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Mechanization Provisions of Modern Farms in Saudi Arabia

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Abstract. The objective of this study was to investigate the mechanization provisions as well as the uniformity of level of mechanization among the modern farms in Saudi Arabia. Field data of 56 farms was studied on the basis of tractor power and implement size available per unit area. The average tractor power per hectare was found to be 1.84 kw. The width of machines and implements such as combines, chisels, moldboards, seed drills and bailers were 0.051, 0.052, 0.026, 0.047 and 0.025 m./ha. The average number of tractors per farm was 2.32 and that for combines, chisels, moldboards, seed drills and bailers were 1.21, 1.43, 1.43, 1.26 and 1.20, respectively. On the basis of width of machine or implement per unit area, the acquirement of farmers for tractors, chisels and moldboards was inconsistent. However, the acquirement of the combine and seed drills on the basis of the machine width per unit area was more consistent. Improper selection of tractors and/or implements was attributed to lack of technical data and farming experience among the farmers.

Introduction

The agricultural sector in Saudi Arabia has fastly developed in the last ten years and the products increased considerably meeting the country needs of the main agricultural products, especially wheat. The wheat cultivated area has multiplied about four times during the period 1975 to 1987 [1]. This vast expansion was made possible through encouraging rapid introduction of the modern agricultural technology by the government. A program of subsidization was started through SAAGB (Saudi Arabian Agricultural Bank) and huge amounts of subsidies have been paid to the farmers. During the last 20 years the subsidized tractors were 29028 in number, 98.6% of these during the period 1976 to 1983 [2]. The number of implements subsidized in the same period was 98176, with 97.3% during the period 1976 to 1983. This indicates the high rate at which agricultural machinery has been introduced to the country. However, the lack of research and basic information about performance of machinery characteristics, under Saudi Agricultural conditions, might lead to improper selection of suitable equipment for different farm operations.

A few studies are available regarding actual equipment and farm implements survey in Western countries farms. A survey study was conducted by Krutz *et al.* [3] on 46 Indiana farms in U.S.A. to determine the actual mechanization level based on tractor power and implement size per hectare. He concluded that scatterness prevails in decision making by farmers for suitable machinery selection. In close agreement with the above conclusions, another study conducted in England [4], showed that there was a great variation exist between farms in mechanization provisions. Krutz *et al.* [3] concluded that a small farm had a tendency to have a greater machinery capacity per unit area. The range of tractor power provisons per hectare in England is 0.87 - 2.98 kw, while in Indiana (U.S.A.) it averages 0.97 kw.

It has been felt that the modern farms in Saudi Arabia are over mechanized. Hence the purpose of this study was to investigate the mechanization provisions of the machinery complement of a number of modern farms and to compare the uniformity of mechanization among different farms.

Materials and Methods

Field data about tractors and implements were collected from fifty-six farms in the mid-region of Saudi Arabia. The data acquired consisted of tractors' power, implements' width, cultivated area, soil type and crops raised. However, with few exceptions the farms can be described as a wheat farms. The farms in the survey used a center pivot irrigation system.

The soil type ranged from sandy loam to loamy sand. The farms were considered new if mostly established in the last 10 years. The total cultivated area of the 56 farms was 9238 ha. The average farm area was 165 ha, the smallest farm had an area being 13 ha and the largest was 1500 ha. The standard deviation of the farm areas was 250.

Results and Discussion

The data collected was processed and analyzed to determine the following:

a- The mechanization provision and,
b- The mechanization distribution among the farms of the different equipment.

The analyzed data of tractor power and implement sizes were summarized in Table 1. Results of other studies were also included. In comparison, the average tractor power per hectare in farms in Saudi Arabia was about double of that in Indiana (U.S.A.) and more than three times that in Nebraska farms (U.S.A.) [5,pp. 82-872]. The combines used in Nebraska have a width of about one third (1/3 rd) as compared to those used in farms with similar area in Saudi Arabia. All other implements,

except bailers were also found to be of larger sizes on the farms under study than those in Indiana or Nebraska (U.S.A.).

Direct comparison like the ones previously made might not be valid without looking into the main parameters affecting machinery selection. These include the soil type and conditions, weather probabilities, and tillage systems used. The soil type of the farms under study varies between sandy loam to loamy sand, while the most common type of soil encountered in Nebraska and Indiana (U.S.A.) is medium texture, i.e. a heavier soil [6]. In case of sandy loam or loamy sand soils the tractive efficiency is low which requires more power for tractor mobility and less power in processing the soil in comparison to the heavier soils. The precipitation in the mid-region of Saudi Arabia is 87 mm [7]. This has very limited effect on field working days as compared to that in the midwest of U.S.A., where the weekly field working days range from 1.8 to 5.9 at a probability of 50%, [8, p. 324].

This may lead to the conclusion that under similar circumstances of the tillage systems used, the mechanization level required should be less in Saudi Arabia as compared to that in U.S.A. However, the study shows the opposite, which could be explained by the lack of farmers' experience with farm machinery as well as the lack of farm machinery performance characteristics data in Saudi Arabia.

The number of units of tractor and other field machines available on farms are summarized in Table 2. The average number of tractors per farm was 2.32, whilst the number of implements per farm range between 1.2 and 1.43. The highest number of tractors were 6 in a farm of 1200 ha. The highest number of combines, chisels, moldboards, seed drills and bailers in a single farm were 3,4,3,5 and 3 respectively.

Mechanization level distribution

The distribution of tractor power and implement sizes are shown in Figs. 1 through 6. The tractor power distribution in Fig. 1 shows a noticeable difference among farmers in acquiring tractors. The inconsistency was greater among farms

Table 1. Average mechanization provisions per hectare at modern farms compared to other studies data

	Tractor (kW)	Combine (m)	Chisel (m)	Moldboard (m)	Seed drill (m)	Bailer (m)
SUM	103.065	2.447	2.781	1.085	2.513	0.953
STD	1.246	0.038	0.041	0.021	0.037	0.026
NO. OF OBS.	56.000	48.000	53.000	42.000	53.000	38.000
MAX.	6.716	0.180	0.246	0.115	0.177	0.154
MIN.	0.265	0.008	0.002	0.003	0.004	0.004
AVG	1.840	0.051	0.052	0.026	0.047	0.025
Other studies U.S.A.						
Indiana (AVG)	0.97			0.020	0.025	0.028
Nebraska (AVG)	0.50	0.018	0.018	0.17	0.0225	

with a size of 67 ha or less. The variation among farmers was similar to what was reported by Krutz *et al.* [3] and Yule *et al.* [4]. Some of the farms with a power level higher than 3.75 kw/ha intended to cover more area than presently cultivated but the shortage of water or lack of management ability limited the cultivated area.

In spite of the fact that the combine is the most expensive piece of equipment to own and use, 47 farmers out of 56 owned one or more combines. Survey data showed that combines were owned in farms of small area for economic operations, i.e., 13, 28 and 48 ha. With the exception of farms having areas of 13, 28, 50 and 127 ha, Fig. 2 shows the general trend that the combine size distribution was reduced as the farm size increased.

The seed drill acquirement is shown in Fig. 3. With exception of some farms, the size distribution decreases as the area increases. The size distribution of chisel and moldboard plows is shown in Figs. 4 and 5 respectively. The distribution among the farms is less consistent in comparison to those for combines and bailers.

Table 2. Average agricultural machinery number of units available at modern farms

Parameter	Tractor (kw)	Combine (m)	Chisel (m)	Moldboard (m)	Seed drill (m)	Bailer (m)
SUM	130.00	58.00	76.00	60.00	67.00	49.00
STD	1.14	0.50	0.71	0.58	0.70	0.45
NO. OF OBS	56.00	48.00	53.00	42.00	53.00	41.00
MAX.	6.00	3.00	4.00	3.00	5.00	3.00
MIN.	1.00	1.00	1.00	1.00	1.00	1.00
AVG	2.32	1.21	1.43	1.43	1.26	1.20

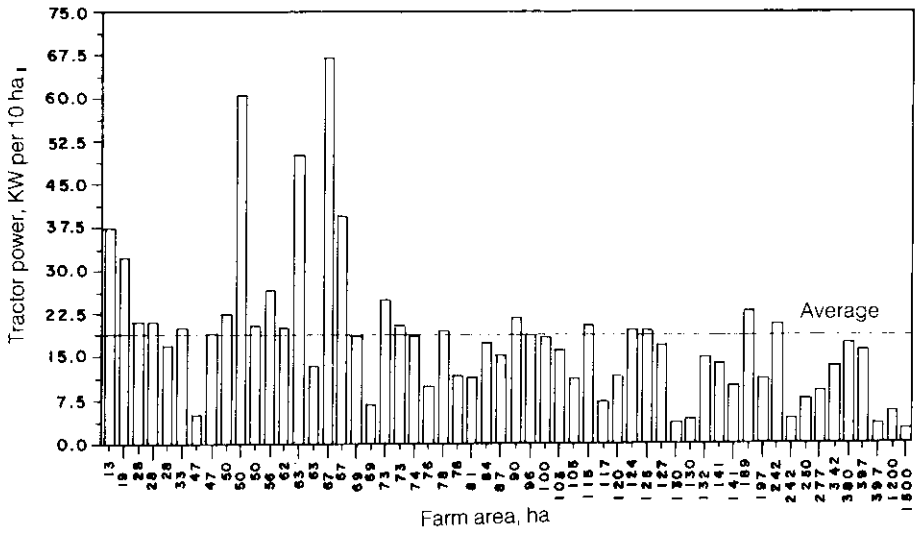

Fig. 1. Power level distribution on farm size basis

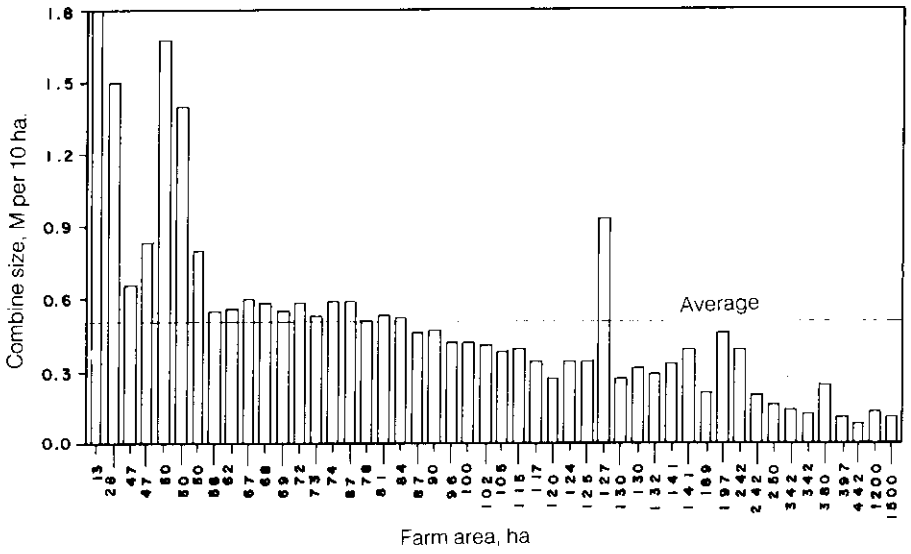

Fig. 2. Combine size distribution on farm size basis

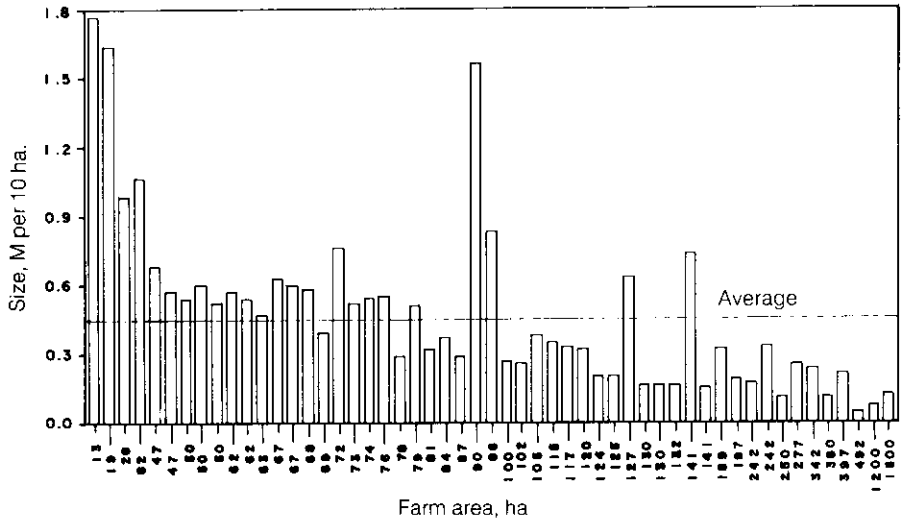

Fig. 3. Seed drill size distribution on farm size basis

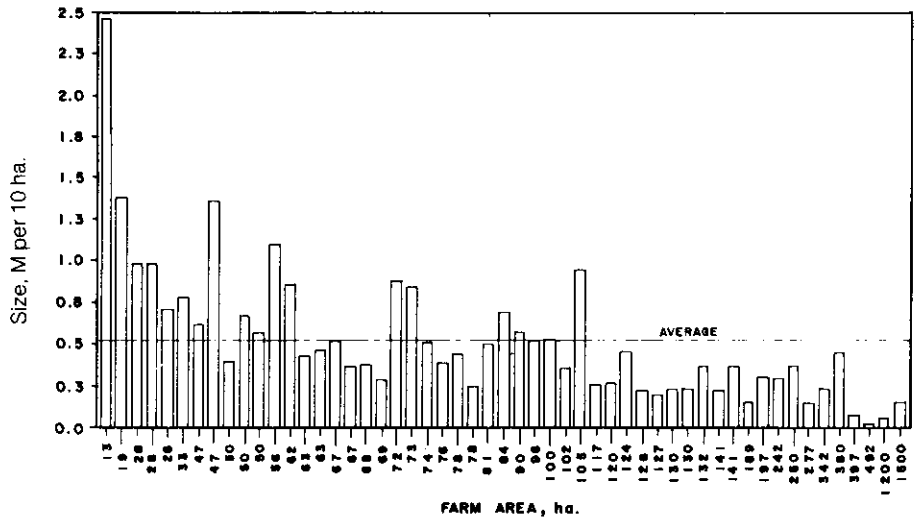

Fig. 4. Chisel plow size distribution on farm size basis

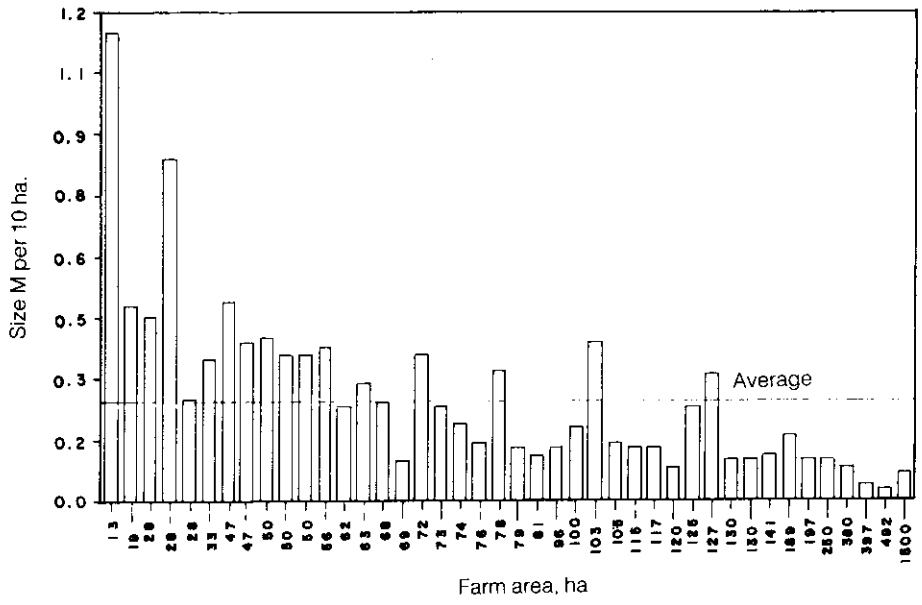

Fig. 5. MB plow size distribution on farm size basis

Fig. 6 shows the bailer size distribution on farm size basis. It must be noted that leaving a part of the field for grazing is a common practice in some farms, reduced the bailing requirements.

Some of the reasons of discrepancy and inconsistency in machinery provisions are: the difference in operating policies among farmers such as number of working hours per day and lack of experience and good management which limited the use of the total farm area.

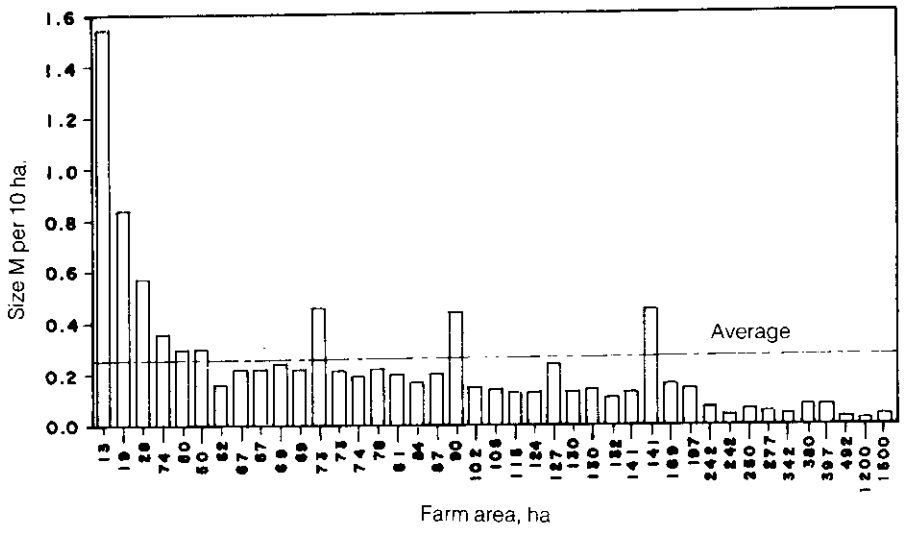

Fig. 6. Bailer size (width) distribution on farm size basis

Summary and Conclusion

Mechanization provision of 56 modern farms were studied on the basis of tractor power and implement size distribution per unit area and comparisons were made with the findings of other studies. The following conclusions were made:

1- The Mechanization provisions in Saudi farms is much higher as compared to that in Indiana or Nebraska (U.S.A.), and the acquisition per unit area is double or more. This was considered as highly overpowered.

2- The distribution of machinery acquirement by farmers was not consistently distributed for tractors, chisel and moldboard plows; while the consistency was better for most of the farms in case of combines, seed drills and bailers.

3- Lack of experience, non-availability of data and shortage of research were the main reasons of improper selection of equipment.

References

[1] Al-Jazirah Daily News Paper. "A Ministry of Agricultural Study." **25**, No. 5536 (1987).

[2] Saudi Arabian Agricultural Bank (SAAGB). "The Bank in 20 Years." *Department of research and studies*, - SAAGH (1986).

[3] Krutz, G.W., Combs, R.F. and Parsons, S.D. "Equipment Analysis with Farm Management Models". *Transactions of the ASAE*, **23**, 1 (1980), 25-28.

[4] Yule, I., Copland, T.A. and O'Callaghan, G.R. "Machinery Utilization on Arable Farms". *The Agricultural Engineer.*, **43**, No.2 (1988), 35-39.

[5] Jose, H.D., Bitney, L.L.,Duey, D.D.,Lutgen, L.H.,Miller, P.E.,Perry, R.E.,and Sheffield,L.F. *Estimated Crop and Livestock Production Costs.* Department of Agricultural Economics, Institute of Agriculture and Natural Resources, EC: University of Nebrask-Lincoln, 1982.

[6] Al-Darby, A. Personal Communication (1988).

[7] Al-Zeid, A.A., Quintana, E.U., Abu Khate, M.I., Nimah, M.N., Alsamerai, F.H., and Bashour, I.I. "Guide for Crop Irrigation Requirements in the Kingdom of Saudi Arabia"- *FAO and Ministry of Agriculture and Water. Department of Agricultural Development.* (1988).

[8] Hunt, D. *Farm Power and Machinery Management.* 7*th* ed. 2 nd. printing. Ames: Iowa State University, 1979.

مقدار المكننة للمزارع الحديثة في المملكة العربية السعودية

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ملخص البحث. هدفت هذه الدراسة إلى استقصاء مستوى المكننة في المزارع الحديثة بالإضافة إلى دراسة مدى انتظام المكننة في المزارع، ولذلك تم تجميع معلومات من ٥٦ مزرعة ودراستها على أساس قدرة الجرارات وحجم الآليات المتوافرة لوحدة المساحة. وقد وجد أن متوسط قدرة الجرار هي ١,٨٤ كيلوات للهكتار الواحد. أما عرض آلات الحصاد والدراس، والمحاريث الحفارة، والمطرحية والسطارة وآلة عمل البالات فهي ٠,٠٥١، ٠,٠٥٢، ٠,٠٢٦، ٠,٠٤٧، ٠,٠٢٥ متر للهكتار على التوالي. ومتوسط عدد الجرارات للمزرعة الواحدة كان ٢,٣٢، بينما لآلات الحصاد والدراس، المحاريث الحفارة والمطرحية، السطارة، وآلة عمل البالات كان ١,٢١، ١,٤٣، ١,٤٣، ١,٢٦، ١,٢ على التوالي، وكان الاختلاف بين المزارع كبير في اقتناء الجرارات، والمحاريث الحفارة والمطرحية على أساس وحدة العرض لكل هكتار، بينما الاختلاف كان أقل في حالة آلات الحصاد والدراس والسطارة، ومن الأسباب للاختيار غير المناسب هو عدم توافر المعلومات الأساسية اللازمة لاختيار الآليات الزراعية والجرارات بالإضافة إلى قلة خبرة المزارعين.