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# The Importance of the Conservation Agriculture for Turkey*

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**ÖZET:** Conservation agriculture (CA) is concerned with profitableness and sustainability by optimizing agricultural procedures while conserving input and minimizing any impact on natural resources. Technologies that benefit the environment can often have negative effect on crop productivity and offer short-term profitability. CA is one of few practices that can enhance yield, economic returns, and food security while conserving the natural resources. The principles of the CA are zero-tillage, permanent soil cover and programing crop rotation or diversification in annual crops. However, CA practices have direct influence on climate regulation through carbon sequestration and less greenhouse gas emissions, and on regulation and provision of water through soil physical, chemical and biological properties. For the last couple of decades the degradation caused by agricultural activities increased linearly as a result of unsustainable intensification of agricultural production in Turkey. For this reason, it is necessary to apply the techniques which will protect both land and optimum production in the whole country. The aim of this research is emphasize the importance of the conservation farming in Turkey. In addition, measures and national strategies for the spread of CA throughout the country have been discussed in detail.

**Anahtar Kelimeler:** Conservation farming, conventional farming, no-tillage, soil tillage, Turkey.

IĞDIR ÜNİVERSİTESİ FBED JIST

# Türkiye için Koruyucu Tarımın Önemi

**ABSTRACT:** Koruyucu tarım, girdileri koruyarak doğal kaynaklar üzerindeki etkiyi en aza indirip, tarımsal işlemleri kolaylaştırdığından dolayı faydalı ve sürdürülebilir bir üretim tekniğidir. Koruyucu tarım tekniği; verimi, ekonomik geri dönüşleri ve gıda güvenliğini artırabilmek için günümüzde kullanılan uygulamalardan biridir. Koruyucu tarımın ilkeleri; sıfır toprak işleme, kalıcı toprak örtüsü ve bitki münavebesidir. Bunlara ilaveten, koruyucu tarım uygulamaları, toprakta karbon birikimi ve daha az gaz yayılımı aracılığıyla iklim düzenlemesi üzerinde etkili olmaktadır. Ayrıca; suyun etkili bir şekilde kullanımını sağladığından dolayı bu yöntem; toprağın fiziksel, kimyasal ve biyolojik kalite kriterlerinin de gelişmesine yardımcı olur. Son yıllarda Türkiye'de yoğun tarımsal üretim sonucu ülke topraklarının yapısında ciddi derecede bozulmalar başlamıştır. Bu nedenle ülke genelinde hem toprağı koruyacak hem de optimum üretim yapılabilecek üretim tekniklerinin uygulamaya konulması gerekmektedir. Bu araştırmanın amacı; Türkiye'deki koruyucu tarımın önemini vurgulamaktadır. Buna ilaveten koruyucu tarımın ülke çapında yaygınlaşması için gerekli olan önlemler ve ülke stratejileri de detaylı bir şekilde tartışılmıştır.

**Keywords:** Geleneksel tarım, koruyucu tarım, toprak işlemesiz tarım, toprak işleme, Türkiye.

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## INTRODUCTION

The world-wide population is growing rapidly, and as a result, agricultural production will be inadequate to feed the population in the forthcoming years. Because of this danger, countries have turned to manufacture more agricultural products. However, uncontrolled and unsustainable agricultural production in accordance with this purpose, leads to the depletion or destruction of the existing resources. The main indicators of this deterioration are declining water resources, wind and water erosion, reduced soil fertility, and low levels of water use by plants.

The predominantly sloping land in Turkey constitutes 6% of the total land area. This means that 76% of the land is susceptible to erosion. Turkey's existing arable land is mostly at risk of water (55%) and wind (5%) erosion. In addition, there is low organic matter content in 69% of the land as a result of applications such as continuous stubble burning or stubble collecting after harvest as well as continuous and non-rotational agricultural production on throughout the country. Furthermore, the intensive use of conventional tillage methods also reduces the content of organic matter in the soil.

The conventional tillage method causes more $CO_2$ emission from the soil to the atmosphere. Carbon is a component of organic matter and increases soil fertility. As a result of intensive soil tillage, soil organic carbon accumulation is reduced. Stubble is an important factor in conservation agriculture (CA). The stubble covering soil surface not only prevents erosion but also raises the quality criteria of the soil and increases the amount of organic matter in the soil.

According to the United Nations Food and Agriculture Organization (FAO), CA is defined as an approach to the management of agricultural ecosystems for improved and sustainable productivity, increased profitability and food safety while protecting the resources and the environment. CA applications have been successfully implemented in countries such as Brazil, Argentina, Australia and Canada.

No-tillage is among the protective agricultural practices. In this method, the seeds are sowed into the soil without tillage with the specially designed sowing machines. Because of the soil surface is covered with stubble, the soil is protected against wind and water erosion. In addition, the stubble on the soil surface increases the content of organic matter in the soil.

Besides because the soil is not cultivated, there is a significant reduction in $CO_2$ emissions from the soil to the atmosphere. Thus, carbon, the basic building block of organic matter, is trapped in soil. While the agricultural land where sowing is performed by means of no-tillage worldwide was 120 million hectares in 2009 (Derpsch, Friedrich, 2009), this value reached 155 million hectares in 2013 (Kassam, 2014).

Even though CA, especially no-tillage in Turkey, was introduced for the first time 45 years ago, the application of the method remained limited. Researches about the CA has been carried out in universities and state research institutes. However, the findings we not adequately explained to the farmers, and consequently the adoption of the method throughout the country was far less than expected.

In this research, the importance of CA practices and the importance of CA farming for Turkey is emphasized. In addition, national measures and strategies for the development of CA are also included.

### Benefits of CA

CA is an application that improves productivity, economic return and food safety while preserving natural resources. CA practices benefit for both farmers on an individual basis and larger communities throughout the country. It is also an important way to deal with problems arising from climate change, especially in arid regions.

Increase in productivity is noticed at the CA system managed according to the rules. However, it needs time to observe this effect. The time for increase in productivity varies depending on factors like farmer experience, climatic factors, and soil structure. Efficiency of CA applications is usually observed after 4 years. Many studies emphasize that CA especially no-tillage method can be used very effectively in dry farming conditions. In CA, stubble left on the surface of the field increases the moisture holding capacity of the soil, reduces the evaporation and acts as a barrier on the soil surface.

CA may not be able to increase production in some cases. However, due to the reduction of production inputs, protective farming reduces costs and therefore increases the profitability. When evaluated in this way, the net economic contribution rate is higher compared to other systems. In many studies conducted in Turkey, lower production costs are obtained in the lands where CA is applied compared to traditional methods.

**Principles of CA**

CA has three basic principles. These basic principles are no-tillage, permanent soil cover and crop rotation. In the no-till system, the target is to plant into narrow lines drawn by using special machines without soil tillage. No-tillage agriculture is also known as direct seeding into the stubble. In this method, the moisture holding capacity of the soil is very high because of the soil surface covered with stubble.

In the case that the method is successfully applied, the physical and chemical quality criteria of soil will develop at a considerable level. Although the method of no-tillage is used extensively over the world, the situation in Turkey is not at a satisfactory level. In order for the direct seeding to the stubble method to be applied successfully, the farmers must be informed in depth about the method. Despite the fact that there are lots of scientific studies on the subject in Turkey, the findings has not been reflected on the producers.

Before using the method of direct seeding to the stubble, some aspects which will primarily affect the production, need to be examined in detail. Weed control for example, is one of the issues that must be studied up on before production. Also the nutrient element and pH level of the soil should be known. The soil surface to be as flat as possible is an important subject for machine performance. For this reason, it is also beneficial to make soil grading before sowing. The fault must be fixed before planting directly. This problem should be solved if there is excessive soil compaction before using the method. If the farmer is applying the method for the first time, only 10% of the total land area should be used for no-tillage. Crop rotation, green manure and cover plant should be used during the production periods. In addition, developments related to the direct sowing method should be followed closely.

In order to use the no-tillage method, at least one year of preparation is required. At this stage it is very important to carry out the soil tillage with the equipment that operates without overthrowing the soil. The crop obtained during the preparation phase must be harvested with harvesters. The stubble to be left on the soil surface must be uniformly distributed on the field. This prevents the sowing machine from clogging at the time of sowing. No-tillage is completely different from the conventional tillage. One of the most important problems encountered in this method is weed control. In order to solve this problem, firstly we should have detailed knowledge about the type of weeds. In addition, it is necessary to know which medicines and when should be used with weeds. The herbicide active ingredient, the drug norm and the pH of the water are important for weed control. Moreover, nozzle type of the pulverizer which will be used in disinfestation should not be ignored to be appropriate for the region applied.

**Turkey's CA Potential and Problems**

Compared to other countries in the region, Turkey seems to have many advantages in terms of CA. Turkey has an advanced and high-end agricultural machinery manufacturing capacity producing with the latest technology.

Also; agricultural machinery manufacturers have accelerated the production of direct sowing machines in recent years and their production amounts have reached at serious levels. Besides, machine manufacturers are also engaged in research and development (R&D) activities in close cooperation with universities and farmers to ensure that the produced machines are appropriate for the soil of the country.

There are agricultural research, development and publishing institutions in Turkey. The Ministry of Food, Agriculture and Livestock has a widespread service network throughout the country. Most of the protective agriculture investigations have been conducted at this institution. In addition, many universities have agricultural faculties, colleges, and technical schools.

It can be said that the biggest farmer organizations of Turkey are the chambers of agriculture partaking in all the provinces and almost in every municipality. They have an enormous potential to promote the use of CA. Some chambers of agriculture provide soil analysis laboratory services and technical consulting services to farmers. The proprietary level of tractors and sowing machines in Turkey is the highest in the world. Tractor ownership per hectare in Turkey coincides with the ninth place in the world (FAO, 2008). However, most of the existing tractors have completed their economic life.

Unlike other countries where agricultural chemicals are limited, all pesticides can be accessed in order to successfully implement CA practices in Turkey. Crop rotation is very important for preventive agriculture. All the seeds suitable for rotation in Turkey are on the market. There are also no sanctions and limitations during trade stage throughout the country for CA practices. In addition to these, Turkey has extensive trade agreements with many countries. CA research and development studies in Turkey have a history of nearly thirty years. Numerous scientific studies have been conducted in this area (Table 1). In addition, many research institutes and universities throughout the country carry out projects related to CA. (Table 2). Various subsidy programs provide support for farmers to purchase sustainable agricultural services like CA practices and specific agricultural machinery like no-till seeder.

In Turkey, some problems are experienced in the application of conservation tillage and no-tillage. Weed control is one of the most intense problems. Weed density is very high in the no-tillage method because the soil is not plowed. Effective crop rotation must be done to solve this problem. As a result of no-till applications which are carried out unknowingly, the total yield slopes down and the farmers are discouraged although they are at the beginning.

The stubble on the surface of the field is very important for conservation agriculture. Necessary stubble is neither sufficient nor uniformly distributed in order to be successful over the land in the applications throughout the country. This situation raises the weed pressure after seeding. Another frequently encountered problem is that the farmers must harvest by means of harvesters with flail mulcher unit

**CA Strategy of Turkey**

Most of the agricultural land in Turkey has been affected by intensive tillage, excessive irrigation and monoculture applications. The low variability in crop rotations across the country has weakened soil humus and significantly reduced micronutrients. The number of studies on crop rotation in Turkey is very few. CA practices have significant contributions to the revitalization of the degraded soil and ecosystem. CA based on parameters such as diversification and development of natural crops in the country as well as the protection of natural resources is compatible with the agricultural strategy of Turkey. It can be said that the most suitable start point for Turkey's agricultural strategy is CA practices.

Some steps must be taken by the farmers to adopt a new method. These can be listed as follows; initial awareness, thought and desire to try technology, evaluation of the convenience and suitability of the technology, adaptation and improvement, evaluation of the benefits and risks of the technology.

There are a number of obstacles preventing the adoption of CA in Turkey. Foremost among them is the lack of knowledge of farmers about CA. Lack of information leads to unawareness of the benefits of CA. There are not enough planning and coordination units throughout the country. In addition, the initial investment costs in CA are higher than in other applications. The fragmentation of agricultural land prevents the implementation of CA practices in large areas. The decline in crop yield in the first years of CA is another factor affecting the spread of CA. Protective agriculture should be included in the national action plan. Thus, it can be ensured that spreads effectively throughout the country. In order to solve the problems in protective agricultural practices; establishment of a protective farming department in the Ministry of Food, Agriculture and Livestock, educational and publishing services should be made more effective and incentives should be at encouraging level.

CA should be included in national programs. The Ministry of Food, Agriculture and Livestock has contributed to agricultural productions with a number of subsidies. These methods are incentive programs, irrigation systems method and agricultural publishing activities. Farmers must benefit from state subsidies by registering the chambers of agriculture. Agricultural education in Turkey is housed in technical vocational high schools, two-year associate degree programs and four-year faculties of agriculture at universities, but; currently none of these schools have a CA program or department. It is important to place the education of CA into curricula at all levels of education. Additional financial support must be provided for manufacturers who produce with CA by the hand of government.

**Table 1.** Some of the past and ongoing conservation agriculture projects in Turkey

| Subject | Location | Years | Systems | Crops | Researchers |
|---|---|---|---|---|---|
| Conservation tillage | East Anatolia | 2003-2005 | Rainfed and irrigation | Maize and sunflower | Prof. Dr. Ahmet ÇELİK<br>Doç. Dr. Sefa ALTIKAT |
| No tillage | East Anatolia | 2008-2011 | Rainfed and irrigation | Vetch and wheat | Prof. Dr. Ahmet ÇELİK<br>Doç. Dr. Sefa ALTIKAT |
| Conventional tillage and soil compaction | East Anatolia | 2003-2005 | Rainfed and irrigation | Wheat | Prof. Dr. Ahmet ÇELİK<br>Doç. Dr. Sefa ALTIKAT |
| Conventional tillage and compaction | East Anatolia | 2013-2014 | Rainfed and irrigation | Corn | Prof. Dr. Ahmet ÇELİK<br>Doç. Dr. Sefa ALTIKAT |
| Machinery and agronomy | Central Anatolia | 2007-2009 | Rainfed | Wheat, chickpea | Prof. Dr. Kazım Çarman |
| Soils and Agronomy | East Mediterranean | 2006-2009 | Rainfed and irrigation | Wheat, corn, soybean | Prof. Dr. İsmail ÇELİK |
| Machinery and agronomy | Aegean | 2001-2002 | Irrigation | Cotton as a second crop | Prof. Dr. Erdem Aykas |
| Tillage and soil | Black sea region | 2007-2009 | Rainfed | Corn | Prof. Dr. Engin Özgöz |
| Machinery 3E | Central Anatolia | | Rainfed | Wheat-Fallow | Prof. Dr. Kazım Çarman |
| Soil | Central Anatolia | | Rainfed | Wheat-legume | Agr. Eng. Derya Sürek |
| Agronomy and soil | Southeastern Anatolia | | Rainfed | Wheat-fallow | Agr. Eng. Ahmet Çıkman |
| Weeds Agronomy | South Eastern Anatolia | | Rainfed | Lentil | Agr. Eng. Murat Urgun |
| Agronomy, and machinery | Eastern Anatolia | | Rainfed | Wheat, vetch and fallow | Agr. Eng. Zinnur Gözübüyük |

**Table 2.** Some of the academic publication of no-tillage and conservation tillage

| Subject | Location | Years | Crops | Researchers |
|---|---|---|---|---|
| Performance of no-till seeders | Mediterranean | 2006 | Maize | Karayel, 2009 |
| Tillage and energy consumption | Mediterranean | 2006-2007 | Maize | Barut et al., 2011. |
| Residue management and crop yield | East Anatolia | 2003-2006 | Cotton | Gürsoy et al., 2010 |
| Soil physical properties and crop yield | Southeastern Anatolia | 2003-2004 | Maize | Sessiz et al., 2010 |
| Tillage systems and economic analyses | Aegean | 2004-2005 | Wheat | Yalçın et al., 2005 |
| Tillage- energy analyses | Mediterranean | 1999-2000 | Corn | Öztürk et al., 2008 |
| Tillage- biomass-nitrogen content | Mediterranean | 2007-2008 | Soybean | Doğan et al., 2011 |
| Tillage-microbial properties | Mediterranean | 2006-2009 | Wheat | Çelik et al., 2011 |
| Tillage-energy analyses-crop yield | Southeastern | 2003-2004 | Sunflower | Sessiz et al., 2008 |
| Tillage-predators | Aegean | 2000-2001 | Cotton | Gençsoylu and Yalçın, 2004 |
| Tillage hydraulic properties | East Anatolia | 2000-2012 | Wheat-vetch | Gözübüyük et al., 2014 |
| Tillage –compaction-seed emergence | Eastern Anatolia | 2006-2007 | Red lentil | Altikat and Çelik , 2011 |
| Tillage-physical properties-crop yield | Eastern Anatolia | 2004-2005 | Maize | Çelik and Altıkat ., 2010 |
| Tillage-$CO_2$ emission, microbial population | Eastern Anatolia | 2005-2006 | Common vetch | Altıkat et al., 2010 |
| Tillage-stubble-sowing performance-crop yield | Eastern Anatolia | 2004-2005 | Maize and sunflower | Altikat S., 2012c |
| Tillage-soil physical properties seed emergence | Eastern Anatolia | 2008-2009 | Summer vetch-winter wheat | Altikat and Çelik, 2012a |
| Tillage-soil physical properties-seed emergence | Eastern Anatolia | 2008-2009 | Vetch-wheat | Altikat and Çelik , 2012a |
| Tillage and equipment | Eastern Anatolia | 2008-2009 | Wheat | Çelik and Altikat, 2012 |
| Tillage – Stubble distribution | Eastern Anatolia | 2008-2009 | Vetch-wheat | Altıkat and Çelik, 2012b<br>Çelik A., 2012 19 |

## CONCLUSION

Conservation Agriculture is the idea of direct production, taking into account the humanitarian needs and long-term effects of its activities on the environment and other living species. There are two important considerations in this production activity. These are production without polluting the environment and protecting natural resources. Generally, CA involves one of the methods of reducing, changing or removing soil tillage. Stubble is not-burned and remains on the ground throughout the year in the CA. As a result of increased energy and labor costs in recent years, the profitability of agricultural products in our country is showing a tendency to decrease rapidly. This situation has led to some deviation of agricultural production from its target. Country markets are open to all countries in the world as well as agricultural products. In order to dominate the world market, it is absolutely necessary to sell the product cheaply and to present to the bazaar at reasonable prices. In this way, profitability will be maximized and natural resources and production of land will be protected. CA and no-tillage are of great importance for these reasons in Turkey.

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