Crop Pattern and Mechanization Level in the Farms of a Sustainable Agricultural Region, The Northwest Turkey

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Abstract

The main objective of this study was to evaluate the impact of water resources and mechanization inputs on the productivity and technical efficiency of crop production in the Bayramiç-Ezine-Kumkale plains located in Çanakkale province, the irrigation water was supplied by Bayramiç Dam constructed in 1996 with a capacity of 96 m^3. Data were collected during a questionnaire with farmers interviewing in villages of 3-plain. According to pre-1996 period, dry-agriculture decreased while irrigated-agriculture increased in both annual and perennial crop areas, especially in silage maize, clover, feeder, peas, sorghum, apple, meddler, pomegranate, palm, quince, fig, plum, cherry, apricot, olive. With these improvement, many cold storage and olive processing factories opened with a capacity of 100% and 50%, respectively. The tractor increased by 71% in the province, 69.29% of them are in 3-plain. Tractor brands increased from one to seven, particularly New Holland. Plough (10.22%) cultivator (26.88%), disc harrow (13.90%), weed tiller (16.67%) and row-sowing (20.42%) commonly using in dry agriculture are also increased in 3-plain. Similarly, fruit harvester is increased in the province (93.92%) and 3-plain (95.48%), self-powered or tractor-powered. The increase by 5.5 times in irrigated silage maize in 3-plain which is increased maize harvester (37.31%) and stalk shredder (86.49%). This also increased sprinkling (10.89%) and drop irrigation (32.69%), while milking, seedling and maize drying machines were by 28%, 37.50%, 83.33%, respectively. Tractor power was 2.5 kW ha^{-1} in 1995 before the irrigation application, but this is increased by 2.5 times (5.50 kW ha^{-1}) in the last period of 2017. The area per tractor decreased from 11.55 ha to 7.05 ha, but tractor power size increased from 35 kW to 48 kW, most of them are over 15-year old. Tractor per 1000 ha is 132 in the province, 37.4 of them are in economic life and 94 of them have over their economic life, but in 3-plain, 50% of the total park is in economic life.

Agriculture systems, mechanization, crop production

Introduction

The agricultural sector, as in all developing countries, is also the basis of the national economy in our country. It is known that the importance of using machinery in agricultural production comes after inputs such as seed, fertilizer, pesticide and fuel. The input of machinery in agriculture is 35%, of which 20% is direct mechanization and 15% is fuel. With the use of machinery in agricultural production, it is expected that the yield per unit will increase and also product quality. As is known, the effectiveness of the machinery is increased by the positive effects on yield and product quality in the area, with using irrigation and other cultural practices. The consideration of the change in machinery use, which constitutes an important input in agriculture and increases the efficiency of other applications, is of importance in terms of sustainability of production. Therefore, the use of machinery should be considered in every agricultural production area at periodically to put out machinery using level in agriculture. Çanakkale province which is suitable for polyculture farming and almost all agricultural products are grown. However, pepper, tomatoes, bean, peach, cherry, apple, olive, grape, sunflower and oat have economic importance among all crops. In the province, there are a total of 50145 agricultural farms with an average size of 66 decares by average 7-parcel number per farm. Approximately, 67% of agricultural farms owned by small parcels has a land size of 50 decares or less. 77.3% of arable areas in the current farms are associated with field crops, 9.7% olive production, 6.1% vegetables and 5.5% fruit production and 1.4% grape (TUIK, 2017).

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113258 (34%) hectares of total 331633 hectares in the province is suitable for irrigation, but only 23% is irrigated by using water resources such as groundwater or water supplied by dams. The great rate of irrigable area is belonging to vegetables and fruits by using sprinkling or dripping irrigation systems. Therefore, on the Bayramic-Ezine-Kumkale plains where the study carried out, cereals, vegetables and fruits have an importance in agriculture market to compare pre-irrigation period and post-irrigation period using water supplied by Bayramic Dam. For this purpose, the potential of agricultural production in 3-plain considered. Two basic data sources used to determine the agriculture production potential in both pre- and post-irrigation periods. Data required pre-irrigation, including before 1996, provided from the registration system of the TUIK and relevant agricultural institutions. For post-irrigation, data obtained in a similar way by both the registration systems and a questionnaire during 2017-2018.

Material and methods

Çanakkale province (39°27'-40°45' N, longitude; 25°40'-27°30' E, altitude), having field (wheat, maize, rice), vegetable (tomatoes, pepper) and perennial (apple, cherry, peach, plum, quince, fig, walnut, etc.) farming systems, located in Marmara Region which has about 9% of agriculture area of the country. In recent, irrigated cropping systems of province increased by 3% instead of dry farming due to increasing irrigation dams or other water resources, especially in the arable area of 3-plain named Bayramic-Ezine-Kumkale, which covers 12% of the agricultural area of the Marmara Region that leading to increased crop variety, productivity and quality. The study was conducted in villages of 3-plain have irrigation water by Bayramic Dam during 2017-2018 growing season. 123 villages among 177 villages in 3-plain were recorded while agriculture is the main occupation. 30 villages determined among 123-village and questionnaire was conducted (Table 1). The numbers of questionnaire were 11 of 34 villages in Bayramiç (Agackoy, Ahmetceli, Cavuskoy, Dogancı, Pınarbası, Pıtıreli, Sacaklı, Tululer, Yahsieli, Turkmenli, Centre), 11 of 39 villages in Ezine (Akkoy, Balıklı, Gulluce, Kızılkoy, Pazarkoy, Tastepe, Yenioba, Uvecik, Mamudiye, Pınarbası, centre) and 8 of 50 villages in centre of province covering only Kumkale plain (Dumrek, Gokcalı, Akcapınar, Kumkale, Halileli, Cıplak, Tevfikiye, Kalafat). In the selection of the villages which are the basis of the questionnaire, a purpose of sampling method was applied so that the farmer characteristic of the plains remaining in the irrigation area. In total, 11781 farms are occupied in agriculture of districts located in 3-plain, but only 66% (7773) of them are in the Bayramic Dam basin area (DSI, 2017). The rest are in plains of Ezine and Kumkale which are the biggest alluvial area on the sediments carried by Karamenderes River and has intensive farming (Özcan, 2004). Farmers were interviewed face to face, researchers used the questionnaires to conduct personal interviews with farmers or workers known to use machinery intensively. Questions concentrated especially on the agricultural land, crop production pattern, total parcel of agriculture land, parcel size in owned or hired type, farmer numbers as labour, their age and education level, machinery use. In particular, the data required pre-irrigation provided from the registration systems of the TUIK and relevant agricultural institutions (DSI, Directorate of Provincial Food Agriculture and Livestock). After the irrigation as post-irrigation period, it obtained in a similar way by both the registration system and the questionnaire. Data analysis was conducted to find out the required results of the study. All data obtained from the questionnaire were evaluated in Excel programme.

Table 1. The number of villages, farms and production area under the study area

District	Total village (number)	Bayramic farms (number)	Total village in Dam basin area (%)	Questionnaire village (number)	Total farms in districts (%)	Possible farms to be questionnaire (number)	Questionnaire in districts (number)	(number)
Bayramic	75	34	45.33	11	32.25	2433	2757	206
Ezine	49	39	79.59	11	28.21	1164	926	110
Center (Kumkale)	53	50	94.34	8	16.00	4535	4090	80
Total	177	123	-	30	24.39	11781	7773	396

Results and discussion

Characteristics of social structure of farms

The socio-economics characteristics of the sampled farmers including age, family population, the role of family person in agriculture and educational status are outlined in

the following paragraph (Table 2). The number and quality of human labour has significant importance to maintain the quality of farms and crops by doing physical labour of agricultural operations and operating an agricultural machinery. Person age who worked for each farm is a significant indicator for qualified and conscious production. After interviewing farmers, data clearly indicate that majority of the farmers are belonging to middle-age (20-50 years), while age under 30-year and over 60-year is comparable very low. It was found that majority of the farmers were in the age of 41-50-year by 29.80% (Table 2). Age above 61-year was the lowest by 6.06%, followed by 20-30-year with 11.87%. The farmers covered a narrow of age groups with the least under 42-year in villages of Bayramic. Considering over all, average age was around 45-year, and more middle-age group was occupied with agriculture activities. This shows that the young people's income is mainly from non-agricultural sources. 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 years old were more popular in European when the least farmers were under 40. In another research carried out in the study area by questionnaire for vineyard farmers (Aydın et al., 2017) found the highest rate in 41-50 age range by 31.2% followed by 51-60 age by 30.9%. In considering different levels of education in 3-plain, the approximately 58.98% of farmers were graduated from primary school, followed by seconder and high school, 19.59% and 12.47%, respectively. The rate of farmers who graduated from university was found very low by 8.86% compared to other education level, but this rate was higher than in the national level with 6% (TUIK, 2017). The rate of farmers who have no-formal education by 0.5% was lower than in the education level of the national agriculture by 15.2% (TurkStat, 2017). In similar, a research conducted under different countries resulted that 84% of farmers had different education level while the rest of them had no-formal education (Matthews, 2008). In another research by Aydın et al. (2017) who found all farmers have different level of education when university graduation rate was 0.6%. However, they concluded that primary and high school were higher by 70.6% and 14.5%, respectively, but secondary school was lower by 13.2%. Farmers are generally composed of middle-size families (4-5 persons per family). The proportion of multi-person family (6 or more persons per family) is 20.3%. This can be considered as a sign that young people prefer to live in the city instead of living in the village. In a similar study conducted by Aydın et al. (2017) in the same area concluded middle-size family as 44.2% in total while multi person type family is 21.3%. In the scope of the questionnaire, the farmers are conducted their activities under some organizations relation to agriculture, for example, the Chamber of Agriculture. Farmers usually prefer this type social organization in order to be able to carry out their agricultural activities and to benefit from the support given by government. There were recorded many others social organization such as Agricultural Credit Cooperative, Irrigation Association (Bayramic-Ezine Plains, Pınar and Troy Irrigation Association), etc.

Table 2. General characteristics of farmers in the study area

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

Crop pattern and agricultural machinery

The study area has high potential in terms of both crop and animal production by using mechanical energy in almost all agricultural activities without human energy. Machinery per unit area are higher than national level (TUIK, 2017), usually using mechanical power, except for apple and grape harvest operations done by human. Considering land structure and water resources in 3-plain located in Karamenderes Basin, drip-irrigation has been widely used (Fig. 1). It was also determined that the machinery was intensively used in agriculture, especially in Kumkale plain located in the province centre, followed by Bayramic and Ezine plains (Özpınar, 2002; Özpınar and Ürkmez, 2017). In 3-plain, agricultural production is usually carried out in small size parcels which are irrigated by underground water or streams gathering water from Ida mountain to dams such as Bayramic Dam (Table 3). By using Bayramic Dam for irrigation under 3-plain, has led an increase the variety of crop patterns compared with pre-irrigation period (Table 3, 4). Considering crop pattern for pre-irrigation (Table 4), it has been identified a limited variety of crops, but production area was found higher than post-irrigation covering 1996-2017. Pre-irrigation, cereals are commonly grown crops under rainfed conditions (dry-farming), whereas crop growth under irrigation conditions is more restricted (Table 4). For example, a large part of farmers in irrigated area of the Kursak stream located Karamenderes Basin have continued to produce cereals, and the same production was continued during post-irrigation period (Table 5). So it is determined that wheat is the most important crop among cereals in the area of the current basin for both periods. Vetch, barley and oat, which are used in animal husbandry as well as wheat, are among the crops that continue to be produced. However, some crops that have been produced by using underground water in the period covered pre-irrigation before 1996 have increased in production areas with Bayramic Dam irrigation application in period between 1996 and 2017. For example, considering maize was increased from 310 decares in pre-irrigation to 1711 decares in post-irrigation by approximately 5.5 times in only Bayramic plain area, this was supported increasing the number of maize harvester by 37.31% and stalk shredder by 86.49% (Fig. 1). The improvement in clover or silage maize which are under sprinkling and drop irrigation has been found to be 10.89% and 32.69%, respectively, while pumps using in the irrigation showed increase around 11.01%. Pre-irrigation practice in the 3-plain agriculture area, some crops such as silage maize, sorghum, animal bean, lentil, alfalfa, grass have almost no-growing area, but they were grown by irrigation application (Table 5). By growing such as crops using in animal husbandry leads to grove animal production (Özpınar, 2002). This has also lead to the opening of factories which were processed milk to produce cheese or other dairy products. It has been found that alfalfa and silage maize is common crops in the north of Ezine-Bayramic plain in the central part of the Karamenderes Basin, especially between Ahmetceli, Agackoy, Sacaklı and Dogancı villages (Table 4), therefore, animal husbandry has become an important agricultural occupation in the area. Rice was being come to grow with irrigation applications and has begun to be produced widely in Pınarbası, Mahmudiye and Uvecik villages located in the south of Kumkale plain by using Bayramic Dam water. Additionally, rice also produced in the south of Ahmetceli located in the east of the Ezine-Bayramic plain, and it was also produced throughout Agaçkoy-Doğancı-Bayramic (Table 5).

Along with the widespread use of these crops, they have been developing in the agricultural tools or machinery and diversity has led to an increase in the agricultural machinery park by increasing crop variety, especially in number of baler, feed preparation and dairy milking machine by 64.28% (Fig. 1). By intensive agriculture system in the current irrigation area covering Bayramic-Ezine-Kumkale plains, there has also been an increase in surface tillage machines such as rototiller and rotovator which were usually used in conservation soil tillage systems. Additionally, the others are dropping irrigation

Table 3. Some crops and their farm size in the study area

Crop	<5 da		5-49 da		50-149 da		≥ 150 da		Total	
	(number)	(%)	(number)	(%)	(number)	(%)	(number)	(%)	(number)	(%)
Wheat	5	1.63	179	58.31	98	31.92	25	8.14	307	100
Pepper	14	7.57	164	88.65	5	2.70	2	1.08	185	100
Tomato	24	13.11	141	77.05	17	9.29	1	0.55	183	100
Maize	1	0.75	109	81.34	19	14.18	5	3.73	134	100
Olive	6	5.61	70	65.42	29	27.10	2	1.87	107	100
Rice	0	0.00	29	35.37	37	45.12	16	19.51	82	100
Peach	2	2.44	66	80.49	14	17.07	0	0.00	82	100
Barley	0	0.00	57	69.51	23	28.05	2	2.44	82	100
Cherry	9	15.79	48	84.21	0	0.00	0	0.00	57	100
Oat	2	3.51	40	70.18	14	24.56	1	1.75	57	100
Apple	4	7.69	43	82.69	5	9.62	0	0.00	52	100
Bean	7	17.07	34	82.93	0	0.00	0	0.00	41	100
Sunflower	0	0.00	20	50.00	16	40.00	4	10.00	40	100
Melon	3	11.11	24	88.89	0	0.00	0	0.00	27	100
Plum	6	27.27	16	72.73	0	0.00	0	0.00	22	100
Vineyard	8	42.11	11	57.89	0	0.00	0	0.00	19	100
Vetch	0	0.00	17	100.00	0	0.00	0	0.00	17	100
Bean	3	20.00	10	66.67	2	13.33	0	0.00	15	100
Watermelon	1	7.14	83	592.86	0	0.00	0	0.00	14	100
Strawberry	2	16.67	10	83.33	0	0.00	0	0.00	12	100
Apricot	4	36.36	7	63.64	0	0.00	0	0.00	11	100

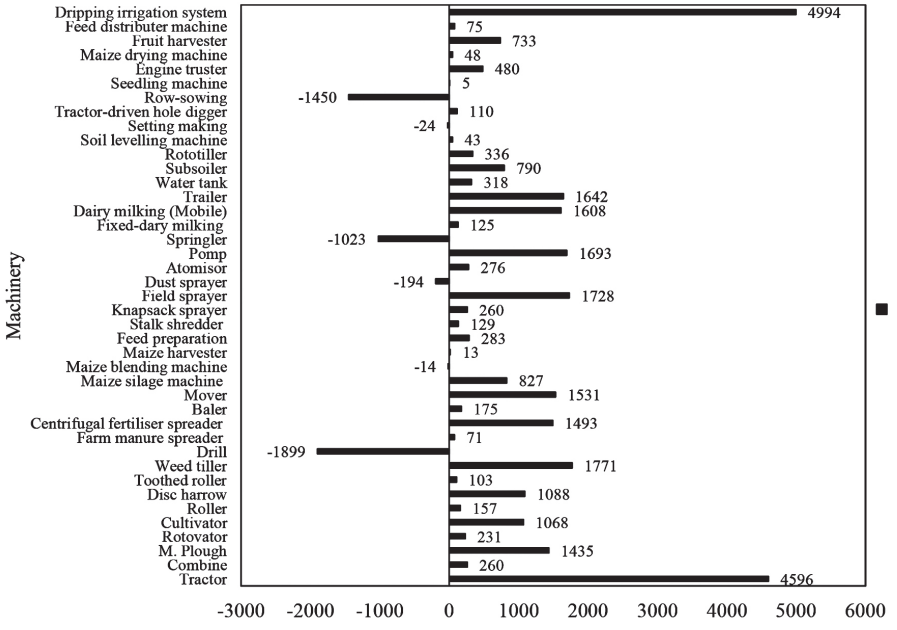

Figure 1. Increase and decrease number of agriculture machinery in post-irrigation period (the first quarter of 2018) according to pre-irrigation period (1996)

systems by 32.69%, pump by 11.01% and tractor. When compared with period pre-1996 for the study area, there has been an increase in the number of tractors about 71% regardless of the tractor power size, brand and axle properties compared with pre-irrigation period, but 69.29% of them are in Bayramic-Ezine-Kumkale plains while each farmer has at least one tractor. Tractor brands have varied from one to seven, particularly New Holland by 48.77%, Massey Ferguson by 32.42% and others such as John Deer, Tümosan, Valtraa, Ford, etc., usually used tillage and seedbed preparation per year.

Data obtained from the study results, it was determined that the tractor power per unit area was 2.5 kW ha^{-1} in 1995 before the irrigation application to the agriculture area, but this is increased by 2.5 times, 5.50 kW ha^{-1}, in the first quarter of this year. The area per tractor decreased by 4.46 ha, from 11.55 ha to 7.05 ha, but the average tractor power size increased from 35 kW to 48 kW in the economic life range. It has been say that the increase in tractor power is a result of the more power tractor in the tractor park according to the pre-irrigation period, when the traditional dry farming was common. Nevertheless, it has been say that the number of economic tractor life is still low in both province and 3-plain, because many tractors are over 15-year old. The total number of tractors per 1000 ha is 132 in the province, however, 37.4 of them are in economic life and 94 of them have over their economic life. This is more optimistic in the 3-plain and that the economic tractor park constitutes 50% of the total park it means that half of the tractors were bought after irrigation application period. Decrease in the rate of economic life in the tractor park, fuel and accordingly oil consumption, repair-maintenance costs increased and this leads increased the cost of production in unit area of the cropping systems. When considering the agricultural machinery such as mouldboard plough, cultivator, disc harrow, weed tiller and row-sowing machines used commonly in dry farming in 3-plain are increased by 10.22%, 26.88%, 13.90%, 16.67%, 20.42%, respectively, compared with pre-irrigation period (Fig. 1). In similar, with the growing of perennial crops increasing with dam irrigation, the fruit harvesting machine is increased by 93.92% in the province, while this is higher by 95.48% in 3-plain, and many of the machines were found to be for olive harvesting such as self-powered or tractor-powered. Additionally, the increase by 5.5 times in irrigated silage maize cultivation areas, especially in 3-plain, increased the number of corn harvester and stalk shredder by 37.31% and 86.49%, respectively. Variety of vegetable crops (such as capy-pepper) and their production area increased and resulted in an increase of the seedling machine by 37.50% in the agriculture machinery park, while both rotovator and rototiller used in soil preparation, especially in the field or perennial cropping system, were numerically increased by 26.88% and 75.61%, respectively. With the increase of maize production areas as silage or grain, the rate of drying product machine was also increased in the province and 3-plain as 97.14% and 83.33%, respectively. In addition, rice production started to grow with irrigation application in 7197 decares (Table 5) instead of wheat grown in dry farming, which has increased sprayer and rice harvester. On the other hand, cotton commonly produced during pre-irrigation period almost under rainfed conditions as dry-farming, but it is gradually decreased throughout post-irrigation period by around 12% due to higher inputs and lower outputs (Table 4, 5). Despite that, with irrigation, the production areas of some crops have increased, especially for tomatoes and pepper. Similarly, variety and production areas in perennial crop production also increased with irrigation applications (Table 5), for example, the production area of peaches and pears has increased by about 300%. Similarly, it was also recorded for the production of apple, meddler, pomegranate, date, quince, fig, plum, cherry, apricot have been increasing steadily in recent years. With the increase of the production area and fruit yield, the number of cold storage was increased by 100% in the study area. It was also found higher production areas of pistachio, hazelnut, chestnut, walnut and almond that had high market impact due to the fact that the area is favourable in the climatic conditions. The another favourable

Table 4. Crop pattern for pre-irrigation in Bayramic-Ezine-Kumkale irrigation plains

Crop Branches	Crop	Bayramic (da)	(%)	Ezine (da)	(%)	Kumkale (da)	(%)	Total (da)	Total (da)
	Wheat	69152	28.40	64390	26.44	109984	45.16	243526	
	Maize	310	40.90	185	24.41	263	34.70	758	
	Barley	37584	42.31	31870	35.88	19370	21.81	88824	
	Rye	798	75.57	115	10.89	143	13.54	1056	
	Oat	17384	83.92	936	4.52	2396	11.57	20716	
	Vetch	1448	23.85	1638	26.98	2986	49.18	6072	
	Potato	498	87.06	-	-	74	12.94	572	
	Broad bean	16418	28.62	15994	27.89	24944	43.49	57356	
Field crops	Chickpea	4134	25.56	1932	11.95	10108	62.50	16174	
	Cotton	-	-	34213	37.58	56836	62.42	91049	
	Sunflower	246	2.44	458	4.54	9394	93.03	10098	
	Sesame	16058	75.26	1900	8.90	3380	15.84	21338	
	Peanut	142	60.17	94	39.83	-	-	236	
	Clover	690	17.92	2320	60.26	840	21.82	3850	
	Bean	1046	24.31	1913	44.46	1344	31.23	4303	
	Kidney bean	158	56.83	100	35.97	20	7.19	278	
	Animal bean		0.00	1750	97.22	50	2.78	1800	568006(69.02)
	Apple	23725	90.64	100	0.38	2350	8.98	26175	
	Peach	1500	43.99	110	3.23	1800	52.79	3410	
	Strawberry	-	-	20	100.00	-	-	20	
	Pear	130	100.00	-	-	-	-	130	
	Cherry	60	100.00	-	-	-	-	60	
Fruit	Apricot	-	-	-	-	60	100.00	60	
	Grape	20070	64.99	3560	11.53	7250	23.48	30880	
	Olive	32600	25.37	88775	69.08	7140	5.56	128515	
	Almond	200	47.62		0.00	220	52.38	420	189670(23.05)
	Onion	1383	24.33	2464	43.34	1838	32.33	5685	
	Garlic	112	21.21	252	47.73	164	31.06	528	
	Leek	50	9.11	234	42.62	265	48.27	549	
	Carrot	50	71.43	10	14.29	10	14.29	70	
	Radish	50	48.08	10	9.62	44	42.31	104	
	Cauliflower	14	8.64	100	61.73	47.5	29.32	162	
	Cabbage	163	14.78	505	45.78	435	39.44	1103	
	Lettuce	108	39.56	20	7.33	145	53.11	273	
	Spinach	105	28.38	65	17.57	200	54.05	370	
	Purslane	-	-	-	-	10	100.00	10	
Vegetables	Parsley	22	52.38	20	47.62	-	-	42	
	Rocket	10	100.00	-	-	-	-	10	
	Tomato	2188	5.77	11725	30.93	24000	63.30	37913	
	Cucumber	325	20.09	963	59.52	330	20.40	1618	
	Pepper	243	18.74	228	17.58	826	63.69	1297	
	Okra	110	24.28	253	55.85	90	19.87	453	
	Eggplant	200	11.03	563	31.05	1050	57.92	1813	
	Pumpkin	40	17.94	80	35.87	103	46.19	223	
	Pea	233	10.30	-	-	2030	89.70	2263	
	Melon	1900	40.88	1298	27.93	1450	31.20	4648	
	Watermelon	2150	35,29	1493	24,50	2450	40,21	6093	65227(7.93)
Total		253807	30,84	272656	33,13	296439,5	36,02	822903	822903(100.00)

Table 5. Crop pattern for post-irrigation period in Bayramic-Ezine-Kumkale irrigation plains

Crop branches	Crop	Bayramic (da)	(%)	Ezine (da)	(%)	Kumkale (da)	(%)	Total (da)	Total (da)
	Wheat	93030	63.63	40586	27.76	12579	8.60	146195	
	Maize	1711	18.62	5494	59.78	1986	21.61	9191	
	Barley	45479	62.53	22290	30.65	4960	6.82	72729	
	Rye	125	55.80	60	26.79	39	17.41	224	
	Rice	-	-	6221	86.44	976	13.56	7197	
	Oat	18700	67.14	7450	26.75	1701	6.11	27851	
	Vetch	3900	43.42	4400	48.99	682	7.59	8982	
	Broad bean	1020	31.04	2100	63.91	166	5.05	3286	
	Chickpea	3500	76.09	680	14.78	420	9.13	4600	
	Cotton	-	-	100	87.72	14	12.28	114	
Field crops	Sunflower	360	5.26	2992	43.69	3496	51.05	6848	
	Sesame	2870	91.00	170	5.39	114	3.61	3154	
	Clover	7500	58.18	4900	38.01	490	3.80	12890	
	Bean	1100	71.29	320	20.74	123	7.97	1543	
	Animal bean	1350	47.01	970	33.77	552	19.22	2872	
	Silage(Maize)	9000	53.58	6800	40.48	998	5.94	16798	
	Sorghum	1590	75.46	450	21.36	67	3.18	2107	
	Grass	150	38.66	220	56.70	18	4.64	388	
	Canola	860	100.00	-	-	-	-	860	
	Safflower	50	100.00	-	-	-	-	50	
	Sainfoin	170	96.59	-	-	6	3.41	176	
	Apple	29925	96.62	328	1.06	720	2.32	30973	
	Peach	6760	67.10	660	6.55	2655	26.35	10075	
	Strawberry	120	88.89	10	7.41	5	3.70	135	
Fruit	Pear	560	84.85	50	7.58	50	7.58	660	
	Cherry	4940	90.23	265	4.84	270	4.93	5475	
	Apricot	77	7.93	558	57.47	336	34.60	971	
	Grape	19720	91.83	1500	6.99	254	1.18	21474	
	Olive	40320	25.20	116530	72.84	3134	1.96	159984	
	Almond	690	22.22	2300	74.07	115	3.70	3105	
	Date	42	47.73	20	22.73	26	29.55	88	
	Quince	260	44.22	310	52.72	18	3.06	588	
	Jujube	-	0.00	-	0.00	8	100.00	8	
	Plum	425	55.19	225	29.22	120	15.58	770	
	Medlar	3	37.50	-	-	5	62.50	8	
	Mulberry	-	-	3	75.00	1	25.00	4	
	Pomegranate	20	4.30	420	90.32	25	5.38	465	
	Peanuts	26	50.98	18	35.29	7	13.73	51	
	Hazelnut	17	100.00	-	-	-	-	17	
	Chestnut	44	100.00	-	-	-	-	44	243097
	Walnut	3550	43.28	4300	52.43	352	4.29	8202	(39.69)
	Onion	190	39.26	230	47.52	64	13.22	484	
Vegetables	Garlic	135	85.99	12	7.64	10	6.37	157	
	Leek	25	31.25	40	50.00	15	18.75	80	
	Radish	6	42.86	2	14.29	6	42.86	14	

Table 5. Crop pattern for post-irrigation period in Bayramic-Ezine-Kumkale irrigation plains

Crop		Bayramic		Ezine		Kumkale		Total	Total
branches	Crop	(da)	(%)	(da)	(%)	(da)	(%)	(da)	(da)
	Cauliflower	85	18.85	350	77.61	16	3.55	451	
	Cabbage	90	31.58	160	56.14	35	12.28	285	
	Lettuce	177	44.25	151	37.75	72	18.00	400	
	Spinach	116	41.13	140	49.65	26	9.22	282	
	Parsley	20	62.50	2	6.25	10	31.25	10	
	Rocket	5	62.50	2	25.00	1	12.50	8	
	Tomato	6800	34.26	10600	53.40	2450	12.34	19850	
Vegetables	Cucumber	114	32.95	217	62.72	15	4.34	346	
	Pepper	5180	49.68	4879	46.79	368	3.53	10427	
	Okra	25	29.41	55	64.71	5	5.88	85	
	Eggplant	42	23.60	100	56.18	36	20.22	178	
	Pumpkin	200	79.68	40	15.94	11	4.38	251	
	Pea	453	29.45	1009	65.60	76	4.94	1538	
	Melon	950	32.93	1550	53.73	385	13.34	2885	41390
	Watermelon	1100	30.29	2400	66.10	131	3.61	3631	(6.76)
	Total	315659	51.53	255637	41.73	6.73		41224	612542
									612542
									(100.00)

crop in the area is olive which increased in terms of production area by 25% using highly yielded varieties and suitability with mechanized-cultivated systems along with irrigation application. In recent, by increasing olive production area, olive oil processing units with a capacity of 50%.

Conclusion

Agricultural mechanization is an indicator of agricultural input in the sustainable agriculture. From the results; it can be seen that agricultural machinery was found fairly high and used for most field operations in the study area, but their work-efficiency depends on cultural practices such as seed quality, fertilization and irrigation, etc. By irrigation applications in 3-plain, crop patterns and their variety were increased. Crops, such as rice and walnut which have never grow in the area in pre-irrigation period, have begun to be grown. Similarly, the production area of maize-silage and clover was increased that leading to increase the animal husbandry. The diversity and number of machinery have increased depending on the crop patterns, especially in soil tillage machines such as rototiller and rotovator using in usually conservation tillage for all crop patterns, baler, dairy milking, feed mixing and preparation, and olive harvester, except in medium size of plough, cultivator, disc harrow, drill, fertilizer spreader, sprayer in usually dry-farming. Most of the farmers are occupied with small size parcels are averagely 50 decares or less, but cereals are usually grown in larger size parcels while fruit and vegetables cultivated slightly in smaller ones. So, the small size parcels have led to create the medium-sized tractor type with 40-48 kW power and machinery in agricultural machinery park.

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