TYPE OF FARM, SELECTION AND OPTIMAL UTILIZATION OF AGRICULTURAL MACHINARIES IN ALBANIA

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Abstract *There is a total of 353486 agricultural farms across Albania which operate in an area of 696000 ha of agricultural land (equivalent to 24% of total surface area). The total population coverage of farms is 1626019 and the average size of farms under crops is 1.14 ha. Expenditures on agricultural machineries in 2009 were estimated at around 574,612,000 leks (≈574612$), out of which around 60% (≈ 352120$)) were expended on fuel. In the context of small-sized and fragmented farms the selection and optimal use of agricultural machineries is quite an important task to be performed. To this end a study was conducted in the experimental agricultural plot at Agricultural University of Tirana. The objective of the study was to evaluate the effectiveness of the utilization of different types of agricultural aggregates under present conditions of land fragmentation in Albania. The experiment was administered in three plots of land: plots 1 and 2 with an area equal to 0.2 ha and number 3 with an area of 0.1 ha. In plots 1 and 2 the processes of agricultural processes including plowing, cutting and sowing were 100% mechanically run. They were accomplished with agricultural aggregates of different capacity. With reference to plot no.3 the agricultural processes were semi-mechanized. The plowing and cutting were achieved by means of motor-powered cultivators and planting was manually done. The indicators being the focus of the study were: field machine index, fuel consumption the number of plants sprouting per unit, labor capacity for each aggregate used. Also, on the basis of these indicators was determined the area covered by each aggregate from the energy perspective.*

Key words*: Tractor, plowing, cutting, sowing, plot, effectiveness, farm.*

INTRODUCTION

In many parts of the world agricultural mechanization has made a significant contribution to agricultural and rural development. Levels of production have increased, soil and water conservation measures constructed, the profitability of farming improved, the quality of rural life enhanced, and developments in the industrial and service sectors stimulated.

In some countries, however, farm power and equipment have failed to realize their potential. In part, this may be attributed to the inappropriate selection and use of certain mechanized inputs. It is also due to the piecemeal approach adopted by governments and donors to encourage mechanization without reviewing the agricultural engineering sector in its entirety. If key components were not in place, inputs were frequently not available, or were poorly maintained and operated below capacity. Consequently, mechanization has often become a burden to National budgets and the farming community, leading to financial losses and restricted agricultural production, as well as environmental degradation (CLARE BISHOP, 1997).

Agriculture is a very important sector in Albania in terms of the employment it generates, the livelihood it sustains in the rural areas, food security, sustainability as well as exports. 58% of the population is employed in this sector which accounts for approximately 21% of the GDP of the country (WORLD DEVELOPMENT INDICATORS, 2009,). Use of land for

agricultural purposes is at relatively high levels, where arable land, agricultural land, grazing grounds and forests occupy 40% of total land use in the country.

The fact that Albania depends heavily on imports of agricultural products (natural and processed ones) as opposed to exports, points to a low efficiency of agricultural production. This can be explained in various ways and tied up to a multitude of factors, among which mechanization might be commonly regarded as an input of particular importance currently standing at a low level.

"Tools, implements and powered machinery, are essential and major inputs to agriculture; it can be argued that they are one of the most important. The term ***"Mechanization"*** is generally used as an overall description of the application of these inputs. There are three levels of farm power used to provide an energy source for the utilization of these tools, machines and equipment; manual power, animal draft and motorized power.…" (L.J.CLARKE, 2000).

Agricultural mechanization provides that agricultural operations be carried out easily and with a degree of quality and within time frames. It also increases the efficiency of farm production. Increasing the efficiency in the production is associated with the decreasing production costs related to input usage and increasing the production quantity. Another problem facing farmers is the selection of optimal size of farm machinery. Very large or very small sizes of farm machineries result in either increase in cost or inability to perform the required farm operations within a reasonable time. The selection of a machinery size is a difficult task. In multiple cropping patterns a similar implementation and power unit are often require at the same time. This makes the selection more complicated.

Investment inputs of tractors and its equipment comprises 30 to 60% of the production costs (ASAE Standards).

MATERIAL AND METHODS

Evaluation of farm types and level of utilization of mechanization was carried out on the basis of the statistical data which were collected in the field. On the basis of the findings there was a field experiment set up in full accordance with the actual conditions of farms in the country. In this way it was possible to determine by field testing such indicators as field machine index, fuel consumption, the number of plants spouting per unit as well as the effective field capacity. The experiment was conducted in the experimental agricultural plots at Agricultural University of Tirana

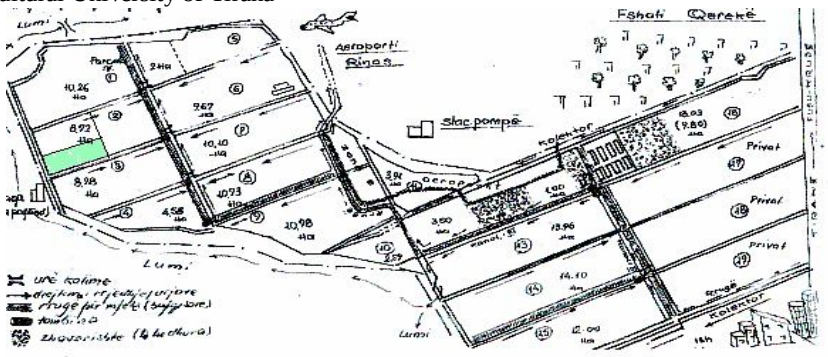


Figure 1 Experimental field at AUT

The agricultural farm is situated in Valias, Tirane which is typical of a central

Mediterranean low-lying area of Albania. The average amount of rainfall varies from 950 to 1200 mm. Their distribution is erratic in pattern. The average temperature ranges from 14 to 16 degrees Celsius. The soil type is brown-hued and meadow type. The texture is of medium mechanical composition.

The experiment was administered in three plots: 1, 2 with an area equal to 0.2 ha and number 3 with an area of 0.1 ha. In plots 1 and 2 the processes of agricultural works including plowing, cutting and sowing were 100% mechanically run. The plowing and cutting were achieved by means of motor-powered cultivators and planting was manually done.

The sizes of the three plots were as follows: Plots 1and: 16m x 125 m (0.2 ha) and plot no. 3: 8m x 125 m (0.1 ha). The cultivar cultivated was corn/maize FAO 350. All of the measurements were done for all types of basic operations including plowing, cutting and sowing. The reasons for this operations to happen might be sought with: the three operations enjoy the highest level of mechanization in the country, they are operations which require the highest energy levels and at the same time they are well covered in agronomic timelines. Moreover the same tilling system was applied.

The agricultural aggregates used according to operations are as follows:

Table 1

Used farm aggregates

Parcels	Operation	Used farm aggregates
1	Plowing	Tractor New Holland 35 hp(26 kw) + Plow Nardi 2x35; deep 25 - 30cm
	Cutting	Tractor New Holland 35 hp (26 kw) + Cutter Nardi B 1.6 m; deep 20 - 25cm
	Sowing	Tractor Fiat 56 hp (42 kw) + Precision pneumatic seeder with 4 rows (B=2.8 m)
2	Plowing	Tractor New Holland 75 hp (56 kw) + Plow Nardi 3x35; deep 25-30 cm
	Cutting	Tractor New Holland 75 hp(56 kw) + Cutter Breviglieri B 2.2 m; deep 20-25 cm
	Sowing	Tractor Fiat 56 hp (42 kw) + Precision pneumatic with 4 rows (B=2.8 m)
3	Plowing	Moto cultivator Bertolini 411, 8 Kf (6 kw) + Rotary Plow B65, deep 20 - 25 cm
	Cutting	Moto cultivator 8 hp (6 kw) + Rotary Plow B65; deep 10 – 15 cm
	Sowing	With hand

The determination of indicators was accomplished:

Field Machinery Index (FMI) is the ratio of the productive machinery time to the sum of productive machine time plus the row–end turning time. Productive time is the actual time a machine is doing its specific job. For a planting operation, this would be the time actually spent placing seed in the ground. Time used for support functions, such as filling hoppers, making adjustments, and other "down time" is omitted before the FMI is calculated.

Determination of this index done according to formula (ELMO RENOLLY, 1979:

$$FMI = \frac{A - B - C}{A - B} \times 100$$

A __ total time used to complete the field operation
B __ total support function time, not including turning
C __ total turning time

Fuel consumption was gauged directly while at work in every type of operation and for each aggregate utilized.

Number of plants sprouting was measured for each plot.

Determination of effective field capacity, EFC, for every aggregate done according to formula (ASAE Standards):

$$EFC = \frac{S_i}{A} \text{ ha/h}$$

S_i__ Parcels, 1, 2 and 3
A __ total time used to complete the field operation

In order to determine the area that each agricultural aggregate covers from the energy perspective the following diagram was applied:

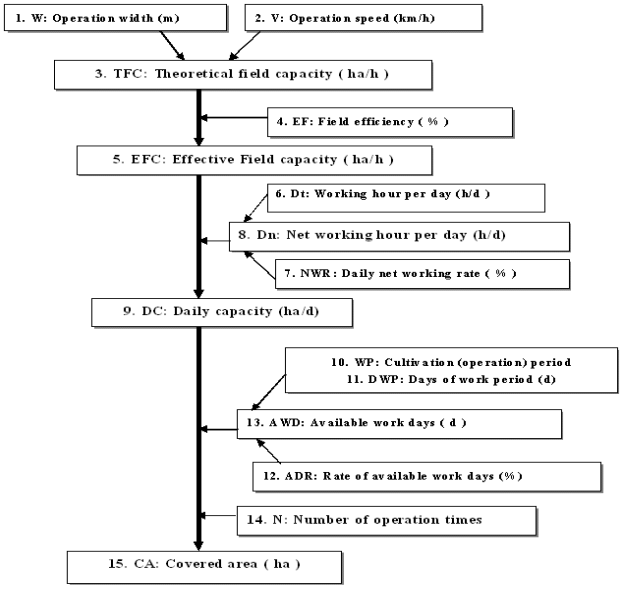


Figure 1. Covered area, Source: (FARM MECHANIZATION Planning)

RESULTS AND DISCUSSIONS

There is a total of 353486 agricultural farms across Albania which operate in an area of 696000 ha of agricultural land (equivalent to 24% of total surface area). The total population coverage of farms is 1626019 and the average size of farms under crops is 1.14 ha. Expenditures on agricultural machineries in 2009 were estimated at around 574,612,000 leke (≈574612$), out of which around 60% (≈ 352120$)) were expended on fuel.

From the type of data obtained in the ground and the interviews conducted the situation of farms in Albania is as follows below:

Table 2.

Gross Crop Farm Size

Totali Farms	Total Parcels Planted	No. Parcels per Farm	Average Farm Size
353486	1434086	4.1	1.14

Source: [6] and personal interview

Chart 2.

Number of total farms

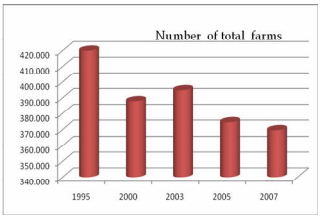
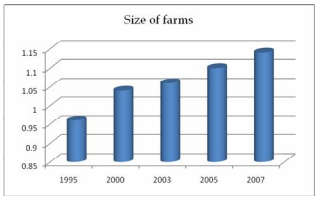


Chart 3.

Size of farms



From the data processing the scale of utilization of mechanization at the country level based on the various processes applied is as follows:

Table.3

Degree of agricultural mechanization

Using of farm machinery according to operation	Refer of total agriculture land	Refer of used agriculture land
Plowing	42 %	79 %
Cutting	39 %	81 %
Sowing	32 %	68 %
Cultivation	8 %	72 %
Spraying	10 %	41 %
Harvesting	19 %	72 %

The findings obtained from the direct measurements in the field and their analysis are as follows:

1. Field Machinery Index (FMI)

Table.4

Time for each parcels according to opetation Assessment of FMI

Parcels	Time used (minutes)	Plowing	Cutting	Sowing
1	Total time to field operation	59.6	21.3	8.3
	Total support function time	1.1	0.8	1
	Total time turning	2.6	1.3	0.5
2	Total time to field operation	34.72	21.1	8.2
	Total support function time	1.2	1.3	1
	Total time turning	2.55	1.9	0.6
3	Total time to field operation	418.2	89	-
	Total support function time	2.8	1.5	-
	Total time turning	7.13	5.1	-

Table.5

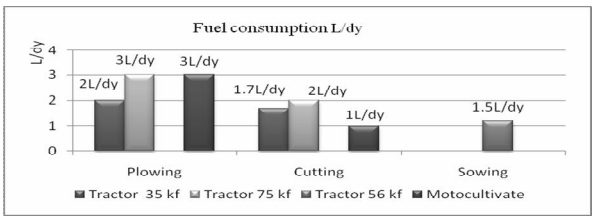
Assessment of FMI

Parcels	Operations	FMI
1	**Plowing**	95.5
	Cutting	93.6
	Sowing	93.1
2	**Plowing**	92.3
	Cutting	90.4
	Sowing	91.6
3	**Plowing**	98.2
	Cutting	94.1
	Sowing	-

2. Fuel consumption according to used farm aggregate:

Chart 4.

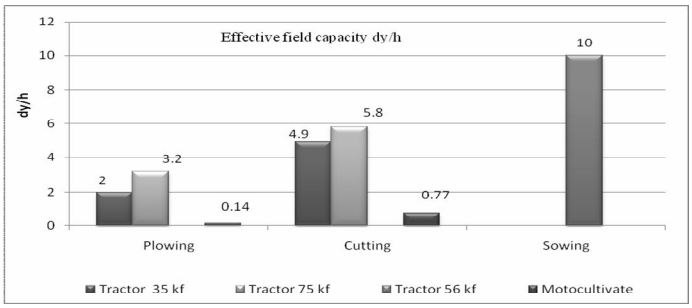
Fuel consumpustion



3. Effective field capacity used farm aggregate

Chart 5.

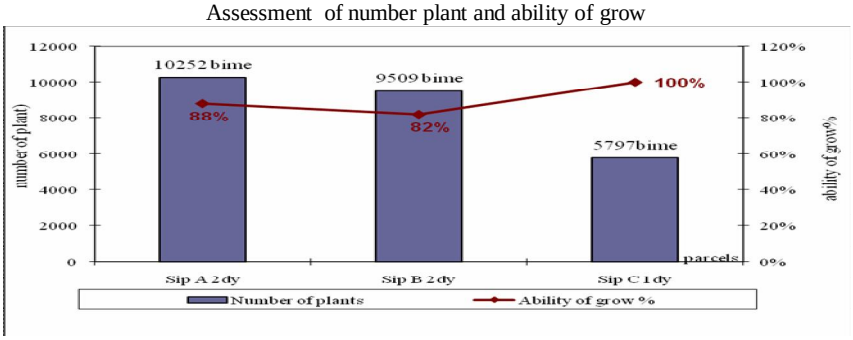
Assessments of EFC



4. Number of sprouted plants and % of sprouted plants

Chart 6.

Assessment of number plant and ability of grow



5. The evaluation of the area covered by the aggregates under study. Calculations were made for the three basic operations including plowing + cutting-sowing. It should be acknowledged that these operations use the highest energy level and simultaneously have agronomic timelines which overlap one-another. Satisfying the needs with such equipment and machinery allows for the expansion of mechanization even across other operations which have not been looked at in this study.

On the basis of calculations done in the study as in the diagrams 1, for each set surveyed it is shown that:

Table.5

Assessment of Covered area

Set	Agricultural aggregate	Covered area
I	Tractor New Holland 35 hp(26 kw) + Plow Nardi 2x35; deep 25 - 30cm	26 ha
	Tractor New Holland 35 hp (26 kw) + Cutter Nardi B 1.6 m; deep 20-25cm	
	Tractor Fiat 56 hp (42 kw) + Precision pneumatic seeder with 4 rows (B=2.8 m)	
II	Tractor New Holland 75 hp (56 kw) + Plow Nardi 3x35; deep 25-30 cm	45 ha
	Tractor New Holland 75 hp(56 kw) + Cutter Breviglieri B 2.2 m; deep 20-25 cm	
	Tractor Fiat 56 hp (42 kw) + Precision pneumatic with 4 rows (B=2.8 m)	
III	Moto cultivator Bertolini 411, 8 Kf (6 kw) + Rotary Plow B65, deep 20 - 25 cm	1.7 ha
	Moto cultivator 8 hp (6 kw) + Rotary Plow B65; deep 10 – 15 cm	
	With hand	

CONCLUSIONS

1. The selection of the type of tractors and machineries should be done by looking at the farm size, land fund based on planted crops as well as at the cultivation technology applied alongside with type and structure of land, ownership type over agricultural machinery.

2. Agricultural aggregates that come complete with a plough in the minimum, cutters and sowing machines seen from the energy angle which might cover respectively:

- ✓ motor-powered cultivators with 6 to 18 kw operations in 1.5 - 2 ha of average agricultural area per season
- ✓ tractors of 20-28 kW operation class in 25 to 30 ha of average agricultural area per season
- ✓ tractors of 49-56 kW operation class in 45 to 50 ha of average agricultural area.

3. The increase of the effectiveness in the use of agricultural mechanization cannot be realized in the current size of farms and with the fragmentation level as it exists today, hence it is recommended that stimulation from the state should be the way forward in the path of cooperation.

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