ECONOMICAL ASPECTS OF CONSERVATION AGRICULTURE (ZERO TILLAGE-DIRECT SEEDING) SYSTEM IN TURKEY

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ABSTRACT

Conservation agriculture (CA) is a valuable practice for managing agroecosystems for an improved and sustained productivity, increased profits and food security while preserving and enhancing the natural resource base, particularly in dry areas. It is potentially considered to be a promising system for sustainable crop production in the rain-fed areas of Turkey. However, bio-economically efficient crop rotations under CA need to be developed for successful practice of the system. Thus, in the current study, the cost of production and net profit in various crop rotation options in CA and conventional cropping system (CS) under rain-fed conditions were compared in Konya Province of Central Anatolian Region in Turkey for a period of three years. Crop rotations were designed around various combinations of bread wheat (W), chickpea (C), Hungarian vetch (HV) and safflower (S) crops. The total net profit of nine crop rotation systems in CA were 1.55 times greater than those in the CS system. In a 4-year-crop rotation, chickpea and Hungarian vetch in rotation with wheat and safflower provided a more efficient crop rotation option as compared to cereal-fallow (F) rotations.

KEYWORDS:
Economic analysis, Conservation agriculture, Crop rotation, Turkey

INTRODUCTION

Due to growing environmental concerns, economic production demands, and obligation to save energy, the radical changes have begun to be made in cropping systems across the globe. Conservation agriculture system is considered to be a promising alternative to conventional tillage in arable farming systems. Direct seeding, also called zero tillage is one of the important elements of the CA and is practiced with minimal soil disturbance (no more than 20% soil disturbance) and planting the seeds directly into soil bed that is covered by stubbles remaining from the previous crop [1]. The arable land that is under CA has increased from about 6 million ha in 1980s, to about 150 million ha in 2000s [2]. gaining momentum that is stemmed from the reported environmental and economic benefits in research studies and demonstrations.

CA has also a positive effect on soil structure (biotic and abiotic) [3-7] through the accumulation of more organic substance, leading to more effective use of water resources [8-10]. It is also considered to be an environmentally friendly production system as it helps preventing erosion and greater carbon sequestration, and CO_2 emission potential as compared to CS [11- 16]. In terms of the climate change which is central in rural development policies and practice, CA is a promising technology which is potentially contributing to sustainable agricultural practices to adapt climate change [11, 14, 17-18]. From the economic standpoint, CA reduces production costs through lower labor and fuel needs. Furthermore, it helps diversifying the income distribution and spreading the need for labor more evenly across the seasons [17-20].

In Turkey, scientific studies on tillage methods were initiated by pioneering scientist "Numan Kıraç" in 1931. After similar studies, a consensus formed that the soil must absolutely be rehabilitated. Detailed results regarding to time of tillage and tillage methods and tools to be used were presented. With the effect of supports made and developing machinery - equipment park, our farmers have also begun to adopt and implement suggested tillage methods. Farmers also often burn stubble to avoid extra tillage and reduce costs. This makes soils more vulnerable to erosions and leads to reduction in organic substance and water use efficiency. In addition, it forms an impediment for suitable crop rotation to place in and seeding to be made in ideal conditions [21-22].

In Turkey, a number of projects conducted by Ministry of Food, Agriculture, and Livestock (MFAL) and universities reported that reduced tillage and direct seeding systems held promise for sustainable cropping [23-30, 18]. These results, especially MFAL, attracted attention of machinery manufacturers and farmers, who are stakeholders of the issue. The support made by MFAL, in the scope of the project of "The Conservation of Agricultural Lands for Environmental Purposes (CATAK)" has been implemented in Turkey [31] but slightly as a result of that machinery manufacturers develop machinery and that producers begin to apply.

This study attempted to put forward the economic results of conventional tillage and direct seeding system by cost analyses in case of substituting either forage legumes or food legumes besides cereal-fallow system that is widely applied in the rainfed areas of Konya region. Meanwhile the importance of this type of environmentally friendly techniques in terms of agricultural and rural development was mentioned by emphasizing that it supports sustainable agricultural production.

MATERIALS AND METHODS

Study Area. The research was carried out at Bahri Dağdaş International Agricultural Research Institute (BDIARI) 37°510N, 32°330E, 1,008 m asl), Konya, Turkey, from 2011-to 2014 (Figure 1). Air temperatures and precipitation at the site during the experiment period are given in Table 1.

The study area is 5 km away from the city center and its coordinates are between North latitude of 37º 52', 37º 51', 37º 51', 37º 50' and East longitude of 32º 32', 32º 36', 32º 32', 32º 35'. The physical and chemical properties of soil in the study site were presented in Table 2. The analyses were conducted in the Soil Analysis Laboratory of Selçuk University, Agricultural Faculty in Konya province.

FIGURE 1
The map of the study area

TABLE 1
Climate Data* Belongs to the Trial Field

Months	Total Rainfall (mm)				Temperature (Celsius)			
	2011-2012	2012-2013	2013-2014	Long Term Mean (1950-2014)	2011-2012	2012-2013	2013-2014	Long Term Mean (1950-2014)
October	36.6	34.0	10.2	30.1	11.7	14.2	9.7	12.4
November	9.2	37.2	6.0	32.6	3.1	7.3	7.1	6.1
December	28.6	63.0	8.8	42.0	3.3	3.5	-2.6	1.7
January	83.2	26.6	58.8	35.9	-0.4	1.5	2.1	0.0
February	38.0	33.6	17.4	28.0	-0.6	4.4	3.9	1.4
March	15.0	8.6	20.4	27.5	5.0	7.0	7.2	5.7
April	9.0	33.0	19.2	32.3	14.6	11.3	12.3	11.0
May	40.0	32.6	26.0	43.3	16.5	17.8	15.5	15.7
June	8.6	17.0	31.4	24.3	23.3	21.1	19.7	20.2
July	1.0	2.2	3.0	6.6	26.4	22.8	25.1	23.6
Total/Mean	269.2	287.8	201.2	302.6	10.3	11.0	10.0	

* The climate data was compiled from BDIARI METOS climate station.

TABLE 2
Some Physical and Chemical Properties of Soil Belongs to The Trial Field

Abbr.	Unit	Label	Value
pH	(1:1)	Power of Hydrogen	8.37±0.07
EC	(1:1; µS cm^{-1})	Electric Conductivity	447±51.19
L	(%)	Lime	35.50±2.01
OM	(%)	Organic Matter	4.16±0.56
N	(%)	Total Nitrogen	0.13±0.02
NH_4-N	(mg kg^{-1})	Ammonium Nitrogen	27.28±2.44
NO_3-N	(mg kg^{-1})	Nitrate Nitrogen	14.51±3.89
Pb	(g cm^{-3})	Volume Weight	1.23 ±0.08
Pk	(g cm^{-3})	Particle Density	2.63
Ph	(%)	Calculated Porosity	53.13±3.12
SN	(w/w,%)	Wilting Point	16.53±2.63
FS	(w/w,%)	Available Water	13.02±1.98
FCv	(v/v,%)	Field Capacity	36.31±2.15
SNv	(v/v,%)	Volumetric Field Capacity	20.28±2.50
FSv	(v/v,%)	Volumetric Wilting Point	16.03±2.53

TABLE 3
The Applied Rotation System in Rain-fed Agricultural System

Rotation System No	1st Year	2nd Year	3th Year	4th Year	Abbreviation
1	Wheat	Fallow	Wheat	Fallow	W-F-W-F
2	Hungarian Vetch	Wheat	Fallow	Wheat	HV-W-F-W
3	Safflower	Wheat	Fallow	Wheat	S-W-F-W
4	Wheat	Wheat	Fallow	Wheat	W-W-F-W
5	Chickpea	Wheat	Fallow	Wheat	C-W-F-W
6	Hungarian Vetch	Wheat	Hungarian Vetch	Wheat	HV-W-HV-W
7	Wheat	Safflower	Wheat	Safflower	W-S-W-S
8	Hungarian Vetch	Wheat	Wheat	Wheat	HV-W-W-W
9	Wheat	Chickpea	Wheat	Chickpea	W-C-W-C

Experimental design. The experimental design was split plot in a randomized complete block with four replications. Seeding systems was the main plot while the rotation was the sub plot. Plot sizes were 10 m length and 6 m width in seeding and in harvesting, in 6 m length and 3.2 m width. The study has been designed so that a yield from every plant can be obtained every year. In accordance with the results of the study, based on all data of each plant in rotation every year, the average of 3rd year was extrapolated to 4th year. As a result, from study subjects free from the effect of year, an opinion was obtained in such a way that it will enable to evaluate the systems, which are necessary to be tried for long years, from economic point of view.

As plant material, bread wheat (Karahan'99), chickpea (Gökçe), safflower (Remzibey), and Hungarian Vetch (Altınova) were used. In the study, 9 different quad rotation system was formed. These systems were presented in Table 3.

Data Collection. The data related to production and cost parameters were recorded for each rotation system by the researchers at every application (Soil preparation, sowing, fertilizer application, pesticide application, harvesting). The production costs were calculated for each crop as variable expenditures and fixed expenditures [32]. The items of expenditures were presented in Table 4.

In the CA system, the seeding was made through a direct seeder with a single disk (Özdöken AŞ, Konya, Turkey), at 20 cm row spacing. Before planting, glyphosate application was made for weed control. In CS, the first tillage was realized by moldboard plow and the following secondary operations by the combination of sweep + harrow or disc harrow. In seeding, traditional cereal seeder was used. Also in both application, stubbles were left in the field.

For each activity, Gross Production Value (GPV) was calculated by multiplying the crop production(kg/ha), by the prices of product. All prices were drawn from the market prices and the value of Turkish Lira that was converted to American Dollar through exchange rate of the year 2014 (1 \$ = 2.19 TL), declared by Central Bank in Turkey [33]. In calculation of inlet expenditures, the average fertilizer and diesel fuel prices of Ministry of Food, Agriculture, and Livestock [34], and the product prices of Konya Commercial Exchange for the year 2014 as product prices were taken into consideration [35]. In calculation of expenditures of harvest and labor force, the average values of the year 2014, obtained from the interviews made by BDIARI, Department of Economic Statistics and Extension with producers during R&D activities were used. For each activity, gross profit was calculated by subtracting total variable expenditures made these production activities from Total Crop GPV. Net Profit was calculated by subtracting production expenditures (variable expenditures and fixed expenses) from Gross Production Value [32].

TABLE 4
The Cost Items Used in Comparison of the Crop Rotation Systems in Rainfed Condition

VARIABLE COST	FIXED COST
∞ Soil Preparation (1st, 2nd,3th etc.)) ∞ Seed and Seeding Cost ∞ Fertilizer Cost ∞ Fertilizing Cost ∞ Pesticide (Insecticide, Herbicide, Fungicide) and Application Cost (Labor) ∞ Harvesting Cost ∞ Transportation Cost ∞ Capital Interest (Total Variable Cost* Half of Republic Turkey, Ziraat Bank Current Interest Rate (0.05))	∞ Field Rent ∞ General Management Cost (Total Variable Cost* 0.03)

RESULTS AND DISCUSSION

The success of the direct sowing system is in Turkey, which is at the initial stages, consideration of economic factors is important in terms of becoming widespread and espousing of the system by the farmers. Today, conventional tillage is a more prevalent practice across the study area. General practice for the conventional tillage involves using moldboard plow, and mostly sweep + harrow or disc harrow in the following operations and seeding is carried out by conventional cereal seeding machine (Grain drill). While this system based on intensive tillage, especially erosion, causes negative effects in the structure of soil, it increases fuel consumption and labor force demand. This, also leading increased production costs and product quality to be negatively affected, damages to the sustainable agricultural structure [36-40]. However, in direct tillage, besides eliminating these negativities aspects, it is known that together with seeding, soil structure is improved and that it is made more productive [20]. As reflections of this study, an interest formed in direct seeding, our farmers have begun to implement the practice. However, in case that the operations that are necessary to be made in direct seeding is applied as a whole, it is expressed that the desired benefits will emerge [41]. Direct seeding should be managed as a whole system which requires efficient crop rotation and stubble retention and cannot be a practiced by only as a mere elimination of intensive tillage operations. Although operation of zero tillage and leaving stubble in field is a perceivable application for farmers, it is necessary that crop rotation to be implemented in the light of scientific data. Hence, crop rotation should be determined based on the agro-ecological conditions of the regions. In developing crop rotations, besides t the agro-ecological suitability of a crop, it is imperative to consider the subsequent effect of crops for the yield of the following crops. Bio-economic efficiency of the rotation systems and tillage methods will ultimately determine their potential for adoption by farmers. In the dryland conditions of the central Anatolian region, small grain winter cereals form the basis of agricultural production. In the main cereal belts of the country, cereal-fallow rotations are commonly practiced traditional cropping system, Subsidies made in the different periods and economic changes that emerge enabled some species to take place in fallow areas. However, these applications were temporarily adopted and could not be sustained without the continuity of the subsidies.

With this study, economic aspects of crop rotation systems under CA was revealed. The province of Konya, in which the study is carried out, is the province of Turkey having the largest land existence with the surface area of 4,081,382 ha and agriculture is made in the area of 1,904,439 ha. In 595,859 ha of this area, irrigated agriculture is made. The share of dry areas arable lands in the total agricultural land is 68.75%. Annual rainfall varies between 300 and700 mm. 35.5% of cultivated agricultural land is fallow, while its 61.5% is cultivated. The most cultivated crops in rain-fed regions are wheat, barley, chickpea, and Hungarian vetch [42]. In study region, there are predominantly fallow and rotation system based on these products. Therefore, rotation system included in the scope of research represents the most common rotation systems in dry agricultural system of Konya. In the region, in which conventional tillage system is dominant, direct seeding system is becoming increasingly practiced. This study is important in terms of introducing economic performances in both production systems that are practices in dry agricultural areas.

As a result of the study, it was calculated that 3 times less expenses in tillage expenditures of 9 possible different rotation systems were made in zero tillage+direct seeding system according to CS totally (Table 3). In contrast, the seed and planting costs are calculated by 3.50% and 32.52% more respectively. As a result, it can be said that zero tillage +direct seeding system is more profitable by 35.54% compared to CS+conventional seeding (Figure 2). In another tillage trial carried out in dry agricultural areas in the region in 2002, in 3 different rotation systems (Fallow-Wheat, Chickpea-Wheat and Wheat-Wheat), it was reported that the applications of zero tillage and reduced tillage are more profitable compared to conventional system [18].

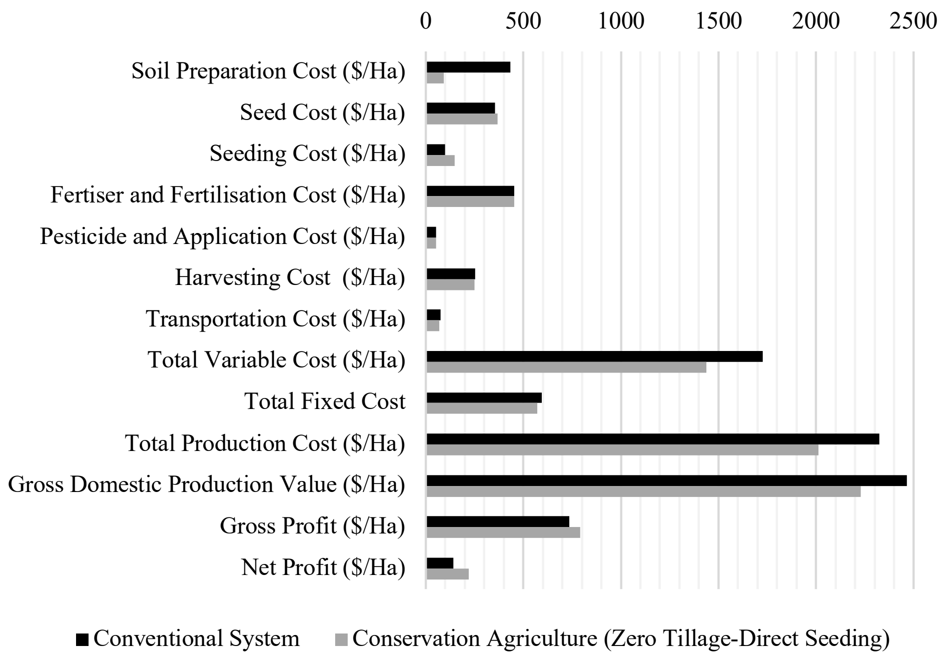

FIGURE 2
The Comparison of Production Cost and Returns Belongs to 9 Different Rotation Systems in Two Different Production Systems (CS-CA)

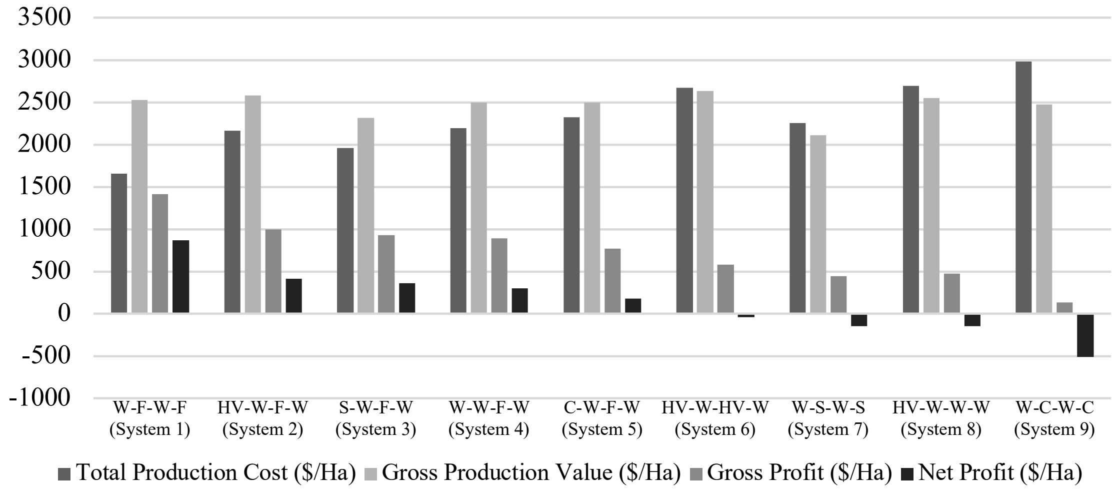

FIGURE 3
Some Economic Indicators by Rotation Systems Applied in CS

When economic performances of CA and CS systems are individually examined, it appears that the first 5 rotations (System 1-5) applied in conventional agricultural system provided a positive return (Figure 3, Table 5). In this system, the rotation having the most return is no.1 (W-F-W-F) with 866.35$/ha. The common feature of 5 systems having positive returns (net profit: 866.35$/ha, 413.22$/ha, 360.34$/ha, 303.68$/ha, and 176.08$/ha respectively) is that there must be at least one time of fallow in a rotation system of 4 years. In conventional system, fallow is an indispensable element of rotation in rain-fed agricultural areas (Figure 3).

The economic comparison of 9 rotation systems in the CA is presented in Table 6. The results revealed that the net profit of 7 systems (Systems 1, 2, 3, 5, 6, 7, and 9) was positive (net profit: 873.61$/ha, 584.68$/ha, 583.62$/ha, 538.22$/ha, 295.75$/ha, 293.63$/ha and 202.84$/ha respectively) (Figure 4, Table 6). In conservative agricultural system, although the economic return of the rotation system including at least 1-time fallow application was higher than the rest, it was found that the rotation systems, in which fallow is eliminated and, instead of it, the legumes (chickpea and Hungarian vetch) were produced, had also positive return (Figure 4, Table 6). Similar positive economic outcomes of including food and forage crops in crop rotations were also reported by different studies [43-44].

TABLE 5
The Distribution of Production Cost by Applications in CS

Applications/ Rotation System	Conventional Method (Conventional Tillage + Conventional Seeding (Seed Drill))								
	Sys. 1	Sys. 2	Sys. 3	Sys. 4	Sys. 5	Sys. 6	Sys. 7	Sys. 8	Sys. 9
Soil Preparation Cost (% in Prod. Cost)	17.04	17.94	20.45	18.27	17.24	18.50	22.96	18.76	17.35
Seed Cost (% in Prod. Cost)	13.07	18.05	11.82	14.84	13.35	21.15	10.89	18.51	13.51
Seeding Cost (% in Prod. Cost)	3.27	3.76	4.16	3.72	4.80	4.07	4.82	4.03	5.64
Fertilizer and Fertilization Cost (% in Prod. Cost)	20.76	18.92	20.92	23.58	17.60	17.77	21.05	21.57	15.84
Pesticide and Application Cost (% in Prod. Cost)	2.19	1.68	1.85	2.48	3.31	1.36	1.61	2.02	3.93
Harvesting Cost (% in Prod. Cost)	6.05	8.64	8.16	6.87	15.14	10.25	9.72	8.80	20.19
Transportation Cost (% in Prod. Cost)	4.73	4.08	3.62	3.54	2.96	3.68	2.80	3.24	1.97
Total Variable Cost (% in Prod. Cost)	67.12	73.07	71.00	73.30	74.39	76.77	73.85	76.92	78.43
Total Fixed Cost (% in Prod. Cost)	32.88	26.93	29.00	26.70	25.61	23.23	26.15	23.08	21.57
Total Production Cost ($/Ha)	1659.65	2165.46	1957.65	2192.00	2322.40	2671.28	2255.64	2697.81	2985.14
Yield (1st Crop, Kg/Ha)	3440.27	579.70	1678.83	1897.60	1897.60	1897.60	1793.33	974.84	1992.47
Yield (2nd Crop, Kg/Ha)	0.00	1992.47	1678.83	2403.65	2403.65	2403.65	974.84	1793.33	579.70
Yield (3th Crop, Kg/Ha)	3440.27	0.00	0.00	0.00	1678.83	1897.60	1793.33	0.00	1992.47
Yield (4th Crop, Kg/Ha)	0.00	3440.27	3440.27	3440.27	1678.83	2403.65	974.84	3440.27	579.70

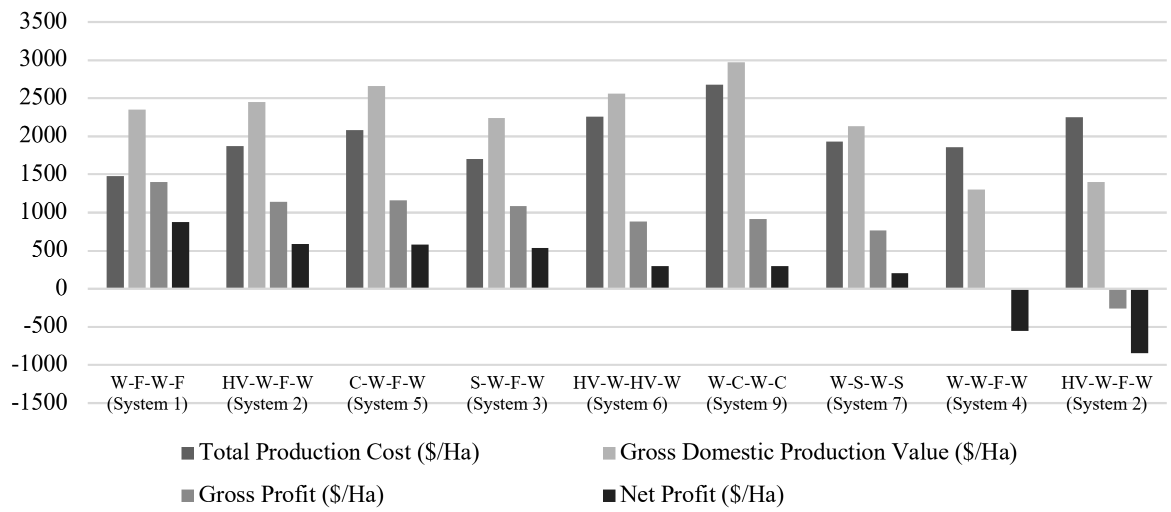

FIGURE 4
Some Economic Indicators by Rotation Systems Applied in CA

TABLE 6
The Distribution of Production Cost by Applications in CA

	Conservation Agriculture (Zero Tillage + Direct Seeding)								
Rotation System	**Sys. 1**	**Sys. 2**	**Sys. 5**	**Sys. 3**	**Sys. 6**	**Sys. 9**	**Sys. 7**	**Sys. 4**	**Sys. 2**
Soil Preparation Cost (% in Prod. Cost)	5,29	4,27	5,01	6,12	3,60	4,85	6,75	3,63	3,07
Seed Cost (% in Prod. Cost)	15,06	20,40	16,97	14,12	23,89	18,02	13,40	17,94	21,88
Seeding Cost (% in Prod. Cost)	6,05	7,18	6,45	7,88	7,91	6,67	9,27	7,22	7,95
Fertilizer and Fertilization Cost (% in Prod. Cost)	23,34	21,92	19,66	24,07	21,00	17,64	24,63	27,82	25,86
Pesticide and Application Cost (% in Prod. Cost)	2,46	1,94	3,69	2,13	1,61	4,37	1,88	2,93	2,42
Harvesting Cost (% in Prod. Cost)	6,81	9,76	16,92	9,39	11,69	22,48	11,37	8,11	10,34
Transportation Cost (% in Prod. Cost)	4,95	4,50	3,55	4,04	4,20	2,78	3,35	2,18	2,29
Total Variable Cost (% in Prod. Cost)	63,95	69,96	72,25	67,75	73,89	76,82	70,66	69,83	73,80
Total Fixed Cost (% in Prod. Cost)	36,05	30,03	27,75	32,25	26,11	23,18	29,34	30,17	26,20
Total Production Cost ($/Ha)	1476,25	1868,49	2078,46	1701,85	2260,72	2680,67	1927,45	1857,74	2249,97
Yield (1st Crop, Kg/Ha)	3200,37	576,40	172,40	1792,90	1792,90	1792,90	2116,93	707,80	2685,82
Yield (2nd Crop, Kg/Ha)	0,00	2685,82	172,40	2366,79	2366,79	2366,79	707,80	2116,93	576,40
Yield (3th Crop, Kg/Ha)	3200,37	0,00	0,00	0,00	172,40	1792,90	2116,93	0,00	2685,82
Yield (4th Crop, Kg/Ha)	0,00	3200,37	3200,37	3200,37	172,40	2366,79	707,80	3200,37	576,40

This study confirmed the profitability of the CA reported by several previous studies in Turkey [45-46, 27]. One of them was carried out with the different seeding systems on sesame agriculture in Harran Plain in the years of 2002-2004 [45]. They emphasized that direct seeding application, which is more advantageous in terms of cost and time saving, should be become widespread in the locality. In another study that was conducted in Çukurova Region of Turkey, it was reported that the second product silage maize, compared conventional tillage and conservative tillage seeding system from economic and technical point of view. They suggested that direct seeding method provided an approx. 85-92% saving through reduced fuel consumption and increased work productivity [46]. Çarman and Marakoğlu, in the study they carried out between the years of 2006-2008 in Konya province of Turkey, compared the different tillage systems for wheat production. Trials were carried out in the form of 4 different applications as conventional tillage, reduced tillage (vertical shaft rotary tiller), direct seeding, and direct seeding (with herbicide application). When the values of fuel consumption were examined, it was identified that conventional method, reduced tillage method and direct seeding method caused fuel consumption of 51.5 lt/ha, 28 lt/ha, and 9.1 lt/ha respectively [27].

As we know that agriculture is reaching the limits of available land and water resources. For this reason, increasing agricultural production and rural rural income in the future depends on more conscious and effective use of these resources. The methods in CA such as no tillage, direct seeding etc., integrates ecology into the farming system design and considers the complex biological web that is at work in a system of healthy and efficient soils, plants, and animals [47]. There is also a perception in the study region about the benefit of CA system by the farmers. A study carried out in Konya province, 62% of the farmers using CA system indicated that the system is beneficial in terms of fuel, labor and time saving [48]. It means that they are looking this system as environmentally friendly and cost reduction system.

CONCLUSION

Due to environmental concerns that develops, economic production demands, and obligation to save in energy use, in the recent years, in the world and Turkey, radical changes have been made in tillage. Depending on these thoughts and changes, conservative tillage, alternative to conventional tillage, especially method of direct seeding rapidly becomes widespread. In the recent years, together with the negative effect of global warming, drought conditions have becoming increasingly evident in dry areas of Turkey. Drought is one of the most important stress factors of environment. The efforts to struggle with drought increase its importance every passing day. Especially crop rotation, studies on conservative soil agricultural systems to enable water to be conserved in soil gradually become widespread. The studies on crop rotation and seeding systems should be updated and strengthen especially in rain-fed conditions together with climatic change seen in the recent times and developing technology, although the studies begun in 1930 about crop rotation, especially in Central Anatolian Region of Turkey.

In this study, the economic aspect of the rotation of wheat with various crops and fallow in rain-fed conditions in the CA and CS systems was demonstrated. On this purpose, chickpea, Hungarian vetch, and safflower, which are able to be in rotation with wheat in the rain-fed condition, were included to the rotation. In Central Anatolian Region, among the plants, which is commonly seeded, legumes have a large importance in terms of suitability.

In conclusion, the rotation system, under CA, in terms of providing positive return to the producers, stood out as compared to CS system. In particular, in rain-fed agricultural areas, reducing fallow areas, through direct seeding system is a promising option in terms of including the legumes such as Hungarian vetch and chickpea in the crop rotations. As a result of the study, 15.50% decrease in total production expenditures was calculated in general average of total 9 rotation systems. In direct seeding system, although 10.49% total decrease in gross production value was experienced due to yield loss, in general average, 35.54% increase in net profit was determined.

Increasing the practice of CA, which is at the introductory stage in Turkey, larger areas should be dedicated to CA as a tool for to attain the strategic targets of MFAL. ÇATAK program, one of the supports provided by MFAL has a great importance and an application helping to be adoption of tillage methods in the different provinces of Turkey. Majority of fallow areas keeping a large space in the existing system can be included in production and second-crop agriculture can be made in the areas, which has appropriate ecology that is not cropped due to time limitations for tillage. In addition, in Turkey where the soils are lost through erosion, and about 70% of agricultural areas contain low organic matter, direct seeding system will make contribution to carrying out agricultural production system in a sustainable structure. Together with all of these contributions, the farmers will achieve a more profitable production model, and will add plus value to the national economy. As a reflection of these positive developments, year-dependent changes will be bottomed out by ensuring national food security supply to a healthier structure, and consumers will be affected by the price fluctuations at minimum level.

The other important point is in sides of adaptation and mitigation to the climate change. This type of the techniques has potential benefits for reducing carbon emissions in the atmosphere. Therefore, to achieve sustainable food production with minimal impact on the soil and the atmosphere, conservation tillage practices are becoming more important now. This is climate-smart practice and promising system with its contribution to environment, habitat and also farmers income. Because of that it is very important tool in terms of agricultural, rural and environmental development.

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