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Total Costs, Labor Requirements, and Work Efficiencies in Rice Production Mechanization in Turkey: A Case Study From Samsun Province

Türkiye'de Çeltik Üretim Mekanizasyonunda Toplam Masraflar, İşgücü Gereksinimleri ve İş Başarıları: Samsun İli Örneği

Hasret TÜRER[1]
Taner YILDIZ[2]

[1]Ministry of Industry and Technology, Automotive Assistant Specialist, Ankara, Turkey
[2]Department of Agricultural Machinery and Technologies Engineering, Ondokuz Mayıs University, Faculty of Agriculture, Samsun, Turkey

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Sorumlu Yazar/Corresponding Author: Taner YILDIZ
E-mail: tyildiz@omu.edu.tr

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ABSTRACT

Rice has an important place in Turkey's economy and human nutrition. Bafra town of Samsun province is one of the luckiest provinces in terms of rice production potential in Turkey. It takes second place among provinces in our country in terms of rice cultivation area and production amount. It is necessary to pay attention to agricultural machinery operation to use inputs in optimum as it comprises a significant share of inputs used for plant production like seeds, fertilizer, pesticides, and mechanization. This study was carried out to determine the total costs, labor requirements, and work efficiencies in the rice production mechanization by survey method in Bafra county of Samsun province in 2018. The data obtained through face-to-face questionnaires applied to previously determined businesses were evaluated. According to the results, the total variable and fixed costs are calculated as 4036.40 and 6229.90 TLha^{-1}. The share of variable and fixed costs in total production costs was determined as 60.68% and 39.32%, respectively. Among the variable costs, the highest share was obtained by harvesting (13.12%) and tillage costs (6.93%). The highest share in the fixed costs was land hire (22.46%). The highest and the lowest labor requirements were found for tillage (4.52 hha^{-1}) and for the drying process (0.87 hha^{-1}). The highest work efficiency was obtained for the drying process (1.15 hah^{-1}). In particular, it was emphasized that variable costs can be reduced by good mechanization planning, which can lead to more profitable production with the effective use of agricultural machinery.

Keywords: Labor requirement, mechanization, rice, total cost, work efficiency

ÖZ

Çeltik, Türkiye ekonomisinde ve insan beslenmesinde önemli bir yere sahiptir. Samsun ili Bafra ilçesi, Türkiye'nin çeltik üretim potansiyeli açısından en şanslı illerinden biridir. Ülkemizde iller arasında çeltik ekim alanı ve üretim miktarı açısından ikinci sırada yer almaktadır. Bitkisel üretimde kullanılan tohum, gübre, zirai ilaç ve mekanizasyon gibi girdiler, önemli bir bölümü oluşturduğu için bu girdilerin optimum düzeyde kullanılması için tarım makineleri işletmeciliğine dikkat edilmesi gerekmektedir. Bu çalışma, 2018 yılında Samsun ili Bafra ilçesinde çeltik üretim mekanizasyonunda anket yöntemi ile toplam masrafların, işgücü gereksinimlerinin ve iş başarılarının belirlenmesi amacıyla yapılmıştır. Daha önce belirlenen işletmelere uygulanan yüz yüze anket yoluyla elde edilen veriler değerlendirilmiştir. Sonuçlara göre, toplam değişken ve sabit maliyetler sırasıyla 4036,40 ve 6229,90 TLha^{-1} olarak hesaplanmıştır. Değişken ve sabit masrafların toplam üretim masrafları içindeki payı sırasıyla %39,32 ve %60,68 olarak olmuştur. Değişken maliyetler içinde en yüksek payı hasat (%13,12) ve toprak işleme masrafları (%6,93) almıştır. Sabit masraflar içinde en yüksek pay, arazi kiralama olmuştur (%22,46). En yüksek ve en düşük işgücü gereksinimleri toprak işleme (4,52 hha^{-1}) ve kurutma işlemi (0,87 hha^{-1}) için bulunmuştur. En yüksek iş başarısı ise, kurutma işleminde (1,15 hah^{-1}) elde edilmiştir. Özellikle iyi bir mekanizasyon planlaması ile değişken masrafların düşürülebileceği, bunun da tarım makinelerinin etkin kullanımı ile daha karlı üretime yol açabileceği vurgulanmıştır.

Anahtar Kelimeler: İş gücü gereksinimi, mekanizasyon, çeltik, toplam masraf, iş başarısı

Introduction

One of the most important nutritional sources for humanity is rice (*Oryza sativa* L.) which meets 80% of the calorie requirements of nearly half the world. The countries with the most rice production in the world are China, India, Indonesia, and Bangladesh in that order. Rice has the second-highest cultivation area and the highest production amounts after wheat in the warm climate cereals. Turkey is a very avaliable country in terms of rice cultivation climatically. May be cultivated in all regions in Turkey. In terms of the highest cultivation area and production amounts, the Marmara region is in first place followed by the Black Sea region. The two regions exceed 90% of total production amounts. Table 1 shows the rice cultivation areas, production amounts, and yield status for the last 10-year period in Turkey according to Turkish Statistical Institute data.

When Table 1 is investigated, the rice cultivation area was 99.500 hectares in 2008 and reached 118.000 hectares by 2018. The highest cultivation area is located in the Marmara region. The Black Sea region follows this (Anonymous, 2019b). Edirne province alone meets more than 40% of the total production amount and cultivation area. Samsun province comes second after Edirne. Samsun has nearly 15% of the country's cultivation area with 18,056.40 hectares and 14% of production amount at 133.821 tonnes (Akay et al., 2017; Anonymous, 2016, 2019b).

Rice Agriculture in Samsun Province and Bafra County

Samsun province is one of the luckiest provinces in terms of rice production potential. Samsun takes second place among provinces in our country in terms of rice cultivation area and production amount. Rice production is performed by 3401 agricultural enterprise at 8 counties and 146 villages. Suitable areas for rice agriculture include 19 Mayıs, Bafra, Alaçam, and Yakakent counties in Bafra Plain and Çarşamba, Terme, Tekkeköy, and Salıpazarı counties in Çarşamba Plain. Of production, 86.70% comes from Bafra Plain. Edirne-İpsala takes the first place and Samsun-Bafra takes the second place among the 15 districts of producing rice in Turkey. The share of rice agriculture reaches nearly 13.60% of plant production value for Samsun province (Anonymous, 2019a). This research aimed to determine the labor requirements, work efficiencies, and total costs for mechanization operations in rice cultivation in Bafra Plain, one of Turkey's most important plant production areas.

Table 1.
Harvested Areas, Production Amounts, and Yield of Rice Production According to Years in Turkey (Tonnes, t)

	Harvested Area (ha)	Production Amount (t)	Yield (kg ha⁻¹)
2008	99.500	753.000	7570
2009	96.754	750.000	7750
2010	99.000	860.000	8690
2011	99.400	900.000	9050
2012	119.725	880.000	7350
2013	110.592	900.000	8140
2014	110.884	830.000	7640
2015	115.856	920.000	7940
2016	116.046	920.000	7930
2017	110.000	900.000	8180
2018	118.100	940.000	7960

Samsun province located in the Central Black Sea region where the Yeşilırmak and Kızılırmak rivers flow into the Black Sea has 958.000-hectare area. Of this, nearly 104.000 operations perform agricultural production covering nearly 47% of this area. The research was completed with operations in the plain section of Bafra county in Samsun located on the broad delta formed by rich alluvium soils deposited by the Kızılırmak River (Figure 1).

The Bafra Plain is nearly 40 km in length and 20 km in width and is the largest plain in the Black Sea region. The elevation is 17 m above sea level and it is located between 41°38′23″ north and 35°59′7″ east. It is 50 km from the provincial center of Samsun. The area of the Bafra Plain, formed entirely by the Kızılırmak, is 145,700 hectares. The county has a typical Black Sea climate with cool summers and mild and wet winters. The dominant wind in Bafra reduces humidity in the air with annual mean relative humidity values above 70%. Annual rainfall is 750–1000 mm. The coastal area has low snowfall which does not last long. The coldest months in the province are January and February based on mean values for many years, with the hottest month being August. Nearly 40% of the total land area is used for agriculture. Of the total agricultural area in Samsun province, Bafra comprises nearly 17% (Anonymous, 2018).

Methods

Determination of Producers to be Surveyed

Of a total of 2212 licensed producers in Bafra county where the research was completed, the simple random sampling method was applied and 328 operations were identified to complete the survey (Yıldız & Bircan, 1994). Surveys were completed by meeting producers face-to-face. Additionally, the Republic of Turkey Ministry of Agriculture and Forestry statistics and previous studies were used.

Determination of Rice Production Costs

It is necessary to pay attention to physical amounts and unit prices when calculating the variable costs related to plant production activities. The physical input information related to these costs may be obtained from the operator or accountancy records, research results from the region, or from information collected directly from agricultural operations via the survey (Kıral et al., 1999). Input amounts related to fuel, oil, fertilizer, seed and pesticide related to machinery used in mechanization applications from tillage to transport and storage, related unit prices and unit manpower and labor prices were determined in the region. Fixed costs include interest, depreciation, and taxes-village common expenses (Dinçer, 1976).

Determination of Labor Requirements and Work Efficiencies

Values related to labor requirements and work efficiency obtained from the surveys were assessed and classified into three sections. Later, they were grouped according to the standard parcel (hha^{-1}) and as follows (Beyhan & Pınar, 1996; Kadayıfçılar & Dinçer, 1972; Yıldız, 2000, 2016).

(1) Basic time (BT):
  (a) Basic time to tillage (t_BT_1),
  (b) Basic time to leveling (t_BT_2),
  (c) Basic time to making levee (t_BT_3),
  (d) Basic time to seeding (t_BT_4),

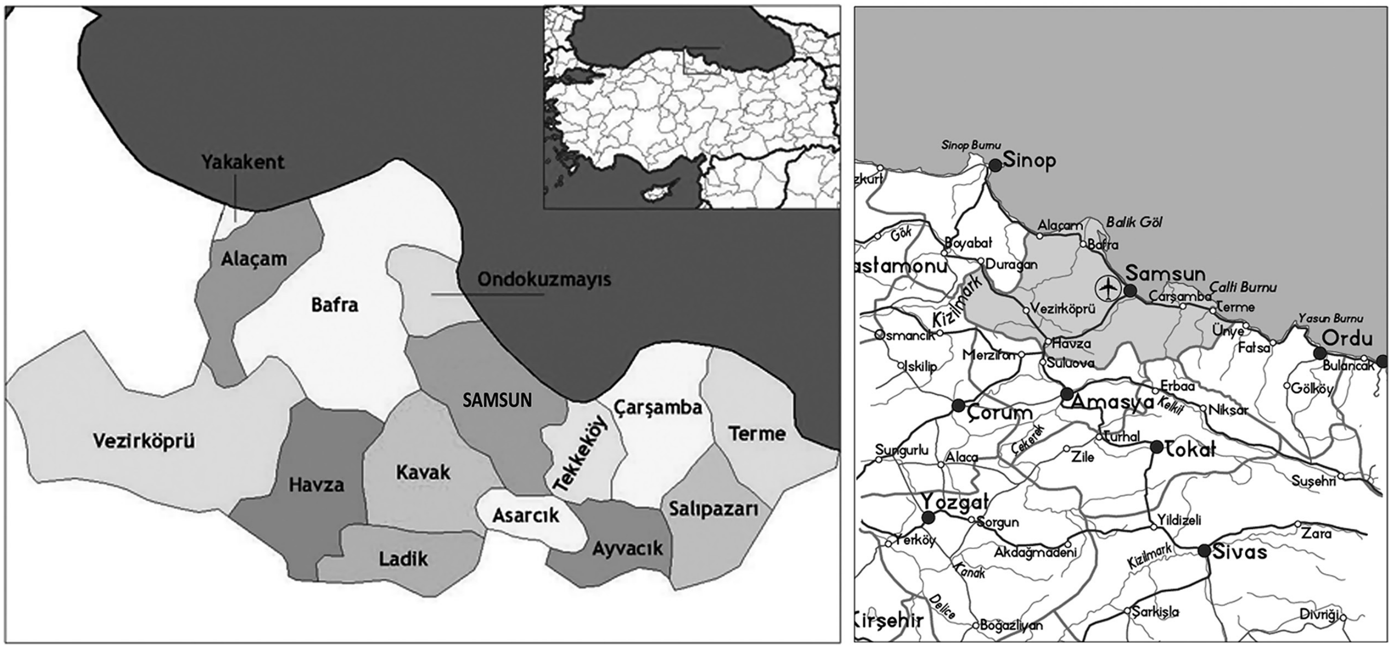

Figure 1.
Location of Bafra in Turkey (Yıldız, 2016).

(e) Basic time to fertilizing (t_BT_5)
(f) Basic time to spraying (t_BT_6),
(g) Basic time to irrigation (t_BT_7),
(h) Basic time to harvesting with combine harvester (t_BT_8),
(i) Basic time to transportation (t_BT_9),
(j) Basic time to drying (t_BT_{10}).

(2) Auxiliary time (AT): Necessary time spent was found by combining a variety of time segments (hha^{-1}). Auxiliary time was classified into subsections for standard parcels (Yıldız, 2000). These are as follows:

(1) Unavoidable time losses (UTL).
(a) Auxiliary time to tillage (t_AT_1),
(b) Auxiliary time to leveling (t_AT_2),
(c) Auxiliary time to making levee (t_AT_3),
(d) Auxiliary time to seeding (tAT$_4$),
(e) Auxiliary time to fertilizing (t_AT_5)
(f) Auxiliary time to spraying (t_AT_6)
(g) Auxiliary time to irrigation (t_AT_7): It isn't included in the calculation.
(h) Auxiliary time to harvesting with combine harvester (t_AT_8)
(i) **ı)** Auxiliary time to transportation (t_AT_9)
(j) Auxiliary time to drying (t_AT_{10})

The arithmetic means of the necessary time requirements belonging to all mechanization processings were taken from questionnaires and results were analyzed. To calculate labor requirements and work efficiencies, arithmetic means of measurements of the time segments for each process were used. To determine work efficiency in the field, effective working time (EWT) was noted. To determine the EWT, BT and AT were added to calculate the principal time (PT) (Beyhan & Pınar, 1996; Yıldız, 2016).

$$PT = BT + AT\left(hha^{-1}\right) \tag{1}$$

Effective working time was calculated from the following equation.

$$EWT = BT + AT + UTL\left(hha^{-1}\right) \tag{2}$$

Unavoidable time loss (UTL) was determined as a percentage of the PT obtained by adding BT and AT (Beyhan & Pınar, 1996; Caran, 1994; Yıldız, 2016, 2000).

$$UTL = \frac{P}{100}PT\left(hha^{-1}\right) \tag{3}$$

where,

P is a multiplication factor showing variations according to the machine used and labor power. In this study, P was 1 for labor power, while for machine power P was 6 (Beyhan 1996; Beyhan & Pınar, 1996; Caran, 1994; Yıldız, 2000; Yıldız & Tekgüler, 2012).

The working efficiency per unit area (WPA) in the study with the different operations was determined with the following equation linked to the EWT.

$$WPA = \frac{1}{EWT}\left(hah^{-1}\right) \tag{4}$$

The utilization coefficient of time (UC_z) was calculated from the following equation using EWT and BT.

$$UCz = \frac{BT}{EWT}100(\%) \tag{5}$$

Results and Discussion and Conclusion and Recommendations

Findings Related to General Features

The general characteristics of rice operations surveyed in Bafra county are given in Table 2. When Table 2 is investigated, 40.14%

Table 2.
General Features of Rice Producers

	Smallest	Largest	Mean	Standard Deviation
Age	27	65	50.05	9.42
Experience	8	40	18.90	10.07
Population	3	12	6.25	2.55
Education (%)				
Primary school (%)	-	-	50	-
High school (%)	-	-	40	-
College (%)	-	-	10	-
Total agricultural land (da)	44	600	236.95	153.32
Irrigated land (da)	22	340	141.35	95.08
Rice fields (da)	20	300	95.10	69.64
Number of parcels	1	7	3.00	1.75

of the mean agricultural land (95.10) comprised rice fields. The investigated operations had generally low land management with rents and brokerage, with mean number of parcels identified as three. Educational level was primary school for 50%, high school for 40%, and college for 10% (Table 2). The operations displayed differences in terms of rice yield, techniques, and methods used with operations yielding a mean of 9027.30 kg ha^{-1} (Table 3).

Findings Related to Costs of Rice Production Mechanization

The rice cost and profitability table were organized according to unit area (ha) and given in Table 3. Accordingly, 39.32% of total production costs for rice production are variable, while 60.68% comprise fixed costs. Within variable costs, the highest costs are harvest costs at 13.12%, while the lowest costs were irrigation labor at 0.24%. The differences between variable costs and fixed costs may be explained by not many procedures being performed externally for a price within agricultural equipment and machinery costs and the farmers undertaking costs of agricultural equipment and machinery they own. As a result, in this research, nearly 10.99% of fixed costs comprised fixed costs related to tools-machinery (depreciation, insurance, interest, taxes-release protection). Within fixed costs, 22.46% was land rental, while 19.48% was family labor fees.

The costs of tillage were 711.30 TLha^{-1} and leveling processes were highest at 536.40 TLha^{-1}. As the preparation of pan or levee costs 95.90 TLha^{-1}, seeding 118.10 TLha^{-1}, fertilizer 135.90 TLha^{-1}, pesticides 200.30 TLha^{-1}, harvest 1346.60 TLha^{-1} and transportation costs 119.90 TLha^{-1} were calculated. The unit cost of the product was calculated as 1.13 TLkg^{-1} (Table 3). In a study in which the operating costs for rice cultivation with iron wheel tractors, it was determined that the total variable costs 7.35 and 7.95 TLha^{-1} with mechanical cultivation at 540 and 540E PTO speeds, respectively. In the same study, total variable costs were obtained as 48 TLha^{-1} with manuel seeding. (Çiçek & Sümer, 2009). Cost analyses were performed according to gross profit in trials about the production of second fodder silage maize production with four different tillages and seeding methods of stalk shredder + heavy spring-tyne cultivator + seeder (T1), stalk shredder + rototiller + seeder (T2), stalk shredder + chisel plow + Goble disk + seeder (T3), and plow + Goble disk + seeder (T4). The highest gross profit was obtained with T4 method at 4824.03 TLha^{-1}, followed by T3 at 4697.92 TLha^{-1}, T1 at 4436.88 TLha^{-1}, and T2 at 4328.47 TLha^{-1} (Baran et al., 2014).

Table 3.
Costs and Profitability of Mechanization of Rice Production

Variable Costs (VC)	Mean (TLha^{-1})	Percentage
Tillage	711.30	6.93
Leveling	536.40	5.22
Pan creation (Making levee)	95.90	0.93
Seeding	118.10	1.15
Fertilizing	135.90	1.32
Spraying	200.30	1.95
Harvesting*	1346.60	13.12
Transportation and marketing	119.90	1.17
Irrigation costs	502.60	4.90
Irrigation labor costs	25.10	0.24
Drying	111.40	1.09
Interest on variable costs (circulating capital interest)**	132.90	1.29
Total variable costs	4036.40	39.32
Fixed costs (FC)	Mean (TLha^{-1})	Percentage (%)
General administrative expenses***	121.10	1.18
Family labor cost equivalent	2000.00	19.48
Land rental	2305.50	22.46
Depreciation	897.50	8.74
Capital interest	174.80	1.70
Repair-maintenance	500.00	4.87
Taxes-village common expenses	115.90	1.13
Insurance (TLYear^{-1})	115.10	1.12
Total fixed costs	6229.9	60.68
Total costs (production costs, PC)	10,266.3	100.00
Yield (kg ha^{-1})	9027.30	
Price (TL)	2.60	
Gross agricultural production value (GAPV)	23,471.00	
Gross profit (GAPV-VC)	19,434.60	
Net profit (GAPV-PC)	13,204.70	
Relative profit (GAPV/PC)	2.29	
Unit cost (TLkg^{-1})	1.13	

Republic of Turkey Central Bank January 2018 interest: 13.62, Republic of Turkey Central Bank January 2018 inflation: 12.14, reel interest rate: 1.48.
Tractor depreciation: 0.0416 (Turkish Agricultural Tools and Machinery Manufacturers Association, 2018).
Other tools-machinery depreciation (Republic of Turkey Directorate of Revenue Management, 2018): −0.2.
Building depreciation (Republic of Turkey Directorate of Revenue Management, 2018): −0.02.
*Taken as 4–6% of the harvested product amount. In this study, harvest costs were taken as 5% of the obtained product amount.
**Variable cost interests (circulating capital interest): represents production cost interest and opportunistic costs. Simply, if the production input amounts had been used in an alternative area, a certain amount of interest income would have been obtained. The use of these inputs in production means interest income is not received. As a result, it is necessary to assess this as a cost (Kıral et al., 1999).
***General administrative outgoings: taken as 3% of variable costs.

Findings Related to Labor Requirements and Work Efficiencies

The values of basic, auxiliary and effective times were obtained by surveys. Then area work efficiency was converted as the standard plot of 1 ha (66.67 m × 150 m) and given in Table 4. Here, total

Table 4.
Labor requirements and Area Work Efficiency Needed for Rice Production Mechanization

Tillage		Leveling		Making Levee		Seeding		Fertilizing		Spraying		Harvest		Drying		Transport		Total
t_BT_1 (hha^{-1})	3.28	t_BT_2 (hha^{-1})	3.90	t_BT_3 (hha^{-1})	0.93	t_BT_4 (hha^{-1})	0.84	t_BT_5 (hha^{-1})	0.68	t_BT_6 (hha^{-1})	0.69	t_BT_8 (hha^{-1})	1.50	t_BT_9 (hha^{-1})	0.55	t_BT_{10} (hha^{-1})	2.84	$\sum BT = 15.21$ (hha^{-1})
t_AT_1 (hha^{-1})	0.98	t_BT_1 (hha^{-1})	0.32	t_BT_1 (hha^{-1})	0.15	t_BT_1 (hha^{-1})	0.56	t_BT_1 (hha^{-1})	0.17	t_AT_6 (hha^{-1})	0.23	t_AT_8 (hha^{-1})	-	t_AT_9 (hha^{-1})	0.27	t_AT_{10} (hha^{-1})	-	$\sum AT = 2.68$ (hha^{-1})
PT_1 (hha^{-1})	4.26	PT_2 (hha^{-1})	4.22	PT_3 (hha^{-1})	1.08	PT_4 (hha^{-1})	1.40	PT_5 (hha^{-1})	0.85	PT_6 (hha^{-1})	0.92	PT_8 (hha^{-1})	1.50	PT_9 (hha^{-1})	0.82	PT_{10} (h/ha)	2.84	$\sum PT = 17.89$ (hha^{-1})
UTL_1 (hha^{-1})	0.26	UTL_2 (hha^{-1})	0.25	UTL_3 (h/ha)	0.06	UTL_4 (h/ha)	0.08	UTL_5 (h/ha)	0.05	UTL_6 (h/ha)	0.06	UTL_8 (hha^{-1})	0.09	UTL_9 (hha^{-1})	0.05	UTL_{10} (h/ha)	0.17	$\sum UTL = 1.07$ (hha^{-1})
EWT_1 (hha^{-1})	4.52	EWT_2 (hha^{-1})	4.47	EWT_3 (hha^{-1})	1.14	EWT_4 (hha^{-1})	1.48	EWT_5 (hha^{-1})	0.90	EWT_6 (hha^{-1})	0.98	EWT_8 (hha^{-1})	1.59	EWT_9 (hha^{-1})	0.87	EWT_{10} (hha^{-1})	3.01	EWT = 18.96 (hha^{-1})
WPA_1 (hah^{-1})	0.22	WPA_2 (hah^{-1})	0.22	WPA_3 (hah^{-1})	0.88	WPA_4 (hah^{-1})	0.68	WPA_5 (hah^{-1})	1.11	WPA_6 (hah^{-1})	1.02	WPA_8 (hah^{-1})	0.63	WPA_9 (hah^{-1})	1.15	WPA_{10} (hah^{-1})	0.33	
UCz_1 (%)	72.57	UCz_2 (%)	87.25	UCz_3 (%)	81.58	UCz_4 (%)	56.76	UCz_5 (%)	75.56	UCz_6 (%)	70.41	UCz_8 (%)	94.34	UCz_9 (%)	63.22	UCz_{10} (%)	94.34	

PT, Principal Time; EWT, Effective Working Time; UTL, Unavoidable Time Loss; UCz, Utilization Coefficient of Time; WPA, Working Efficiency Per Unit Area.

values for BT, ATs, and lost time and BT and EWT from tillage to drying and transport processes are given in the rightmost column. The coefficient values based on efficiency per area and time of procedures are given in the lowermost two rows.

In Table 4, the highest BT for procedures is for leveling (3.90 hha^{-1}), with lowest BT for drying (0.55 hha^{-1}). The lowest AT was determined for pan creation or levee-making (0.15 hha^{-1}) and for fertilizing (0.17 hha^{-1}). The lowest UTL was 0.05 hha^{-1} for fertilizing and drying. Again, from Table 4, the highest EWT was for tillage (4.51 hha^{-1}) with lowest EWT identified for drying processes (0.87 hha^{-1}). When assessed in terms of area work efficiency, the highest value was 1.14 hah^{-1} for the drying process. A study about work efficiency in vetch production under wet and dry agriculture conditions in Erzurum found the unit time for tillage-seeding had labor force requirements of 0.13 hah^{-1} with traditional methods, while direct seeding methods were 12 times greater (1.60 hah^{-1}). It was determined that the machine labor force required 8.17 hah^{-1} in the traditional method, while the direct seeding method required five times less time (1.63 hha^{-1}) (Gözübüyük et al., 2017). Another research determining the work efficiency in wheat agriculture determined work efficiency as machine labor-hour and human labor-hour and identified that machine labor-hour for three-cylinder plow was 3.38 hha^{-1} and human labor-hour work efficiency was 3.63 hha^{-1}, while for two-cylinder plow, machine labor-hour work efficiency was 4.89 hha^{-1} and human labor-hour work efficiency was 5.36 hha^{-1}. For duplexing, machine labor-hour value was 1.14 hha^{-1} with human labor-hour work efficiency of 1.22 hha^{-1}, while for seeding, the same values were identified as 5.34 and 5.78 hha^{-1}, respectively. For fertilizing, these values were found to be 0.16 and 0.18 hha^{-1}, respectively (Özden, 1991).

Trials were held for second fodder silage maize production with four different tillages and seeding methods of stalk shredder+heavy spring-tyne cultivator+seeder (T1), stalk shredder+rototiller+seeder (T2), stalk shredder+chisel plow+Goble disk+seeder (T3), and plow+Goble disk +seeder (T4). Mean work efficiency was highest at 4.91 hah^{-1} with T3 tillage system, while it was calculated as 3.56 hah^{-1} for T1, 3.64 hah^{-1} for T4, and 3.70 hah^{-1} for T2 (Baran et al., 2014).

After seeding (56.86%), the lowest time benefit coefficients were for drying (62.93%) and pesticide procedures (70.94%). The low time benefit coefficient for seeding is due to relatively small fertilizer stores and losses due to fertilizer filling and returns. In addition to the small pesticide storage volumes and working widths of field sprayers used for pesticides, disruptions during the preparation of pesticide doses cause a low level of time benefit coefficient. In another study on wheat agriculture, it was stated that the work should be completed in a shorter time to reduce the need for machinery and human labor in order to increase work efficiency. Therefore the machines used should have wider working widths and higher working speeds, and the working speed could be increased. It has been emphasized that the use of machines with more than one working combination and the experience, skills, planning and organizational skills of the person using the machine affect work efficiency (Özden, 1991).

The highest time benefit coefficient was for transport processes (94.34%). The reason for the high work efficiency of transport processes may be explained by drying and storage facilities being close to the fields and good planning. Additionally, dual-axis agricultural wagons used to transport material have elevated bodies, in other words, have increased carrying capacity which may have led to the high time benefit coefficient for transport processes. A study about transport processes forming an important link in the chain of maize silage production mechanization in the Trakya region identified that only one operation was sufficient in terms of transport techniques with transport wagons (Kayışoğlu & Tan, 1994).

Turkey has very suitable conditions in terms of rice production. However, mechanization processes applied in production have still not reached desired levels. The Marmara region is encountered as the most developed region in terms of production technology. Processes like laser field leveling, drying facilities, and other mechanization implementations are used more intensely in the Marmara region compared to other regions with rice production. The continuous need for irrigation of rice fields is encountered as the most important problem from seeding to harvest in our country. This situation leads to problems during the rental of land, causing increases in field rents. Due to the common use of motor pumps for irrigation, electrical energy use increases and this increases production costs.

Rice production requires high rates of labor, agricultural machinery, and technology. The yield obtained from rice production without mechanization implementations may be reduced and costs will be high. As with the general structure of the country, a significant portion of rice operations is small family operations. These operations that cannot obtain expensive machinery also cannot perform quality agricultural work in time. For example, due to harvesting using combine harvesters obtained through rental, yields may reduce due to harvesting not occurring in time and product quality may fall. The number of operations performing soil analysis is very few. There will be benefit from using high-capacity pesticide stores and pesticide machinery with wide working width to increase work efficiency. Losses in parcel returns occur mostly in tillage and leveling operations. These losses may be significantly reduced with appropriate turns ,good organization and planning.

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