

Research Article

**Projection of Technology Equipment Usage in Agriculture in Turkey**

Mehmet Fırat BARAN<sup>1\*</sup>, Osman GÖKDOĞAN<sup>2</sup>, Ali İhsan KAYA<sup>1</sup>, Halil İbrahim OĞUZ<sup>2</sup>

<sup>1</sup>Adıyaman University, Technology Faculty, Energy Systems Engineering Department, Adıyaman

<sup>2</sup>Nevşehir Hacı Bektaş Veli University, Faculty of Engineering and Architecture, Biosystem Engineering Department, Nevşehir

\*Corresponding author: [mbaran@adiyaman.edu.tr](mailto:mbaran@adiyaman.edu.tr)

Received: 27.06.2018

Received in Revised: 19.09.2018

Accepted: 27.11.2018

**Abstract**

Agricultural mechanization is the most critical factor that provides effective usage of agricultural inputs. In order to increase the technical efficiency in mechanization. Organization quality and mechanization operation need to be increased. In this study, it was aimed to determine the projection of the usage of technology equipment in agriculture in Turkey. Projection coefficients were calculated based on past ten years production and usage amounts of the technology equipment used in agriculture. Next ten year projections of technology equipment used in agriculture in Turkey have been determined in line with the increase or decrease of the projection coefficients. Within this framework, the projections of 40 agricultural machinery equipment widely used in Turkey are taken into consideration and the usage projection of these tools and machines are determined. It has been concluded that the projections of 35 technology tools and machines technology used in agriculture in Turkey will increase up to 2026 in accordance with determining positive projection coefficients and 5 tools and machines usage in agriculture will decrease in line with determining negative projection coefficients.

**Key words:** Turkey, agricultural machinery, mechanization, projection.

**Türkiye Tarımsal Alet ve Makina Teknoloji Kullanım Projeksiyonu**

**Özet**

Tarımsal mekanizasyon tarımsal girdilerin etkin kullanımını sağlayan en kritik faktördür. Mekanizasyonda teknik etkinliğinin artırılması için mekanizasyon işletmeciliği ve organizasyon kalitesinin artırılması gerekir. Bu çalışmada Türkiye’de tarımda teknoloji kullanım projeksiyonunun belirlenmesi amaçlanmıştır. Tarımda kullanılan teknolojinin geçmiş on yıllık üretim ve kullanım miktarları baz alınarak projeksiyon katsayısı hesaplanmıştır. Projeksiyon katsayısının artışı veya azalışı doğrultusunda Türkiye’de tarımda teknoloji kullanımına ait on yıllık projeksiyonları belirlenmiştir. Bu kapsamda Türkiye’de yaygın olarak kullanılan 40 adet tarım alet makinası belirlenerek, bu alet ve makinaların kullanım projeksiyonu belirlenmiştir. Türkiye tarımda teknoloji kullanım projeksiyonunun ele alınan 35 adet alet ve makinaları için belirlenen projeksiyon katsayılarının pozitif elde edilmesi doğrultusunda 2026 yılına kadar artacağı, 5 adet alet ve makine için belirlenen projeksiyon katsayısının ise negatif elde edildiği ve bu alet ve makinalarda azalma olacağı sonucuna varılmıştır.

**Anahtar kelimeler:** Türkiye, tarım makinaları, mekanizasyon, projeksiyon.

**Introduction**

Agricultural Mechanization is an agricultural machinery sector, aims to make the agricultural

areas healthier, to increase the diversity of agricultural production and to use agricultural products more effectively and variously and in this

respect. Agricultural Mechanization can be defined as one of the sub-sectors of the manufacturing sector which produces, manufactures, develops, and markets, sells and manages many different mechanical designs (Anonymous, 2017a). The most important indicators that define the degree of agricultural mechanization of a country are the quantitative and qualitative status of the tractor park, the development according to years, the relation with agricultural machinery, the density and the level of power in unit farming (Evcim et al., 2010).

Agricultural mechanization is the field that covers the utilization of tools, instruments and machines for agricultural land development, harvesting, product production, storage and farm processing. Power sources used in agriculture can be classified under three main terms, namely; human, animal and mechanic. Within this framework, it is important to understand how farm mechanization inputs can be provided efficiently and effectively. To do that the production, distribution, repair, maintenance, management and utilization of agricultural equipment, appliances and machinery must be understood clearly (Banaeian and Zangeneh, 2011).

The use of machinery in agriculture, unlike other agricultural technological applications, allows the use of new production methods in rural areas, but does not directly affect the productivity increment. This improves the efficiency and economic coverage of other technological applications and improves working conditions. Thus, to ensure higher productivity in agricultural mechanization equipment that utilized must provide the use of appropriate technologies opportunities (Saral et al., 2000).

Turkey is above the world average of agricultural mechanization with regard to the conditions that determines the current standards. However, in order to increase the current production and productivity level, it is necessary to raise the demand for agricultural production significantly in this area. In addition, determination of agricultural mechanization level according to Turkey per regions, would make it possible to increase the diversity of the machinery park as well as more efficient of tractors and other agricultural machinery (Altuntaş and Demirtola, 2004).

The agricultural sector, as in all developing countries, is the basis of the national economy in our country. When the sectoral distribution of employment is viewed, it is seen that approximately 20.9% of the total employment is working in the agricultural sector according to the data of July of 2017 (Anonymous 2017b). A strong agricultural equipment and machinery sector has

been formed as a result of such a large agricultural sector in Turkey (Anonymous 2017b). Within the scope of this study, the projection of the usage of some technological farmer equipment, of which farmers used intensively in agriculture sector of Turkey, has been determined.

### Material and Methods

The material data of the study, agriculture tools and machines data for the years 2007-2016, are obtained from Turkey Statistics Institution (Anonymous 2017c). By taking ten years (2007-2016) production and usage amounts of agricultural machinery into consideration in Turkey, percentage ratios of increase and decrease in numbers are calculated and then the average coefficients of these percentage ratios are determined. Depending on the number of machines belonging to the previous years, the coefficients determined for that machine as mentioned above and the projections of the agricultural equipment and machines until 2026 are calculated by using the same calculation method as in ref. (Demir and Kuş 2016).

Positive gain of the projection coefficient means an increase in the number of available instruments and machines while a negative gain result means a decrease for same equipment that are taken into consideration (Demir 2013; Demir and Kuş 2016).

### Results and Discussions

Processing of the soil in accordance with the technique of the soil by means of the soil cultivation tools and machines facilitates the growth, ripening and fruitfulness of the plants. In line with this objective, soil cultivation equipment and machines are widely used in Turkey. The past years change numbers and the projection coefficients of some tillage machines and machinery commonly used in Turkey calculated according to past ten years production and usage amounts are given in Table 1 and Table 2. Moreover, the projection coefficients with other information mentioned above for the sowing-planting and fertilizing machines, harvesting machines, spraying machines and tractor & trailer with silage, mowing and baling machines are shown in Table 3, Table 4, Table 5 and Table 6 respectively.

When Table 1 is examined, it can be seen that the highest projection coefficient is occurred in case of subsoiler with 4.66 % among those reviewed and usage numbers of this equipment is raised from 23.708 to 36.515 for 2007 and 2016. It is possible to say that with the projection coefficient of 4.66%, the subsoiler will rise to 57.591 units in 2026. When other soil cultivation

equipment and machines are examined, it is quite obvious to say that disc harrows, furrow opener plough, disc type tractor plough and disc type stubble plough have positive projection coefficients with percent of 2.23, 1.23, 0.94 and 0.92 respectively. On the other hand, when 2007 and 2016 usage units are compared, wooden plow and toothed harrow have a decreasing trend resulting in negative projection coefficients with percent of 10.44 and 0.34 respectively.

The projection coefficients, calculated according to past years data, of another group of soil cultivation equipment and machines are given in Table 2. When this table is examined it is obvious to say that the highest projection

coefficient with positive percent of 4.85 value is occurred in case of stubble plough (moldboard type) among those taken into consideration. Rototiller, rotary cultivator, cultivator, land roller and mouldboard type tractor plough are followed stubble plough with positive projection coefficient value of 4.10%, 3.79%, 1.58%, 1.58% and 0.77% respectively. Furthermore, harrow combination (combicurum) has negative projection coefficient with a percent of 0.29. Projection units of soil cultivation equipment and machines, which can be seen in Table 2, are calculated according to those percentage averages for 2017 to 2026 year.

**Table 1.** Projections of some soil cultivation equipment and machines widely used in Turkey

Soil cultivation equipment and machines (1)		Subsoiler	Disc type stubble plough (one way)	Disc harrows	Disc type tractor plough	Toothed harrow	Furrow opener plough	Wooden plow
Years	2007	23708	41725	198548	66491	355991	60475	84304
	2008	24654	41964	204665	66933	353128	61198	77175
	2009	26150	42280	205804	67838	348587	61456	68463
	2010	27688	43642	213909	67954	351866	63926	58695
	2011	27541	43251	221884	67452	350406	64402	51889
	2012	29054	44220	229761	68332	350968	66664	49453
	2013	30401	44387	232278	68773	343906	66791	45965
	2014	32568	45405	235594	70701	341050	66150	40695
	2015	35132	45002	240303	71829	343954	66879	37455
	2016	36515	45365	243310	72448	345533	68117	34643
Change rates over years	2007-2008	3.84	0.57	2.99	0.66	-0.81	1.18	-9.24
	2008-2009	5.72	0.75	0.55	1.33	-1.30	0.42	-12.73
	2009-2010	5.55	3.12	3.79	0.17	0.93	3.86	-16.64
	2010-2011	-0.53	-0.90	3.59	-0.74	-0.42	0.74	-13.12
	2011-2012	5.21	2.19	3.43	1.29	0.16	3.39	-4.93
	2012-2013	4.43	0.38	1.08	0.64	-2.05	0.19	-7.59
	2013-2014	6.65	2.24	1.41	2.73	-0.84	-0.97	-12.95
	2014-2015	7.30	-0.90	1.96	1.57	0.84	1.09	-8.65
2015-2016	3.79	0.80	1.24	0.85	0.46	1.82	-8.12	
<b>Projection coefficient (%)</b>		4.66	0.92	2.23	0.94	-0.34	1.30	-10.44
The projections	2017	38217	45781	248728	73132	344371	69004	31027
	2018	39999	46200	254266	73823	343212	69904	27788
	2019	41864	46624	259928	74521	342057	70814	24887
	2020	43815	47051	265716	75225	340907	71737	22289
	2021	45858	47482	271633	75935	339760	72672	19962
	2022	47996	47917	277681	76652	338617	73618	17878
	2023	50233	48356	283864	77377	337478	74578	16012
	2024	52575	48800	290185	78107	336342	75549	14340
	2025	55026	49247	296647	78845	335211	76534	12843
	2026	57591	49698	303252	79590	334083	77531	11503

The past ten years production and usage amounts, rates of change in previous years and the projection coefficients, which are calculated

according to these numbers, of some 4 kinds of sowing, 2 kinds of fertilization and 1 kind of planting equipment widely used in Turkey are in

shown in Table 3. Projection coefficients of all equipment seem to be positive and the highest one is occurred in case of manure spreading machinery with the percent of 8.47. When types of sowing machines in Table 3 are examined, it is seen that stubble drill tool was 690 units in 2007 and then it reached 1292 units in 2016. With the 5.94% projection coefficient stated in the table, it

is possible to say that, the stubble drill tool will raise 2301 units by 2026 year. Besides, when other projection coefficients of other sowing machines in Table 3 are viewed, it can be seen that pneumatic precision drill has 5.23%, tractor-drawn seed drill has 3.51% and combined seed drill has 2.40% projection of coefficient.

**Table 2.** Projections of other soil cultivation equipment and machines widely used in Turkey (Table 1 Continued)

Soil cultivation equipment and machines (2)		Harrow combination (Combicurum)	Stubble plough (moldboard type)	Cultivator	Mouldboard type tractor plough	Land roller	Rotary cultivator	Rototiller
Years	2007	24891	28304	451214	986291	75682	37604	9584
	2008	24984	29411	457711	996013	77445	38937	9807
	2009	24600	33791	466727	1002734	77294	40739	10297
	2010	25971	36797	479972	1014188	81094	41685	10760
	2011	26029	37752	488802	1025892	82100	42649	11080
	2012	24840	39834	500126	1041903	83033	43972	11640
	2013	24495	39909	503786	1045122	83487	46716	11942
	2014	23555	42483	508218	1046048	84819	50100	12870
	2015	23881	44151	515172	1050237	86138	51860	13443
	2016	24352	44579	520970	1057870	87374	53301	13978
Change rates over years	2007-2008	0.37	3.76	1.42	0.98	2.28	3.42	2.27
	2008-2009	-1.56	12.96	1.93	0.67	-0.20	4.42	4.76
	2009-2010	5.28	8.17	2.76	1.13	4.69	2.27	4.30
	2010-2011	0.22	2.53	1.81	1.14	1.23	2.26	2.89
	2011-2012	-4.79	5.23	2.26	1.54	1.12	3.01	4.81
	2012-2013	-1.41	0.19	0.73	0.31	0.54	5.87	2.53
	2013-2014	-3.99	6.06	0.87	0.09	1.57	6.75	7.21
	2014-2015	1.37	3.78	1.35	0.40	1.53	3.39	4.26
	2015-2016	1.93	0.96	1.11	0.72	1.41	2.70	3.83
<b>Projection coefficient (%)</b>		-0.29	4.85	1.58	0.77	1.58	3.79	4.10
The projections	2017	24282	46740	529214	1066063	88750	55321	14551
	2018	24213	49007	537589	1074319	90148	57418	15147
	2019	24144	51383	546097	1082640	91568	59594	15767
	2020	24075	53874	554739	1091024	93010	61853	16413
	2021	24006	56486	563518	1099474	94475	64197	17085
	2022	23937	59225	572436	1107989	95964	66630	17785
	2023	23869	62096	581495	1116570	97475	69155	18513
	2024	23800	65107	590697	1125218	99010	71776	19272
	2025	23732	68264	600045	1133932	100570	74497	20061
	2026	23665	71573	609541	1142714	102154	77320	20883

When the projection coefficients of the various fertilizer machines in Table 3 are further examined, it is seen that manure spreading machinery has 8.47% while fertilizer broadcaster machine has 2.04% value. The projection coefficients calculated according to past years predicts that manure spreading machinery and fertilizer broadcaster machines will increase to 500.137 and 15.158 units in 2026 year respectively.

Furthermore, planting machines projection coefficient is calculated as 0.84%. Based on this calculation, it is anticipated that the planting machines will be 9879 units in 2026.

Combine harvester is the most advanced universal harvesting machines of modern-day and it can harvest, blend, sort and clean at the same time the products that have reached the harvesting stage (Baran, 2010). It can be seen from

Table 4 that the units of combine harvester was 12.775 in 2007 year in Turkey and this number reached to 16.247 units in 2016. It is possible to say that the number of combine harvesters in

Turkey will rise to 21.063 units in 2026 year with help of calculated 2.63% projection coefficient in Table 4.

**Table 3.** Projections of some sowing-planting and fertilizing machines widely used in Turkey

Sowing-planting and fertilizing machines		Stubble drill	Combined seed drill	Tractor-drawn seed drill	Pneumatic precision drill	Manure spreading machinery	Fertilizer broadcaster	Transplanter (transplanting machinery)
Years	2007	690	169695	101633	22048	339461	12900	1938
	2008	743	173654	106533	22919	346471	12960	1967
	2009	814	179048	111049	23165	354973	13016	2223
	2010	633	187459	117276	25390	366781	13270	2282
	2011	736	196147	119889	27153	371771	13036	2508
	2012	860	199640	128675	29377	385149	13391	2519
	2013	1046	202915	131471	30921	389918	13894	2915
	2014	1209	205286	134786	32048	392908	14145	3628
	2015	1257	208403	136846	34589	399451	14188	4090
	2016	1292	211348	140329	35850	408737	13939	4382
Change rates over years	2007-2008	7.13	2.28	4.60	3.80	2.02	0.46	1.47
	2008-2009	8.72	3.01	4.07	1.06	2.40	0.43	11.52
	2009-2010	-28.59	4.49	5.31	8.76	3.22	1.91	2.59
	2010-2011	13.99	4.43	2.18	6.49	1.34	-1.80	9.01
	2011-2012	14.42	1.75	6.83	7.57	3.47	2.65	0.44
	2012-2013	17.78	1.61	2.13	4.99	1.22	3.62	13.58
	2013-2014	13.48	1.15	2.46	3.52	0.76	1.77	19.65
	2014-2015	3.82	1.50	1.51	7.35	1.64	0.30	11.30
2015-2016	2.71	1.39	2.48	3.52	2.27	-1.79	6.66	
Projection coefficient (%)		5.94	2.40	3.51	5.23	8.47	2.04	0.84
The projections	2017	1369	216424	145249	37725	417069	14056	4753
	2018	1450	221622	150342	39697	425572	14175	5156
	2019	1536	226945	155614	41773	434248	14294	5592
	2020	1627	232396	161070	43958	443100	14414	6066
	2021	1724	237978	166718	46256	452133	14536	6580
	2022	1827	243694	172563	48675	461350	14658	7137
	2023	1935	249547	178614	51220	470755	14781	7741
	2024	2050	255540	184877	53899	480352	14906	8397
	2025	2172	261678	191359	56717	490145	15031	9108
	2026	2301	267963	198069	59683	500137	15158	9879

Projection coefficients of other harvesting machines commonly used in Turkey are calculated as positive percent of 32.66, 6.44, 5.57, 5.17, 4.95 and 1.07 for harvesting machinery (fruit), binder, maize harvester, complete beet harvester, combine potato harvester and hazelnut thresher respectively. In case of thresher, negative projection coefficient of 1.70% is calculated due to decreasing trend of units between in 2007 and 2016 years.

Spraying machines are widely used to protect the agricultural production and storage of obtained product against diseases, harms and adverse effects of weeds (Anonymous 2017d). Referring Table 5, PTO (Power take off shaft)

driven sprayer units was 255.582 in 2007 and reached to 338.625 in 2016. It is possible to say that with the 2.63% projection coefficient calculated from given numbers of covered years, PTO driven sprayer will rise to 458.190 units in 2026 year. Furthermore, projection coefficients of other widely used spraying equipment and machinery in Turkey have an increasing trend and are calculated as 2.29%, 1.66% and 0.83% for engine driven sprayer, atomizer and knapsack sprayer respectively. Besides, due to decreasing trend of barrow duster and combine sprayer units between in 2007 and 2016 years, projection coefficient has found to be negative.

Tractors can be described as self-propelled force machine used in agricultural activities wheeled, tracked or both present together. The tractor, which means drawing something, is a

French word and they are being used extensively not only for drawing purposes but also for pulley, power take-off, loading and unloading objectives (Anonymous 2017e).

**Table 4.** Projections of some harvest-threshing machines widely used in Turkey

Harvest-threshing machines		Combine harvester	Binder	Thresher	Complete beet harvester	Combine potato harvester	Harvesting machinery (Fruit)	Hazelnut thresher	Maize Harvester
Years	2007	12775	5039	194847	3593	608	320	5315	677
	2008	13084	6107	192440	3716	612	510	5409	726
	2009	13360	6139	190856	3932	630	647	5276	749
	2010	13799	6451	187978	4271	766	1535	5309	863
	2011	14313	6987	188153	4590	811	2522	5362	915
	2012	14813	7409	185327	4921	839	4119	5474	987
	2013	15486	8468	181320	5288	902	6565	5621	1019
	2014	15899	8882	173555	5448	993	8117	5616	1030
	2015	15998	9210	170836	5593	924	10556	5687	1043
	2016	16247	9305	167581	5807	980	13243	5861	1142
Change rates over years	2007-2008	2.36	17.49	-1.25	3.31	0.65	37.25	1.74	6.75
	2008-2009	2.07	0.52	-0.83	5.49	2.86	21.17	-2.52	3.07
	2009-2010	3.18	4.84	-1.53	7.94	17.75	57.85	0.62	13.21
	2010-2011	3.59	7.67	0.09	6.95	5.55	39.14	0.99	5.68
	2011-2012	3.38	5.70	-1.52	6.73	3.34	38.77	2.05	7.29
	2012-2013	4.35	12.51	-2.21	6.94	6.98	37.26	2.62	3.14
	2013-2014	2.60	4.66	-4.47	2.94	9.16	19.12	-0.09	1.07
	2014-2015	0.62	3.56	-1.59	2.59	-7.47	23.11	1.25	1.25
2015-2016	1.53	1.02	-1.94	3.69	5.71	20.29	2.97	8.67	
<b>Projection coefficient (%)</b>		2.63	6.44	-1.70	5.17	4.95	32.66	1.07	5.57
The projections	2017	16674	9904	164739	6107	1029	17568	5924	1206
	2018	17113	10542	161946	6424	1079	23307	5987	1273
	2019	17563	11221	159200	6756	1133	30919	6051	1344
	2020	18025	11944	156500	7106	1189	41018	6116	1419
	2021	18499	12713	153846	7473	1248	54416	6181	1498
	2022	18985	13532	151237	7860	1310	72189	6247	1581
	2023	19485	14403	148673	8267	1374	95768	6314	1669
	2024	19997	15331	146152	8694	1442	127048	6381	1762
	2025	20523	16318	143673	9144	1514	168544	6449	1860
	2026	21063	17369	141237	9617	1589	223595	6518	1964

By reviewing Table 6, it can be seen that the tractor units was 1.056.128 in 2007 year and rose up to 1.273.531 units in 2016 year. It is possible to say that the number of tractors in Turkey will increase to 1.560.252 in 2026 with 2.05% projection coefficient calculated from data of past ten years units. In case of trailers (agricultural cars) used together with tractors generally, it is seen that the units of trailers was 1.026.389 in 2007 year and rose up to 1.137.709 in 2016 year. It can be calculated that the projection coefficient of ten years average for trailer (agricultural car) is 1.14% and by using this projection it is obvious to say that the agricultural car in Turkey will increase to 1.273.763 in 2026. Furthermore, the calculated

projection coefficients of the other agricultural equipment in Table 6 are; 8.31% for corn forage harvester (Silage maize), 7.16% for Baler, 6.48% for forage harvester (Haysilage) and 5.29% for tractor drawn mower.

Projection coefficients of agricultural equipment and machines are given in Figure 1. When Figure 1 is examined in detail, it can be seen that harvesting machinery (fruit) has the biggest projection coefficient among all equipment considered. Besides it can be predicted that, wooden plow, toothed harrow, thresher and barrow duster and combine sprayer units will decrease by 2026 year because of negative

projection coefficient calculated by data units of past ten years.

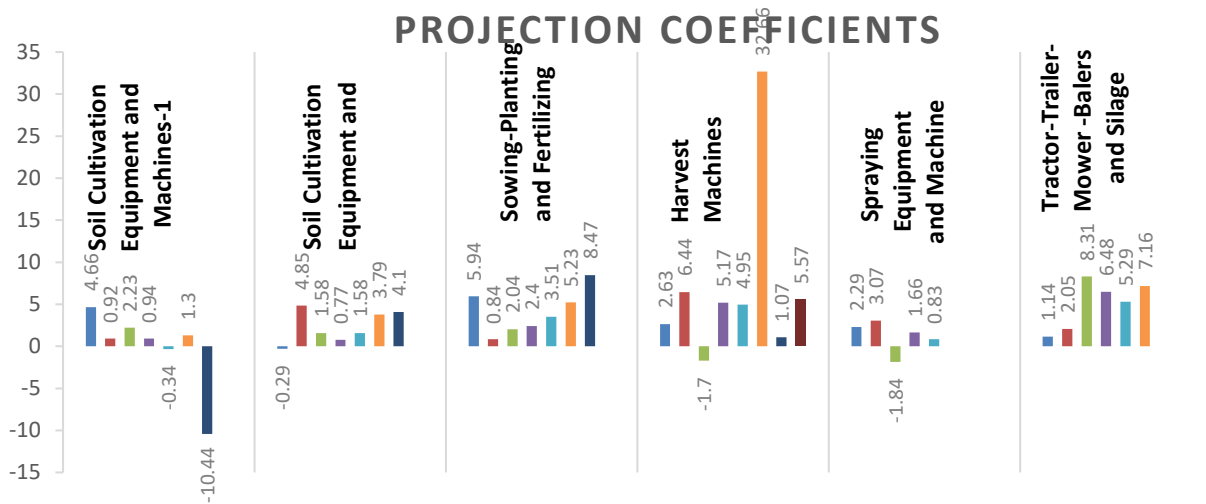


Figure 1. Projection Coefficient of agricultural equipment and machines widely used in Turkey

Table 5. Projections of some spraying equipment and machinery widely used in Turkey

Spraying equipment and machinery		Engine driven sprayer	PTO driven sprayer	Barrow duster and combine sprayer	Atomizer	Knapsack sprayer
Years	2007	71015	255582	14993	103324	587821
	2008	72171	259475	15084	103490	590590
	2009	72494	264421	13955	105036	588556
	2010	73745	278761	14188	112738	591373
	2011	75905	291505	14020	113641	597460
	2012	78151	305295	14303	114435	606366
	2013	80457	312651	14325	116789	612626
	2014	84093	322174	13811	115995	623190
	2015	85974	329768	12731	116883	628059
	2016	87486	338625	12802	120402	633598
Change rates over years	2007-2008	1.60	1.50	0.60	0.16	0.47
	2008-2009	0.45	1.87	-8.09	1.47	-0.35
	2009-2010	1.70	5.14	1.64	6.83	0.48
	2010-2011	2.85	4.37	-1.20	0.79	1.02
	2011-2012	2.87	4.52	1.98	0.69	1.47
	2012-2013	2.87	2.35	0.15	2.02	1.02
	2013-2014	4.32	2.96	-3.72	-0.68	1.70
	2014-2015	2.19	2.30	-8.48	0.76	0.78
2015-2016	1.73	2.62	0.55	2.92	0.87	
Projection coefficient (%)		2.29	3.07	-1.84	1.66	0.83
The projections	2017	89485	349021	12566	122404	638845
	2018	91531	359736	12335	124440	644136
	2019	93623	370781	12108	126509	649471
	2020	95762	382164	11885	128613	654849
	2021	97951	393897	11667	130751	660273
	2022	100190	405990	11452	132926	665741
	2023	102479	418454	11241	135136	671255
	2024	104822	431301	11034	137383	676814
	2025	107217	444542	10831	139668	682419
	2026	109668	458190	10632	141990	688071

**Table 6.** Projections of some tractor & trailer/mower & balers and silage machines widely used in Turkey

Tractor & trailer / mower & balers and silage machines		Trailer	Tractor	Corn forage harvester (silage maize)	Forage harvester (haysilage)	Tractor drawn mower	Baler
Years	2007	1026389	1056128	11998	2853	10998	50669
	2008	1036613	1070746	14000	3087	11839	54072
	2009	1041239	1073538	15287	3156	12613	55762
	2010	1061656	1096683	16627	3471	13303	61248
	2011	1074764	1125001	18507	3778	14524	66193
	2012	1098995	1178253	19988	3917	15887	68579
	2013	1109917	1213560	21887	4248	18024	73314
	2014	1121371	1243300	24486	4674	19459	79115
	2015	1126166	1260358	25370	4908	20446	81480
	2016	1137709	1273531	26347	5227	21520	82899
Change rates over years	2007-2008	0.99	1.37	14.30	7.58	7.10	6.29
	2008-2009	0.44	0.26	8.42	2.19	6.14	3.03
	2009-2010	1.92	2.11	8.06	9.08	5.19	8.96
	2010-2011	1.22	2.52	10.16	8.13	8.41	7.47
	2011-2012	2.20	4.52	7.41	3.55	8.58	3.48
	2012-2013	0.98	2.91	8.68	7.79	11.86	6.46
	2013-2014	1.02	2.39	10.61	9.11	7.37	7.33
	2014-2015	0.43	1.35	3.48	4.77	4.83	2.90
	2015-2016	1.01	1.03	3.71	6.10	4.99	1.71
<b>Projection coefficient (%)</b>		1.14	2.05	8.31	6.48	5.29	7.16
The projections	2017	1150633	1299655	28538	5566	23061	87287
	2018	1163705	1326315	30910	5926	24713	91907
	2019	1176924	1353521	33480	6310	26483	96771
	2020	1190294	1381286	36264	6719	28380	101893
	2021	1203816	1409620	39279	7154	30413	107286
	2022	1217491	1438536	42545	7617	32591	112965
	2023	1231322	1468044	46082	8110	34925	118944
	2024	1245309	1498158	49914	8636	37427	125240
	2025	1259456	1528890	54064	9195	40108	131869
	2026	1273763	1560252	58559	9791	42980	138848

### Conclusion

There are 4 basic elements of agricultural mechanization. These are people, environment, tractors and agricultural machinery. Strategic planning of agricultural mechanization can be described as the optimization of these four basic elements to minimize the costs of agricultural mechanization (Anonymous 2017f). Mechanization equipment, which are utilized to achieve the goal of basic agricultural jobs, constitutes 30-60% of agricultural production costs depending on the product type and manufacturing technique (Dilay and Ozkan, 2007).

In this study, the utilization projections of 40 agricultural machines extensively used in Turkey are taken into consideration. In Turkey, the

projection of technology utilization of 35 tools or machines in agriculture will increase by 2026 year in the direction of obtaining the positive projection coefficients and the projection coefficients of 5 tools or machines determined to be negative which projects a decrease in the units of these tools and machines.

The low level utilization of technology equipment result low projection values in agriculture also suggests that the usage of machinery in Turkey is low. For that reason, the main purpose should be to disseminate agricultural technology applications and increase awareness of increasing agricultural production.



### Acknowledgement

This paper was submitted as oral abstract in I. International Agricultural Science Congress (9-12 May 2018, Van-Turkey).

### References

- Altuntas, E., Demirtola, H. 2004. The evaluation of the agricultural mechanization level of Turkey according to the geographical regions. *Journal of the Agricultural Faculty of Gaziosmanpasa University*, 21(2): 63-70.
- Anonymous, 2017a. Tarım Makinaları Sektör Raporu. Batı Akdeniz Kalkınma Ajansı, 2012.
- Anonymous, 2017b. Tarım Alet ve Makine Sektörü, (Access date: 20.11.2017).
- Anonymous, 2017c. Tarımsal Yapı ve Üretim. T.C. Başbakanlık Türkiye İstatistik Kurumu (TÜİK) (Access date: 20.11.2017).
- Anonymous, 2017d. İlaçlama Makinaları. (Access date: 20.11.2017).
- Anonymous, 2017e. Traktör ve Yapı Elemanları. (Access date: 20.11.2017).
- Anonymous, 2017f. Diyarbakır İli Tarımsal Mekanizasyon Durum Analizi ve Planlaması Projesi (Access date: 20.11.2017).
- Baran, M.F. 2010. Kanalola'nın Hasat Mekanizasyonu ve Hasat Kayıplarının Saptanması Üzerine Bir Araştırma, Doktora Tezi, N.K.Ü. Fen Bilimleri Enstitüsü, Tekirdağ.
- Banaeian, N., Zangeneh, M. 2011. Mechanization and economic analysis of wheat production in Iran. *Agricultural Mechanization in Asia, Africa, and Latin America Vol.42 No.4*.
- Demir, B. 2013. Mersin İlinin tarımda teknoloji kullanım projeksiyonu. *Alinteri Zirai Bilimler Dergisi*, 24(B): 29-34.
- Demir, B., Kuş, E., 2016. İç Anadolu bölgesinin tarımda teknoloji kullanım projeksiyonu. *Nevşehir Bilim ve Teknoloji Dergisi TARGİD Özel Sayı* pp. 89-95, 2016.
- Dilay, Y., Özkan, A. 2007. Karaman il'indeki tarım makinaları imalatçılarının durumu ve sorunları. *Tarımsal Mekanizasyon 24. Ulusal Kongresi, Kahramanmaraş*.
- Evcim, Ü.H., Ulusoy, E., Gülsoylu, E., Tekin, B., 2010. *Tarımsal Mekanizasyon Durumu, Sorunları ve Çözüm Önerileri*. (<http://www.zmo.org.tr>).
- Saral, A., Vatandaş, M., Güner, M., Ceylan, M., Yenice, T. 2000. Türkiye tarımının makinalaşma durumu. *TMMOB Ziraat Odası 5. Teknik Kongresi, 17-21 Ocak 2000*, pp. 901-923, Ankara.