

Usage of Tractors and Field Machinery in Agriculture in Oman

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ABSTRACT

Heavy inputs of tractors and field machinery to promote mechanization in the Sultanate of Oman started in the mid-1970s. The provision of tractors and associated machinery has been reviewed, the current state of power and machinery usage has been determined and the future needs of tractors have been assessed.

Results obtained showed that between 1976 and 2002 the Government of Oman distributed 1803 double axle tractors to farmers at 50% subsidized price. Small pedestrian tractors totaling 908 were distributed from 2000 to 2002.

Current usage of equipment as indicated by mechanization index and power input are 75% and 1.10 kW/ha, respectively.

A regression equation has been developed linking total tractors distributed to land area cultivated. It has been assessed that at least 916 double axle tractors are needed after 2002 for cultivable land. This will raise the mechanization index to 81%.

Keywords: Tractors, field machinery, mechanization, needs assessment.

INTRODUCTION

Tractors and field machinery are tools of agricultural production. These equipment increase the productivity of the producer, improve the quality of product and reduce the hazards of operations. Since 1970 agriculture in the Sultanate of Oman has received a major thrust. From the mid-1970s, the Government through the Ministry of Agriculture and Fisheries Wealth began to distribute tractors and field machinery to farmers at subsidized prices to encourage their use in modern agriculture.

Through the use of tractors and machinery by farmers, cultivated area has been doubled over a 25-year period from 1976 (Ampratwum and Dorvlo, 2003). Their further use is necessary to achieve a sustained agricultural development. This paper therefore examines the current usage of tractors and machinery and establishes future mechanization needs.

OBJECTIVES

The paper aims at the following specific objectives:

1. Review the provision of power units and field machinery to farmers in Oman.
2. Determine the current state of power and machinery usage.
3. Estimate future needs of power and machinery.

LITERATURE REVIEW

The interjection of power and machinery between humans and materials in an agricultural production system is essential for the success of agriculture. In the process of interjection, mechanical and electrical power driven machinery is applied for the improvement of land and for the economic production of crops. The importance of the application of equipment lies in replacing manual labour, improving labour productivity, increasing efficiency in operations, enabling economic production of products, reducing drudgery in operations and improving product quality (Goering, 1992; Srivastava *et al.*, 1993). The farm equipment user, usually the farmer, but also including some equipment contractors, is therefore concerned about getting the needed farm equipment on a timely basis and at the lowest possible cost.

Farmers' needs create equipment demand for which adequate supply and supply-facilitation should be available. Equipment suppliers include importers, distributors, dealers, local manufacturers and equipment hire, repair and service agencies. The government is the main facilitator to eliminate market failure and to ensure that supply meets the demand in an efficient and satisfactory manner (Rijk, 1999).

The use of power units and field machinery is a major component of agricultural mechanization. Mechanization as it relates to agriculture requires the study, manufacture, utilization, maintenance and repair of all tools, implements, machines and structures. Owende and Ward (1999) studied field power and equipment use trends in Kenya and found that the sales of tractors and tillage equipment was dominated by the demand for units in the 30-60 KW power range. Tractor sizes in Oman in the 1990s ranged from 30-80 KW (Ampratwum, 1994).

The level of use of tractors and associated machinery can be referred to as a mechanization indicator (MI) which is expressed as the ratio of mechanical power to total farm power. Three main power sources on the farm are human, animal and mechanical power. The ratio therefore is as follows (Singh and De, 1999):

$$MI = (MP)/(HP + AP + MP) \quad (1)$$

where MP = Mechanical Power
 HP = Human Power
 AP = Animal Power

Other indices of equipment usage is the power input, i.e. KW/ha, and the number of equipment in a country.

Meeting future power and machinery needs requires emphasizing key operations in planning. Key operations vary for different farms as well as for different locations. Numbers, types and sizes of power units and machinery will therefore have to be determined according to the operations. There is a positive relationship between tractorization and more land being cultivated (Ampratwum and Dorvlo, 2003).

PROCEDURE

The methods adopted to obtain information on provision of equipment to farmers and on current usage situation involved literature search and personal interviews. The Oman Directorate General of National Statistics (ODGNS) publishes annual statistical data on various sectors of the economy of Oman including agriculture. The Oman Ministry of Agriculture and Fisheries (OMAF) has published the results of the first nationwide agricultural census conducted in 1992/1993. These documents (ODGNS, 1973-2003; OMAF, 1992/93) were reviewed together with other publications such as Arab Agriculture, which is an Arab World Agribusiness Magazine produced in Bahrain (Arab Agriculture, 1991 and 1992). Personal interviews included farmers, government ministry officers, private sector companies, and other individuals.

Information obtained was analyzed. Some quantitative data were subjected to mathematical and statistical analyses. The results of the analyses are presented under various topics as indicated below.

PROVISION OF EQUIPMENT

Oman has a dry tropical climate characterized by extreme heat in the summer, around June, and coolness in the winter, around January. The southern part of the country has a moderate climate. This region receives fairly considerable rainfall in the latter part of the calendar year which makes the pursuit of agriculture possible. In the north, agriculture is practiced under irrigation.

Intensive agricultural development started in 1970 when the era of modernization started. Since that time the use of modern equipment in agriculture was vigorously promoted by the

Ministry of Agriculture and Fisheries. With the promotion of agricultural mechanization came the demand for tractors and field machinery. The supply of equipment for use in agriculture has been undertaken by the Government through an extension service of the Ministry of Agriculture and Fisheries. With the exception of participation by machinery companies in the supply process, no strong private sector supply bodies have been developed. The Government has therefore been a major equipment supplier as well as a supply-facilitator.

The extent of cultivated land in Oman in the early 1970s was about 30 000 ha. Between 1970 and 1975, 55 tractors were supplied to experimental agricultural farms, 35 in 1971 and 20 in 1974. In subsequent years tractors and other equipment were distributed to farmers (ODGNS, 1973-2003). This distribution enabled further cultivation and cropping of land. Tractors and field machinery distributed to farmers over five-year periods are presented in table 1 and table 2. In table 1 cultivated areas for the various periods are also shown. The tractors and machinery were distributed at subsidized prices. The level of subsidy is 50%. Initially, tractors of at least 15 KW capacity were distributed.

Table 1. Tractors distributed to farmers and areas cultivated.

Period	Tractors		Cultivated Area (ha)
	Single Axle	Double Axle	
1970			30000
1971-75		55*	6000
1976-80		446	5024
1981-85		641	12562
1986-90		108	4724
1991-95		296	10330
1996-00	734**	280***	4195
2001-02	174	32 [#]	665
Total	908	1858	73500

*Supplied to experimental farms in 1971 and 1974.

**Data for 2000 only.

***Excludes data for 1999.

[#]Data for 2002 only.

Table 2. Field machinery distributed to farmers.

Period	Single Axle Tractor Equipment			Water Pumps	Sprayers
	Rotovator	Mower	Trailer		
1976-80				2388	2604
1981-85				3598*	8675
1986-90				986	4656
1991-95				256	3490
1996-00	✓	✓	✓	16**	-
2001-02	✓	✓	✓	-	165***

*Data for 1983-85.

**Data for 1996 only.

***Data for 2001 only.

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It is not clear, how many field machinery associated with the tractors were distributed but the list of machinery listed in table 3 indicates the range of equipment available in the country for various field operations. Since 2000 small and medium tractors of 1.5-7.5 KW together with associated equipment are being distributed. The associated equipment included rotovator, mower and trailer.

Table 3. Machines for field operations.

Machine	Operation	Agent/Supplier
1. Plough (Disc, Mouldboard, Chisel)	Primary tillage or land preparation	Government
2. Harrow: Sprink-tooth, Disc	Secondary tillage; seedbed refining	Government
3. Pulverizer	Secondary tillage; seedbed refining	Government
4. Cultivator	Seedbed refining; weed control	Government
5. Rotovator (rotary tiller)	Seedbed preparation; weed control	Rasnia Enterprise PO Box 4484, Ruwi Tel. 704720/704035
6. Ridger	For forming ridges	Government
7. Planter	Cuttings and tubers planting	Government
8. Seed Drill	Seed planting	Government
9. Sprayer and duster	Weed control; pest and disease control	Muscat (Overseas) Ltd POBox 3488, Ruwi Tel. 703844 Omani Company PO Box 6353, Ruwi Tel. 701800/796627 Muna Noor Inc. PO Box 8598, Muttrah Tel. 590483 (6 lines)
10. Fertilizer Distributor	For applying chemical fertilizer	Government
11. Manure Spreader	For applying manure	Government
12. Mowers	Weed control; harvesting	Omani Company Muscat (Overseas)Ltd.
13. Chain Saw and Pruners	Woodcutting	Omani Company
14. Harvesters	For harvesting grain, forage, fibre, root and tuber crops	Government
15. Rakes	For crops picking during harvesting	Government
16. Baler	For producing bales from harvested forage crop	Government
17. Trailer	For transportation	Government
18. Bulldozer	Land leveling	Government
19. Grader, Scraper	Land grading	Government
20. Front-end loader	For moving materials	Government
21. Water Pumps	Water pumping	Government
22. Irrigation system with pump, sprinkler/bubbler/dripper and accessories	Water application	Government and various agents.

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CURRENT USAGE OF EQUIPMENT

The current level of use of tractor power as indicated by mechanization index, i.e., % mechanical power and by power input per hectare (KW/ha) has been obtained based on figures in table 1 and other available and assumed data given in table 4.

Table 4. Available and assumed data for calculation.

Item	Value	Source
Total no. of agricultural workers	187820	OMAF Staff
No. of draft animals (male cattle)	14000	SQU Staff
No. of tractors (single axle)	908	Table 1
No. of tractors (double axle)	1858	Table 1
Humanpower output, kW/worker	0.08	Odigboh, 1999
Draft animal output, kW/animal	0.37	Havards & Wanders, 1999
Tractor output (single axle), kW/tractor	5.60	OMAF Staff
Tractor output (double axle), kW/tractor	30.00	Ampratwum & Dorvlo, 2003
Total cultivated area, ha	73500	Table 1

SQU – Sultan Qaboos University.

From calculations, the mechanization index was found to be 75% for use of mechanical power and total power input was 1.10 KW/ha. Humans and animals accounted for 19 and 6 % of power input, respectively.

Small-size farms dominate agriculture in Oman. Holdings with cultivated land areas of 2 ha and less constituted 86% of 16,114 holdings surveyed in the 1992/92 agricultural census. The total cultivated area of the holdings was 90% of total land under cultivation in 1992/93 (Ampratwum and Dorvlo, 2003; OMAF, 1992/93). There are also medium-size and large farms with most areas up to 84 ha. Some farms have areas greater than 84 ha.

Besides the existence of various climatic and environmental conditions, there are different types of soil. Different crops comprising fruits, vegetables, cereals, legumes, fodder (alfalfa) and root (potato and carrot) crops are grown.

A variety of equipment apart from tractors as indicated in table 3 are available for various farm operations which have been mechanized. The major mechanized field operations include the following:

- Land leveling
- Land ploughing and cultivation
- Weeding and lawn mowing
- Pesticides and fungicides spraying
- Transporting of manure and agricultural products
- Water pumping and modern irrigation

Other field operations have been mechanized especially on large farms. These have been indicated in table 3.

Initially, the use of tractors, mainly two-axle and field machinery concentrated on limited number of farmers who received distributed equipment. Currently the use of equipment has been diversified to benefit farmers who have small farms and are in remote and mountainous areas, by distributing single axle or pedestrian tractors and associated equipment.

ASSESSMENT OF EQUIPMENT NEEDS

There is a strong positive correlation between number of tractors and land area under cultivation (Coefficient of determination, $\gamma = .72$). The estimated regression line (Figure 1) is

$$Y = 16 + 0.04 X \quad (2)$$

where Y = No. of tractors

X = Cultivated land area, ha.

It was estimated that, with irrigation, a total of 96 000 ha of land can be cultivated in Oman (Arab Agriculture, 1992). As at the end of 2002, the area of land under cultivation was 73 500 ha (Table 2). From the regression equation, it was estimated that 916 tractors would be needed to cultivate the remaining 22 500 ha. The additional input of tractors will increase the mechanization index and power input to 81% and 1.13 kW/ha, respectively.

The average annual rate of double axle tractor input from 1976 to 2002 was 67 distributed tractors per year. At this rate of input, it will take 14 years to meet the assessed need.

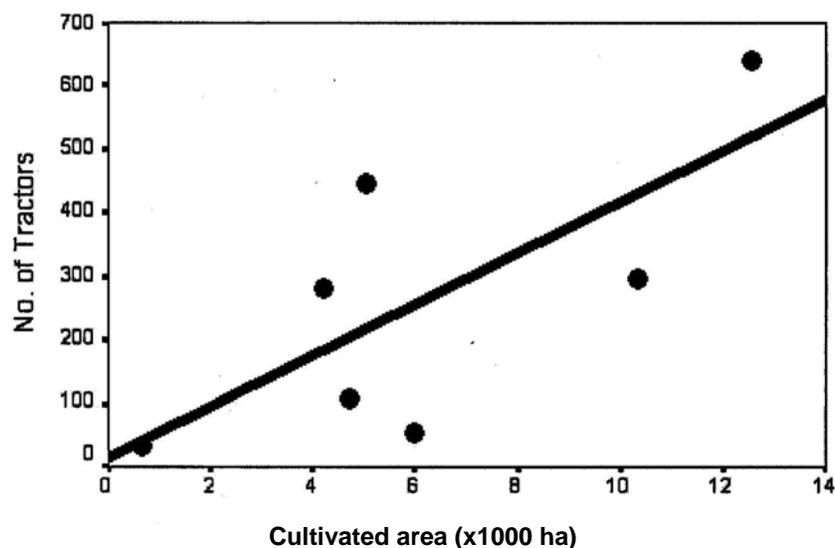


Figure 1. No. of distributed tractors vs. cultivated area.

DISCUSSION

Tractors distributed to farmers initially were highly powered, up to about 80 KW. From the 1992/93 agricultural census, it was realized that most farms in Oman are 2 ha or less. The Ministry of Agriculture and Fisheries therefore began distributing small and medium size pedestrian tractors from 2000.

Both the Mechanization Index of 75% and tractor power input of 1.10 KW/ha indicate that Oman currently has a high level of mechanical power usage when compared with recommended minimum disposable power input of 0.75 kW/ha (Davie, 1973 quoted by Owende and Ward, 1999). This has made it possible to more than double the cultivated area based on 1970. The calculated values did not include any tractors associated with cultivated land up to 1970 as they were unknown.

The assessment of future needs of tractors indicates that for zero cultivated land area 16 tractors are needed. This is justified by the fact that tractor travel, transport and stationary operations require tractor power. The need assessed does not include replacement equipment.

The need assessment is based on distributed tractors at 50% subsidy. Tractors which have been acquired outside the subsidized tractors will add to the assessed need.

When the assessed need is provided and the remaining cultivable land is cultivated, the power input level will be at least 50% more than the recommended minimum disposable power input. The figure does not include changes in human, animal and single axle power levels.

The current trend in tractor provision indicates that more single axle than double axle tractors will be distributed in future.

CONCLUSION

Farmers in the Sultanate of Oman have been encouraged to use tractors and field machinery since the mid-1970s. In this paper provision of tractors and associated machinery has been reviewed, the current state of power and machinery usage has been determined and the future needs of tractors have been assessed.

Results obtained show that:

1. From 1976 to 2002 the Government distributed 1803 double axle tractors to farmers at 50% subsidized price. Smaller pedestrian tractors totaling 908 were distributed from 2000 to 2002 together with associated equipment.
2. Current usage of equipment as indicated by mechanization index and power input are 75% and 1.10 KW/ha, respectively.
3. By the use of a regression equation, agricultural census information, and expected land area to be cultivated in future, it was assessed that at least 916 double axle tractors will be needed.
4. The assessed need will increase the mechanization index to 81% and the power input to 1.13 kW/ha.

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