UNITED ARAB REPUBLIC

THE INSTITUTE OF NATIONAL PLANNING

Memo. No. 1064

Equiping Farms With Means Of Mechanisation And Their Utilisation

(Some Problems Only)

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June 1974.

CAIRO

EQUIPPING FARMS WITH MEANS OF MECHANISATION AND THEIR UTILISATION (SOME PROBLEMS ONLY).

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Mechanisation of agricultural production as we can imagine it in the advanced countries is nonexistant in Ethiopia. Therefore any kind of comparison or evaluation i.e. the differences in the ... degree of mechanisation would be wrong.

The main triler implement is a hook which is drawn by two bulls. The hook doesn't turn the earth over, it only rakes it. By raking the root system gets disturbed and the grass and weeds dry. Then they are put on to heaps and burned.

The introduction of the plough into broad agricultural practice is a very important condition for cutting down the big losses of nutrients in the earth, caused by burning the grass and weeds. They could be ploughed in to the ground and used to complement the formation of humus in the soil.

The development of mechanisation is, however, very slow and hindered by some objective factors. For instance, a tractor can be economicaly fully utilised only on large coherent areas. The land ownership system and the ensuing tillage of small disintegrated very often sloping fields doesn't provide proper conditions for good utilisation of a tractor or of other mechanisation. Most of the land tilled by ragging a hook is not ready for the use of mechanisation.

Then there are problems concerning skilled qualified labour, repair and other services which all slow down the development of mechanisation. That is why mechanisation is being introduced or used only on large newly established farms and plantations, and why there are no more than 220 - 250 tractors in the whole country.

The Ciaffa farm was sufficiently equipped with mechanisation. The inventory as follows:

Tractors: Six Z-25
twenty-two Z-50 Super
fourteen DT-54
three S-100
eight Caterpillar

Lorries : one T-111
one V 3 S

Besides the mentioned heavier means of mechanisation, the farm was also sufficiently equipped with tractor trailers, trailer implements such as three or five blade ploughs, harrows (spring-tired, discus), rod weeders, hoes etc.

From this list it is apparent that the farm's mechanization was unproportionately high which is especially evident with tractors- there are more than four tractor-units per 100 hectares and 1.028 HP per one hectare. If we compare this equipment with the data of some world regions then we find that it is 2.6 times better than in European agriculture (1.5 tractor-units per 100 hectares) and three times beter than the agriculture in North America (.3).

This positive index could be very well reflected even in the indices of the labour productivity. On the other hand, it could have a negative effect on the structure of costs, in the proportion of amortization, in the consumption of fuels and lubricants, in the costs for repairs etc., in comparison with an enterprise optimally equipped with machinery. When evaluating the equipment of the given farm one questions not only the utilisation of the tractors but also the cost for their repair and upkeep. The primary data of the farm provide us with the following data:

From 1960 - 1965 the average annual ammount of work done was by:

Caterpillar tractor	1.658 motor-hours
Wheel tractors	1.050 "
Bulldozers	2.194 "

Alltogether the tractors worked at the given period for 259.500 motor-hours which is approximately 1.256 motor-hours per tractor per year.

According to FAO (page 67, Agricultural Development Paper No 85 - Multifarm use of agricultural machinery - 1967 Rome) in the developing countries the cost of maintenance of wheel tractors during their service life is supposed to be 105 pc. of the reproduction price, caterpillar tractors - 100 pc., bulldozers - 105 pc. and lorries - 105 pc. of their reproduction price.

This means that from 1960 - 65 the costs of maintenance and repair of tractors could have been according according to stated norms altogether 573.309 E $ and individually as follows: wheel tractors

105 pc. of the reproduction price 184.645 E$	- E$ 193. 870
caterpillar tractors	
100 pc. of the repr. price 174.020 E$	- E$ 174. 020
bulldozers	
100 pc. of the repr. price 136. 372 E$	- E$ 136. 372
lorries	
105 pc. of the repr. price 65.760 E$	- E$ 69. 047
	E$ 573. 309

According to the accounts of the farm the real cost of all the reapirs, not only of tractors and lorries but also of the other machinery, equipment and buildings, was 516.100 E$ which is even less than the norm stated for tractors and lorries only. From the above analysis it is evident that from the total of 516.100 E$ 53.6 pc. i.e. 276,000 E$ was used for repairs of tractors and lorries and the remaining 46.4pc for repairs of the other machinery and equipment. The comparison of the actual results of the farm with the norms for consumption of repair costs give an overall idea from which a positive conclusion can be drawn to the credit of the work of the farm.

It is more convincing if we have the possibility to compare and evaluate the results with those of other farms which are operating under about the same conditions.

We have already said that all the tractors worked 259.500 motor-hours in the period 1960-65. This means that the cost of repairs per motor-hour is 276.600 E$. This makes expenditure on repairs per motor-hour 276.600 : 259.500 =
= 1.06 E$ or 0.424 US $ (one US $ = 2.5 E$).

If we compare this fact from the Ciaffa farm with the results from farms of the developing countries followed up by FAO then we get the following data:

	Average amount of motor-hours	Costs of repairs per Mth in US $	Number of tractors in evidence
FAO Farms	866.5	0.54	98
Ciaffa farm	1.256,-	0.424	45

From this comparison an even more exact conclusion may be drawn:

a) the annual utilisation of tractors of the Ciaffa farm in Mth units is 45 pc. higher than on 10 farms followed up by FAO

b.) the cost of repairs per Mth were 21pc. lower

This positive conclusion proves not only the good quality of the means of mechanisation but also the good level of their operation ensured by Czechoslovak workers.

Considerable differences in the qualities of soil around the farm had their effect even on the daily outputs of individual types of tractor which again was reflected in the cost of land cultivation. At this point it is necessary to supplement the analysis by some additional facts. If we analyses the structure of the costs of individual crops we find considerable diferences in the costs per hectare of ploughing. In respect to the difficult

soil conditions only the DT-54 and S-100 tractors could be used (the Caterpillar tractors were not taken into evidence). The result was that the DT-54 were not strong enough for these conditions. They could work only with the three-blade phloughs and only in first gear. Their daily output was 1 - 2 hectare and the method of driving substantially increased fuel consumption up to 110 litres. Only the fuel costs were often as much as 35. - E$ per hectare and the daily direct costs of ploughing with the DT-54 came up to 54.80 E$.

With daily working 1.5 hectares, the daily direct costs per hectare of ploughing by the tractor DT-54 were 34.50 4$ in comparison to the planned 9, - and 13.50. There were also additional costs, so that some areas had to be reworked as a consequence of bad quality ploughing.

The daily output of a caterpillar tractor S-100 with the five-blade plough and the same level of consumption of 100 litres of fuel was 6 - 7 hectares, the planned costs. But as there were only two S-100 tractors working on the farm (one was scrapped) as bull-dozers, so they were permanently used for repairs on the dikes and could be used for ploughing only for a short period, hence the whole task in the volume of work had to be ensured with DT-54 tractors even under the given uneconomical conditions.

The unsiutable structure of the tractor fleet on the farm caused high overstepping of costs multiplied by the fact that after consuming an allowed norm of tax-free fuel the farm had to purchase it at retail price which was much higher (38-42 cents instead of 14).

When stating the number of the basic machines which every enterprise should have at its disposal so as to ensure crop-production requirements, a few factors are decisive, mainly:

a) the area of land under cultivation
b) the number and type of agrotechnical measures given acording to the sowing rotation
c) agrotechnical timing of individual measures

d) daily output of the respective machines in relation to the conditions.

e) the number of workers and trailors average transport distances and so on.

Before calculating the number of certain machines for an agricultural enterprise some of the above facts must be ascertained. A projection of the basic agrotechnical measures acording to different crops into a time harmonogramme shows the need of the overall volume of mechanised work for the respective separate months. The attached harmonogramme shows that the greatest need is in May, June, July, when the overlapping agrotechnical terms of different work appears. The highest requirement at all is in July. This peak period lasts about 40 days; it is the result of the regional climatic conditions and can be changed only partially by means of organisation. In this period the decisive agrotechnical tasks must be secured ,as the economic results of crop-production are dependent on their fulfillment.

From this it is evident that the volume of mechanised operations in the peak period will determine the maximum need of mechanisation on the farm.

The number of machines for every operation is calculated separately and at the same time the very operation will determine the kind of machine required. The method may be as follows:

a) the need of machines used for only a single agrotechnical operation for one or more crops in the same agrotechnical time, is asertained according to the ratio between the area of crops and the multiple of the agrotechnical period in days and the daily output of the machine. The formula

$$x = \frac{P}{A \times V}$$

x - number of machines
P - crops area on which the operation is to be performed
A - agrotechnical timing
V - daily output of the machine

The agrotechnical period is given in days and it represents the period when a certain operation must be performed without endangering the yield per hectare.

The daily output of the machine is dependent on the shift output, on the shift coefficient which increases the shift output, and on the weather coefficient that cuts the daily output.

The shift output is the output of an eight-hour working day.

b) so as to asertain the need of machines that perform the same operation (i.e. ploughing) for different crops, if agrotechnical timing of these operations overlaps, we must start with the total area which is to be worked and with the common term for all the crops.

Then the formula is:

$$x = \frac{\Sigma P}{SA \times V}$$

Σ P - total area of all crops, subject to the operation
SA - common agrotechnical time-limit
V - daily output of machine

Granted that the volume of work at the culminating point will determine the maximum need of machinery on the farm and if formulae B) is used for the calculation, then the total need of tractors according to the harmonogramme will be as follows:

Calculation of the number of tractors required for ensuring tasks in crop-production (according to the sowing rotation in 1965/66).

a) ploughing - the task in ploughing

mustard	- 313 hectares
Teff	- 370 "
nug	- 50 "
ground nuts + castor-oil plants	- 230 "
castor-oil plants + + mustard	- 70 "
	1 033 hectares

Shift output of tractor	- 5 hectares
Shift coefficient	- 1.25
weather coefficient	- 0,9
daily output of tractor S-100 (5 . 1.25 . 0.9)	- 5,6 hectares
agrotechnical time jointly	- 30days

$$x = \frac{\leq P}{SA \cdot V} = \frac{1.033}{30 \cdot 5.6} = 6,1$$

b) preparation of land and sowing

maize prep.	250 hec.	sowing	688 ha	938 ha
mustard	330		626	956
nug	65		65	130
teff	550		---	550
ground nuts/castor-oil plant	323		---	323
castor-oil plant/mustard	111		111	222
hybrid maize	37		37	74
				3193

The daily output of Z-50 Super tractor together with the shift and weather coefficients is 8 hectares. Joint agrotechnical time is 60 days.

$$x = \frac{\Sigma P}{SA \cdot V} = \frac{3\ 193}{60 \cdot 8} = 6,6$$

c) cultivating operations

maize	- 688 hectares
ground nuts 2x	- 646 "
maize hybr.	- 37 "
	1371

The shift output of the z-25K tractor	- 8 hectares
Shift coefficient	- 1.25
Weather coefficient	- 0.75
Daily output of 7-25 K tractor	- 7.50 hectares

$$x = \frac{P}{SA \cdot V} = \frac{1\ 371}{60 \cdot 7.5} = \frac{1\ 371}{450} = 3.0$$

From the calculations it is evident that for ensuring all agrotechnical measures the following number of tractors, compared with the present number, would be quite sufficient.

	Real number	Theoretical number
tractor Z - 25 K	6	3
Z - 50 Super	22	7
DT - 54	14	-
S -110	3	8 x)

x) including two bulldozer tractors

The total purchase cost of tractors delivered was 495.037 E£ and the purchase cost of the theoretical amount would be aproximately 400.000 E£ which would mean an investment saving of about 95.000 E£. The number of tractor-units per 100 hectares of agricultural land would drop from the original 4 to 1.8.

In view of the soil conditions it is assumed that only the S-100 caterpillar tractors will be used for ploughing , because their daily output is economically more profitable and the tillage is of good quality.

For preparation of the soil and for sowing DT-54 caterpillar tractors could be used or even Z-50 Supper wheel tractors. For greater utilization of the wheel tract rs, especially when ensuring tasks of inter-enterprise transport it would be better to choose the Z-50 wheel tractors. The amount of cultivation work is not so extensive therefore Z-25 K wheel tractors can well ensure the necessary operations including the application of chemicals to the crops.

From the given number of trailer mechanization the necessary amount of trailer implements and machines can be ascertained. Summing up the results of calculations of the number of tractors required for tasks in crop-production and comparing them with the real number of tractors on the farm we arrive at an overall figure that supports the original thesis about the exceedingly high numbers of machines. At the same time, the real structure of tractors doesn't make possible their economic utilization, and increases the production costs. Besides this, by equipping the farm as proposed, a saving of 95.000 £ in investments would be achieved.