--	--	--	200	500	300	--	1000
45	Otus (Rom)	--	500	500	--	--	--	--	--	--	--	1000
50	Zeilor	--	1000	1500	--	--	--	--	--	--	--	2500
60	TMT	--	--	--	--	--	100	--	--	450	350	900
60	Ebro	--	--	--	--	--	--	--	79	71	--	150
65	Univ	--	--	150	150	150	--	--	--	--	--	450
55	U550	--	250	100	150	--	--	--	--	--	--	500
45	Belaros	2000	1500	--	--	--	--	--	--	--	--	3500
50	Fordson Major	200	--	--	-	--	--	--	--	--	--	200
50	David Brown	300	200	--	--	--	--	--	--	--	--	500
50	John Deere	100	--	--	--	--	--	--	--	--	--	100
TOTAL		2600	4250	3250	1300	1650	1600	2700	2579	3325	2350	25604

Source: Ministry of Agricultu

Note: Assm. = Assembled
Imp. = Imported
(Rom) = Romania

In many villages, the number of privately owned tractors so exceeds that of cooperative owned units as to leave the co-ops essentially in the position of suppliers of last resort. However, with even a modest role in the custom service market, cooperatives can, and apparently do, provide a user-controlled means of keeping custom rates within reasonable bounds. That role likely will become less important as the number of privately owned tractors increase and competition among private owners regulates custom rates.

TABLE 8 - TRACTOR MANUFACTURE BY NASCO, 1962-1977

Year	Yugoslav IMR HP	Yugoslav IMR 60 HP	Romanian UT 65 HP	Italian Fiat (3-cyl)	"UK" MF 165 65 HP	"USA" MF 265 65 HP	TOTAL
1961	-	-	-	-	-	-	-
1962	426	-					426
1963	533	-					533
1964	537	-					537
1965	788	-					788
1966	1,078	-					1,078
1967	751	-					751
1968	564						564
1969	76	474					550
1970	-	1,176					1,176
1971	-	950					950
1972	-	251	976				1,227
1973	-	133	1,010				1,143
1974	-	-	1,201	58			1,259
1975	-	194	795	446			1,435
1976	-	561	1,132	1			1,694
1977	-	274	1,720	-	241	1	2,236
Total	4,753	4,013	6,834	505	241	1	16,347

TABLE 9 - AGE OF FARM TRACTORS BY CONDITION AND OWNERSHIP
FARM MACHINERY SURVEY 1978

Age	Privately Owned				
	Condition			All Conditions	
	Good	Fair	Inoperable	Percent	Number Reported
Years	Percent of total reported				
1	24.9	1.5	6.1	15.2	692
2	19.9	3.0	2.0	12.7	578
3	12.2	4.1	3.3	8.8	400
4	6.7	4.0	1.4	5.5	251
5	7.8	6.5	2.7	7.1	325
6	3.3	4.2	1.4	3.6	165
7	2.5	3.9	1.4	3.0	139
8	3.4	5.1	3.4	4.1	186
9	.9	1.9	1.4	1.3	60
10	4.3	12.6	6.1	7.6	347
Over 10 1/	14.1	53.1	70.8	31.1	1423
All ages	100.0	100.0	100.0	100.0	-
Total number Reported	2637	1781	148		4566

	Co-op Owned				
1	16.4	1.0	1.5	5.6	68
2	21.2	1.9	.4	7.2	87
3	5.9	1.7	.7	2.7	33
4	5.1	1.0	1.8	2.4	29
5	10.5	6.0	4.0	6.9	83
6	4.2	2.6	3.7	3.3	40
7	3.6	2.4	3.9	2.9	35
8	5.4	2.0	3.7	3.6	43
9	.8	1.5	1.5	1.3	16
10	4.0	8.7	9.2	6.6	90
Over 10 1/	22.9	70.8	70.6	57.3	691
All ages	100.0	100.0	100.0	100.0	-
Total number Reported	354	588	273	-	1215

1/ Of all privately owned tractors in this age group 66 percent were reported to be 10-15 years of age; 22 percent 15-20 years and 12 percent 20 or more years. Comparable data for cooperative-owned tractors are: 89 percent 10-15 years, 8 percent 15-20 years and 3 percent 20 or more years.

TABLE 10 - FARM MACHINERY SURVEY 1978

Make	Condition			All Conditions	
	Good	Fair	Inoperable	Percent	Number Reported
	Percent of total reported				
Privately Owned					
Yugoslavian	69.3	29.8	.9	100.0	1693
Rumanian	79.7	18.1	2.2	100.0	714
Russian	26.7	68.7	4.6	100.0	307
Zetor	51.0	45.0	4.0	100.0	420
Fiat	82.1	16.7	.2	100.0	84
Ebro	89.3	9.1	1.6	100.0	121
David Brown	43.6	51.1	5.3	100.0	94
Massey-Ferguson	77.9	19.8	2.3	100.0	86
IHC	59.5	35.5	5.0	100.0	121
Other	26.5	65.9	7.6	100.0	1051
All makes	57.0	39.6	3.4	100.0	---
Total number Reported	2673	1859	159	---	4691
Co-op Owned					
Yugoslavian	37.0	47.9	15.1	100.0	1662
Rumanian	28.3	40.4	31.3	100.0	198
Russian	15.8	48.3	35.8	100.0	120
Zetor	30.8	49.2	20.0	100.0	65
Fiat	87.5	12.5	--	100.0	16
Ebro	-	--	--	100.0	1
David Brown	10.4	62.7	26.9	100.0	67
Massey-Ferguson	--	--	--	100.0	1
IHC	6.2	--	93.8	100.0	16
Other	17.9	56.1	26.0	100.0	123
All makes	30.3	47.4	22.3	100.0	--
Total number Reported	384	601	284	--	1269

TABLE 11 - HOURS OF TRACTOR USE, BY TYPE AND OWNERSHIP

(Farm Machinery Survey, 1978)

Ownership	Type of Use					
	Plowing	Irrigation	Threshing	Transportation	Other	All uses
		Hours per tractor*				
Co-operative	291	8	162	96	-	557
Private						
Own farm	85	37	58	46	9	235
Custom work	271	28	260	100	14	673
Total Private	356	65	318	146	23	908
All tractors	345	56	291	137	19	848
		Percent of all uses				
Co-operative	52	2	29	17	-	100
Private						
Own farm	36	16	25	19	4	100
Custom work	40	4	39	15	2	100
Total private	39	7	36	16	2	100
All tractors	41	7	34	16	2	100
		Percent of total hours				
Co-operative	16	3	10	13	-	12
Private						
Own farm	20	55	16	27	38	23
Custom work	64	42	74	60	62	65
Total private	84	97	90	87	100	88
All tractors	100	100	100	100	100	100

* Inoperable tractors are excluded from base numbers.

TABLE 12 - FARMERS USING CUSTOM-HIRE TRACTORS FOR SPECIFIED OPERATIONS

(Farm Machinery Survey, 1978)

Farm Size* (cultivated area)	Users as Percent of Total Number in Size Group			Percent of All Users		
	Plowing	Threshing	Transp.	Plowing	Threshing	Transp.
feddans						
Less than 1	62.3	49.9	5.3	38.6	38.5	24.9
1 - 3	66.7	53.6	8.9	37.4	37.4	38.1
3 - 5	68.4	56.9	10.5	13.8	14.3	16.0
5 - 10	67.7	52.6	14.7	6.5	6.2	10.6
10 - 15	58.4	45.4	18.1	2.3	2.2	5.4
15 and over	65.1	50.3	30.6	1.4	1.4	5.0
All Sizes	65.0	52.2	8.6	100.0	100.0	100.0

* Wording of questionnaire unfortunately prompted some respondents to interpret farm size as area owned, instead of total area cultivated as was intended. This resulted in some downward skewing in the farm size distribution. Indications are, however, that this skewedness does not seriously affect the general conclusions regarding custom tractor usage. The Farm Management Survey which did reflect operating units found an even higher percentage of very small farms using tractors for plowing—a difference well within the range of sampling error.

b) Age and Condition: In addition to Table 9, which provides information relative to age and condition of Egypt's tractor fleet, Table 10 relates their condition to make and ownership. However, as age strongly affects condition, it is doubtful that any significance should be attached to differences between makers other than with regard to its importance from the standpoint of keeping the various makers in good working condition. Age, itself, is also relevant to the problem at hand - namely the need for replacement parts and the problems associated with their provision. With more than one third of all farm tractors over 10 years of age, replacement needs will be high over the next several years. Part of the investment that buyers are able and willing to make in new tractors, consequently, will go to replacing machines too old for economical repair. To be sure, in terms of power available, replacements may add nearly as much as do additions to the existing stock; nonetheless, they are a factor to be reckoned with in estimating the feasible degree of mechanization of the next several years.

With regards to their condition, more than one-fifth of all cooperative-owned tractors were inoperable at the time the Farm Machinery Survey was conducted. Three percent of the privately owned tractors likewise were reported to be inoperable. These ratios indicate that approximately 1500 of Egypt's apparent tractor stock is not in operable condition. In both instances, 70 percent of the inoperable units were more than 10 years old; however, this does not mean that with proper repair those tractors could not work for several more years. A surprising number that were 20-25 years old reportedly did several hundred hours of custom work during the preceding year. Even more surprising are the numbers of fairly new machines reported to be inoperable. As there was no indication as to how long the respective tractors had been inoperable, some may only have been waiting for spare parts. In many instances, though, the number of hours worked indicated the inoperable tractors had been out of service for some time.

c) Annual Use: Table 11 mainly confirms several popular impressions about tractor useage in Egyptian agriculture. That is, tractors are used mainly for custom work, accounting for roughly 80 percent of all tractor hours; plowing and threshing account for the bulk of all tractor hours; and, co-ops utilize their tractors less effectively than do private owners.

The gross data for irrigation and transportation are, however, somewhat misleading in terms of general practice. Inspection of the individual reports of the survey indicate that a high percentage of the tractors used for irrigation are quite old; hence, they may have little other utility than as stationary power units. Also, the transportation data are heavily influenced by the fact that some operators use their tractors a large number of hours per year for hauling bricks. Indications are that, by and large, farm transportation is a small factor in the total use of most tractors.

As regards optimal tractor power for the years ahead, interest in Table 10 data centers upon: the possibility of increasing total tractor hours per year, especially those of co-op owned machines; reducing the hours devoted to threshing, so as to make more time available for widening tractor use in land preparation; and, the prospect of transportation becoming a large claimant upon total tractor hours. However, it seems doubtful if average annual use can be expected to go much above the 900 hours now realized by private operators, despite Egypt's custom-based system and the two-season characteristic of its agriculture, which enable tractors to work more hours than is normally the case in many other countries. The increased use of tractors in transportation could be a noteworthy exception to this predication. In any case, with more efficient threshers, enough tractor time could be saved to extend tractor plowing to a larger acreage, including the proper preparation of seed beds using modern tillage equipment.

d) Users of Custom Services: With respect to the users of custom services, Table 12 indicates that access to these services has brought tractor power to even the smallest Egyptian farmer. To avoid confusion it must be stressed that the data in Table 12 refer to the number of users, which is not necessarily the same as the percentage of a given operation performed with tractor power. For instance, the tractor hours used for plowing in Table 11 indicates that about 40 percent of all plowing is done by tractor; whereas, column 1 of Table 11 make it clear that many farmers use a tractor for plowing but are doing their second plowing with animal power.

Optimizing tractor power necessarily must include consideration of the way the benefits of mechanization are shared among different groups of farmers. So far as could be discerned, the only economies of scale under Egyptian conditions are those that result from reduced hired labor requirements on the one hand and the reduced milk and meat losses on the other. The former obviously favors operators of larger than family farms; the latter would favor the smaller-sized units. Over all, small farmers probably benefit nearly as much percentage-wise from the use of tractors as do the larger ones which have a high cropping intensity. As large farms presently have a lower average cropping intensity than small ones, they have more scope of increasing crop production. As increased tractor power will enable such operators to use their lands more intensely, they and the nation benefit more from mechanization than do families tilling only 1-3 feddans.

B. Opportunities for Improvement

In general terms, the priority opportunities for mechanization to increase farm production in the near term can be visualized most easily as forming four links in a typical means-end chain. Taking the desirability of increased farm production for granted, the end-point of this sequence becomes those on-farm operations that directly

affect output. The preceding link comprises the equipment and inputs of technical expertise which enable and/or encourage farmers to efficiently mechanize farming operations. Standing as a means toward that intermediate end is the Egyptian support system comprising a wide range of elements from broad program management, including research and development, to the provision and/or promotion of adequate repair/maintenance services and replacement-parts supply. With regard to formulating a plan for exploiting these opportunities, below is the outline of the guidelines proposed in the feasibility Study Report.

1. Further Mechanization of Farming Operations.

The most promising areas of opportunity for directly increasing production in Egypt, relative to further mechanization appear to be:

a) Better seedbed preparation, which can result if farmers use more appropriate equipment, achieve a higher tractor density and have a better understanding of the relationship between tillage practices and crop yields.

b) More timely planting, which, assuming no change in relative product prices, again depends mainly upon increased tractor density, use of more appropriate equipment and, most importantly, better appreciation by farmers of the relationship between timely planting and crop yield.

c) Increased sub-soiling and precision leveling operations of the roughly three-million feddans of Class III and IV lands so that yields, particularly for cotton, can be dramatically increased; and, leveling the one million or so feddans (mainly in upper Egypt) - which are sorely in need of it, for efficient irrigation.

d) Replacement of animal-drawn sakias with motor-driven pumpsets which would have the result of increasing milk and meat production significantly.

e) More diversified use of tractors extending tractor usage from plowing and threshing operations (to which it typically is presently limited) to additional tasks in land preparation, planting and cultivation. More diverse use of tractor power is part and parcel of the "more appropriate equipment" prerequisite for achieving the yield-increasing effects of better seedbed preparation and more timely planting alluded to above. Achieving more diverse tractor usage, however, depends upon an increased number of tractors, keeping those available running and reducing the inefficient use of tractors for powering drum threshers.

f) Placing thresher-winnowers and mechanical grain harvesters into general use to save grain, free tractors for more efficient operations in field work; ease current peak season shortages of both power and labor; and, in turn, permit more timely planting of maize, in particular, and other affected crops in general.

2. Relieving Equipment Constraints

Implicite in the above recommendations of how to achieve greater agricultural productivity and output through further mechanization is the companion need to significantly increase the number and type of tractors and other equipment to serve these needs. With regard to the latter, priority should be given to the following:

a) Tractors to expand custom operations and make tractor services available to farmers on a more timely basis.

b) Subsoiling and land leveling equipment to enable the Soil Amelioration Organization to at least double its subsoiling operations over the next five years and to demonstrate the benefits of precision land leveling sufficiently to develop a market for private custom work in this field.

c) New types of land preparation, planting and cultivation equipment to capitalize upon the yield-increasing potential of improved tillage, better seed placement and the freeing of labor from hand cultivation during the summer peak season for more timely attention to other crop operations.

d) Self-powered thresher-winnowers and mower-binders to reduce grain losses, release tractors for field work and reduce turnaround time between summer crops, making possible more timely planting of crops following wheat, rice and grain sorgum.

e) Motor-driven pumpsets (mostly diesel) to free cows and buffaloes from draft work, thereby increasing the production of milk and meat; and, to relieve children, women and elderly family members from the drudgery of minding the animals pulling sakias.

3. Improving the Service-Support System

As will be analyzed and discussed in detail in Parts III and IV, this is a crucial and presently inadequate link in the overall mechanization development chain. There are urgent needs to strengthen and expand this component, even if the existing farm equipment/ machinery stock were not to be augmented. With any increase in numbers and types of tractors and equipment the aggressive action on all fronts indicated below becomes essential prerequisites, if the sought-after increases in production are to be obtained, as well as achieving an acceptable financial/economic return on the investment.

a) Better management of machines by farmers and custom operators to improve the contribution of equipment to increased farm production. Significant opportunities were found for small-shop fabricators to increase their effectiveness in meeting urgent needs for spare parts. Mainly, what is needed is a better understanding among farmers and others in the food production chain as to the importance of and methods for equipment management.

b) Improve repair facilities and availability of spare parts which would have the same effect as increasing the farm equipment stock by reducing down-time and lengthening the useful life of machines.

c) Modernize local manufacture capacity for farm equipment other than tractors to ensure an adequate supply of new types of machines to meet functional requirements of Egyptian agriculture. Managers of these plants should orient their efforts to market development and establishment of local dealerships with on-hand stocks of major machinery items and spare parts.

d) Expand and improve farm mechanization research and development to provide an improved basis for policy planning, program administration, extension education and to develop new types of equipment to take advantage of opportunities as they arise for further mechanization of particular crop operations.

e) Increase effectiveness of on-going machinery introduction programs by broadening the range of items to include required, new-types of equipment and by gearing machinery introduction efforts more positively to market development.

f) Increase the supply of trained mechanics available to man the local repair facilities essential to efficient repair and maintenance of farm equipment.

g) Establish a more effective management information system to provide program leadership on a timely basis with a flow of information needed for policy guidance.

IV. MAGNITUDE AND IMPACT OF SPARE-PARTS/REPAIR-MAINTENANCE PROBLEMS.

As presented and discussed in the preceeding sections (Parts II and III), the Farm Machinery Survey, in conjunction with other (secondary) informational sources, has provided data for a rather comprehensive analysis of the present state of mechanization within Egyptian agriculture. It has also afforded a basis for assessing the extent and seriousness of the spare-parts and repair-maintenance problems, which is not only the central concern of this case study but also a major impediment to both realizing the full productive and economic benefits of the farm mechanization that has taken place as well as achieving the expansion and improvement, necessary to underwrite the accelerated rate agriculture development urgently needed.

Unfortunately, this assessment relies largely on proxy indicators derived from examining the 'condition profile' of Egypt's national tractor fleet; little in the way of direct information from surveying/analyzing existing repair facilities and replacement-parts supply systems or their capabilities is available. Neither has there been any direct examination of the down-time and/or field-time lost due to

lack of spare parts or unavailability of local repair shops, although some overall evaluation was possible from the information gained.

In this section, the focus is exclusively on the spare-parts/repair-maintenance problems, starting with a consolidation of the observations and findings noted in Part III, relative to the working conditions of Egyptian farm tractors and the resulting implications about the state and quality of existing service-support systems. It concludes with an attempt to more fully determine the magnitude of these problems in various quantitative terms, as well as their economic impact on the economic well-being of Egyptian farmers, the productivity and output of Egypt's agriculture sector and the overall growth of the economy.

A. General Assessment of Service-Facilities Infrastructure

Although no detailed survey and/or analysis of service facilities were undertaken, as was done relative to farm machinery and equipment itself (particularly tractors), some general assessments as to the availability of repair shops and replacement parts and the quality of service support systems have been possible. For the most part, as noted earlier, these range from mediocre to non-existent in most localities; moreover, this unfavorable situation is taking a heavy toll on Egypt's farm tractor stock. It is costing the country an estimated one-half million hours in lost tractor-time annually, as a result of both excessive down-time and the relatively large number of machines that remain permanently inoperable because of the unsatisfactory conditions relative to one or both of two determining factors - inadequate repair/maintenance facilities and unavailability of needed replacement parts.

1. Pattern and Density of Service Facilities

As also noted earlier, all tractors are imported into Egypt, even though about 2,000 of them have been assembled locally each year since 1972. All spare parts are likewise imported, except for a few made-to-fit replacements (mostly for non-tractor items) and those that come from robbing other, disabled units that are inoperable; the latter is a common practice in most LDCs and a growing one in Egypt, especially among older-model tractors, whose spare-parts are next to impossible to obtain.

Several companies, both in the public and private sector, import tractors and act as dealers, including those that act as distributors for tractors assembled in the country. Some have one or more larger workshops that can perform major overhauls. A few also have stations in outlying areas that represent the importer, carrying a limited supply of spare parts and having ability to repair or make arrangements for repairs with local (private) repair shops. However, company repair-stations, somewhat like their sales offices, tend to be

located in or close to the larger cities, like Cairo and Alexandria. A few have a reasonable good network of branch outlets throughout, having replacement parts for sale and a capability to do repair work on their premises.

Another aspect of the problem is that, although parts inventories are sometimes large, too often the mix is wrong - they do not fit current models or are made up mostly of infrequently-used items. The result, shortages of those parts most needed and a costly over-supply of less-required and/or obsolete replacements. Mechanics often search for 'will-fit' parts, with several days or more required to locate something that will work. Spot checks indicate that the number of overhauls being performed in some localities are only 30 percent of what would be expected, given the size and age of the tractor stocks in those areas.

With regards to agricultural implements, local manufactures typically do not maintain spare parts inventories. Implements are relatively simple in construction and replacement parts are manufactured as needed. Some parts, such as chisel points which wear and require replacing on a regular basis, are manufactured in some larger plants and local shops, but usually on a demand basis. Buyers of agricultural implements normally buy the implements directly from the factory. When repairs are needed, either a local repair shop or the original manufacturer is contacted. Much of the repair work is done by private mechanics who have learned by trial and error, rather than through formalized training by equipment manufacturers. While many of them are quite good, they are limited in their ability to handle specialized problems due to the lack of workshop facilities, testing equipment and/or their access to procurement of spare parts.

In summary, manufacturers and importers of agricultural tractors and equipment operate through central sales offices and a few large repair facilities. They lack local outlets for parts and service which leads to poor or no preventive maintenance for a large percent of the machines, excessive down-time for those undergoing repair and/or too large a number that are never returned to service because parts cannot be found or repair facilities are too distant.

2. Machine Condition As A Measure Of Support-System Quality

Overall, between 7-8 percent (7.5 percent of those surveyed) of all tractors on Egyptian farms may be inoperable. In addition, another 41 percent are estimated to be in less than 'good' working order. Thus, based on estimates of overall tractor stocks in the country, as many as 2,250 tractors may be permanently inoperable and up to 12,300 more in only 'fair' operating condition. Table 13 provides a summary picture of the 'condition-profile' of Egypt's overall tractor stock, based on results of the Farm Machinery Survey and estimates of the country's total tractor inventory.

a) Examining the Condition Profile Further: As noted in the previous section (Part III), in general, the condition of privately-owned units is significantly better than those owned cooperatively, with 22.3 and 47.4 percent of co-op owned tractors surveyed found to be respectively inoperable and in only 'fair' condition, as compared to 3.4 and 39.6 percent for those privately owned. Consequently, less than one-third (30.3 percent) of cooperatively-owned tractors are in 'good' working order and only slightly over one-half (51.5 percent) of Egypt's total tractor stock can be classified as better than 'fair' in terms of operating condition.

In terms of age, while by far the largest share of inoperable tractors are over 10 years old (70.2 percent), as shown in Table 14, only 14.1 percent of all tractors surveyed in the 'over 10 years' category were found to be permanently out of working order (See Table 15). A rather impressive record, that gives some indication of the attitude and repair/maintenance efforts of Egyptian farmers generally. Table 15 further provides a cross-sectional examination of the age-profile of tractors in terms of condition and ownership. As may be seen, the figure for inoperable tractors, 10-years old or over is about four-times as high (27.8 percent) for cooperatively-owned units as those privately-owned (7.3) and twice as high as the over-all average.

However, returning to Table 14 for a moment, it is interesting to note that, while the proportions of inoperable tractors in the 'over 10 years' category are essentially the same for both ownership classes (70.8 percent for privately-owned; and, 70.6 percent for cooperatively-owned), it differs considerably in the younger-age categories, with a higher ratio of the privately-owned tractors in the 1-5 years old class 15.5 percent,found to be inoperable as compared to only 8.4 percent for the cooperatively-owned class. The same relationship holds true for those in 'fair' condition; 19.1 percent of privately-owned tractors classified as only in 'fair' condition were less than six-years old, with the level at only 14.2 percent for cooperatively-owned machines. Needless to say, the relationship reverses for the '5-10 year' categories. This phenomenon is most likely related to age-structure differences between the two ownership classes; however, the underlying causes and the implications are not totally clear.

TABLE 13 - CONDITION OF NATIONAL TRACTOR STOCK 1/

Condition of Tractors	Privately Owned		Cooperatively Owned 2/		Overall	
	Number	Percent	Number	Percent	Number	Percent
Good	11,679	57.0	2886	30.3	15,458	51.5
Fair	8,114	39.6	4515	47.4	12,307	41.0
Inoperable	697	3.4	2125	22.3	2,251	7.5
Total	20,490	100.0	9526	100.0	30,016	100.0

1/ Estimates projected on basis of results of Farm Machinery Survey, covering 2,000 villages and 7,000 tractors, and estimated total tractor stock shown in Table 2.

2/ Includes tractors on State Farms.

TABLE 14 - CONDITION OF TRACTORS IN TERMS OF AGE & OWNERSHIP

Age Range	Privately Owned			Cooperatively Owned			Overall		
	Good	Fair	Inoperable	Good	Fair	Inoperable	Good	Fair	Inoperable
1-5 years	71.5	19.1	15.5	59.1	14.2	8.4	70.0	17.1	10.2
5-10 years	14.4	27.7	13.7	18.0	17.2	22.0	14.7	25.3	19.4
Over 10 years	14.1	53.1	70.8	22.9	70.8	70.6	15.2	57.6	70.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 15 - AGE OF TRACTORS IN TERMS OF CONDITION & OWNERSHIP

Condition	Privately Owned			Cooperatively Owned			Overall		
	1-5 years	5-10 years	over 10 years	1-5 years	5-10 years	over 10 years	1-5 years	5-10 years	over 10 years
Good	83.0	41.3	27.1	69.8	28.6	11.8	82.1	39.2	22.1
Fair	15.1	55.2	66.6	22.2	45.3	60.4	16.1	53.6	63.8
Inoperable	1.9	3.5	7.3	8.0	26.1	27.8	1.8	7.2	14.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

b) Implications Relative to Spare-Parts/Repair Maintenance Services: Perhaps the most revealing finding, with respect to indicating the seriousness of the spare-parts and repair- maintenance problem and how it reflects the quality of existing service-support systems does, however, relate to the above statistics. Almost two percent of all 1-5 year old tractors are out of working order; an additional 16 per cent are classified as only 'fair',in terms of operating condition. Moreover, the figures increase to 7.2 and 53.2 percent respectively for tractors in the 5-10 year old age-group. As would be expected from earlier comparisons, the percentages for cooperatively-owned tractors are even higher; 8 per cent of 1-5 year-old (co-op owned)units are unoperable and another 22 percent in only 'fair' condition. The situation worsens for 5-10 year-old machines - only one-fourth (28.6 per cent) of those cooperatively-owned were found to be in 'good' working order.

Consequently, while the quality of service-support systems generally appear to be poor, they are even less-satisfactory for cooperatives as a group, even recognizing that the average age of cooperatively-owned tractors is considerably higher than those privately-owned.

In addition, while the data has not been thoroughly analyzed in detail, there is rather clear evidence that the quality of services deteriorates further with movement away from the larger metropolitan areas, as reflected by differences in these 'condition' statistics based on geographic distributions. Such a conclusion supports the earlier descriptive assessment, helping to better establish the nature and location-specific characteristics of the problem.

B. Overall Assessment of the Situation

In summarizing the above assessment, it becomes clear that, even without precise or detailed information, relative to existing maintenance-repair/spare-parts services, the quality and/or level of Egypt's service-support system performance is low and contributing to economic losses to producers, custom operators and the economy as a whole, as well as acting as a constraint to achieving the full and much-needed productive potential of the country's agricultural sector. In total, it is estimated that as much as 500,000 hours of potential tractor-power is lost annually due to inoperable tractors, both temporarily and permanently. This represents a significant loss to the economy in the form of reduced yields due to late planting, poorer tillage and seed-bed preparation than otherwise would have resulted, as well as other undesirable effects; not to mention the losses to tractor owners from having their equipment out of service for extended periods.

1. Magnitude of Losses

No attempt will be made to place a monetary value on these losses but, based on the above figures, the cost of down-time due to lack of spare parts and/or the distance to adequate repair facilities, and the delays this causes, is staggering. Farmer reports of waiting 3-6 months for replacement parts are by no means uncommon. Nor does this reflect the other dimension of the repair services/spare parts problem - the large number of tractors reported as only in 'fair' operating condition. That so many younger machines are in this category, as well as actually inoperable, suggests poor maintenance. While this no doubt reflects, in part, owners' general lack of appreciation of the importance of preventative maintenance, it also is a result of the widespread lack of convenient access to service facilities and the difficulty of finding even such simple items as oil filters contribute to the problem.

With respect to other farm machinery, the repair/spare parts situation apparently is not nearly so critical as it is for tractors. Except for a comparatively few diesel and electric powered pump sets and some sprayers, tractors are the only motorized machines currently found on Egyptian farms. Sakias, plows, sprayers, and even the water pumps used with imported engines are fairly simple in construction and are locally manufactured. Additionally, farmers know how to repair these implements themselves; village blacksmiths can make parts or even entire pieces of equipment; and, if necessary, the manufacturer can be reached in a few days. At worst, complete replacement of these types of farm machinery if they become totally inoperable does not require major investment. However, despite this relatively more-favorable situation for non-tractor, machinery items, the losses due to poor maintenance-repair facilities and inadequate and/or inconvenient spare-parts supply to service this equipment is also costly to producers and to the nation.

2. Causal Factors

a) Attitude of Farm Machinery Dealers/Supplies: That service facilities are so inadequately able to provide for self-evident needs is attributable in no small part to lack of initiative on the part of machinery dealers. Even though it has tried, NASCO2/, long the predominant supplier of farm tractors in Egypt, does not have an effective dealership system in place. Their mainly private outlets, like Egyptian dealers in general, prefer to keep their offices in the major cities and let customers come to them. This practice stemmed no doubt from several years of a strong sellers market when relatively few tractors were imported. When the Open Door Policy of 1973 freed the importation of tractors and many individuals suddenly became "dealers", there developed no spirit of dealer outreach and service to local communities. Still today, with in-country tractor supplies pressing hard upon the market, a farmer from upper Egypt who wants to

buy a tractor has to journey to Cairo and make his purchase in a dealer's office. For all practical purposes this is a catalogue store, not a place where equipment can be inspected or operated. Needless to say, this view of proper dealer/customer relations does little for either the accessibility or quality of after-sales services.

While the parts/service problem today relates mainly to tractors, it will grow in both volume and complexity as farm mechanization in Egypt becomes increasingly sophisticated. Water lifting will become more motorized. Self-powered thresher-winnowers will replace tractor powered drum threshers and release tractors for field work. New-type threshers will require more attention by skilled mechanics than do the drum thresher and hand-turned winnowers now in use. These and other technological advances will force increased farmers' dependence upon repair, service and spare parts supply facilities outside their own villages.

Even the cooperative system, which maintains its own spare parts inventory and supply facilities, experiences delays in repairing co-op owned machines equal to those faced by private tractor owners. Much, but not all, of the difficulty appears to lie in the cumbersome and time-consuming procedures required of the village co-op manager to get parts. Simplifying those procedures would help. However, this alone would not remedy the larger problem, namely that of bringing repair services closer physically to the co-ops where the inoperable tractor is located.

b) Regulations and Policies: As discussed earlier (Part II), not only does broad policy decisions affect directly the rate and extent of agricultural mechanization development, but it also affects the system and means by which this development takes place, which in turn influences the farmer, and, more importantly, its impact on overall agricultural development. The affect on the establishment of an adequate and well-functioning service-support system is a case in point. However, over and above the national policies a government may pursue, it is the body of regulation and rules concerning day-to-day administration that give these policies practical effect. Thus, planners concerned with agriculture mechanization must look beyond broad policies in estimating how any proposed intervention may affect development efforts.

In Egypt's case, several policies and regulations such as the 'Open Door' policy, the minimum (20 feddans) acreage requirement to acquire tractor import license or size requirements as preconditions to obtaining tractor-purchase loans from the Agricultural Development Bank, have all affected the pattern, extent and rate of farm mechanization. They have also indirectly affected the quality of service-support systems that developed and, ultimately the quality of maintenance

and conditions of the agriculture equipment stock within the country. Another regulation, more directly affecting the development of dealer-associated service facilities is the narrow profit-margin which the government allows private dealers handling NASCO-assembled tractors. It gives dealers no incentive for localizing either their outlets or their after-sales service capabiiities.

Perhaps the most deleterious set of regulations affecting machinery maintenance is that which the co-op system applies to the repair of their tractors. In concept, the related procedures are laudable as they are ostensibly designed to give local co-ops ready access to spare parts and minimize opportunity for profiteering by their managers. In practice, however, the control aspect seems to dominate. As a result, the time and red tape involved in obtaining parts is said to discourage many local co-ops from making repairs that would keep their machines in operation. At a minimum, down-time reportedly is excessive. Much the same outcome results from NASCO's administrative practice of selling spare parts only to purchasers of tractors. This reportedly is intended to minimize the black-marketing of parts. Desirable as that objective may be, NASCO's method of furthering it deprives owners of other tractors needing repair of access to the best organized source of tractor parts currently in existence.

3. Remedial Steps in Process

Discouraging as the repair/parts picture is, there are some bright spots. Plans have been developed in several quarters for coping with the problem, and some remedial action has been started. Thus, the climate is unusually favorable for directed action to bring competent repair facilities and an assured supply of spare parts within convenient reach of tractor owners. And the plans themselves, though largely paper at present, provide a valuable body of informed Egyptian judgement on which to build a remedial strategy.

Bringing repair, maintenance and dealer services much closer to local communities than they are today is a central focus of Egyptian planning and action. In this area the MOA plan, still in the incubation stage, visualizes a network of privately owned and operated service-dealer facilities with Ministry of Agriculture monitoring to assure that farmers get dependable service and can find spare parts when they need them. As a stop-gap, the Ministry also pools procurement of major spare part items on behalf of the cooperatives, private dealers and the two quasi-private corporations that are extensively engaged in the farm machinery business. NASCO has for some time operated a system of small mobile teams to work their own dealers in providing after-sales service during the tractor warranty period. They also maintain a stock of spare parts for the types of tractors they assemble. These are available through dealers to purchasers of NASCO tractors. Massey-Ferguson has tried the mobile-van repair service approach on a limited

scale and has evolved a plan much like the Ministry's for area dealer-service centers in connection with the prospective MF-NASCO private sector joint venture for manufacturing tractors in Egypt.

Although differing in detail, all the plans and trial approaches the Study Team encountered shared two basic objectives: (1) to make competent repair and maintenance services easily accessible to equipment owners and (2) to provide for private ownership and operation of repair facilities. The latter is established government policy in keeping with the more generally applied Open Door Policy. It also reflects the conviction of MOA farm mechanization leadership that only through private initiative will Egypt develop an efficient network of farm machinery repair and maintenance facilities.

V. RECOMMENDATIONS FOR IMPROVING THE SERVICE-SUPPORT SYSTEM

As noted earlier (Part I), the purpose of the overall investigation and analysis, from which this case study has been extracted, was to determine whether increased mechanization of Egyptian agriculture would be beneficial; whether it would improve the economic returns and well-being of farmers; and, whether it would result in greater productivity and output from the country's limited agricultural resources. However, as also noted in Part II and further documented in Parts III and IV, Egypt's repair-maintenance and replacement parts supply-system is grossly inadequate and is in need of urgent and extensive improvement, even if the present level of mechanization were not to be increased. With any expansion in agricultural mechanization, as recommended by the study team, this need for an aggressive program to establish a countrywide network of repair-service/part-supply facilities becomes crucial.

A. Outlining An Improvement Strategy

Given the complex of considerations (described in the preceeding section - Part IV), the overall feasibility study team recommended a three-part strategy for improving the quality and performance of Egypt's service-support system, which in the main would serve to energize the Ministry of Agriculture's (MOA) and private sector plans already in the making. In general, this strategy calls for external economic and technical assistance that would:

(1) Create an Incentive-loan Fund to encourage private and semi-private entrepreneurs to develop a network of competent service centers throughout Egypt, with outreach to local communities through arrangements with local repair/maintenance facilities.

(2) Provide expert assistance in getting the presently inoperable tractors back into use, either as rehabilitated units or as spare parts for other machines. Beyond its immediate purpose, this phase of the strategy would contribute directly to facilitating development of the proposed service-center system.

(3) Assist the Engineering Department of the MOA Under-secretariat for Engineering and Farm Mechanization develop: (a) performance standards for farm machinery service facilities/dealerships, to insure farmers-users of reliable repair services and easy access to spare parts; and, (b) the Department's capability to monitor the performance of service/dealer facilities without intervening in the operation of the facilities.

1. Incentive Loan Fund

The principle purpose of an Incentive-Loan Fund would be to make loans on an attractive basis; to encourage qualified private or quasi-private operators develope the capability to promptly and reliably service farm machinery; and, to supply spare parts, as needed, to equipment owners and small repair shops servicing rural communities. However, without going into detail regarding the recommended conditions/requirements for making loans, including applicant eligibility, technical certification and overall loan-fund administration, the following features and characteristics do need to be mentioned.

a) Type of Service-Facility Development: Two broad types of service-facility development would be encouraged - establishment of Area Service-Centers and the up-grading of local (usually small) Farm Machinery Repair Shops. The former would be through already-licensed, private or quasi-private farm machinery dealers or operators, optimally sited or willing to relocate in service deficient areas. Regarding the latter, only private individuals now operating successful, small-shop repair facilities would be considered eligible for loans. In addition, location of a proposed facility, vis-a-vis an Area Center, and/or size, composition, etc. of the shop's prospective service area, would be prime considerations. Willingness and ability to establish working arrangements with nearest Area Center for supplying spare parts would be mandatory.

b) Uses of Loan Proceeds: Area Center borrowers would be permitted to use loan proceeds for any reasonable purpose that would lead to establishment of a high-quality farm machinery service facility-shop equipment, hand tools, spare parts inventory sufficient to serve as a wholesale/retail outlet for the area to be served, remodeling and expanding of physical facilities, purchase of land as an operations site, new construction for reasonable spare parts and repair shop needs and/or operating expenses during the first, three years. Loans to small-shop operators also would be made for the above purposes, with the exception of wholesale spare-parts supply. Obviously there would be no need to include purchases of land or undertake building construction unless the business was being relocated; however, minor construction relative to improving better service to farmers and custom operators would be encouraged.

2. Tractor Rehabilitation

As discussed in Part IV, of all tractors in the hands of private owners and cooperatives, nearly one out of ten is inoperable. More than 20 percent of all those owned by cooperatives are in that condition; and, according to an MOA report, the figures for State Farms developing the 'New Lands' is even higher - 55 percent. All told, this means that nearly 2,500 tractors may be out of service for one reason or another. The program being proposed would get these tractors back into use, either as rehabilitated units or as parts for other machines. In addition to its direct benefits, the rehabilitation effort would contribute significantly toward helping the Area-Center/ Satellite (local) Repair Shop scheme (discussed above) get off to a fast and financially sound start.

a) Source of Technical Assistance: As mentioned earlier, these overall recommendations are predicated on availability of external assistance in the form of both financial and technical inputs. To facilitate the tractor rehabilitation process, it is proposed that two Technical Assistance Advisors be assigned to the Engineering Department of the MOA, to function as members of a joint Egyptian-Donor team, which would carry out the actual field work involved in this proposed program. The Engineering Department now has general responsibilities for farm machinery maintenance throughout the country and this technical assistance would help them not only carry out the proposed rehabilitation program but also permit on-the-job training for its staff as they participate under the supervision and guidance of the Technical Assistance Advisors. This assistance will be clearly tied to other aspects of the overall program. (See 3,b, below).

b) Operational Plan: A two-year rehabilitation program is envisioned. Besides the two technical advisors, it is recommended that funds be provided for initially supplying spare parts, fuel, oil and lubricants, as well as funds for acquiring maintenance and repair service assistance from local repair shops and maintenance facilities. In order to ensure sufficient mobility and flexibility, it is also recommended that two pick-up trucks be provided the teams, along with funds for their operation and maintenance. From the Egyptian side, the Engineering Department should rotate its team members to provide opportunity for more individuals to profit from the experience afforded by the field work and participation with the technical advisors.

3. Performance Standards and Monitoring

To insure that farm machinery repair and maintenance facilities throughout the country provide reliable services and spare parts when they are needed, it is essential that Government set standards of acceptability to guide them and effectively monitor their

performance. Neither standards nor an effective monitoring system exist today. Consequently, it is recommended that, as part of the overall assistance-proposal, the following steps be taken:

a) Technical Assistance to Engineering Department: Provides technical assistance to help the Engineering Department of MOA develop performance standards and develop the capability of carrying out an effective monitoring/counselling program to assist (Area Center and local shop) Incentive-Loan Fund recipients maintain an acceptable quality of services to their communities. The Engineering Department staff would explicitly refrain from intervening in Center or local-shop operators' business. Their role would be fact-finding and counselling, not supervision. If remedial action were called for beyond professional counselling, which the monitors themselves could provide, it would be taken by means other than intervention by those monitors.

It is anticipated that in due course the MOA monitoring system would extend beyond Incentive-Loan Fund participants as a means of upgrading farm machinery repair and maintenance facilities in general. Such expansion might be several years away, however, as the Engineering Department would need the experience of working extensively with Fund participants before undertaking the much larger and more difficult task of bringing local shops, in general, up to an acceptable quality of performance.

b) Relationship to Rehabilitation Program: As indicated previously, the two Technical Assistance Advisors proposed for assisting the standards preparation/performance monitoring aspects of the Engineering Department's overall activities also would participate with members of the Engineering Department staff in carrying out the tractor rehabilitation program. This dual approach should strengthen both activities. When participating in the monitoring of Center and local-shop performance, the Advisors would play a strictly advisory role, vis-a-vis both the Engineering Department staff conducting site inspections and the operators of the facilities being inspected. Especially in the early stages, the primary purpose of such participation would be to develop an understanding of kinds of performance standards best suited to the Egyptian environment.

B. Upgrading Spare-Parts/Repair-Maintenance Facilities

As indicated earlier, a complex of repair-maintenance/dealer network is envisaged, comprised of area centers and local repair shops that would bring essential services within easy reach of farm machinery operators throughout Egypt. As proposed, the major centers would be equipped to completely overhaul tractors and other agricultural machines and would carry a supply of spare parts for both wholesale and retail sales. After they are developed, these major centers would also provide training and advisory service to the smaller shops, as part of their concessionary agreement. Persons now operating small shops

would be encouraged to up-grade their facilities and to utilize the centers for local supply of parts and for work requiring specialized equipment. On the other hand, as many of these smaller shops are currently struggling to service the agricultural machinery industry, it is in the best interest of the service center network to include these shops.

1. Establishing a Service Center Network

These Centers themselves would provide services directly to farmers, co-ops and others in their immediate vicinities; be available to more distant machinery operators in their respective territories, who require repairs more sophisticated than local shops can service; stock spare parts for sale to local shops or others as needed; and, function as equipment dealers to their entire territories. In addition, each Area Center would have specific "satellite " arrangements with a number of local shops, strategically located throughout its area. This arrangement would help insure that reliable services were conveniently available to all farm machinery owners throughout the country.

Service Centers should be located in areas where they are readily accessible to tractor owners throughout Egypt. In Upper Egypt, centers should be located in natural trade centers with distance between centers dictated by convenience for tractor owners, present tractor and implement populations areas of potential tractor and implement growth. In Lower Egypt, centers should be located in normal trade centers. It is anticipated there will be overlapping territories with the density of the Centers related more toward machinery population than distance.

2. Physical Arrangement and Staffing

Each Center should have:

a) Storage for spare parts. All parts should be in organized storage, catalogued, with a current inventory listing.

b) Spare parts counter should be manned by trained competent parts salesperson.

c) There should be a display area for selected spare parts and machine attachments.

d) The workshop area should have specialized areas or stalls for specific operations and/or makes. The original workshop area should include at least four specific working areas with space and plans for expansion.

e) There should be an area in the workshop area for records. This should include a desk or small bookkeeping area.

f) There should be an inside display area for one or more tractors or implements.

g) There should be offices for the owner-manager, for secretaries, areas for filing, and a conference room or conference area for discussion with farmers.

h) There should be an outside display area for new and used tractors and implements.

i) There should be adequate space for expansion. A two thousand square meter area or larger is recommended.

j) The Center should develop and implement a plan to maintain a staff of competent mechanics and spare parts specialists. Evidence of an acceptable program might include:

(i) Employing persons with formal training and/or experience.

(ii) Employing former military personnel who have received training or experience in mechanization while in the service.

(iii) Employing secondary agricultural school graduates and adding on-the-job practical training to their formal training.

(iv) Maintaining an on-going program to improve the competency of employees on a continuing basis. This could include on-site formalized training or arranging with machinery manufacturers for employees to attend specialized schools.

3. Spare-Parts Inventory Management

The center should have a warehouse or storage area with a stock control system that assures an 85% off-the-shelf availability. A competent, efficient staff that would maintain the stock control system and provide immediate service for persons or firms requesting spare parts. To assure an adequate inventory of spare parts, the Center would take the following action:

a) With the aid of the MOA Undersecretariat for Engineering and Farm Machines and the Technical Assistance Advisors, determine the inventory of tractors and other agriculture machinery in the area, evaluating both machine numbers and condition. Using this information, estimate spare-parts needs as a basis for determining the spare parts inventory.

b) Contract with importers in-country manufacturers to maintain a parts supply in the Cente It is assumed the MOA would adopt and firmly follow a policy of allowing only those firms that are serious contenders for the Egyptian agricultural machinery market to import tractors or other machinery. This would, in effect, force all importers to either sign contracts with the Centers or develop other service-dealer networks.

c) With the assistance of the MOA Undersecretariat for Engineering and Farm Machines and the Technical Assistance Advisors, investigate all possible sources of spare parts, including original equipment manufacturers, manufacturers specializing in produding "will fit" parts, junked tractors or persons specializing in the sale of used parts and distributors or dealers specializing in the sale of spare parts. Also, the Centers would have for their use a list of all spare parts in storage or warehouses in Egypt prepared and kept current by the MOA Undersecretariat for Engineering and Farm Machines.

d) Work through the MOA Undersecretariat for Engineering and Farm Machines to purchase confirmed orders of spare parts to obtain volume discounts and obtain other assistance in obtaining parts and maintaining an adequate inventory.

e) Offer spare parts individually as requested by tractor owners. Spare parts would also be available to small sales and/or repair shops in the area on a wholesale basis for resale.

4. Workshop Operators

The workshop should be equipped for complete overhauls of tractors and other agricultural equipment, including irrigation pumps and engines. The workshop should be equipped with a PTO dynomometer to check tractor engine performance.

It is assumed small private workshops in the area would look to the Center for specialized work. The Center would negotiate with NASCO to provide before-delivery checks, advisory assistance in operation and maintenance, new machine warranty service and spare parts or repair work needed on the machine.

Centers would be encouraged to contract with local co-ops to provide the same services to any owner of a tractor purchased through this source and to repair all tractors now inoperable or salvage tractors beyond repair for spare parts. They would also make contracts or agreements to provide maintenance and repair services to the co-ops.

5. Distribution and Sales

The Center should become a complete mechanization center either offering any needed service or assisting tractor owners or potential tractor owners to obtain that service. Through agreements

with tractor distributors, it should offer for sale at least three but not more than five tractor makes. The tractors should be on display at the Center where there should be full authority to complete sales of machines. The Centers should provide full service, including before delivery checks, advise on operations and maintenance, new machine warranty service, a complete supply of spare parts and a well-equipped shop with mechanics trained to repair specific makes of machines.

As a matter of policy, the Centers should not become franchised dealers for one machinery company excluding all others. They should also make agreements with implement manufacturers to offer the same complete service for implements as for tractors.

C. Beneficiaries

Ultimately, the beneficiaries of improved farm machinery maintenance will be the Egyptian public. Keeping tractors and other equipment in operation implies greater farm production and reduced imports of machinery to meet agricultural needs. The immediate beneficiaries would, of course, be the farmers and cooperatives who have machinery in need of repair and/or spare parts and the small local shop operators who now have a difficult time finding spare parts to keep their repair businesses going. Also benefitting directly would be farmers who want to buy tractors or other equipment from a local dealer where they can see the machine before buying and have reliable after-sale service conveniently at hand.

By no means are all tractor owners big farmers. According to the Farm Machinery inventory Survey carried out as part of the overall study, owners of one-third of all privately owned tractors have land holdings of less than five feddans; nearly half have holdings of less than 10 feddans. For several years prior to 1977, farm size was used by Government as the criterion for rationing scarce tractor imports. The sizeable number of 1-3 year old machines owned by farmers with less than five feddans of cultivated land suggests that many relatively small farmers are now getting into the custom-hire business. They would, of course, benefit directly from improved repair and maintenance facilities as much if not more than the operators of larger farms who use their tractors more extensively on their own holdings.

Consequently, although derived second hand, the principal benefits of this proposed strategy program for improving spare-parts/maintenance-repair facilities would go to the users of custom tractor equipment. Currently, less than one-fifth of all tractor hours used for plowing and threshing, which make up the bulk of farm tractor usage, go to the machine owners' own farming operations. Surprisingly, about the same proportion of very small farms now use custom tractor service as do larger ones. Farms of less than two feddans today make up at least half of all Egypt's roughly 3 million farm operating units, those of less than 3 feddans about two-thirds. Thus,numerically the principal

beneficiaries of improved farm machinery repair and maintenance facilities would be small farmers who would have a more dependable supply of custom tractor service; hence,they could get their farm work done in a much more timely fashion, resulting in increased productivity and output, with improved economic returns the ultimate benefit.