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Mechanization and agricultural farm structure in the agricultural area of the Dardanelles region

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Abstract

This study was conducted to determine the current mechanization in agricultural farms of the Bayramic-Ezine-Kumkale agricultural plains, in Canakkale (Dardanelles) region of west of Turkey. For this purpose, a questionnaire was carried out for 401 farms capable of growing both field and horticulture crops. Results indicated that each farm having small size characteristic has at least one tractor, but 19.20% of farms had more than one tractor. The status of having one (91.67%) or more (41.67%) tractors in a farm was higher in Bayramic, due to field and horticulture crops, than both others. However, the highest number of tractors was recorded in Kumkale farms (60.00%), followed by Ezine (31.65%) and Bayramic (8.35%). Most of them are young, but 12.00% are older than 24-year, especially Massey Ferguson-135, Universal and Fiat (54C, 480). The most used tractor brand has been New Holland (32.15%), followed by Massey Ferguson (18.99%), Fiat (9.11%), John Deere (8.10%), Case IH (7.85%), Same (5.05%), Deutz (4.05%), Steyr (3.54%), Valtra (2.28%) and others (Ford, Hattat, Erkunt, Basak, Tumosan, Universal, Kubota and Landini). On average three-plain, 77.03% of farms were preferred to purchase the new tractors, 22.97% preferred the second-hand ones. Tractor was 0.99 per farm, but it was the highest in Ezine (1.17). Agricultural area per tractor was 117 decare on average three-plain, the highest for Kumkale (136 decare) and the lowest for Ezine (83 decare tractor^{-1}). Machinery per tractor was 7.67 for all farms, but Kumkale (8.78) had the highest, and then followed by Bayramic (6.58) and Ezine (5.87).

Keywords: Mechanization, Farmer Status, Crop Pattern, Farm Structure

Introduction

Turkey's agricultural economy is among the top ten in the world, with half of the country consisting of agricultural area and nearly a quarter of the population employed in agriculture. The country is a major producer of wheat, sugar beet, cotton, tomatoes, and it is the top producer in the world for apricot and hazelnut. Therefore, the agriculture sector is a raw material that provides the industry with an economic and social contribution to the national income and industrial sectors. In order to meet the needs of rapidly growing human communities, more qualified and quantitative production in agricultural areas is one of the main purposes of agricultural cultivation in nowadays. For this purpose, the use of technological facilities in agriculture such as agricultural mechanization has become inevitable. In recent years, the necessity and tendency of reducing the labour directly affecting cultivation costs increases the importance and development of mechanization in agricultural activities. Tractor is the main important indicator taken into consideration in the activities of agricultural areas for determining the mechanization level. Canakkale region is one of those areas where many annual and perennial crops are grown throughout the country because of many agricultural locations. In the region, agricultural cultivation is carried out on 3320 thousand decare of agricultural area corresponding to 1.39% of the country level by 240 million decare (TUIK, 2018). The current number of agriculture farms is around 49 thousand most of which

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are family farms employing by family labour corresponding to 2.45% of the national (over 2 million). However, 45.13% of them are only under Farm Recording System which significant contributions to farmers, especially information flow and other services such as soil analysis, weather forecasts. The average size of farms is 66 decare in the region which is lower than the country (76 decare). Small size agricultural farms ranging from 0 to 50 decare constitutes 66.76% of the total farms in the region, while several sources define small farms as those with less than 20 decare of cultivated (World Bank, 2003; Hazell et al., 2007). Medium-sized farms vary between 50 and 200 decare and the share of farms in total is 31.23%, while the number of farms of 200 decare and above represents 2.00% and being the larger parcel of farms. Although the presence of small size farms in the region is proportionally high, cereals are generally grown in medium and large sized farm parcels in dry agricultural areas as dry farming. In addition, vegetables, fruits, corn and rice which are usually grown under irrigable conditions are mostly cultivated in small size parcels. Moreover, there has been an increase recently in legume cultivation, due to increasing livestock incentives by government, which is taken into crop rotation with cereals, especially in dry farming under rainfed conditions. On the other hand, 34.15% (~1 million decare) of the total cultivated agricultural area in the region tend to be irrigable when 67.47% of these areas (764 thousand deacre) were recently irrigated by water supplied from irrigation dams (for example, Bayramic), ponds and groundwater wells. In all agricultural area of the region, field crops were grown in 415 thousand decare (53.20%) under the irrigable conditions growing mostly rice, maize, alfalfa, beans, while vegetables (tomato, pepper, melon, cabbage and others) were cultivated in around 196 thousand decare of the area, the remaining of 169 decare were cultivated for horticulture (apple, cherry, peach, pear, plum, etc.).

The potential of agricultural cultivation is popular in the study area when considering the geographical structure and climate characteristics, and also the soil structure, crop pattern, cultivation systems under both dry-farming (rainfed) and irrigable conditions. In recent years, with the being of water resources into dams and ponds, as well there has been an increase in the crop variety, especially under irrigable conditions, and there is also an effort to achieve higher efficiency from unit area. For higher crop yield from unit area, the agricultural mechanization which accounts for almost 40.00% of the total investment of farms, especially tractor, is one of most important factors being effect on crop yield (Ruiyin et al., 1999) because tractor is one of the most important power sources in agriculture (Singh, 2006). For this reason, it is to determine the current-mechanization as tractor (brand, age and other properties) and other social status and farm structure for the agricultural plains of Kumkale, Ezine and Bayramic which are located in basin of Bayramic Dam, the part of which is also known as Karamanderes Basin. A questionnaire survey was conducted in the pre-determined agricultural farms by using the Farmer Registration System under Directorate of Agriculture and Forestry. The questionnaire was completed by interviewing face-to-face with farmers in the villages of the three-plain. The data obtained from the studied farms were evaluated in Excel spreadsheet to achieve the results of the mechanization and farm characteristics.

Material and Method

Study area

The study was conducted in Canakkale (*Dardanelles*) region (39°27'-40°45' N, 25°40'-27°30' E, altitude: 10 m a.s.l.). The region surrounds the southern edge of Ida mountain (1774 m elevation) which is one of the most representative nature water source in the area. Therefore, it has a few agricultural plains due to land fragmentation in the foothill of the mountain in topological view. This region covers an area of 9737 square kilometres, lying in South Marmara Region of west of Turkey which is surrounded by three sides by Mediterranean, Black and Aegean Seas (Figure 1). In the study area, annual rainfall, average humidity, the lowest and highest temperature are 620 mm, 65%, 12 °C and 30 °C, respectively, on average years of 1958-2018 (average, National Meteorological Service) (Figure 2). Many annual and perennial crops are growing under both irrigation and dry farming systems under specific agricultural locations having different micro climatic conditions due to the hills and altitudes created by Ida mountain. The water used in these agricultural locations is generally provided by the transformation of ground-wells, dams (Bayramic Dam) or ponds as surface water collecting by rivers from Ida mountain. Therefore, some of the most important agricultural plains are Bayramic-Ezine-Kumkale where different annual (e.g., tomatoes, pepper, corn,) and perennial (apple, cherry, peach, walnut) crops are grown. Irrigable cultivation systems have recently increased by 98.20% the replacement of the dry farming due to increasing irrigation facilities such as dams or other water resources, especially in the agricultural area of three-plain. The 70.41% of the total irrigable agricultural area are mostly irrigated by dams and groundwater wells in the region, but this is lower at the country level with 65.00%.

Sampling method and data collection

During 2017-2018 growing season, the study was conducted in villages of three-agricultural plain have already irrigated by Bayramic Dam, with a capacity of 96 m^3 and completed at the beginning of 2000 years. The size of required sample was determined using Neyman method in order to collect data from the studied area (Yamane, 1967).

$$n = \frac{N^2 \ x \ s^2 \ x \ t^2}{(N-1)\, d^2 + (s^2 \ x \ t^2)} \qquad (1)$$

where n is the required population (sample size), N is the number of farmers in the target population, s is the standard deviation, t is the t-value at 95% confidence limit (1.96), and d is the acceptable error. The permissible error in the sample size was defined to be 5% for 95% confidence. Based on this method of sampling, 401 farms were identified from the study area. 123 villages among 177 villages of three-plain in the Bayramic basin area were recorded, whose main occupation was agriculture. The questionnaire was conducted in only 30 of 123 these villages. Thus, the number of questionnaires were 11 out of 34-village on the Bayramic plain, 11 out of 39-village on Ezine and 8 out of 50-village in centre of region covering only Kumkale (Table 1). Researchers used the questionnaire to conduct personal interviews face to face with farmers or workers

known to use machinery intensively. Questions concentrated especially on the farmer social statues, farm structure and the use of mechanization in the agricultural cultivation. Data was analysed to find out the required results of the study. All data obtained from the questionnaire were evaluated in Excel programme.

Figure 1. Location of Canakkale (Dardanelles) region in west of Turkey

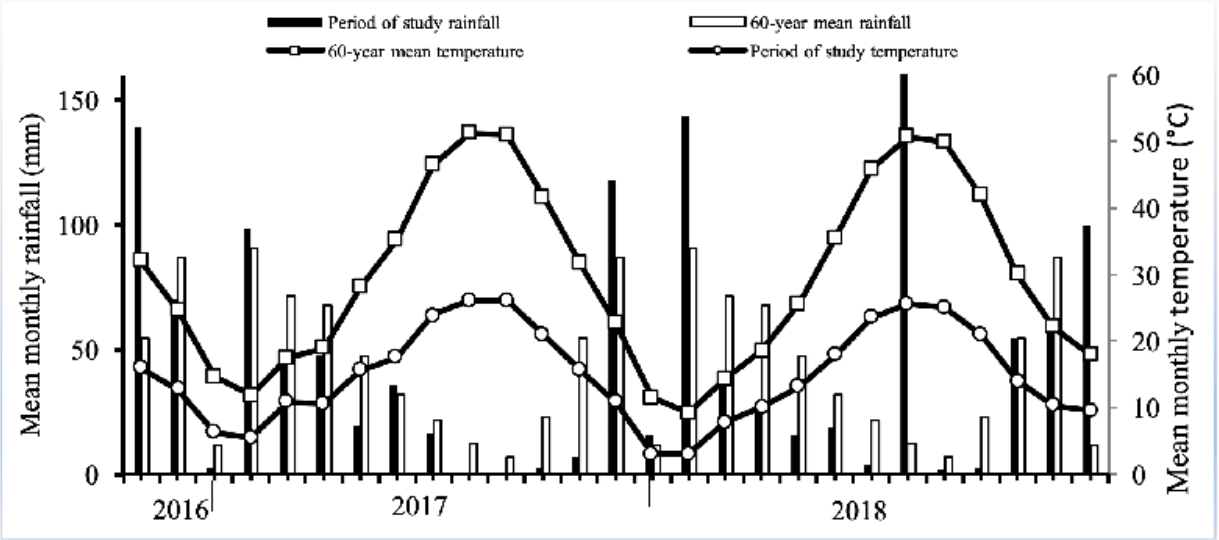

Figure 2. Monthly rainfall and mean temperature from August 2016 to December 2018, and for long term

Table 1. The number of villages and farms in the study area of three-agricultural plain

Plain	Village	Village in basin area		Questioned village		Total farms in districts of plain	Possible farms to be question-naire of districts	Questioned farms of districts	
	(num)$^{+*}$	(num)$^{++}$	(%)	(num)$^{+++}$	(%)	(num)	(num)	(num)	(%)
Bayramic	75	34	45.33	11	32.25	2433	2157	36	1.67
Ezine	49	39	79.59	11	28.21	1164	926	107	11.56
Kumkale	53	50	94.34	8	16.00	4535	4090	258	6.31
Total	177	123	69.49	30	24.39	8132	7173	401	5.59

*, it refers to the number and used in the same meaning throughout the text; $^{+}$the number of total villages of Bayramic, Ezine and Kumkale distirtcs; $^{++}$ the number of total villages only located in Bayramic Dam Basin area; $^{+++}$ the number of questioned villages within each agricultural plain.

Results and Discussion

Social status of farmers

The socio-economic characteristics of the farmers including age, family population, the role of family person in agriculture and educational status are outlined in the following paragraphs (Table 2, 3, 4). The number of human labour has significant importance to maintain the quality of crops by doing physical labour of agricultural practices and operating an agricultural machinery. Age of farmer employed in each farm is a significant indicator for qualified and conscious cultivation. The age distribution of the farmers is ranging between 20 and 76 years on average three agricultural plains (Table 2). After interviewing farmers, data clearly indicate that the majority of the farmers are belonging to middle-age group (20-50 years) (Table 4). The average age of the farmers in the Ezine agicultural plain is 50.13 years, while it was 46.39 and 41.47 years in Kumakle and Bayramic, respectively (Table 2). It was indicated that farmers occupied with agriculture in the plains of Kumkale and Bayramic are younger than in Ezine. The farmers covered a narrow of age groups with the least under 42 years in villages of Bayramic. In recent years, the agricultural incentives provided by goverment for agricultural cultivation have increased the interest and efforts of the young agricultural engineers in agriculture sector. On the other hand, the increase in the use of mechanization in agriculture and the use of various type machinery that require high technology knowledge which was known more by younger age farmer groups. In contrast, it was found that majority of the farmers were in the age of 41-50 years by 29.80%, while age under 30 years and over 60 years is comparable very low by 11.87% and 6.08%, respectively (Table 4). The average age of the farmers is 44.82 years, and it means that more middle-age group was occupied with agriculture activities in the studied area. This shows that the income of the young people is mainly from non-agricultural sources. At the same time, this can be considered as a sign that young people prefer to live in the city instead of living in the village. Similarly, there were few young farmers in European countries; only about one in ten European countries farmer (10.60%) were under the age of 40 years (EuroState, 2018). In another study carried out in the same area of this study by questionnaire for vineyard farmers (Aydın et al., 2017) found the highest labour rate in 41-50 years range by 31.20%, followed by 51-60 years by 30.90%. In addition, another study conducted in Europe, Asia, Africa where were observed similar results that the labour of age in agriculture was stated to be between 40 and 45 years (Matthews, 2008). Author found that 40-49 age were more popular in European countries when the least farmer age was under 40 years. On the other hand, it was reported that the major of farmers (57.90%) is older than 55 years in a study conducted in European countries, while only 6% are younger than 35 years (EuroState, 2018). It was concluded that younger farmers especially tend to manage the largest farms where many small farms are managed by older farmers, often beyond the normal retirement age.

Table 2. Age and number of the farmers in the farms of three-agricultural plain

	Farms	Age-known farmers		Age ranges (year)		
Plain	(num)	(num)	(%)	Max.	Min.	Average
Ezine	107	93	86.92[+]	72	23	50.13±11.78 (23.50)[+]
Kumkale	258	187	72.48	76	23	46.39±10.92 (23.55)
Bayramiç	36	36	100.00	62	20	41.47±9.78 (23.59)
General	401	316	78.80	76	20	46.94±11.33 (24.14)

[+]Mean age± standard deviation (coefficient of variation); + Rate in all farms of each agricultural plain.

Sometimes labour by manpower were used to performed the agricultural activities, for example, such as hand-hoeing, harvesting, etc. (Table 3), but the intensity of use of human labour varies according to the working person in agriculture activities for each family. When considering all of the studied farms, the farming systems remain a predominantly family activity and many farms are family-run with only family members providing help on the farm at different times of the year, and that there are seasonal peaks in labour in harvesting, particularly in the olive for this area. The number of person in the family are changing between 3 and 4 persons, and family size consists of 4 persons on the average of all families (Table 3), and three in every four family members are working regularly in agriculture. Farmers are generally composed of middle-size families (3-4 person per family). In a similar study conducted by Aydın et al. (2017) in the same area for vineyard cultivation concluded that middle-size family is the highest as 44.20% in total while multi person type family is 21.30%.

According to the gender status of the existing family population and the status of working in agriculture, the number of male working per farm is approximately one and a half-person, this was recorded for female as one-person. Agricultural activities were female dominated profession with relatively few male farmers because of many input hand hoeing and hand harvesting practices doing by female in the studied farms (Table 3). 60.16% of the total person were females and 39.84% is males on average three-plain farm, there are results introduced by EuroState (2018) for Netherlands, Latvia and Lithuania where the only one in every twenty farmers was female, corresponding to the 44.90% of farmers. However, the farms manager, who are responsible the normal daily finical and cultivation routines of running a farm, are typically male and relatively old. Only one family male member per farm can be take responsibility as a farm manager who was majority male and 45 years of age and more (Table 4) while this was even lower among female farmers. In contrast, there was a relatively low rate of farmers of 40 years of age or less in many farms of study, and only about one in every twenty-five managers was a young farmer under the age of 40 years. In contrast, in European countries, 71.50% of farmers were male and they are relatively old in EU, 55 years of age or more (EuroState, 2018). As seen in Table 2, although the use of mechanical energy in agriculture is increasing, hu-

man labour is still an important resource. Harvesting and other similar practices were still carried out by human in the area the fact that the labour force in agriculture is needed.

Table 3. Family size and gender status in the questioned farms

	Total family person	Gender rate in family		Gender status in agriculture	
Plain	(num)	Male (%)	Female (%)	Male (num)	Female (num)
Ezine	3.64±1.69 (46.51)[+]	58.12	41.88	1.39±0.87 (62.63)	1.34±0.85 (63.57)
Kumkale	4.17±1.59 (38.15)	61.75	38.25	1.55±0.78 (50.27)	0.96±0.80 (83.22)
Bayramiç	3.75±0.76 (20.12)	53.93	46.07	1.33±0.53 (40.09)	1.14±035 (30.80)
General	4.00±1.57 (39.36)	39.84	60.16	1.49±0.79 (52.81)	1.05±0.79 (75.19)

[+]Average family person number± standard deviation (coefficient of variation).

In considering different levels of education in three-plain, most of the farmers have basic primary education by 58.98%, followed by seconder and high school by 19.59% and 12.47%, respectively (Table 4). The rate of farmers who graduated from university was found very low by 8.86% compared to other education levels, but this rate was higher than in national level with 6.00% (TUIK, 2018). In general, young farmers had higher levels of educational attainment in terms of full agricultural training, and they had followed up to date professional training courses including those on new or innovative farming practices. Only 0.50% farmers have no-education which was lower than in the education level of the national agriculture by 15.20% (TUIK, 2018). In similar, a study conducted for the different countries resulted that 83.82% of the farmers had different education levels while the rest of them had no-formal education (Matthews, 2008). In another study concluded by Aydın et al. (2017), they found that all farmers have different level of education when the proportion of the university graduation is very low by 0.60%. In other hand, they concluded that the farmers with primary and high school education were higher by 70.61% and 14.52%, respectively, but the proportion of the secondary school was lower by 13.23%.

Table 4. General characteristics of farmers of the studied farms

Age	Age		Education level (%)				
range	(year)	(%)	No-formal	Primer	Secondary	High-school	University
20-30	26.02±3.75	11.87	-	46.97	16.33	18.37	18.33
31-40	36.03±2.91	24.49	-	55.45	18.39	13.63	12.53
41-50	45.33±2.77	29.80	-	59.53	14.37	17.00	9.10
51-60	55.39±2.96	27.78	-	63.00	24.50	8.17	4.33
61-+	66.13±4.84	6.08	0.50	69.95	24.36	5.19	0.00
Ave./Tot.	44.82±11.38	100.00	0.50	58.98	19.59	12.47	8.86

Agricultural Organizations

In the scope of the questionnaire, the farmers are conducted their activities under some agricultural organizations which are usually known at the national level, for example, the farmer registration system (FRS), farmer association, dealers (agrochemical, machinery, seed, etc.), agricultural cooperative (agricultural development, irrigation, fisheries), the agriculture chamber. Farmers often prefer the agricultural organizations in order to be able to carry out their agricultural activities confidently and to benefit from the support given by government since they are small type farms and can't reach to the market by their own opportunities. According to Table 5, the farmers had a high tendency to follow to the relevant agricultural organizations to register their own information and kept their rights. The farmers were mostly registered in the FRS of the Directorate of Agriculture and Forestry by 65.84% among the studied farmers (Table 5). Majority of the farmers in the region have been registered for the FRS, and approximately 33.00% of them were found to be composed of farmers who were settled in Bayramic, Ezine and Kumkale agricultural plains. The FRS of professional association of the farmers and governmental organization has an important role in the arrangement of agricultural policies, in the updating of farmer information in the supervision of agricultural support programs, especially for field crops, followed by the farmer associations (51.87%) and the agriculture chambers (31.92%). The irrigation association, known as water user's association from 2008, is the one of associations to serve agricultural water to farmers and make investments for related substructures such as land-levelling, on-farm irrigation system, and operate and maintain existing systems. The majority of irrigated area by groundwater is more common in the studied farms and managed by this association compared to the areas irrigated with surface water such as dams or ponds. In addition, in recent years with the introduction of irrigation dams (e.g. Bayramic Dam) in the studied area, the main priority of the members of the association is to make new investments and improve water collection rates, especially more efficient of the dripping irrigation systems (Figure 2). The chambers of agriculture are a non-governmental organization and play a significantly role in rural development. They provide services in fields such as farmers' registery, the determination of the product prices, balancing of the input prices in the market, laboratory services, soil analysis, registration of the farmers, and recording of the farming files. However, this organisation has been more active in different countries of the world and played an important role in the modernization of the agriculture (Compagnone et al., 2013) and political decision-making at the local and national level (Spiewak et al., 2016).

Table 5. Registration of agricultural organizations in the agricultural farms

	NSF	FRS		FA		AD		COOPS		KOSGEB		AC	
Plain	(num)	(num)	(%)+	(num)	(%)+	(num)	(%)+	(num)	(%)	(num)	(%)+	(num)	(%)+
Ezine	107	67	62.62	41	38.32	8	7.48	4	3.74			20	18.69
Kumkale	258	180	69.77	152	58.91	4	1.55	12	4.65	11	4.26	104	40.31
Bayramiç	36	17	47.22	15	41.67	3	8.33			1	2.78	4	11.11
General	401	264	65.84	208	51.87	15	3.74	16	3.99	12	2.99	128	31.92

+Percentage in the number of studied farms. NSF, number of studied farms; FRS, farmer registration system; AD, agrochemical dealer; COOPS, agricultural cooperatives; AC, agriculture chamber; FA, farmer association; KOSGEB, small and medium-sized farm development organizations.

Agricultural dealers, cooperatives, and small and medium-sized farm development organizations (KOSGEB) are low and range from 2.99% to 3.99%. However, despite the high rate of agricultural organization systems, farmer cannot effectively arrangement on the marketing of the agricultural products as well as determining current prices. Although the cooperatives have little effect on marketing of fresh fruit and vegetable products in all around the studied areas, the cold-storage facilities have an important role to keep the agricultural products for a long term. There are 5 and 4-cold storage (as company or cooperative) in the area of Kumkale and Bayramic plains, respectively, and these are usually store apple, peach, pear, plum, quince and date which are commonly grown-fruits in the study areas, especially for the post-irrigation period (Table 9). On the other hand, it is revealed that the farmers registered in more than one organization have high reasonable level in the area. For example, a farmer with FRS was also found to have registered at the same time in the dealer, cooperatives (agricultural development, irrigation, fishers, sugar beet growers) and agricultural chamber, etc. Although agricultural cooperatives are more active at the national level with large multi-purpose integrated service organization and provide a range of services such as purchasing inputs and equipment (e.g. seed, seedling, milking machines, etc.), providing specialized services (e.g. veterinary services, cold storage facility for some agriculture products, farmer training and extension) as well as processing (e.g. rice cleaning and grading, olive processing) they are very low level in the study area by 3.99%, especially TARIS (association of agricultural sales cooperatives) olive processing due to quite olive growing area (67.76%) within the fruits (Table 9). There is one TARIS processing olive and olive oil in the study region, but there are 33-cooppeartive as TARIS that are operating only in Aegean region with the same purpose. At the national level, the total of cooperative members is about 8 million that makes 11.00% of the population (Okan and Okan, 2013). For example, Agricultural Development Cooperatives, may be established in rural municipalities, villages and districts, include various cooperatives to improve the agricultural production (e.g. the production of olive and fruits etc.) and assist socio-economic development of the members and reduce economic vulnerability.

Farm structure, crop pattern and agricultural machinery

Farms were conducted their agricultural activities in both owned and rental agricultural areas (Table 6), but the management of practices in the area may vary depending on the annual capacity of agricultural activities of farmers such as crop pattern and crop rotation within the same year. On average three-plain, it was recorded that 15.30% of farms are cultivated their agriculture activities on rental fields which are varying from year to year due to the fluctuations of the rental price, and 84.70% are occupied in doing their owned area (traditional owned). The costing of rental price per unit of agricultural area may also vary starkly between the farms of villages within the same agricultural plains because there are different factors depending on localised productivity factors (soil quality, slope, drainage etc.). For example, renting one-unit of agricultural area was most expensive in the lowlands, with the highest regional average, being almost twice compared with slope or dry farming area.

Table 6. Availability of agriculture area in the farms based on ownership and rental status

	Ezine (d+i) (decare)			Kumkale (d+i) (decare)			Bayramic (d+i) (decare)			Generel (d+i) (decare		
	Own	Rent	Total	Own	Rent	Total	Own	Rent	Total	Own	Rent	Total
Total	9239	1193	10432	35469	7103	42572	3840	-	3840	39309	7103	46412
%	88.56	11.44	100.00	81.61	18.39	100.00	100.00	-	100.00	84.70	15.30	100.00
Ave.	840	239	948	3941	1421	4730	349	-	349	1310	355	1547
Max.	2311	380	2576	10737	2770	10737	1220	-	1220	10737	2770	10737
Min.	200	50	200	430	100	430	110	-	110	110		110
St	661.68	119.08	711.27	3764.31	1006.29	4059.93	321.48	-	321.48	2123.68	744.68	2420.72

d, dry farming area in the studied farms; i, irrigable farming area in the studied farms; St, standard deviation (coefficient of variation)

Canakkale region has high potential of the agricultural cultivation for both crop and livestock by using mechanical energy in almost all agricultural activities with slightly human energy. Machinery per unit agricultural area of the farms are higher than national level (TUIK, 2018), usually using mechanical power, except in fruit harvest operations which were done by human, for example, apple, grape, and olive in some farms. Considering arable agricultural structure and water resources from the study area located in Karamenderes basin, machinery and other agricultural technology, for example; drip-irrigation, has been widely used (Figure 2). Machinery was intensively used in all cultivation practices of the different agriculture branches, especially in Kumkale, followed by Bayramic and Ezine. In three-plain, agricultural cultivation is

usually carried out in small size parcels which are irrigated by ground water or streams collected from Ida mountain to dams (e.g. Bayramic Dam) (Table 7). Wheat among the crop patterns was usually cultivated in more farms by 76.56% in regardless of dry or irrigation conditions, followed by pepper (46.13%), tomatoes (45.64%) and maize (33.42%). These were followed by the farms which are cultivated olive (26.68%), and rice, peach and barley by around 20.00%. The size of 73.13% of the farms is below 50 decare among the studied farms due to the high level of land fragmentation. 6.18% of them have the agricultural area of less than 5 decare, whereas only 3.55% are being in 150 decare and above that are known as commercial farms increasing recently in the region despite small size farms. Crop pattern of the post-irrigation was increased compared to the pre-irrigation period by using Bayramic Dam (Table 8, 9). Considering crop pattern for pre-irrigation period (Table 8), it has been identified that there are a limited variety of crops, but agriculture area was found higher than the post-irrigation covering 1996-2018, due to the shift many agriculture areas to facilities such as housing, operation building and agriculture product processing units (e.g. cold storage, olive factory), especially in Kumkale plain decreasing by approximately 86.00%. In pre-irrigation, cereals are commonly grown, especially under dry farming, whereas crop growth under irrigation conditions is more restricted (Table 8). Although wheat is the most important crop among cereals in the area of the current basin for both periods, but its cultivation area is shifted to crops such as maize, rice, and others (cherry, peach, walnut) under irrigable agricultural areas. Although the cultivation area of barley, rye, oats and some legumes, which are generally used to feed the animal, decreased compared to the pre-irrigation period since they continue to be grow in the post-irrigation period (Table 8, 9). However, some crops (e.g. silage maize, clover) that have been cultivated by using water of dams in period covered post-irrigation between 1996 and 2018 (Table 9), and their growing area are increased by using Bayramic Dam for the agricultural irrigation. For example, the growing of grain maize was increased by approximately 5.5 times in only Bayramic plan during the post-irrigation period compared with pre-irrigation when silage maize was grown approximately 17 thousand decare in three-plain agriculture areas (Table 9). This was supported increasing the number of maize harvester and stalk shredder by 75.32% and 98.45%, respectively (Figure 2). The growing of the clover or silage maize are usually under the drip irrigation which has been found to be increased by 77.15% and 100.00%, respectively (Table 9). The practices with irrigation is also increased the using of the water pump in the studied farms by 8.55% (Figure 2). Pre-irrigation agricultural practices of the three-plain agriculture areas, the crops such as silage maize, sorghum, grass, canola, safflower and rice don't have almost growing areas, but they were grown with the irrigation applications (Table 9). By growing such as crops, it has encouraged to grow livestock (Özpınar, 2002), and it also caused to the opening of factories processed milk to produce cheese

Table 7. Number and size of parcels according to crop pattern for both field and horticulture branch in the farms

	<5 decare		5-49 decare		50-149 decare		≥150 decare		Total <5-≥150 decare	
Crop	(num)	(%)	(num)	(%)	(num)	(%)	(num)	(%)	(num)	(%)
Wheat	5	1.63	179	58.31	98	31.92	25	8.14	307	76.56
Pepper	14	7.57	164	88.65	5	2.70	2	1.08	185	46.13
Tomatoes	24	13.11	141	77.05	17	9.29	1	0.55	183	45.64
Maize	1	0.75	109	81.34	19	14.18	5	3.73	134	33.42
Olive	6	5.61	70	65.42	29	27.10	2	1.87	107	26.68
Rice	0	0.00	29	35.37	37	45.12	16	19.51	82	20.45
Peach	2	2.44	66	80.49	14	17.07	0	0.00	82	20.45
Barley	0	0.00	57	69.51	23	28.05	2	2.44	82	20.45
Cherry	9	15.79	48	84.21	-	-	-	-	57	14.21
Oat	2	3.51	40	70.18	14	24.56	1	1.75	57	14.21
Apple	4	7.69	43	82.69	5	9.62	0	0.00	52	12.97
Bean	7	17.07	34	82.93	-	-	0	0.00	41	10.22
Sunflower	-	-	20	50.00	16	40.00	4	10.00	40	9.98
Melon	3	11.11	24	88.89	-	-	-	-	27	6.73
Plum	6	27.27	16	72.73	-	-	-	-	22	5.49
Vineyard	8	42.11	11	57.89	-	-	-	-	19	4.74
Vetch	-	-	17	100.00	-	-	-	-	17	4.24
Field bean	3	20.00	10	66.67	2	13.33	-	-	15	3.74
Watermelon	1	1.19	83	98.81	-	-	-	-	84	20.95
Strawberry	2	16.67	10	83.33	-	-	-	-	12	2.99
Apricot	4	36.36	7	63.64	-	-	-	-	11	2.74
Cotton	-	-	9	90.00	1	10.00	-	-	10	2.49
Trifolium	-	-	8	100.00	0	0.00	-	-	8	2.00
Total	101	6.18	1195	73.13	280	17.14	58	3.55	1634	100.00

or other dairy products. It has been found that silage maize is commonly growing crop by 94.06% in the north of Ezine and Bayramic plains located in the central part of the Karamenderes basin (Table 9); therefore, livestock has become an important agricultural occupation in the same area. This was increased agricultural equipment in the machinery park, especially in number of silage maize harvester, stalk shredder, baler, mover, feed preparation and dairy milking machine and weed tiller (Figure 2). By intensive agriculture system in the current study areas covering Bayramic-Ezine-Kumkale plains, there has also been an increase in surface tillage machinery such as rototiller (89.60%) and rotovator (35.48%) which were usually used in conservation soil tillage systems. Rice started to be grown by the using irrigation application, and it has begun to be cultivated widely in the east of the Ezine plain and partially in the south of Kumkale (Table 9), and this leads to increase the use of combine by 10.04%. On the other hand, there has been an increase in the number of tractor, especially in the last five years by 17.56% in regardless of the tractor power size and brand compared to pre-irrigation period, it means that each farmer has at least one tractor. Moreover, the use of drip irrigation systems instead of sprinkler, which can use water more economically, has become more widely used, especially in the cultivation of vegetables and fruits.

Table 8. Crop pattern in the pre-irrigation period of the farms according to crop branches

	Crop	Bayramic		Ezine		Kumkale		Total		General
Branch		(decare)	(%)	(decare)	(%)	(decare)	(%)	(decare)	(%)	(%)
Field crops	Wheat	69152	28.40	64390	26.44	109984	45.16	243526	42.87	69.02
	Maize	310	40.90	185	24.41	263	34.70	758	0.13	
	Barley	37584	42.31	31870	35.88	19370	21.81	88824	15.64	
	Rye	798	75.57	115	10.89	143	13.54	1056	0.19	
	Oat	17384	83.92	936	4.52	2396	11.57	20716	3.65	
	Vetch	1448	23.85	1638	26.98	2986	49.18	6072	1.07	
	Potatoes	498	87.06	-	-	74	12.94	572	0.10	
	Broad bean	16418	28.62	15994	27.89	24944	43.49	57356	10.10	
	Chickpea	4134	25.56	1932	11.95	10108	62.50	16174	2.85	
	Cotton	-	-	34213	37.58	56836	62.42	91049	16.03	
	Sunflower	246	2.44	458	4.54	9394	93.03	10098	1.78	
	Sesame	16058	75.26	1900	8.90	3380	15.84	21338	3.76	
	Peanut	142	60.17	94	39.83	-	-	236	0.04	
	Clover	690	17.92	2320	60.26	840	21.82	3850	0.68	
	Bean	1046	24.31	1913	44.46	1344	31.23	4303	0.76	
	Kidney bean	158	56.83	100	35.97	20	7.19	278	0.05	
	Animal bean	-	-	1750	97.22	50	2.78	1800	0.32	
	Total	166066	29.24	158058	27.83	242082	42.62	568006	100.00	
Fruits	Apple	23725	90.64	100	0.38	2350	8.98	26175	13.80	23.05
	Peach	1500	43.99	110	3.23	1800	52.79	3410	1.80	
	Strawberry	-	-	20	100.00	-	-	20	0.01	
	Pear	130	100.00	-	-	-	-	130	0.07	
	Cherry	60	100.00	-	-	-	-	60	0.03	
	Apricot	-	0-	-	-	60	100.00	60	0.03	
	Grape	20070	64.99	3560	11.53	7250	23.48	30880	16.28	
	Olive	32600	25.37	88775	69.08	7140	5.56	128515	67.76	
	Almond	200	47.62	-	0.00	220	52.38	420	0.22	
	Total	78285	41.27	92565	48.80	18820	9.92	189670	100.00	
Vegetables	Onion	1383	24.33	2464	43.34	1838	32.33	5685	8.72	7.93
	Garlic	112	21.21	252	47.73	164	31.06	528	0.81	
	Leek	50	9.11	234	42.62	265	48.27	549	0.84	
	Carrot	50	71.43	10	14.29	10	14.29	70	0.11	
	Radish	50	48.08	10	9.62	44	42.31	104	0.16	
	Cauliflower	14	8.67	100	61.92	47.5	29.41	161.5	0.25	
	Cabbage	163	14.78	505	45.78	435	39.44	1103	1.69	
	Lettuce	108	39.56	20	7.33	145	53.11	273	0.42	
	Spinach	105	28.38	65	17.57	200	54.05	370	0.57	
	Purslane	-	-	-	-	10	100.00	10	0.02	
	Parsley	22	52.38	20	47.62	-	-	42	0.06	
	Rocket	10	100.00		0.00	-	-	10	0.02	
	Tomato	2188	5.77	11725	30.93	24000	63.30	37913	58.13	
	Cucumber	325	20.09	963	59.52	330	20.40	1618	2.48	
	Pepper	243	18.74	228	17.58	826	63.69	1297	1.99	
	Okra	110	24.28	253	55.85	90	19.87	453	0.69	
	Eggplant	200	11.03	563	31.05	1050	57.92	1813	2.78	
	Pumpkin	40	17.94	80	35.87	103	46.19	223	0.34	
	Pea	233	10.30	-	-	2030	89.70	2263	3.47	
	Melon	1900	40.88	1298	27.93	1450	31.20	4648	7.13	
	Watermelon	2150	35.29	1493	24.50	2450	40.21	6093	9.34	
	Total	9456	14.50	20283	31.10	35488	54.41	65227	100.00	
General (total)		253807	30.84	270906	32.92	296390	36.02	822903		100.00

Table 9. Crop pattern in the post-irrigation period of the farms according to crop branches

		Bayramic		Ezine		Kumkale		Total		General
Branch	Crop	(decare)	(%)	(decare)	(%)	(decare)	(%)	(decare)	(%)	(%)
Field crops	Wheat	93030	63.63	40586	27.76	12579	8.60	146195	44.56	
	Maize	1711	18.62	5494	59.78	1986	21.61	9191	2.80	
	Barley	45479	62.53	22290	30.65	4960	6.82	72729	22.17	
	Rye	125	55.80	60	26.79	39	17.41	224	0.07	
	Rice	0	0.00	6221	86.44	976	13.56	7197	2.19	
	Oat	18700	67.14	7450	26.75	1701	6.11	27851	8.49	
	Vetch	3900	43.42	4400	48.99	682	7.59	8982	2.74	
	Broad bean	1020	31.04	2100	63.91	166	5.05	3286	1.00	
	Chickpea	3500	76.09	680	14.78	420	9.13	4600	1.40	
	Cotton	0	0.00	100	87.72	14	12.28	114	0.03	
	Sunflower	360	5.26	2992	43.69	3496	51.05	6848	2.09	53.54
	Sesame	2870	91.00	170	5.39	114	3.61	3154	0.96	
	Clover	7500	58.18	4900	38.01	490	3.80	12890	3.93	
	Bean	1100	71.29	320	20.74	123	7.97	1543	0.47	
	Animal bean	1350	47.01	970	33.77	552	19.22	2872	0.88	
	Maize(silage)	9000	53.58	6800	40.48	998	5.94	16798	5.12	
	Sorghum	1590	75.46	450	21.36	67	3.18	2107	0.64	
	Grass	150	38.66	220	56.70	18	4.64	388	0.12	
	Canola	860	100.00		0.00		0.00	860	0.26	
	Safflower	50	100.00		0.00		0.00	50	0.02	
	Total	192295	58.65	106203	32.39	29381	8.96	327879	100.00	
Fruits	Apple	29925	96.62	328	1.06	720	2.32	30973	12.74	
	Peach	6760	67.10	660	6.55	2655	26.35	10075	4.14	
	Strawberry	120	88.89	10	7.41	5	3.70	135	0.06	
	Pear	560	84.85	50	7.58	50	7.58	660	0.27	
	Cherry	4940	90.23	265	4.84	270	4.93	5475	2.25	
	Apricot	77	7.93	558	57.47	336	34.60	971	0.40	
	Grape	19720	91.83	1500	6.99	254	1.18	21474	8.83	
	Olive	40320	25.20	116530	72.84	3134	1.96	159984	65.81	
	Almond	690	22.22	2300	74.07	115	3.70	3105	1.28	
	Date	42	47.73	20	22.73	26	29.55	88	0.04	39.70
	Quince	260	44.22	310	52.72	18	3.06	588	0.24	
	Plum	425	55.19	225	29.22	120	15.58	770	0.32	
	Medlar	3	37.50		0.00	5	62.50	8	0.00	
	Pomegranate	20	4.30	420	90.32	25	5.38	465	0.19	
	Peanuts	26	50.98	18	35.29	7	13.73	51	0.02	
	Hazelnut	17	100.00		0.00		0.00	17	0.01	
	Chestnut	44	100.00		0.00		0.00	44	0.02	
	Walnut	3550	43.28	4300	52.43	352	4.29	8202	3.37	
	Total	107499	44.22	127494	52.45	8092	3.33	243085	100.00	
Vegetables	Onion	190	39.26	230	47.52	64	13.22	484	1.17	
	Garlic	135	85.99	12	7.64	10	6.37	157	0.38	
	Leek	25	31.25	40	50.00	15	18.75	80	0.19	
	Carrot	2	50.00		0.00	2	50.00	4	0.01	
	Radish	6	42.86	2	14.29	6	42.86	14	0.03	
	Cauliflower	85	18.85	350	77.61	16	3.55	451	1.09	
	Cabbage	90	31.58	160	56.14	35	12.28	285	0.69	
	Lettuce	177	44.25	151	37.75	72	18.00	400	0.97	
	Spinach	116	41.13	140	49.65	26	9.22	282	0.68	
	Parsley	20	62.50	2	6.25	10	31.25	32	0.08	6.76
	Tomato	6800	34.26	10600	53.40	2450	12.34	19850	47.96	
	Cucumber	114	32.95	217	62.72	15	4.34	346	0.84	
	Pepper	5180	49.68	4879	46.79	368	3.53	10427	25.19	
	Okra	25	29.41	55	64.71	5	5.88	85	0.21	
	Eggplant	42	23.60	100	56.18	36	20.22	178	0.43	
	Pumpkin	200	79.68	40	15.94	11	4.38	251	0.61	
	Pea	453	29.45	1009	65.60	76	4.94	1538	3.72	
	Melon	950	32.93	1550	53.73	385	13.34	2885	6.97	
	Watermelon	1100	30.29	2400	66.10	131	3.61	3631	8.77	
	Total	15710	37.96	21937	53.01	3733	9.02	41380	100.00	
General (total)		315504	51.52	255634	41.75	41206	6.73	612344		

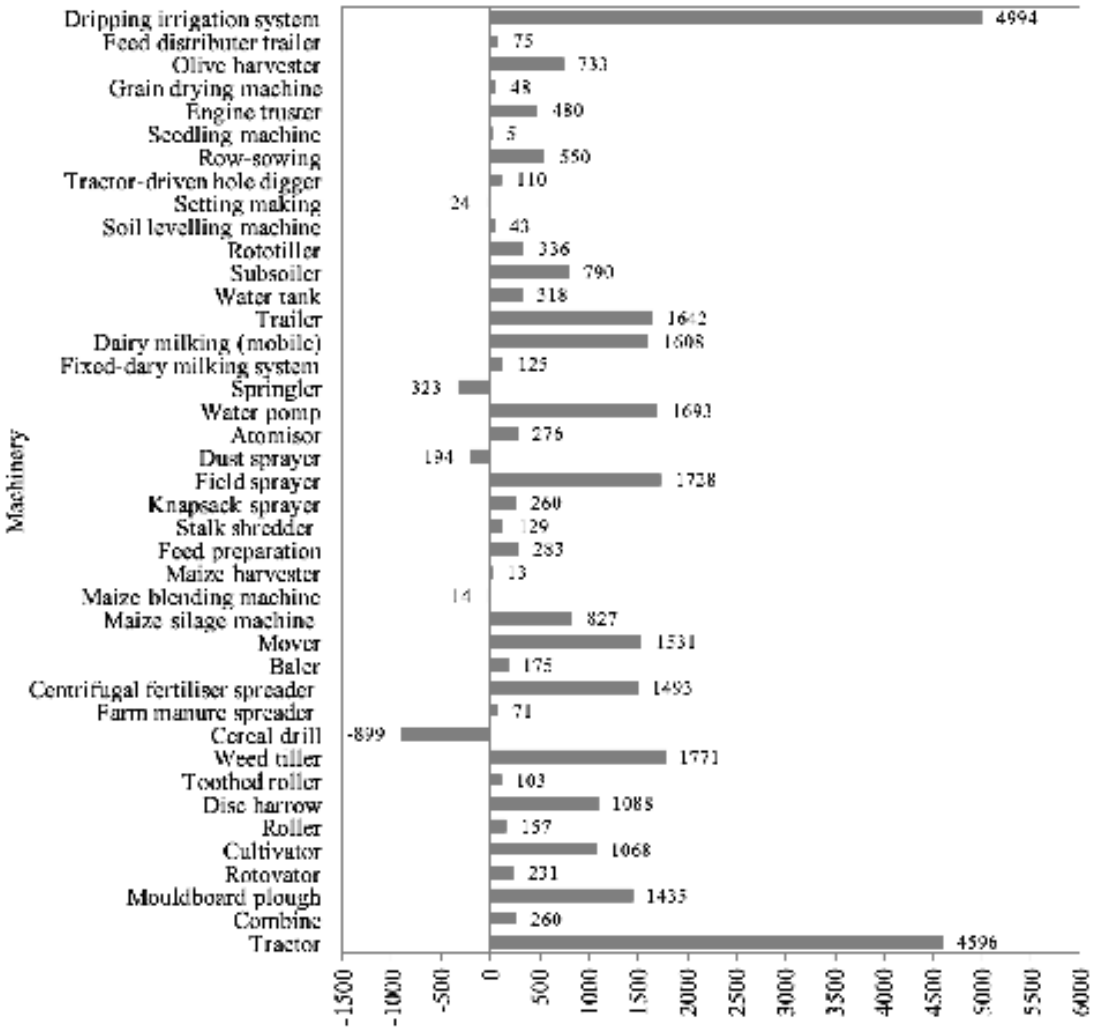

Figure 2. Increase and decrease in the number of agricultural machinery in post-irrigation period (the first quarter of 2018 compared to pre-irrigation period (1996)

Agricultural mechanization and its indicators in the farms

The relationship between agricultural area and tractor

Most farms are family farms and only employ family labour and they are considerably smaller than those in the national, with the size of the average farm in country being 65 decare. Small scale farming is important characteristic of the region agriculture. Region agriculture also suffers from inadequate farm management and technology such as farm tractors and machineries, water shortages and droughts, an inefficient rural credit system to produce the agriculture area, as well as high costs. The farmers for increasing agricultural production of the region, especially for the three-agricultural plain where the study was carried out, are expected to be further productivity growth with irrigation schemes supporting improvements such as Bayramic Dam, and with agriculture tractor and machinery. Tractor has traditionally been used on farms to mechanise several agricultural operations and accessed as mechanization level in terms of number per farm and unit area (Ozmerzi, 1998) (Table 10). A modern tractor is used for ploughing, tilling, planting, landscape maintenance, moving, or spreading fertiliser and cleaning bushes. Tractor offers advantages on small farms as well as horticultural operations, and the various benefits of using tractors to mechanise farming. Effect of tractor power on agricultural cultivation is quite important and varying according to agricultural area. Therefore, tractor power may differ considerably in different area and productivity and it was positively correlated with potential unit farm power. The average agricultural area per tractor was 117 decare on average three-plain, but this was found to be higher for Kumkale with 136 decare tractor-1 which was higher than two other plains, 116 decare tractor-1 for Bayramic and 83 decare tractor-1 for Ezine. When compared with national level, agriculture area per tractor was higher and recorded as 220 decare in 2004, but it was found lower by 178 decare in 2012 (Akdemir, 2013) and 147 decare in 2014 (Civelek, 2016) and 116 decare in 2018 (Yücel, 2019). This means that the tractor number was increased by year. On the other hand, when the current tractors per farm was considered, the average of three plains was 0.99 tractor farm-1. It can be say that there was less than one tractor per farm. The numbers of tractor per farm was determined as 1.17. 0.92 and 0.92 in Ezine, Kum-

kale and Bayramic, respectively. There are results concluded by Oğuz et al. (2017) who recorded higher tractor per farm for Konya as 1.57 tractor farm-1. They also concluded that tractor number per farm was higher (1.64) in large size parcels than in small size parcels (1.17). On average three-plain, machinery per tractor was found as 7.67 which describes conventional farming systems are still dominant in the area because of using many equipment in tillage, seedbed preparation, protection and other cultural practices. It also means that conservation and direct cultivation systems are not much known or used by many local farmers. In Figure 3, it is clearly shows that the machinery used in all studied farms are more suitable for traditional agriculture. This is especially confirmed by the fact that the number of mouldboard plough is one or more per tractor, while other machinery using for conservation or sustainable management systems were lower, for example rototiller, rotovator, etc. On the other hand, it was concluded that from studied farms during the questionnaire, although farmers are willing to buy more new tractors (Table 17), they are not very conscious of the replacement of existing machinery used in conventional agriculture. However, the largest farms such as commercial have managed to improve their technical equipment thanks to the funds from the national budge. However, in general, the majority of machinery are overworked and fully exploited in the studied farms. In general, the owners of small farms do not invest for the new machinery, but prolong the utilization life of the existing machinery even to 30 or 40 years. This increases the frequency and costs of repair. Machinery per tractor was resulted higher by 7.67 for studied farms than the national level by 7.26, but it was lower than some agricultural areas which were located more close the study area, for example; Edirne (9.13), Kırklareli (8.81) and Tekirdağ (9.67), and Thrace region (9.24) (Abdikoğlu, 2019).

Table 10. Agriculture area (owned+rental), tractors and their indicators in the farms of three-plain

Plain	Agri. area (decare)	Farm (num)	Tractor (num)	Machinery (num)	(decare farm^{-1})	(decare tractor^{-1})	(tractor farm^{-1})	(machinery tractor^{-1})
Ezine	10432	107	103	734	97	83	1.17	5.87
Kumkale	32140	258	239	2080	125	136	0.92	8.78
Bayramic	3840	36	33	217	107	116	0.92	6.58
General	46412	401	395	3031	116	117	0.99	7.67

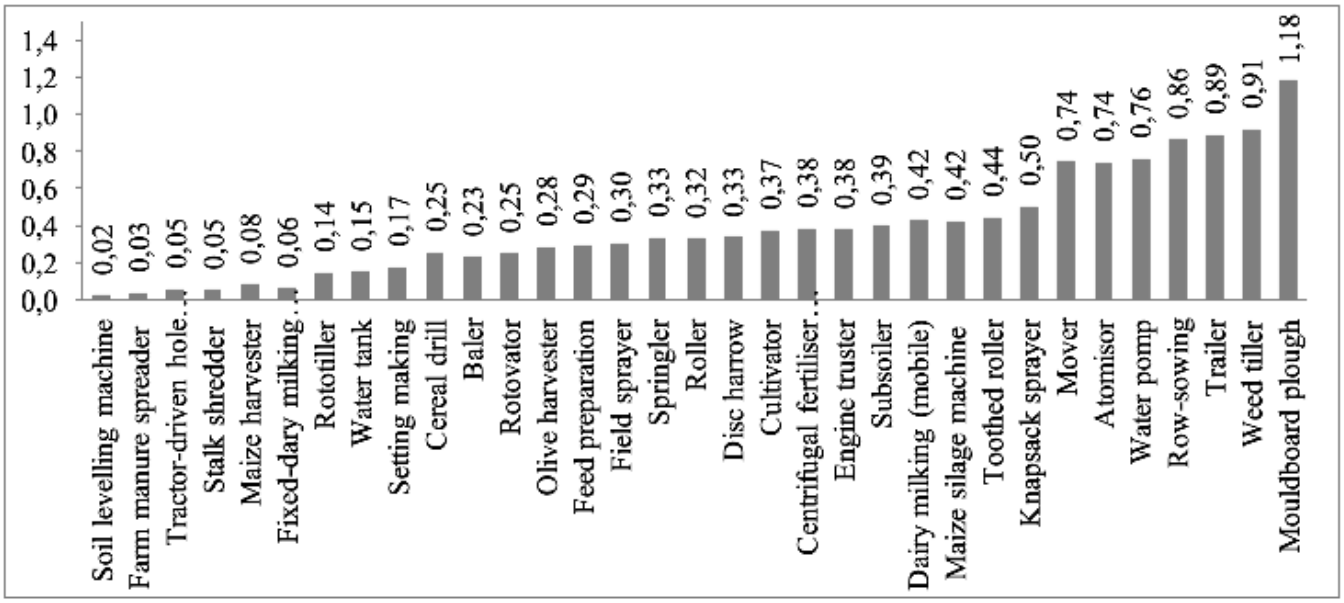

Figure 3. Number of machinery per tractor in each farm depending on average farms of three agricultural plains

Availability tractors and their brands

In questioned agricultural farms, the tractor brands were determined to be more than half of the existing tractor in the country with 30 brands. Thus, 17 tractor brands were identified in the studied agricultural farms and it was determined that they consist of both foreign and domestic brands according to Turkish Association of Agricultural Machinery and Equipment Manufacturers (Tarmakbir, 2018). New Holland was the highest (32.15%) brand within all tractors, followed by Massey Ferguson (18.99%), and Fiat (9.11%), John Deere (8.10%), Case IH (7.85%), Same (5.06%), Deutz (4.05%), Steyr (3.54%), Valtra (2.28%), Tumosan (2.53%), Basak (1.27%), Universal (1.27%), Hattat (0.51%) and Kubota (0.25%), etc. The reason for the higher number of New Holland and Massey Ferguson is the existence of seller dealers and maintenance-repair service facilities in the region. The opportunity of the service and seller dealers for both brands were sometimes found to provide sales to some tractors such as Hattat. Kubota, Valtra and Deutz. It determined that some tractor brands, for example Same, Universal, Stery and Tumosan, were generally sold as second hand at the same seller dealers (Table 11). Similarly, according to the results concluded by Aybek and Sener (2009) for a local agricultural area which are under intensive agriculture, Massey Ferguson has been reported to be the most used

tractor brand with a rate of 36.30% in regardless of model and size. Others recorded that the most commonly used tractor at the national level was Massey Ferguson with a ratio of 32.69 (Civelek, 2016). The same researcher recorded that the other most commonly used tractor brands were Fiat and then New Holland sold by Turk Tractor Company. According to a study conducted in another local area of the country in the same period, it was concluded that the farms had more Tumosan by 30.00%, and then Massey Ferguson (18.18%), New Holland (15.46%) and John Deere (10.00%) (Keleş et al., 2016). When considering these studies carried out under the different region conditions, it can be said that the use of different brands of tractor varies according to the region's climate, crop pattern and most importantly the income level of the farmers.

Table 11. Number and rate of tractors by brands in all farms of three-plain

Brand	Ezine	Kumkale	Bayramic	General
MF	24 (19.20)[+]	38 (16.03)	13 (39.39)	75 (18.99)
NH	35 (28.00)	89 (37.55)	3 (9.09)	127 (32.15)
FR	4 (3.20)	3 (1.27)	0 (0.00)	7 (1.77)
FI	26 (82.16)	10 (16.67)	0 (0.00)	36 (9.11)
SM	7 (5.60)	12 (5.06)	1 (3.03)	20 (5.06)
ER	1 (0.80)	1 (0.42)	0 (0.00)	2 (0.51)
B	1 (0.80)	3 (1.27)	1 (3.03)	5 (1.27)
CS	12 (9.60)	16 (6.75)	3 (9.09)	31 (7.85)
ST	2 (1.60)	10 (4.22)	2 (6.06)	14 (3.54)
TM	3 (2.40)	6 (2.53)	1 (3.03)	10 (2.53)
JD	4 (3.20)	23 (9.70)	5 (15.15)	32 (8.10)
DT	5 (4.00)	10 (4.22)	1 (3.03)	16 (4.05)
UN	0 (0.00)	4 (1.69)	1 (3.03)	5 (1.27)
KB	0 (0.00)	1 (0.42)	0 (0.00)	1 (0.25)
LN	0 (0.00)	3 (1.27)	0 (0.00)	3 (0.76)
VLT	0 (0.00)	7 (2.95)	2 (6.06)	9 (2.28)
HT	1 (0.80)	1 (0.42)	0 (0.00)	2 (0.51)
Total	125 (31.65)	237 (60.00)	33 (8.35)	395 (100.00)

[+] Percentage of tractor brand within total tractors of three-plain. MF, Massey Ferguson; NH, New Holland; FR, Ford; HT, Hattat; FI, Fiat; SM, Same; ER, Erkunt; B, Basak; CS, Case IH; ST, Steyr; TM, Tumosan; JD, John Deere; DT, Deutz; UN, Universal; KB, Kubota; LN, Landini; VLT, Valtra.

The status of having different tractor brands of the farms was determined on the basis of each agricultural plain and the results of the farms having one or more than one brands are given in Table 12, respectively. 19.45% of farms have more than one tractor brands (Table 12), while 74.31% of farms have only one tractor brand (Table 12). The single brand used in the farms are usually New Holland (26.68%), Massey Ferguson (11.22%), John Deere (7.48%), Case (5.49%) and Fiat (5.49%), followed by others such as Same, Steyr, Deutz. etc. (Table 12). It was determined that the farms having more than one tractor brands generally use dual tractor such as NH+NH (4.74%), NH+MF (3.49%), NH+JD (2.50%), NH+CS (1.75%) and NH+TM (1.25%), and others. In both cases. the New Holland can be used widely in the farms that it may be result of its service and seller dealers in the region. The largest proportion of the farms having more than one tractor brands was found in Bayramic with 41.67% of 36 farms, followed by Kumkale with 20.93% of 258 farms and Ezine with 8.41% of 107 farms (Table 12). The reason using of the more tractor brands in Bayramic plain may be attributed to the different agricultural branches such as field crops, horticulture as well as animal production. Aybek and Sener (2009) recorded that 89.30% of farms had one tractor, 7.80% had two, 0.50% had three and 2.40% had four tractors, regardless of brands in an area of intensive agriculture located in Çukurova region.

Effective methods and factors to purchase the tractors for farms

The 395 tractors were recorded (Table 11) in the studied farms in regardless of the brand, size and age of them, but the purchase status of only 370 was determined (Table 13) while no-information was obtained about the purchasing of the remaining of 25 tractors. The first-hand buying as new one, and second-hand purchasing of tractors are identified in farms of all villages (Table 13), but they were recorded only one in some farms, and two type purchasing in others. When considering the results, it is concluded that one of the way to have the tractors in farms is to purchase new tractor which corresponds to 77.03% for three-plain. On the other hand, it was determined that the rate of the tractor ownership in the second-hand was 22.97%. It was concluded that with the change in agricultural cultivation branches and crop pattern in the three agricultural plains of the post-irrigation period, the tractors requirements with the different characteristics has increased and it is appropriate to meet purchasing with second-hand tractors to continue without interruption of the farm operations. In addition, it is also say that the standard type tractors are sufficient for the completion of the work in animal production, especially for feeding operations. For this purpose, it is also emphasized that it is more economical to purchase the second-hand type of tractors without active working properties. Considering that the studied farms having tractors, agricultural cultivation branches

have been identified as an important factor in combination with the availability of service facility, spare parts, while Özpınar and Çay (2018) concluded similar results for purchasing tractor for farms. They also reported that the tractor power was the more efficiently factor, followed by the service availability, PTO properties and others such as the bank loan, fuel saving, wheel and gear characteristics (Table 14).

Table 12. Number and rate of farms having one or more than one tractor brands in three-plain

	Number of farms having one tractor					Number of farms having more than one tractor			
Brand	Ezine	Kumkale	Bayramic	Total	Brand	Ezine	Kumkale	Bayramic	Total
MF	3 (2.80)+	38 (14.73)	4 (11.11)	45 (11.22)	NH+NH	1 (0.93)	16 (6.20)	2 (5.56)	19 (4.74)
NH	9 (8.41)	86 (33.33)	12 (33.33)	107 (26.68)	NH+FI	1 (0.93)	-	-	1 (0.25)
FR	-	2 (0.78)	-	2 (0.50)	NH+MF	-	7 (2.71)	7 (19.44)	14 (3.49)
HT	1 (0.93)	1 (0.39)	-	2 (0.50)	NH+B	1 (0.93)	-	-	1 (0.25)
FI	12 (11.21)	10 (3.88)	-	22 (5.49)	NH+SM	1 (0.93)	3 (1.169	-	4 (1.00)
SM	2 (1.87)	12 (4.65)	1 (2.78)	15 (3.74)	NH+JD	1 (0.93)	7 (2.719	2 (5.56)	10 (2.50)
ER	1 (0.93)	1 (0.39)	-	2 (0.50)	NH+TM	-	5 (1.94)	-	5 (1.25)
B	-	3 (1.16)	1 (2.78)	4 (1.00)	NH+ER	-	3 (1.16)	1 (2.78)	4 (1.00)
CS	4 (3.74)	15 (5.81)	3 (8.33)	22 (5.49)	NH+CS	-	7 (2.71)	-	7 (1.75)
ST	1 (0.93)	9 (3.49)	2 (5.56)	12 (2.99)	MF+MF	-	1 (0.399	1 (2.78)	2 (0.50)
TM	2 (1.87)	6 (2.33)	1 (2.78)	9 (2.24)	MF+FI	2 (1.87)	3 (1.16)	-	5 (1.25)
JD	2 (1.87)	23 (8.91)	5 (13.89)	30 (7.48)	MF+FR+DT	1 (0.93)	-	-	1 (0.25)
DT	-	10 (3.88)	1 (2.78)	11 (2.74)	JD+JD	-	-	1 (2.78)	1 (0.25)
UN	-	3 (1.16)	1 (2.78)	4 (1.00)	JD+KB	-	1 (0.39)	-	1 (0.25)
KB	-	1 (0.39)	-	1 (0.25)	TM+ST	-	1 (0.39)	1 (2.78)	2 (0.50)
LN	-	3 (1.16)	-	3 (0.75)	CS+CS	1 (0.93)	-	-	1 (0.25)
VLT	-	5 (1.94)	2 (5.56)	7 (1.75)					
Total	37 (34.58)	228 (88.37)	33 (91.67)	298 (74.31)	Total	9 (8.41)	54 (20.93)	15 (41.67)	78 (19.45)
FN	107	258	36	401	FN	107	258	36	401

+ The percentage of farms having tractor brand in each agricultural plain of farms. FN, total number of farms questioned for each agricultural plain.

The role of financial capital as a factor of agricultural cultivation is to facilitate economic growth and development. Credit is an important instrument that enables farmers to obtain requirements with consumption materials and also plays an important role in increasing agricultural productivity. The availability of credit enables farmers to purchase the required inputs and machinery to carry out farm operations on time (Marandi and Rashidpour, 2017). Agricultural cultivation in the studied area needs more agricultural credit availability because of certain structural characteristics, notably its small family farm. Most farms are small-scale family type, fragmented and scattered (Özpınar, 2002). So, agricultural credit has great precaution for their development and they meet their credit requirements from formal funds for loans through public sector, alongside with informal sources. At the national level, however, Ziraat Bank and Agricultural Credit Cooperatives have been the principle supplier of loanable funds in the agriculture sector (Gunes and Movassaghi, 2017) as formal credit sources. They also concluded that Ziraat Bank, private banks (domestic and foreign-owned and operated), agricultural credit and sales cooperatives and other cooperatives (e.g. Pankobirlik) are the major formal suppliers of credit, but wealthy farmers and money lenders are among the informal credit sources which are generally provide short term loans, saddling borrowers with high interest rates. On the other hand, small-scale farms need in order to meet short term requirements such as purchasing fuel and long term purposes; for example, investment in agricultural area, irrigation facilities and machinery. When the financial methods used in the purchasing of tractors for farms were considered, it was found that the highest system was agricultural loan system with 61.63% by private or public (Ziraat) banks, whereas in cash purchasing was lower with 35.28% because loan system gives the farmers enough time opportunity to do their re-payments step-by-step (Table 14). Meanwhile,

Table 13. Number and rates of tractors in the studied farms of three-plain according to the purchase

	Ezine			Kumkale			Bayramic			Total of three-plain		
Brand	FH	SH	TT	FH	SH	TT	FH	SH	TT	FH	SH	TT
MF	11 (68.75)	5 (31.25)	16	35 (89.74)	4 (10.26)	39	1 (33.33)	2 (66.67)	3	47 (81.03)	11 (18.97)	58
NH	24 (75.00)	8 (25.00)	32	83 (96.51)	3 (3.49)	86	11(100.00)	-	11	118 (91.47)	11 (8.53)	129
FR	-	1 (100.00)	1	2 (66.67)	1 (33.33)	3	-	-	-	2 (50.00)	2 (50.00)	4
FI	11 (73.33)	4 (26.67)	15	6 (60.00)	4 (40.00)	10	-	-	-	17 (68.00)	8 (32.00)	25
SM	6 (66.67)	3 (33.33)	9	5 (41.67)	7 (58.33)	12	1 (100.00)	-	1	12 (54.55)	10 (45.45)	22
ER	1 (100.00)	-	1	1 (100.00)	-	1	-	-	-	2 (100.00)	-	2
B	-	-	-	2 (66.67)	1 (33.33)	3	1 (100.00)	-	1	3 (75.00)	1 (25.00)	4
CS	4 (57.14)	3 (42.86)	7	10 (66.67)	5 (33.33)	15	2 (100.00)	-	2	16 (66.67)	8 (33.33)	24
ST	3 (23.08)	10 (76.92)	13	9 (69.23)	4 (30.77)	13	2 (100.00)	-	2	14 (50.00)	14 (50.00)	28
TM	4 (80.00)	1 (20.00)	5	6 (85.71)	1 (14.29)	7	1 (50.00)	1 (50.00)	2	11 (78.57)	3 (21.43)	14
JD	4(100.00)	-	4	9 (42.86)	12 (57.14)	21	5 (100.00)	-	5	18 (60.00)	12 (40.00)	30
DTZ	-	1 (100.00)	1	8 (80.00)	2 (20.00)	10	1 (100.00)	-	1	9 (75.00)	3 (25.00)	12
UN	-	-	-	3 (100.00)	-	3	-	1 (100.00)	1	3 (75.00)	1 (25.00)	4
KB	-	-	-	1 (100.00)	-	1	-	-	-	1 (100.00)	-	1
LN	-	-	-	2 (66.67)	1 (33.33)	3	-	-	-	2 (66.67)	1 (33.33)	3
VLT	-	-	-	7 (100.00)	-	7	1 (100.00)	-	1	8 (100.00)	-	8
HT	1 (100.00)	-	1	1 (100.00)	-	1		-	-	2 (100.00)	-	2
Total	69 (65.71)	36 (34.29)	105	190 (80.85)	45 (19.15)	235	26 (86.67)	4 (13.33)	30	285 (77.03)	85 (22.97)	370

FH, first-hand (new) tractor; SH, second-hand (old) tractor; TT, total tractor (first and second hand) for each agricultural plain.

farmers have more confidence in Ziraat Bank because of giving subsidized credit. It is determined that the loan system is generally pay with five percentage cash in advance and the rest is repaid within next 20 or 60 months as long term. Additionally, the loan system is the most effective system to purchase the tractor for farms because it provides financial facilities for long-time period. In addition to this purchase method, agricultural credit system is not preferred by farmers due to its low advantage compared to the loan system due to higher interest rate. Moreover, it was also emphasized that the loan system facilitates provide to the farmers to purchase different type, varying power size, axle type, tractor brands, and improving the agricultural equipment and mechanization level increasing the yield and ensured food security, but this system is varying depending on bank loan system (Özpınar and Çay, 2018). On the other hand, two factors have been emerged to be important to purchase tractors for farms, one of which is the size of the agricultural area, and other is the appropriate or reasonable price of the tractor (Table 15). Therefore, when the Table 15 is considered, it was said that the size of the area is more effective factor to purchase a tractor when the 67.15% of the farms have preferred this type method. On the other hand, the rest of the farms have encouraged the reasonable price in regardless of tractor brand, power size and axle number or type because they have emphasized that the reasonable price is sometimes the easy way system due to simple access way of tractors.

Table 14. Number and rate of farms in terms of methods of the purchasing tractors

	Cash		Loan		Agricultural credit coop.		Total	
Plain	(num)	(%)	(num)	(%)	(num)	(%)	(num)	(%)
Ezine	32	35.56	48	53.33	10	11.11	90	100.00
Kumkale	75	32.89	153	67.11	-	-	228	100.00
Bayramic	14	53.85	11	42.31	1	3.85	26	100.00
General	121	35.28	212	61.63	11	3.20	344	100.00

Table 15. Number and rate of farms according to effective factors of purchasing tractors

	Area size		Reasonable price		Total	
Plain	(num)	(%)	(num)	(%)	(num)	(%)
Ezine	52	56.52	40	43.48	92	100.00
Kumkale	171	74.03	60	25.97	231	100.00
Bayramic	11	39.29	17	60.71	28	100.00
General	234	67.15	117	32.85	351	100.00

The proficiency level of the current tractors in farms

Considering on average tractor number in three-agricultural plains, 64.62% of farms have been found to be sufficient tractors to carry out their agricultural operations (Table 16). However, it is stated that the current tractors are not sufficient to carry out agricultural operations in 35.38% of farms which were occupied more than one agricultural branches such as field, horticulture and as well as animal production. The common of animal production in the region together crop production has revealed the requirement for tractors with different power sizes and characteristics. On the other hand, in some villages of the Bayramic and Ezine agricultural plains, it was determined that the cultivation of the horticulture together with the field cultivation increased the requirement of the tractors in different power and brands. In addition, the absence of sharing farm machinery or tractor system in the region, it was determined that each farmer have to buy required tractor and machinery to carry out their agricultural operations on time. On the other hand, farmers borrow the machinery or tractors from neighbours that is traditionally sustainable system in the area.

Table 16. Number and rate of farms in terms of the proficiency level of the tractors

	Sufficient		Insufficient		Total	
Plain	(num)	(%)	(num)	(%)	(num)	(%)
Ezine	49	56.32	38	43.68	87	100.00
Kumkale	156	67.53	75	32.47	231	100.00
Bayramic	16	66.67	8	33.33	24	100.00
General	221	64.62	121	35.38	342	100.00

Varying and distribution of age statues of owned tractors by farms based on brands

The age characteristics of the tractor brands in the studied farms have been observed in similar for the country farms (Table 17). Current tractors in the farms were classified according to their age on the basis of brand, and then they were divided into two groups as young (0-20-year) and old (20-year and over) while it has been declared that the different economic life for tractor, for example, 20-24 years at the national level. The age grouping on the brand basis was done by selecting the youngest and oldest age tractors. When considered according to age groups; the age of tractors such as Massey Ferguson, Fiat and John Deere are quite high compared to others. For example, Massey Ferguson and John Deere were found to be in the age group of 44 years which is old age group category. However, although there were found to be very old tractors for both tractor brands, the youngest tractors were also recorded for the same brands because of the reason of its long term using in the agriculture area. The other reason may be the presence of Massey Ferguson brand in the region due to the availability of sale dealers, service facilities and spare-parts which were especially settled in Ezine district. On the other hand, some models of New Holland, Erkunt, Kubota and Valtra were found younger than Massey Ferguson and John Deere, for example, although New Holland brand was used in the country for long time, they were reasonability took place in young group range for the studied farms. It can be said that the availability of New Holland tractors in farms as well in the region are directly depending on the availability of the sale dealers, service facilities which provide an increase in the use of this brand. In the region, New Holland tractors have progressively increased in the use of the agriculture after the sales dealers and service facilities were served in the area from 2010-year. Therefore, New Holland has caused to be in the category of young age as well as in the study farms. Similarly, the same opportunities for young age brands have allowed to increase its sales and used widely in the area. Özpınar and Çay (2018) found similar results about tractors age in respect to brands. On the other hand, many tractor brands found within 15-year economic life age range (Tezer and Sabancı, 1997). In a similar study, it was found that the economic life of 45.71% of total tractors is over than 25-year old at the national level, regardless of brands

and sizes (Civelek, 2016) who declared that 9.02% of remaining tractors are in range 20-25 years. 11.03% in 15-20 years, 13.11% in 10-15 years and 21.14% under the age of 10 years. In another intensive agriculture region, it was concluded that 20.80% of tractors were at the age of 16 or more while 79.25% of them were under 16 years (Aybek and Senel, 2009). They explained that 30% of young tractors have 0-5 years, while 36.30% of them are 6-10 years, 12.00% are 11-15 years. When economic life of a tractor is considered to be 20-year (Yılmaz and Sümer, 2018), it can be seen that 12.50% of tractors in the study area have already completed their economic life (Table 17) while 87.00% was in economic life although they have low working hours in year, 500-600 hours compared to developed countries with 1000 hours per year (TAGEM, 2019). Considering tractor age at the national level, 54.00% of tractors varied between 1-24 years, while 46.00% are over 25 years, 50.90% of tractors over 25-years are over 40 years, and remaining take place 25-40 years. It also concluded that very old tractor usage reduces agricultural cultivation activity whereas increases fuel usage costs and greenhouse gas emissions due to old technology engines (Civelek, 2016). Therefore, it needs changing old tractors with new tractors which reduce engine emission levels and time loses on the field with benefits such as electrical control, GPS guidance and ISO-Bus systems. The reason the use of old tractors is due to the low annual working hours with 600-hour in the country compared to 12 thousand hours in development countries. Using of such as old tractors will result in high fuel usage, extend working hours, extra labour costs that means less production and profit.

Table 17. Age of tractors according to their brands in all farms

	Age group (year)		Young		Old		Tot. Trac.
Brand	Young	Old	(num)	(%)	(num)	(%)	(num)
MF	7.29±4.61(63.25)[+]	44.33±15.63(35.25)	60	89.55	7	10.45	67
NH	4.88±3.52(72.15)	6.75±4.92(72.95)	120	94.49	7	5.51	127
FR	6.75±4.92(72.95)	44.38±19.25(43.38)	3	75.00	1	25.00	4
FI	13.50±16.26(120.47)	27.50±15.31 (55.66)	21	84.00	4	16.00	25
SM	4.60±2.41(52.35)	12.50±10.97(87.73)	17	77.27	5	22.73	22
ER	5.00±1.00(20.00)	6.00±2.00(8.00)	1	100.00		0.00	1
B	5.00±3.83 (76.59)	17.67±4.73(26.75)	2	40.00	3	60.00	5
CS	5.75±3.30(57.46)	10.33±8.04(77.82)	21	87.50	3	12.50	24
ST	18.20±12.85 (70.62)	24.00±3.46(14.43)	20	80.00	5	20.00	25
TM	4.91±3.52(71.59)	8.33±4.93(59.19)	13	86.67	2	13.33	15
JD	4.00±4.24(106.07)	8.33±7.07(84.85)	24	80.00	6	20.00	30
DTZ	5.85±1.30(22.23)	15.50±20.21(130.37)	11	91.67	1	8.33	12
UN	15.50±20.21(130.37)	35.75±6.88(19.25)	3	75.00	1	25.00	4
KB	4.91±3.52(71.59)	5.00±2.94(58.88)	1	100.00		0.00	1
LN	3.00±1.00(33.33)	6.75±4.92(72.95)	3	100.00		0.00	3
VLT	5.00±3.35 (66.93)	7.17±2.47(34.42)	8	100.00		0.00	8
HT	5.33±2.52(47.19)	15.50±20.51(132.30)	2	100.00		0.00	2
			330	88.00	45	12.00	375

[+]Mean tractor age± standard deviation (coefficient of variation); MF, Massey Ferguson; NH, New Holland; FR, Ford; HT, Hattat; FI, Fiat; SM, Same; ER, Erkunt; B, Basak; CS, Case IH, ST, Steyr; TM, Tumosan; JD, John Deere; DTZ, Deutz; UN, Universal; KB, Kubota; LN, Landini; VLT, Valtra.

Conclusion

The existence of the possibilities for the sustainability of agricultural cultivation have crucial importance. Sometimes the existence of these possibilities is not enough for sustainable agriculture, but also they have to be used correctly. Therefore, it is necessary to know agricultural possibilities in an agricultural area and to determine them for to be planned for next projections. For this purpose, a questionnaire is conducted to make the necessary determinations about agriculture activities which were performed by mechanization possibilities and human sources. The questionnaire survey was focused to determine the agriculture structure and mechanization for some villages of Bayramic-Ezine-Kumkale agricultural plain in Canakkale region. In studied farms, families generally have four persons on average, and the two male and one female person per family are working and occupying in the agriculture activities. Farmers have some organizations to keep their products right, for example; more popular was the farmer recording system followed by agriculture chamber, agrochemical dealers, and others. On the other hand, agricultural activities are performed according to traditional cultivation systems despite having enough tractors. Tractors of different brands have been recorded in the studied farms, they are Massey Ferguson, New Holland, Ford, Valtra, Tumosan, Deutz, Kubota, Erkunt, Hattat, Case. However, Massey Ferguson and New Holland were the highest because of existence of their service facilities in the

region. Farms generally have more than one tractor brands due to existence of more than one agriculture occupation branches such as field, horticulture crops, and even animal production. The number of tractors per farm is acceptable level in studied farms with 0.99, but it was less than one tractor. Agricultural area per tractor was found higher by 117 decare tractor-1 in the studied farms. The number of machinery per tractor is approximately 8 on average three-agricultural plain, more suitable for traditional cultivation systems. The agriculture area per farm was 116 decare on average three plains, but it consists of many small parcel size which are small than 50 decare. Farmers were preferred the ways that is to purchase the tractor for farms using terming system (loan), which is ranges between 20 and 60 months compared with cash and agricultural credit systems. 88% of tractors recorded in studied farms were included in young group varying 0 and 20 years, while 12.00% were old, 20 years and over, particularly including old series of Massey Ferguson, Ford, Fiat.

Compliance with Ethical Standards

Conflict of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author contribution

The author read and approved the final manuscript. The author verifies that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

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Consent for publication

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