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Political Economy of the Wheat Sector in Turkey

Seed Systems, Varietal Adoption, and Impacts

Editors:

Zewdie Bishaw
Yigezu Atnafe Yigezu
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Preface

In Turkey, wheat is the most important crop in terms of land area, volume of production, and monetary value. Despite varied climatic and agro-ecological conditions, wheat is grown in almost all areas of the country. Although a significant proportion of wheat produced is used for domestic consumption, it plays a dominant role as a source of cash accounting; on average, making up to 45% of household income in some areas where it is grown for market.

Over the last 30 years, wheat production has remained largely stable, in the range of 16 to 22 million tons, with some annual variations. Wheat area has decreased from 9.3 million hectares in 1988 to 6.8 million hectares in 2019. During the same period, there has been a 27% increase in the average yield – from 1.88 tons ha-1 to 2.78 tons ha-1, which has almost fully offset the reduction in total wheat area, leading to only a slight (7%) reduction in total wheat grain production. In 2019, although Turkey ranked eleventh in global total wheat production, it was the number one wheat flour and bourghul exporting country, with a total export of over 3.34 million tons. Turkey is also a major producer of pasta and related products, with a total production volume of 1.3 million tons in 2016.

The establishment, in the 1930s, of regional agricultural research institutes responsible for crop improvement, particularly cereals (wheat, barley), and state farms responsible for production and distribution of seeds of new varieties to farmers, laid the foundation for an organized seed sector in Turkey. The National Wheat Release and Training Project that embarked in 1967 contributed to the start of a 'green revolution' in the country, which gained momentum in the 1970s and continued, though at a slower pace, thereafter. In 1991, the General Directorate of Agricultural Research and Policies was established as a central coordinating body of all national agricultural research, where 12 agricultural research institutes were involved in wheat breeding and research in different parts of the country representing different agro-ecologies.

From its humble beginning in the 1930s, the wheat seed sector in Turkey has seen considerable changes over the years. While most of the changes were incremental over different phases, but sometimes radical, the most important change has been a rapid expansion in variety registration and certified seed production by the private sector over the last 20 years. These changes are mainly attributed to the policy changes and structural transformation that led to the liberalization of Turkey's seed sector. Specifically, the Agricultural Law No. 5488 and Seed Law No 5553, both of which were instituted in 2006, and Law No 5042 for the Protection of Breeders' Rights of New Plant Varieties, which was enacted in 2004. These laws introduced a regulatory framework that encouraged private sector investment in agriculture in general, and the seed sector in particular.

This book, Political Economy of the Wheat Sector in Turkey: Seed Systems, Varietal Adoption, and Impacts is a second book in a series (preceded by a similar book focussing on Morocco and to be followed by another focussing on Uzbekistan). The book series

was possible through support provided by the CGIAR Research Program on Wheat. This book compiles the studies conducted on the Turkish wheat sector, focussing mainly on the seed value chain and covering the entire variety development process –from seed production and marketing, to varietal adoption and impacts; and is organized as follows. Chapter 1 highlights the historical developments of the wheat grain and seed sector, including the policy and regulatory frameworks. Chapter 2 presents the development of agricultural research institutes and hence, the generation of improved wheat varieties, while Chapter 3 focuses on varietal release and protection. Chapter 4 presents a description of the procedures and status of production and commercialization of early generation seed (elite, original), primarily by the National Agricultural Research System, and large-scale certified seed by the private and public sectors. Chapter 5 elaborates on seed quality assurance and certification. Chapter 6 describes the status and identifies the determinants of adoption, assesses the impacts of improved wheat varieties and provides estimates of the annual quantities of wheat seed use. Chapter 7 provides a bird's eye view of the whole wheat sector in Turkey by synthesizing and establishing linkages between the achievements, limitations, challenges and opportunities documented in each of the preceding 6 chapters and makes recommendations for the way forward.

This comprehensive book, where most of the information related to the wheat sector in Turkey is compiled into one document, is the first-of-its-kind in the country. Therefore, we believe that it will be a 'go to' document and a good reference material for several years to come. The rich experiences and possible options for mitigating major challenges that deter the development of the sector documented in this book are expected to inform key stakeholders – including policymakers, researchers, farmers, private and public seed companies, and development partners, and by so doing, help in improving the efficiency of the wheat sector in the country.

Editors

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This book would not have been possible without the financial support obtained from the CGIAR Research Program on Wheat. The authors would also like to thank the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies (TAGEM), General Directorate of Plant Production, the Variety Registration and Seed Certification Center, the Turkish Seed Union and several other institutions in Turkey for providing the valuable information needed to produce this book. Special thanks go to the kind and generous Turkish wheat farmers who willingly committed their precious time to answer the long interviews, which also provided the basis for this study. We also thank the Bahri Dağdaş International Agricultural Research Institute (Konya) of TAGEM for coordinating the collection, digitization, and cleaning of survey data.

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List of Abbreviations

2SLS	Two-stage least squares
ARIP	Agricultural Reform Implementation Project
ARI	Agricultural research institute (Kamu Tarimsal Araştirma Enstitüleri)
BÜGEM	Bitkisel Üretim Genel Müdürlüğü (General Directorate of Plant Production)
CIMMYT	The International Center for Maize and Wheat Improvement
CKS	Çiftçi Kayıt Sistemi (Farmer Registration System)
DUS	Distinctness, uniformity and stability
EU	European Union
FAO	The Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GKGM	Gida ve Kontrol Genel Müdürlüğü (General Directorate of Food and Control)
GMO	Genetically modified organism
GTHB	Gida Tarim ve Hayvancilik Bakanliği (Ministry of Food, Agriculture and Livestock)
ICARDA	The International Center for Agricultural Research in the Dry Areas
IPARD	Instrument for Pre-Accession Assistance Rural Development
IPR	Intellectual property rights
ISTA	International Seed Testing Association
IV	Instrumental variables
IWWIP	The International Winter Wheat Improvement Program
MARA	Ministry of Agriculture and Rural Affairs
MTP	Milli Tarım Projesi (National Agriculture Project)
NARS	National Agricultural Research System
NSAG	The National Seed Advisory Group
NVL	National Varieties List
OECD	Organization for Economic Cooperation and Development
PVP	Plant variety protection
R&D	Research and development

TAGEM	Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü (General Directorate of Agricultural Research and Policies)
TİGEM	Tarım İşletmeleri Genel Müdürlügü (General Directorate of Agricultural Enterprises)
TMO	Toprak Mahsulleri Ofisi (Turkish Grain Board)
TOB	Tarım ve Orman Bakanlığı (Ministry of Agriculture and Forestry)
TÜİK	Türkiye İstatistik Kurumu (Turkish Statistical Institute)
TRY	Turkish lira
TTSM	Tohumluk Tescil ve Sertifikasyon Merkez Müdürlüğü (Variety Registration and Seed Certification Centre)
TUSAF	Türkiye Un Sanayicileri Federasyonu (Turkish Flour Manufacturers Federation)
TÜRK-TED	Türkiye Tohumculuk Endüstrisi Derneği (Turkish Seed Industry Association)
TÜRKTOB	Türkiye Tohumcular Birliği (Turkish Seed Union) and its sub-unions
	BİSAB-Bitki Islahçıları Alt Birliği (Plant Breeders Sub-Union)
	TSÜAB-Tohum Sanayicileri ve Üreticileri Alt Birliği (Seed Industrialists and Producers Sub-Union)
	FÜAB-Fidan Üreticileri Alt Birliği (Sapling Producers Sub-Union)
	FİDEBİRLİK-Fide Üreticileri Alt Birliği (Seedling Producers Sub-Union)
	SÜSBİR- Süs Bitkileri Üreticileri Alt Birliği (Ornamental Plant Producers Sub-Union)
	TYAB-Tohum Yetiştiricileri Alt Birliği (Seed Growers Sub-Union)
	TODAB-Tohum Dağıtıcıları Alt Birliği (Seed Distributors Sub-Union)
TVYS	Tohumluk Veri Yönetim Sistemi (Seed Data Management System)
UPOV	International Union for Protection of New Varieties of Plants
VCU	Value for cultivation and use
WANA	West Asia and North Africa region
WTO	World Trade Organization

CHAPTER I

THE WHEAT SECTOR IN TURKEY

Simon Popay*, Murat Küçükçongar, Mufit Engiz, Mesut Keser, Zewdie Bishaw, Yigezu Atnafe Yigezu, Abdoul Aziz Niane, and Mustafa Kan

Background

The large size of arable land, the wide diversity of agro-ecologies, the multiplicity of production systems, the strategic location of straddling both Europe and Asia, and a leadership in the export of several agricultural commodities, put Turkey in an important global position. The major agricultural and horticultural crops grown are winter cereals, pulses, industrial crops, forages, vegetables and fruits. Agricultural production in the country is predominantly (about 80%) rainfed, while the remaining 20% is irrigated. Cereals and pulses are grown largely under rainfed conditions, whereas maize, sunflower, vegetables, potato, cotton and sugar beet are mainly grown in irrigated areas.

During the last 50 years, Turkey's economy has undergone major structural transformation, leading to the reduction of agriculture's share in total Gross Domestic Product (GDP) – from over 50% in the 1960s, to less than 7% in 2019 (World Bank, 2020). Employment in agriculture has also fallen over the same period. Between 1998 and 2019 alone, the number of people working in agriculture has fallen by over 3.7 million (40%). The agricultural sector now employs only 18% of the labor force (World Bank, 2020; TÜİK, 2017).

Turkey's structural transformation is closely related with changes in the agricultural policies of the government. Prior to the 1980s, state-driven development initiatives were aimed at both expanding and intensifying farming to support industrialization through import substitution. Key policy tools included the establishment, promotion, and operation of the state agricultural bank (Ziraat Bankası), producer and marketing cooperatives, and the Turkish Grain Marketing Board (Toprak Mahsulleri Ofisi, TMO). From the 1980s onwards however, neoliberal reforms have reshaped agricultural policies and institutions, increasing the private sector's role in farming, agro-processing, and marketing (Mazid et al., 2009; Aydin, 2010).

Liberalization in agriculture has been consistent with changing government attitudes in other sectors of the economy (Öniş and Şenses, 2007). Drivers have included pressure from international institutions (the World Bank and the Organization for Economic Cooperation and Development [OECD]), recurring economic crises (e.g. 1978-9, 1994, 2000 and 2001), and the pursuit of European Union (EU) accession. Alignment with international norms and standards, including OECD, the EU, the International Union for Protection of New Varieties of Plants (UPOV) and International Seed Testing Association (ISTA) guidelines on variety registration and seed certification, has been a key focus (Bozkurt and Engiz, 2001).

During and since the 2000s, the Government of Turkey engaged with the World Bank's Agricultural Reform Implementation Project (ARIP) and the EU Instrument for Pre-Accession Assistance Rural Development (IPARD). ARIP attempted to reform subsidies, privatize cooperatives, and reorganize state agricultural administrative structures. New laws were also introduced governing agriculture in general, seeds, plant breeder's rights, organic farming, biosafety, and food safety. At the same time, large-scale regional development projects, such as the South East Anatolia Project (known locally

as Güneydoğu Anadolu Projesi), have contributed to dramatic changes in rural areas (Aydin, 2010; Koçak, 2012). Through liberalization, the state has actively encouraged the private sector in farming and related services, including involving multinational seed companies in various farming support programs. As a result, the farming sector has seen considerable reorientation away from traditional crops to high-value foods that target the export market. This reorientation, coupled with the expansion of commercial farming, has reduced the economic viability of family farming (Öniş and Şenses, 2007; Keyder and Yenal, 2011; Aydin, 2010). In Turkey, most policies are implemented through regulations and directives – indicating the challenges in passing legislation in the country (Ozbag, 2016). Despite all these changes and the new laws that consolidated and institutionalized agricultural policy, the institutional and policy regimes in the Turkish agricultural sector remain complex.

The Wheat Grain Sector

Production

In Turkey, wheat is the most important crop in terms of land area, volume and value of production. Despite varied climatic and agro-ecological conditions, wheat is grown in almost all areas of the country. A significant proportion (about 85%) of wheat produced is used for domestic consumption. Where wheat is grown for the market, it tends to play a dominant role in household income on family farms. Based on a study of five of the largest wheat growing provinces in Turkey, Mazid et al. (2009) estimated that where wheat is grown, it accounts for an average of 45% of household income.

In the last 50 years, wheat yields in Turkey have grown steadily. This can be attributed to various factors including the availability of new improved high-yielding varieties, increased use of fertilizers, better disease and pest management, development of irrigation facilities, and good agricultural practices (FAO, 2015). Despite this progress, Turkey has not kept pace with Europe in terms of wheat yields. In the early 1960s, Turkey and Europe had similar wheat yields, of just over 1 ton ha-1, but 50 years later, the average wheat yield (between 2010 and 2019) in Turkey of 2.7 tons ha-1 was well below that of the European average of 4 tons ha-1 (FAOSTAT, 2020). Lower wheat yields in Turkey can be attributed to a range of factors, including low precipitation, low use of improved varieties, poor agronomic practices, diseases, and pests (Tatlıdil, Dellal and Bayramoğlu, 2013). Overall, Turkey ranks 67th in terms of wheat yields in the world (FAOSTAT, 2020).

Over the last 30 years, wheat production has remained largely stable in the range of 16 to 22 million tons, with some annual variation. The wheat production area has decreased from 9.3 million hectares in 1988 to 6.8 million hectares in 2019 while, during the same period, there has been a 27% increase in the average yield, from 1.88 tons ha-1 to 2.78 tons ha-1. During this time, the increase in average yield has almost fully offset the reduction in total wheat area, leading to a slight (7%) reduction in total wheat grain production. Figures 1.1 and 1.2 show the changes in area harvested, yields and production for wheat.

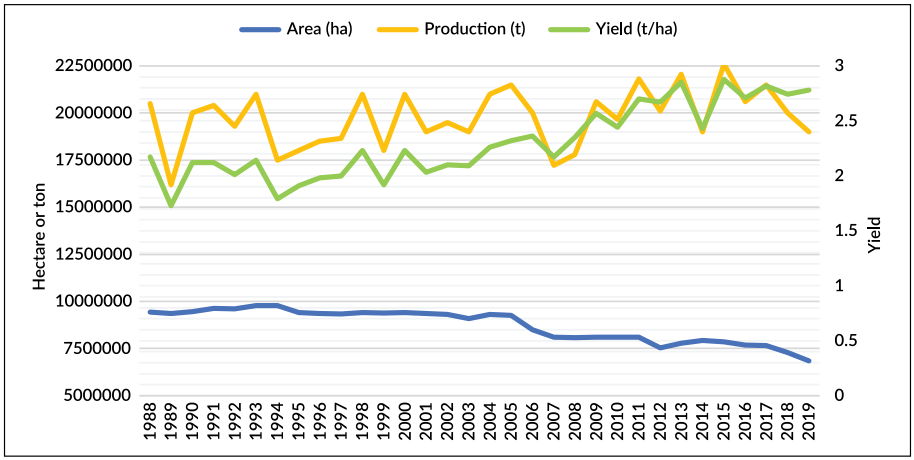

Figure 1.1: Wheat area, yield and production in Turkey

Source: Turkish Statistical Institute (TÜİK) (2021a)

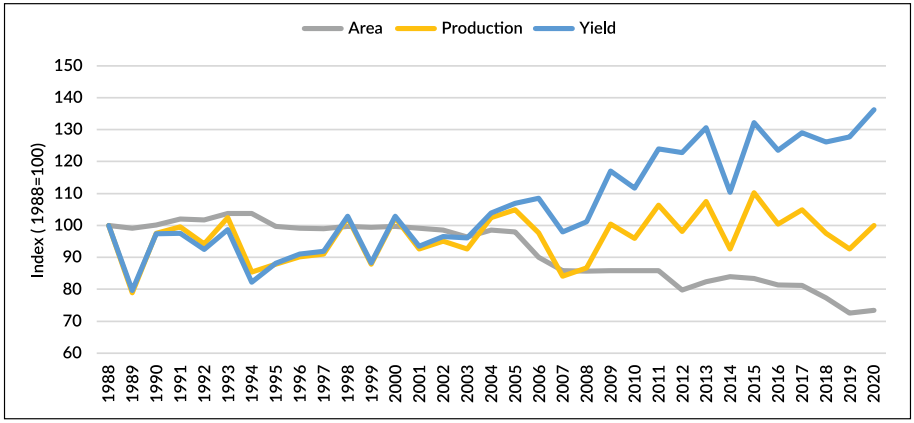

Figure 1.2: Indexed wheat area, yield and production in Turkey

Source: Authors' calculation based on TÜİK (2021a)

Small-scale farming is the dominant form of agricultural production in Turkey, with considerable variation in the distribution of land holdings. In 2001, land holdings under 5 ha made up 65% of farmers but only 21% of farmland. By contrast, holdings over 50 ha made up 0.72% of farms but accounted for 11% of farmland (TÜİK, 2001). In 2016, the number of holdings under 5 ha – and their area share – reduced to 52% and 14%, respectively (Figure 1.3). Smallholdings of less than 10 ha account for about 80.7% of the total agricultural holdings, constituting about 29.1% of the total land, whereas farms with over 10 ha constitute the rest of landholdings (19.3%) and land area (60.9%) (TÜİK, 2018).

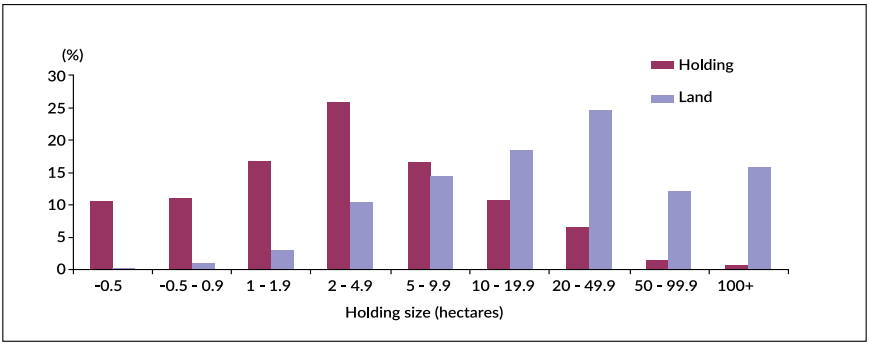

Figure 1.3: Distribution of number of holdings and land size as percentage of national totals

Source: TÜİK (2018)

While larger holdings have become more common, the Ministry of Agriculture and Forestry[(1)] (Tarım ve Orman Bakanlığı, TOB) has also identified land fragmentation as a serious challenge for the development of the agriculture sector. It introduced an 'indivisible parcel size' policy in 2007, which restricts the division of cultivated land below 2 ha (Official Gazette, 2007). Since 2003, TOB has also pursued land consolidation. By 2018, 8.2 million hectares had been consolidated, with aims to consolidate a further 300,000 ha by 2023 (Turkish Presidency, 2019). Another complicating factor is the prominence of shared ownership (hisseli tapu) of land, often emerging through inheritance, which affects 43% of land parcels in the country (Dönmez, 2021).

Wheat grain trade

Wheat farmers in Turkey sell their products through a range of channels. An overview of the wheat value chain in Turkey is presented in Figure 1.4.

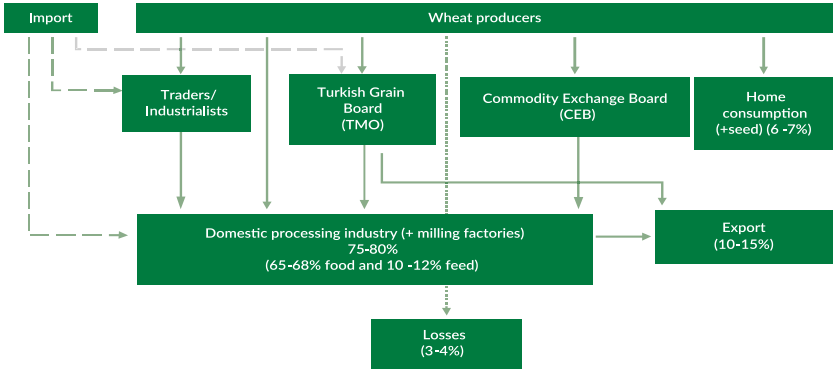

Figure 1.4: The wheat grain trade in Turkey

Source: data on long-term averages from TMO (2021), TÜİK (2021c) and FAOSTAT (2020)

(1) The Ministry of Agriculture and Forestry (Tarım ve Orman Bakanlığı) changed its name over years (ex Ministry of Agriculture and Rural Affairs (Tarım ve Köyişleri Bakanlığı), ex Ministry of Agriculture, Food and Livestock (Gida Tarim ve Hayvancilik Bakanliği). The corresponding names of the Ministry are used when reference is made to specific actions/policies during certain periods, while its current name is used in discussions referring to the present situation.

Wheat is generally traded freely in local markets, ultimately entering national supply chains via traders and the Commodity Exchange Board. However, in its effort to stabilize market prices and to maintain strategic grain reserves, TMO purchases wheat at varying quantities and prices, based on levels of production and reserve inventories. TMO's purchase decisions often determine the price levels as traders always watch its interventions. TMO continues to play a major role in the stabilization of domestic wheat prices, especially in major wheat producing areas. Annually, TMO purchases wheat and other grains when it determines that domestic production is high and market prices are too low, when strategic reserves are depleted, or in response to world market/international trade conditions. TMO's interventions are also aimed at stabilizing seasonal variation in prices by buying grain during the harvest season and selling it during the rest of the year, when there is shortage of wheat and prices start to hike in the market. This leads to large annual variations in the quantity of wheat TMO purchases and the price it pays (see Figure 1.5 and Annex 1).

Turkey is one of the few countries in the region where a grading system exists, and wheat grain with desirable quality attributes fetches premium prices, and a price penalty is applied to substandard quality wheat. TMO sets varying price levels for different classes/grades of bread and durum wheat based on the variety and quality characteristics (purity, moisture, protein and gluten contents), which provide incentives for farmers to produce higher quality wheat.

In 2015, TMO had a total storage capacity of 4.5 million tons (3.2 million are ventilated), of which 546,700 tons were located in ports (Köksel and Cetiner, 2015). Since 2007/8, the Turkish Government has been encouraging the expansion of storage capacity in the country through a law that provides subsidies for the construction of private storage facilities (MARA, 2005). This led to the introduction of a new storage and marketing system where farmers keep their produce in licensed storage service providers for a fee. Farmers determine the time of sales, and the storage service provider is responsible for delivering the desired amount of grain (total or partial) to the grain board. There is mixed evidence on whether the involvement of TMO in wheat grain purchases encourages wheat production. Some anecdotal evidence suggests that TMO's price-setting mechanisms encouraged the uptake of certain varieties and better production practices (Çetınkara, 2012; Özçelik and Özer, 2006; Tatlıdil, Dellal and Bayramoğlu, 2013). Prices are announced around harvest time, rather than before planting or even during the growing season (OECD, 2011). Therefore, while historical pricing trends could potentially be indicative of the prices different varieties and quality standards will fetch, the impact of current year prices on varietal choice and management practices is certainly limited, as decisions have been already made before the prices are announced.

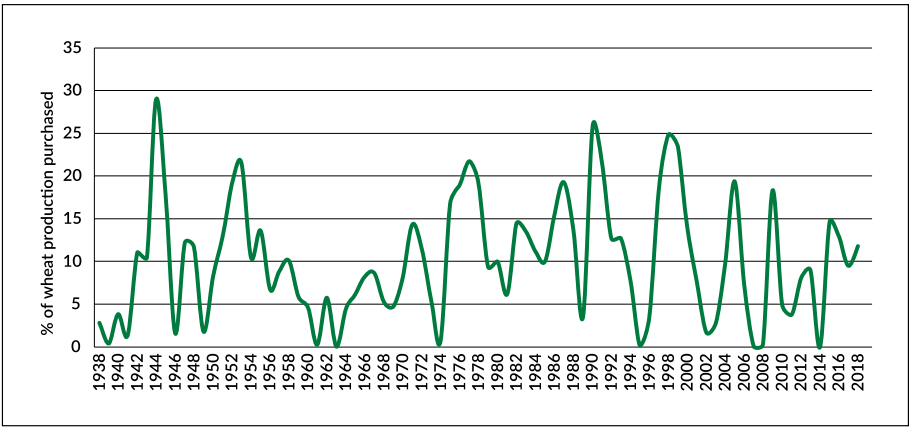

Figure 1.5: Proportion of domestic wheat production purchased by TMO

Source: TMO (2019)

The flour industry is particularly important in Turkey. According to the Turkish Flour Manufacturers Federation (Türkiye Un Sanayicileri Federasyonu, TUSAF), there were approximately 329 flour factories producing over 11 million tons of flour (of different crops) in 2017 (TÜİK, 2017). These factories are spread across almost all provinces, with concentration in the Central Anatolia, Black Sea, and Marmara regions. In 2020, official statistics reported that there are 291 bread wheat and 17 durum wheat flour producing enterprises with a total production of 9.4 million tons of bread wheat flour and 499,000 tons of durum wheat flour (semolina) (TÜİK, 2021b).

In 2019, although Turkey ranked eleventh in total wheat production, it is the number one wheat flour and bourghul/bulgur exporting country globally, with a total export of over 3.34 million tons (FAOSTAT, 2020; TMO, 2017). Turkey is also a major producer of pasta and related products, with a total production volume of over 2 million tons in 2020 (Figure 1.6).

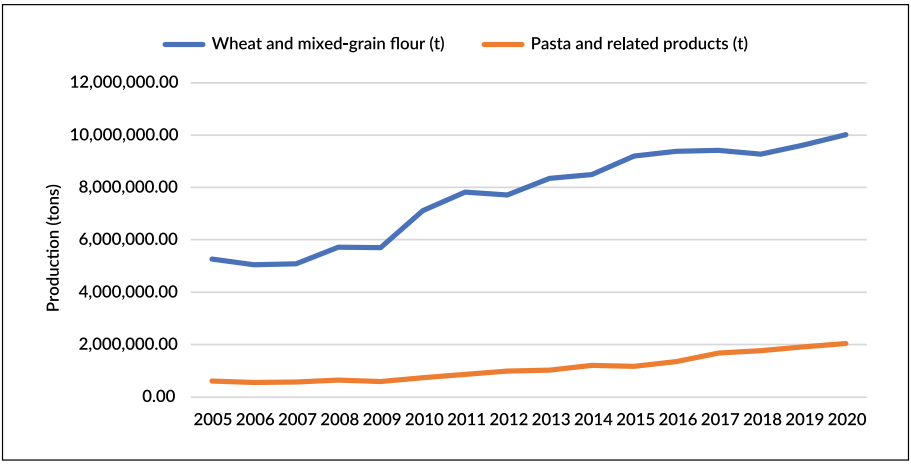

Figure 1.6: Pasta and flour production (tons) in Turkey: 2005–2020
Source: TÜİK (2021b)

Flour, biscuit and pasta producers have clear preferences for certain wheat varieties (Küçükçongar et al., 2006). Varietal preferences are mainly based on nutritional quality, purity (absence of foreign matter), sunn pest damage, and hectolitre mass (Küçükçongar et al., 2009). Along with transmission of market signals through traders to farmers, the downstream demands for wheat with specific traits by flour millers plays a crucial role in driving farmer uptake of certain varieties, as well as encouraging breeders to develop varieties that meet farmer and miller preferences. Another recent trend in Turkey, as elsewhere, is the rise of alternative food networks in which different product traits and production conditions are favored by consumers. This includes the growing appeal of landrace varieties, such as those named Siyez, Karakılçık, Kavılca and İza, particularly among middle-class consumers in large cities (Nizam and Yenal, 2020). While these alternative food networks remain marginal, they may signal important new dynamics in the wheat grain sector.

As indicated in Figure 1.4 above, about 75-80% of total domestic wheat production is used for processing, (including 65-68% for food and 15-12% for feed purposes). About 6-7% is used for home consumption, including saved seed. Postharvest losses in the wheat supply chain are generally low (Figure 1.7 and Annex 2). Losses occur due to transport, loading and unloading, during processing and poor storage. Bread wastage during consumption is also estimated at about 5% (Tatlıdil, Dellal and Bayramoğlu, 2013). The large majority (62%) of bread loss is reported to occur at bakeries, followed by households during consumption (28%).

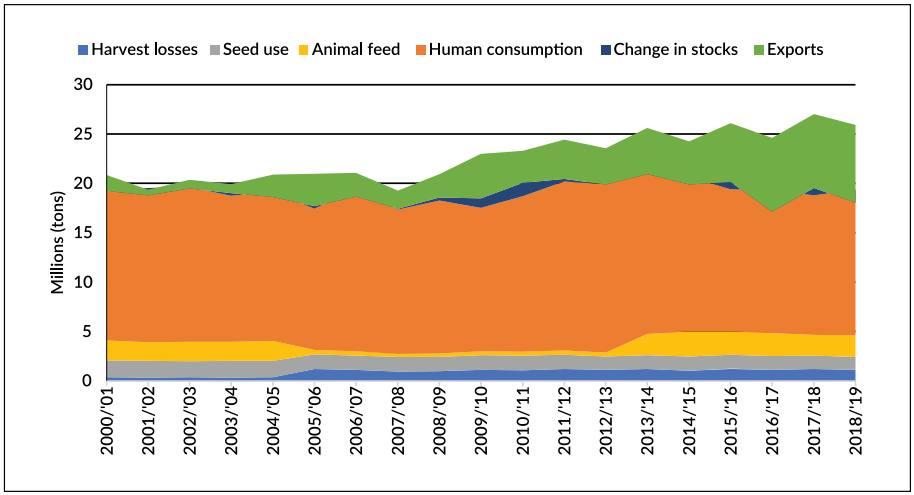

Figure 1.7: Wheat utilization and losses in Turkey

Source: TÜİK (2021a)

Aggregation of wheat produce from smallholder farmers compromises the quality standards for industrial use. Different farmers may use different varieties and different agronomic practices, which can affect the protein content and other attributes of the grain that is produced. Poor conditions of on farm storage facilities might also lead to the deterioration of grain quality in some farmers. Therefore, standardization of agronomic practices, varietal choices, and provision of logistics and infrastructure for aggregation, storage and transport is desirable to maintain the grain quality.

Foreign trade

Historically, there have been inherent fluctuations in both imports and exports of wheat and wheat products. Since the mid-2000s however, the fluctuations have decreased with the general trend showing slight but steady increases. Under normal circumstances, the high import duties in Turkey on wheat imports provide some protection to domestic production. However, during drought years, the government authorizes tariff-free wheat imports to meet domestic consumption and demand for wheat flour exports, thereby leading to increases in wheat grain imports (Tatlıdil, Dellal and Bayramoğlu, 2013). For example, following the 2007/8 drought, Turkey imported 800,000 tons of wheat in 2008 (Aydin, 2010). Figure 1.8 shows the contribution of domestic production, exports and imports to the total wheat supply in Turkey.

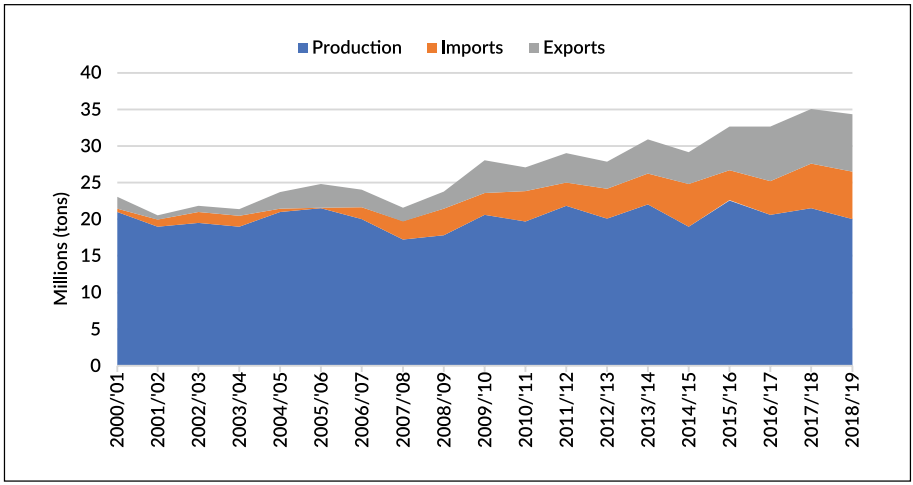

Figure 1.8: Wheat grain supply and demand in Turkey

Source: TÜİK (2021a)

In 2016, Turkey exported 3.5 million tons of wheat flour. According to TUSAF (2017) these exports went predominantly to Iraq (1.4 million tons), Sudan (596,000 tons) and Syria (384,000 tons). The volume and destination of exports also remained more or less the same in 2019. Although wheat flour is predominantly exported by the private sector, the public sector is also involved to some extent (through TMO) in wheat import and export, especially in periods when there is large deficit/surplus in domestic wheat production. TMO also takes other measures in order to regulate the domestic market (Mazid et al., 2009; TMO, 2017).

Generally, the government encourages value addition in the wheat value chain. For instance, processed wheat products (biscuits and pasta) enjoyed considerable export subsidies estimated to be between US$66 and 119 ton-1 in 2010 (OECD, 2011; Official Gazette, 2010). However, these subsidies have been paid in Turkish lira (TRY) instead of US$ (Official Gazette, 2013). Due to the depreciation of the value of TRY, the value of support for export decreased over the years, reaching between US$31 and 56 ton-1 paid in the TRY equivalent in 2018 (Official Gazette, 2018). Although Turkey entered a customs union with the EU in 1996, this excluded agricultural products. Since then, only some products, including processed agricultural products, are entitled to preferential access to the EU market (OECD, 2011; EU, 1995) as per Decision No 1/95 of the European Ccommunity-Turkey Association Council.

Institutions

The configuration of the national research and seed production program in Turkey shows the involvement of different institutions and the arrangements that exist in country. Figure 1.9 provides the structure of the public institutions involved in the

Turkish Seed Sector and summarizes the main delegations of responsibilities as of November 2018.

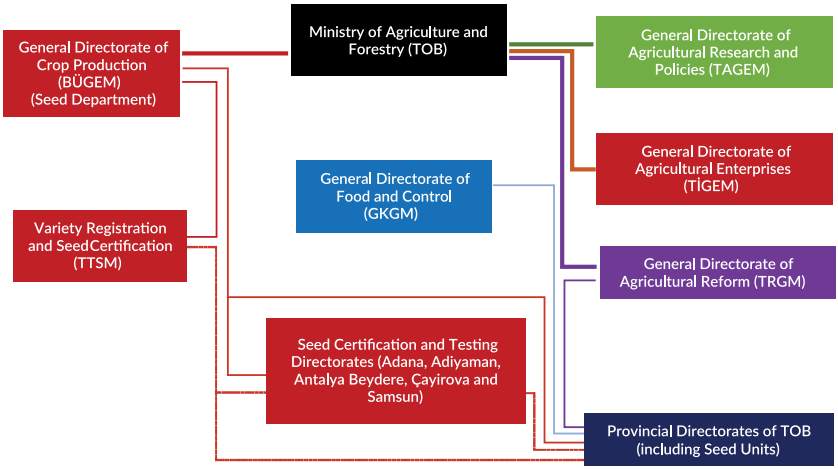

Figure 1.9: The organizational structure of the seed sector in Turkey

TOB is the primary government institution for overseeing the agricultural sector in Turkey. While TOB is responsible for the production, marketing and policy aspects, the Ministries of Finance and Trade are also involved in enhancing domestic production and exports through different mechanisms, including subsidies. TOB's predecessor, the Ministry of Agricultural Rural Affairs (MARA), underwent a major reorganization in 2011 with a broad remit to: (i) conduct agricultural research; (ii) improve plant and animal production; (iii) coordinate rural development; (iv) protect natural resources and the environment; (v) manage agricultural support; (vi) regulate markets; and (vii) develop policies (Karabina, 2015). TOB is also supported with a country-wide network of 81 Provincial Directorates and 887 District Directorates.

The main crop production-related directorates of TOB are:

- General Directorate of Agricultural Research and Policies (Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü, TAGEM)
- General Directorate of Agricultural Enterprises (Tarım İşletmeleri Genel Müdürlügü, TİGEM), which is a quasi-public institution
- General Directorate of Plant Production (Bitkisel Üretim Genel Müdürlüğü, BÜGEM)
- General Directorate of Food and Control (Gida ve Kontrol Genel Müdürlüğü, GKGM), and
- General Directorate of Agricultural Reform (Tarım Reformu Genel Müdürlüğü, TRGM)

TAGEM, established in 1975, is responsible for plant breeding and variety development. It operates a network of 49 agricultural research institutions (12 involved in wheat breeding), which conduct research in different agro-ecologies and regions of the country.

TİGEM, established in 1951, plays a major role in cereal seed production, functioning as a state enterprise during the 20th century. It has played a significant role in coordinating, producing, and distributing cereal seed, particularly wheat and barley. TİGEM continues to play a major role today, producing and distributing the majority of publicly produced wheat seed (TİGEM, 2016; Aydin, 2010), although it has relinquished its role of national coordination of seed production and marketing to farmers, agricultural cooperatives, and the private sector as part of the free market reorientation of the sector.

TRGM coordinates the distribution of seed support and coordinates and manages databases and software associated with the seed support program, including the Farmer Registration System, known locally as Çiftçi Kayıt Sistemi (CKS).

GKGM is responsible for plant protection and agricultural quarantine and controls, auditing of plant health and biosafety issues.

BÜGEM, through its Seed Department, is responsible for formulating and implementing seed policy and legislation, formulating support and incentives to the seed sector, issuing permits for seed import and export, and carrying out market audits. It is also responsible for variety registration, variety protection and seed certification through its affiliated directorates. It encompasses various public entities such as the Variety Registration and Seed Certification Centre (Tohumluk Tescil ve Sertifikasyon Merkez Müdürlüğü, TTSM), seed certification and testing directorates (at Adana, Adiyaman, Antalya, Beydere, Çayirova, Edremit, Karacabey and Samsun), and seed units under branch directorates for plant production and plant health, which are under provincial directorates.

TOB has 81 provincial directorates. Since 2018, each of these has nine branch directorates for agricultural issues, which are under the management of the provincial director of TOB. One of these nine branches is the directorate for plant production and plant health, which works in very close coordination and collaboration with BÜGEM and GKGM. They mostly receive technical directives, decrees, etc. about the seed sector from BÜGEM and GKGM. Seed units are officially under this branch of the provincial directorates. However, staff of seed units are regularly trained and supervised by BÜGEM and GKGM for seed issues.

TTSM was established in 1959 as the Seed Control and Certification Institute (Tohumluk Kontrol ve Sertifikasyon Enstitüsü). It underwent several reorganizations and name changes and finally was merged with the Regional Variety Testing Directorate to become TTSM in 1987. TTSM is the most important agency related to seed, with responsibilities for overseeing variety registration, including distinctness, uniformity and stability (DUS) and value for cultivation and use (VCU) trials, plant variety protection,

maintenance of variety reference collections and seed certification (field inspection, seed testing, control plots). TTSM also has overall responsibility for developing policies and regulatory frameworks, standards, procedures and international agreements (see chapter on Seed Quality Assurance and Certification). TTSM is also a national focal agency for international cooperation with OECD on varietal certification, ISTA on seed testing and UPOV on plant breeders' rights. It also organizes trainings on the above subjects for public and private seed sector employees. TTSM has one variety testing station and eight regional seed testing laboratories spread across the country (GTHB, 2016; Bozkurt and Engiz, 2001). In 2001, TTSM's central seed testing laboratory in Ankara was accredited by ISTA and remains the only accredited laboratory for seed in Turkey.

The regional seed certification directorates, which work in close cooperation with TTSM, are administratively affiliated to BÜGEM and are responsible for executing variety registration trials (testing and reference collection and maintenance), and regional seed certification services (field inspection, seed testing and control plots). The seed units under the provincial directorates that are supervised by BÜGEM and GKGM are also responsible for field inspection, seed sampling, nursery inspection, testing the samples, and seed marketing control. However, the certificate is issued by TTSM, not by the seed units.

TOB also provides public extension services with a major focus on increasing productivity and hence, production, cost reduction and grain quality improvements (Boyacı and Yıldız, 2016). The same study argued that extension services tended to be predominantly 'top down', lacking adequate farmer participation in the formulation of priorities and extension messages – thereby limiting the number of farmers (43%) taking up the advice of extension agents.

The legislative reforms in the mid-2000s created many new provisions allowing TOB to delegate its functions, including to private enterprises. For example, the 2006 Seed Law allows TOB to delegate many of its roles in overseeing seed production, certification and trade. The same law also allows private research institutions to be registered with BÜGEM and carry out breeding activities. These legislative provisions entail a high degree of flexibility in the institutional restructuring of agriculture in Turkey. However, it also raises concerns about institutional complexity and uncertainty, and the private sector's role and influence. Specific delegations relating to seed and some of their impacts are discussed in more detail below.

Incentives for the wheat sector

The Government of Turkey and various international institutions provide support for the agricultural sector, some of which have been under continuous reform. Turkey has introduced changes leading to relatively higher support for agriculture in comparison to other EU and OECD countries (Arisoy and Eraktan, 2011; OECD, 2017). From the perspective of international institutions, such as the OECD and the World Trade Organization (WTO), Turkey's system of financial support is unnecessarily distortionary.

While the EU's Common Agricultural Policy has moved away from production-linked payments, these have increased in Turkey – leading to a higher degree of market distortions (OECD, 2016). Despite a slight reduction in price distortions since the late 1990s, domestic prices of wheat remained on average 31% above world prices in 2014-16 (OECD, 2017).

In the context of the WTO's Agreement on Agriculture and the World Bank's ARIP, Turkey experimented with a 'direct income support' system in the early 2000s. This system was intended to replace distortionary subsidies and price supports for all crops with a flat subsidy for all farmers, where each farmer is entitled to a subsidy for up to a maximum of 50 ha. The system faced difficulties in implementation due to insufficient infrastructure and was eventually abandoned after running from 2001 to 2008 (Aydin, 2010). However, input subsidies and output price supports have continued to date.

To be eligible for subsidies, farmers must be registered in the CKS, which was introduced in 2002 as part of ARIP (OECD, 2011). By 2016, a total of 2,267,176 farmers cultivating 14.8 million hectares were registered in the system. The corresponding figures for 2020 were 2,110,962 farmers cultivating 15.05 million hectares. An estimated 300,000 smallholder farmers (with <1 ha area each) are said to not be in the database. Approximately 8.9 million hectares (38%) of the total farmland were unregistered (Akyıl, 2017; BÜGEM, 2018). In practice, the CKS either records the owner of the land or the leaseholder, and subsidies accrue to the person registered. This has repercussions for the pricing of leases, which also means those with informal land access arrangements are unable to obtain subsidies.

For some crops, including wheat, a production subsidy called a 'premium' or 'deficiency' payment was introduced in 2005. Since 2010, these payments have been based on an agroecology-based crop support model. This model aims to align subsidies for specific crops with geographical areas ('basins') where those crops are considered most ecologically suitable. This model has been refined considerably with the National Agriculture Project (known locally as Milli Tarım Projesi [MTP]) introduced in 2017. The objectives of the project are to increase productivity, diversify production, and improve water management in drought-prone areas. The number of basins has been increased to 941, based on soil and climatic factors, and within each basin, only certain crops are eligible to receive premium payments. Only wheat and forage crops will be eligible for subsidies in all basins. However, wheat and barley subsidies are among the lowest (GTHB, 2017) and, in 2017, the premium for wheat was 50 TRY/ton. MTP is also expected to change the premium from an output-based to an area-based subsidy (although 2017 rates were output-based). Basin-specific crop lists are also expected to determine the purchasing decisions of TMO. Because of the potentially significant impact on farmers' incomes, the crop lists have been subjected to lobbying pressure (Karabina and Duyum, 2016; OECD, 2017; Kan et al., 2015; GTHB, 2017).

Fertilizer subsidies were introduced in 1986, phased out between 1997 and 2001, and re-introduced in 2005. In 2016, the fertilizer subsidy was merged with the diesel subsidy (in place since 2003). The combined diesel and fertilizer subsidy were TRY110

ha-1 (~ US$30 ha-1, at an exchange rate of US$1 = TRY 3.64 in 2017). New subsidies have also been introduced in 2016/17 for young and smallholder farmers with a less than 0.5 ha holding (OECD, 2017). The Turkish Government also encourages farmers to rationalize fertilizer usage by providing them with subsidies for soil analysis. In addition, as stated earlier, TMO often purchases wheat at above market prices, constituting an important form of support for wheat farmers.

The Turkish Government also provides support for the production and use of certified seed (Table 1.1). Since 2005, farmers have received a subsidy for certified seed use, which, in 2017 was TRY 85 ha-1 (~ US$23 ha-1). A subsidy for seed production was originally introduced in 1985, but subsequently removed (Prey, 1997). Since 2008, certified seed producing companies have received subsidies based on quantity of production, which in 2017 was TRY 100/ton (~US$27 ton-1). Additional incentives for seed companies include support for infrastructure development, discounted credit (available through the Agricultural Bank – Ziraat Bankası – and cooperatives), subsidized insurance and export subsidies. Seed growers and seed companies also benefit from general financial support applicable to all farmers for regions experiencing drought, environmental protection, organic agriculture, biological pesticides and regional and rural development initiatives, such as the Southeast Anatolian Project (Güneydoğu Anadolu Projesi).

Table 1.1: Support for domestic production and use of certified seed

Domestic certified seed production (ton-1)					***Domestic certified seed use (ha-1)***				
Crop	2017		2018		Crop	2017		2018	
	TRY	US$*	TRY	US$*		TRY	US$*	TRY	US$*
Wheat, potatoes	100	27	100	21	Wheat, barley	85	23	85	18
Barley, oat, rye triticale	80	22	80	17	Oat, rye, triticale	60	16	60	12
Rice	250	69	250	52	Rice	80	22	80	17
Bean, chickpea, lentil, safflower	500	137	500	104	Bean, chickpea, lentil, soybean	200	55	200	42
Peanut	800	220	800	166	Potatoes	800	220	800	166
Soybean	350	96	350	73	Peanut	150	41	150	31
Canola	1,200	330	1,200	249	Canola, safflower, sesame	40	11	40	8
Sesame	600	165	600	125					
Alfalfa	2,000	549	4,000	832	Alfalfa	150	41	300	62
Fodder peas, sainfoin, vetch,	750	206	1,500	312	Fodder peas, sainfoin, vetch	100	27	200	42
Pre-basic, basic seed and higher classes	100% additional support		100% additional support						

Source: TOB, 2018

*Note: *Average exchange rate for 2017 = 3,64 US$/TRY and for 2018 = 4,81 US$/TRY*

To increase the production and use of certified seeds, The government introduced discounted interest rates on investment and operational loans in 2004, which continue to be updated every year through decrees. Although the purpose and magnitude of discounts of loans exhibits annual changes, the discount rates generally range between 40% and 100% (which means zero interest rate). For example, in 2017 and 2018, the discount rate was 100% for investment and operational loans for seed production, with an upper credit limit of TRY 10 million for seed companies. However, in 2017, for certified seed use by farmers, the discount rate was 50% for both investment and operational costs, and the upper limit was TRY 1 million. In 2018, the discount rate in seed use was 100% for loans of up to TRY 100,000, while it was 50% for loan sizes between 100,001 and the upper limit of TRY 5 million. The interest rates of credits provided by Ziraat Bankasi (the Agricultural Bank) for seed production and use in 2018 were 8% and 11%, respectively. According to the decree issued in 2020, for the 3-year period between 2020 to 2022, the interest rate discount for investment and operational loans is 100% and the upper limit for credit is TRY 20 million for seed producing companies. However, for certified seed users, the discounted interest rate is 20% with a limit of TRY 2.5 million, but the discount rate can be 100% for investment and operational credit worth less than TRY 50,000. Figure 1.10 shows the evolution of wheat subsidies in Turkey.

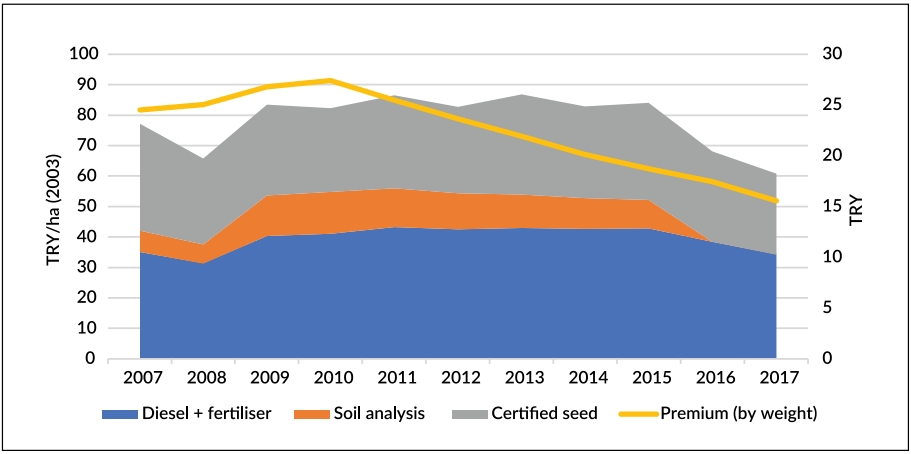

Figure 1.10: Evolution of farm subsidies for wheat production in Turkey (constant 2003 prices)

Source: GTHB (2017)

Other policy directions

The prospect of accession into the EU has been a major driver of agricultural policy since the 1970s. In 2000, Turkey signed an Accession Partnership Agreement which introduced various reforms and led the way to IPARD. In line with EU planning and budgetary cycles, the first IPARD program ran from 2007 to 2013 and was underpinned by the first National Rural Development Strategy (Ulusal Kırsal Kalkınma Stratejisi). A second strategy was in place, running from 2014 to 2020, with the following strategic objectives:

- Enhancing the rural economy and employment opportunities
- Improving the rural environment and ensuring the sustainability of natural resources
- Improving the social and physical infrastructure of rural settlements
- Developing human resources for rural society and reducing poverty, and
- Developing institutional capacity for local development.

If and when EU accession becomes a reality, it will create greater access for Turkish wheat grain and seed to the EU market for exports, while it may not have additional risk for competition in the domestic market because Turkey has already opened its market to the EU. Participation in the Common Agricultural Policy, however, would entail lower support for farmers in Turkey, given the relatively high support under current national policy.

Turkey's Eleventh Development Plan (2019-2023) signals a continued policy priority for agriculture. Along with ongoing land consolidation (mentioned above), the Plan emphasizes an increase in irrigated areas, more support for agricultural added value, and specific goals to increase production of red meat, oil seed, and medical and aromatic plants. With respect to seed production, the Plan indicates ongoing cooperation with the private sector to increase certified seed production areas, produce elite seed, and continue developing new varieties. The Plan also mentions a specific focus on landraces and local animal breeds.

The Turkish Government previously aimed to increase seed production across all crops to 1 million tons by 2023; to export more seed than it imports, and to export seed-related technologies such as seed treatment and high-class seed with high value (GTHB, 2016). In 2016, however, total certified seed production for all crops had already reached 957,925 tons, out of which, 485,225 tons (51%) was wheat. TÜRKTOB has previously set a goal to increase certified seed production of all crops to 1.5 million tons by 2023 (TÜRKTOB, 2017). It seems likely that this will be met, as production of seed reached 1.24 million tons in 2020. TÜRKTOB is now aiming to increase Turkey's ranking in the international trade of seed (TÜRKTOB, 2021). The Ministry of Food, Agriculture and Livestock's (known locally as Gida Tarim ve Hayvancilik Bakanliği [GTHB]) Strategic Plan for 2018-2022 also aims to increase certified seed production, although this is not quantified.

The Wheat Seed Sector

Alongside the wheat grain sector, the formal wheat seed sector plays an increasingly important role in wheat production in Turkey. Figure 1.11 below, adapted from the National Seed Strategy Report (TSÜAB 2017a), depicts the linkage between the seed and grain value chains for wheat.

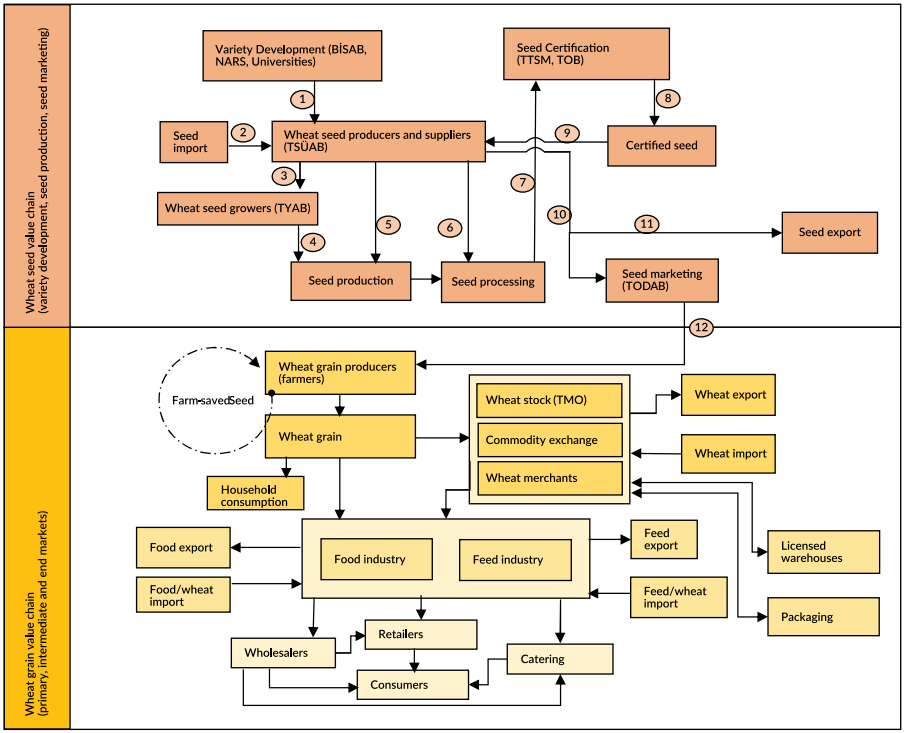

Figure 1.11: The wheat seed and grain value chain in Turkey

Source: Adapted from TÜRKTOB (2021), TİGEM (2016), TSÜAB (2017a), TMO (2017) and (2021)

Historical development

Historically, the development of the organized seed sector went through four major phases: phase 1 (1925-1950); phase 2 (1951-1980); phase 3 (1981-2004); and phase 4 (2004 and beyond). In the 1930s, two key public institutions were established, namely: regional agricultural research institutes responsible for crop improvement (particularly of cereals), and state farms (Devlet Uretme Ciftlikleri) responsible for the production and distribution of seeds for new varieties developed by the research institutes. During phase 1, seed production was limited only to a few crops i.e. wheat, barley and sugar beet; the amount of seed produced and distributed during this period was not significant.

In the second phase, many public seed programs were launched for major crops such as maize and sunflower (1960); cotton (1965); potato, vegetables, forages and rice (1970); pulses (1975); and finally, soybean (1980). The seed programs of cotton, sugar beet, wheat, and barley to a certain extent, had comparatively satisfactory achievements. Nevertheless, due to shortages in supply, some of these seed programs,

especially vegetables, were less successful because uncertified and uncontrolled seed sales were common. Until the mid-1980s, the production and marketing of improved seed for all field crops and many vegetables in Turkey was virtually under the control of public sector.

The third phase of the seed sector lasted from the early 1980s to 2004, when the government adopted a free market economic policy and various regulatory, structural, and institutional changes came one after the other. These reforms, over time, affected the agricultural sector in general and the seed sector in particular. As a result, the national seed sector was transformed with remarkable progress. The government considers the private sector as a fully-fledged partner, with investment in plant breeding, infrastructure development and technology transfer. This economic liberalization paved the way for major investments from both foreign and domestic private seed companies. During this period however, certified seed production never reached more than 10% of annual seed requirements.

In phase four, with the introduction and enforcement of the Plant Breeder's Rights Law 5042 (2004) and Seed Law 5553 (2006), and subsidiary regulations addressing the seed sector, the private seed sector's activities increased steadily, and the structure of the national seed industry changed dramatically. Today, private companies are primarily the suppliers of seed of vegetables and field crops, although their involvement in seed production for other crops continues to grow. By 2020, private companies were producing 70% of Turkey's certified wheat seed supply, meeting over 30% of annual seed requirements. However, the government still maintains an important role in the supply of early generation seed for crops where the public sector plays an important role in variety development.

Institutional arrangements

As discussed above, TOB has two general directorates responsible for agricultural research and development (R&D), both of which play key roles in the wheat seed sector. TAGEM is responsible for agricultural research and the generation of new technologies, while BÜGEM is responsible for variety registration and seed certification. The institutional framework governing variety development and registration has evolved over a long period of time.

During the second phase, the National Seed Advisory Group (NSAG) guided much seed policy since its establishment in 1951, until the late 1970s. NSAG had a very large membership, including about 100 representatives mainly from various general directorates, divisions and sections of TOB's predecessor, MARA, as well as other public agricultural organizations and a few private sector representatives. NSAG was supported by crop specific sub-committees which were responsible for coordinating and controlling seed related activities of the organizations implementing formal seed programs. NSAG annually reviewed the seed supply and made recommendations to MARA regarding varieties to be promoted and produced; the seed production plan; allocation of production targets among various agencies; regional seed quotas; credit

requirements; and seed import needs. The group made its recommendations to MARA for approval and enforcement. Decisions that involved more than one Ministry were referred to a high-level inter-ministerial coordination group (Uyanık, 2008; Uyanik and Bishaw, 2008).

During the third phase, a Seed Consultative Committee of five member institutions or organizations, each represented by at least one person, convened by MARA with members from its general directorates, the State Planning Organization, farmers' representatives, the Union of Chambers of Agriculture, and the Turkish Seed Industry Association was responsible for overall policy advice and guidance. The seed department of the general directorate of agricultural production and development was responsible for implementing national seed policy on behalf of MARA. The department was responsible for:

- Developing policies and incentives for the seed sector
- Implementing legal arrangements to support the seed sector
- Preparing national seed production and distribution plans
- Issuing required permits for seed import and export
- Ensuring cooperation between public and private sectors
- Participating in the Variety Registration Committee.

These functions are now carried out by the seed department of BÜGEM, in cooperation with TÜRKTOB and its sub-unions and the universities (Figure 1.12).

At the beginning of the third phase, the reforms of the seed sector and the emergence and establishment of private seed companies led to the formation, in 1985, of the Turkish Seed Industry Association (locally known as Türkiye Tohumculuk Endüstrisi Derneği, TÜRK-TED). TÜRK-TED is an association of private seed companies established as a non-governmental organization under Law No. 2908. The Association was formed to contribute to the development of the national seed sector and economy, and to realize the following objectives:

- Coordinate its members to protect their rights and promote their interests
- Maintain domestic and foreign relations of the members involved in the seed sector
- Promote understanding among public institutions and members of the Association
- Organize tours, meetings and conferences to raise awareness of its members and enhance knowledge sharing, and
- Collect and provide statistical data on variety, seed production, quality control, trade, etc. to its members.

TÜRK-TED has historically been quite influential, representing a large proportion of the seed industry and working closely with GTHB (Bozkurt and Engiz, 2001). Currently, the seed sector in Turkey is organized into seven sub-unions. According to the Seed Law No 5553 of 2006, all individuals and organizations involved in the seed industry must be members of at least one union and/or sub-union (TOB, 2006). The Turkish Seed Union (Türkiye Tohumcular Birliği, TÜRKTOB), legally registered in 2008, is the umbrella

organization that oversees the seven sub-unions (Figure 1.12), and is a member of the Asia Pacific Seed Association and the Economic Cooperation Organization Seed Association. TOB retains the right to supervise and control the financial and administrative activities of TÜRKTOB as per the mandate of Seed Law No 5553. While TÜRK-TED continues to operate with a membership of 44 seed companies, it has relinquished some of its role and influence on the sub-unions.

The seven sub-unions and two NGOs are:

1. Plant Breeders Sub-Union (Bitki Islahçıları Alt Birliği, BİSAB)
2. Seed Industrialists and Producers Sub-Union (Tohum Sanayicileri ve Üreticileri Alt Birliği, TSÜAB)
3. Sapling Producers Sub-Union (Fidan Üreticileri Alt Birliği, FÜAB)
4. Seedling Producers Sub-Union (Fide Üreticileri Alt Birliği, FİDEBİRLİK)
5. Ornamental Plant Producers Sub-Union (Süs Bitkileri Üreticileri Alt Birliği, SÜSBİR)
6. Seed Growers Sub-Union (Tohum Yetiştiricileri Alt Birliği, TYAB)
7. Seed Distributors Sub-Union (Tohum Dağıtıcıları Alt Birliği, TODAB)
8. Turkish Seed Industry Association (Türkiye Tohumculuk Endüstrisi Derneği, TÜRK-TED)
9. Turkish Plant Breeders Association (Türkiye Bitki Islahçıları Derneği, TÜBID)

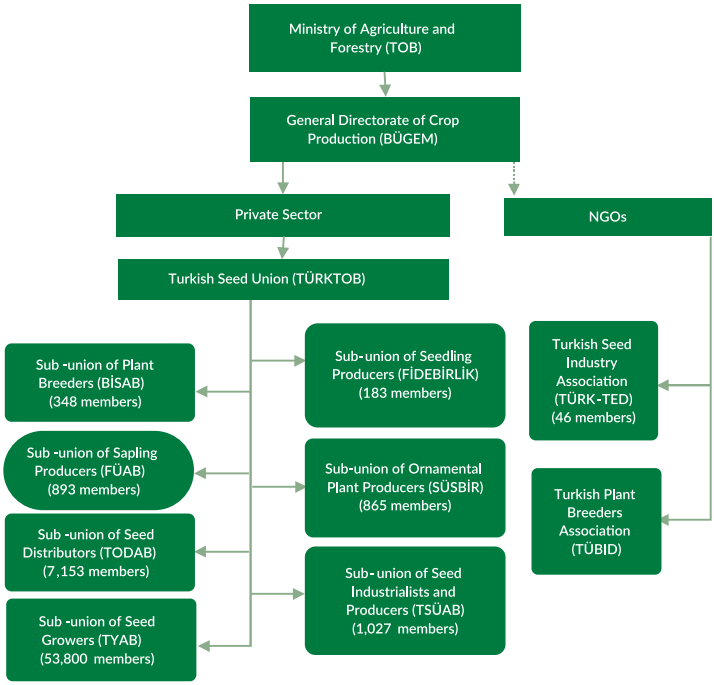

Figure 1.12: Organizational structure of seed unions in Turkey

Source: TÜRKTOB (2021a)

Note: Numbers in brackets are members of sub-unions (as of August 2021) and associations (September 2021)

An individual person or organization may be a member of more than one union. Members must pay a membership registration fee, annual fee, and commission of 0.1% of gross sales to the union through its sub-union(s). The sub-unions have broad functions, including facilitating communication and cooperation amongst members, undertaking research and investment to improve their sector, organizing training programs for their members, and providing advice to TÜRKTOB on policy matters. Both TÜRKTOB and the sub-unions are treated as cooperatives for tax purposes and are as such tax exempt.

An increasingly important feature of the seed sector's institutional structure is the Seed Data Management System (Tohumluk Veri Yonetim Sistemi [TVYS]). The system was introduced as part of a project to increase the seed sector's alignment with that of the EU and has been in active use since 2011. With the involvement of multiple departments in TOB, as well as several sub-unions and other stakeholders, the TVYS aims to streamline many aspects of variety registration and seed certification while providing data for monitoring the sector. While still being developed, it is becoming more important in implementing seed certification policies, including subsidies for production and use.

Seed policies and regulatory frameworks

To set up a legal framework for domestic seed production and marketing, Turkey put into practice its first Seed Certification Directive in 1956. This was further developed into a Seed Control and Certification Directive in 1961. The first basic Seed Law (Law No. 308 of 21 August 1963) was passed, and it remained in force until 2006. This law gave MARA specific responsibilities such as variety registration, seed certification and marketing control, and issuing the regulation and control of seed import and/or export. The national seed industry operated within the framework of Seed Law No. 308 and its amendment (Seed Registration, Control and Certification No. 3976 of 21 February 1994). The former dealt with regulations for variety registration, seed quality control and certification, whereas the latter amends some of the articles of the former according to relevant regulations.

Throughout the 1960s and 70s, Turkey's main economic development strategy was based on import substitution. In parallel with the general economic programs of the time, the seed policies were inward looking, aimed at meeting national demand through domestic seed production.

During the second and third phases, MARA encouraged an increase in domestic seed supply (from local production and imports) and its wider use by farmers. To this effect, MARA put in place several policy and regulatory reforms. For example, during 1985-1990, rapid growth in the seed sector was achieved because the Government of Turkey adopted several policy measures which included: (i) abolishing the state monopoly on seed and creating opportunities for the private sector; (ii) establishing the necessary infrastructure for seed production and marketing; (iii) liberalizing procedures and prices for seed import and export; (iv) providing low interest credit for investments

in the seed sector; and (v) encouraging foreign investments in the seed sector. Kutay (1997, p. 49) characterized the third phase of seed sector reforms as follows: "The Turkish government has taken a series of steps to improve private sector research and development, and public organizations are gradually being withdrawn from seed supply activities. However, the private sector still faces a number of constraints—difficulties in production, cumbersome variety registration and seed certification procedures, lack of effective plant breeders' rights, unrealistic government pricing, frequent changes in export and import regulations, excessive quarantine regulations and mandatory laboratory tests, and high value-added tax on seed".

In Turkey, the liberalization of the seed sector started in 1982 (Pray, 1997). The government did not have a specific national seed policy but enacted several laws and regulations and endorsed several decrees and directives to support and strengthen the performance of the seed sector. These included (Bozkurt and Engiz, 2001):

- Capital transfer (1982): The establishment of private seed enterprises and transfer of capital are encouraged through a decree prepared by the State Planning Organization
- Seed price liberalization (1983): The seed price both in public and private sector has been liberalized based on free competition and market forces
- Seed imports (1984): Guidelines for import were established, and the private sector were allowed to import seed that could not be produced locally
- Seed sector support program (1985):
    - Credit: Private companies were granted credits with low interest rates from state banks
    - Subsidy: Provision of a subsidy for certified seed production depending on the crop species
    - Seed exports (1986): Aligning seed certification with OECD schemes and EU standards to promote seed export
    - Tax exemption (1988): The government introduced a tax exemption to lower the price of imported seed

The series of measures listed above have had a significant impact on the Turkish seed sector, including increased private sector participation, increased used of certified seed, increased number of varieties released, and entry of multinational seed companies into Turkey, which has positive effect in terms of technology transfer and capacity building in seed processing. However, these regulations were not considered enough by the government and stakeholders in terms of institutionalizing and organizing the seed sector.

The 2000s saw new policies and regulations for the seed sector and seed businesses helping to boost the role of the private sector to higher levels. In 2004, the Law on Protection of Breeder's Rights of New Plant Varieties (Law No. 5042) came into force and Turkey became a member of UPOV in 2007. New Seed Law No. 5553, which replaced Seed Law No. 308, came into effect in 2006. The Biosafety Law No. 5977 of 2010 controls the research on genetically modified organisms (GMOs) and products. These new laws have provided new rights and stronger legislative infrastructure addressing

the problems of the private sector (TAGEM, 2018). To support the implementation of these new policies, the government has also introduced several regulations. Some of those relevant to wheat, and which were in force at the time of the publication of this book, include: (for a full list, see Annex 3)

- Regulation on Registration of Plant Varieties (2008)
- Regulation on Specific Requirements for Seed Production Areas and Principles Applied (2008)
- Regulation on Cereal Seed Certification and Marketing (2008)
- Regulation on Delegation of Authority in Seed Services (2008)
- Regulation on Authorization and Control in Seed Sector (2009)
- Regulation on Seed Controller (2010)
- Regulation on Genetically Modified Organisms and Products (2010)
- Regulation on Plant Quarantine (2011)
- Regulation on Plant Passport System and the Registration of Operators (2011)
- Regulation on Transfer of Plant Variety, Candidate Variety and Breeding Material to Seed Institutions including Seed Production and Marketing Right (2014)
- Regulation on the Registration, Production and Marketing of Landraces (2019)

The institutions and policies governing Turkey's seed sector continue to evolve. TAGEM's 'Seed Sector Policy Document (2018-2022)' recommended that seed subsidies and low interest loans be granted to the production of seeds of improved domestic instead of imported varieties in the coming period, emphasizing the balance between supply and demand of domestic seed varieties. The policy also recommended that small-scale companies should come together to establish a unit that conducts R&D activities. The policy stipulates that the new structure may be a subsidiary affiliated to TÜRKTOB or a separate organization, and that TOB should support it. Other policy issues, including challenges and recommendations, are discussed in more detail in the following chapters.

Lessons learned

Lessons from the realities of the Turkish seed system show that creation of an enabling environment through formulation and enactment of relevant laws, regulations, guidelines and enforcement mechanisms is an important ingredient for creating a better functioning and more effective seed sector. The efficacy of such a comprehensive system of regulatory framework would depend on the existence of well-qualified and trained personnel, and digital systems to ensure accountability. Simplifying the organizational structure of the seed system might also contribute to enhance efficacy of the seed system.

References

Akyıl, Z. 2017. Çiftçi kaydında son tarih 30 Haziran [Deadline for Farmer Registration 20 June], Anadolu Ajansı. https://www.aa.com.tr/tr/ekonomi/ciftci-kaydinda-son-tarih-30-haziran/845964. Accessed 26/12/2017.

Arisoy, H. and Eraktan, G. 2011. A comparison of the revenues of wheat producers in Turkey: A case of EU member and non-member status with spatial reference to Central Anatolia Region, African Journal of Agricultural Research 6(25): 5614–5617.

Aydin, Z. 2010. Neo-liberal transformation of Turkish agriculture. Journal of Agrarian Change 10(2): 149–187.

Boyacı, M. and Yıldız, O. 2016. An overview of agricultural extension services in Turkey, Bulgarian Journal of Agricultural Science 22(1): 151–157.

Bozkurt, B. and Engiz, M. (2001) Focus on Seed Programs: The Seed Industry in Turkey. ICARDA, Aleppo, Syria.

BÜGEM. 2018. https://www.tarimorman.gov.tr/BUGEM/Belgeler/Bitkisel%20%C3%25/9Cretim/Tohumculuk/%C4%B0statistikler/ithalat_miktar_parasal_deger.pdf. Accessed 8/09/2021.

Çetınkara, Ş. 2012. Econometric analysis of last ten years wheat production quantity-price relation of Turkey: Koyck-Almon Technique. Journal of the Human and Social Science Researches 1(4) 52–66.

Dönmez, İ. 2021. Problems in shared ownership agricultural lands: Adana-Seyhan case study. Mediterranean Agricultural Sciences 34(2): 181-188. https://doi.org/10.29136/mediterranean.641655

EU. 1995. https://www.avrupa.info.tr/sites/default/files/2016-09/Custom_Union_des_ENG_0.pdf. Accessed 16/12/2019.

FAOSTAT. 2020. FAOSTAT Data Domains; Production and Trade (Crops; wheat yield and wheat flour) http://www.fao.org/faostat/en/#data/QC

GTHB. 2016. Tohumculuk 2015: İstatistikler, Göstergeler, Çalıştaylar [Seed Production 2015: Statistics, Indicators, Workshops]. GTHB, Ankara, Turkey.

GTHB. 2017. Tarımsal Destekler. Available at: https://www.tarimorman.gov.tr/Konular/Tarimsal-Destekler. [Accessed 15/11/2017].

Kan, M., Küçükçongar, M., Keser, M., Morgounov, A., Muminjanov, H., Özdemir, F. and Qualset, C. 2015. Wheat landraces in farmers' fields in Turkey: National survey, collection, and conservation, 2009-2014. FAO, Ankara, Turkey. Available at: https://www.fao.org/documents/card/en/c/2fb32baa-8fca-499e-86d2-96cfa7c787a6/ [Accessed on November 3, 2021]

Karabina, K. 2015. Structure of Turkey Ministry of Agriculture, Food and Livestock, GAIN Report, TR5061. USDA Foreign Agricultural Service, Ankara, Turkey. Available at: https://www.fas.usda.gov/data/turkey-structure-turkey-ministry-agriculture-food-and-livestock. [Accessed on November 3, 2021]

Karabina, K. and Duyum, S. 2016. New Turkish Agricultural Policy and Projected Impacts, GAIN Report, TR6053. USDA Foreign Agricultural Service, Ankara, Turkey. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=New%20Turkish%20Agricultural%20Policy%20and%20Projected%20Impacts_Ankara_Turkey_11-14-2016.pdf [Accessed on November 3, 2021]

Keyder, Ç. and Yenal, Z. 2011. Agrarian change under globalization: markets and insecurity in Turkish agriculture. Journal of Agrarian Change 11(1): 60–86.

Koçak, A. 2012. Farmer support regime and political economy of agricultural reform: Transformation of Turkish agricultural policy in the post-2000 era. MSc thesis, Boğaziçi University, Istanbul, Turkey.

Küçükçongar, M., Cevher, C., Kan, M., Kan, A., Taner, S., Hekimhan, H., Arısoy, Z., Taner, A., Kaya, Y., Karabak, S., Atalay, A., Bolat, N., Çekiç, C., Atmaca, E. and Avcıoğlu, R. 2006. Determination of Technologies on Wheat Production in Central Anatolia and Transitional Zone of Turkey. Unpublished Report.

Küçükçongar, M., Kan, M., Duman, M., Cevher, C., İslamoğlu, M., Semerci, A., Bayraktar, Ö. V., Kan, A., Ünal, Z., Göçmen, A., Aydoğan, S., Hekimhan, H., Gözüaçık, C., Mutlu, Ç., Güllü, M., Kanat, A. D., Kaya, E. and Yılmaz, E. 2009. Türkiye'de süne (Eurygaster sp., Het.: Scutelleridae) mücadelesinde başarıyı etkileyen sosyo-ekonomik faktörlerin araştırılması [Investigation of socio-economic factors influencing the success of Sunn pest control]. Tarım ve Köyişleri Bakanlığı, Ankara, Turkey.

Kutay, A. 1997. The private seed sector in Turkey. Pages 49-53 in Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa-and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, ICRISAT, Andhra Pradesh, India.

Köksel, H. and Cetiner, B. 2015. Grain science and industry in Turkey: past, present, and future, Cereal Foods World: Future of grain science series 60(2): 90–96.

Mazid, A., Amegbeto, K. N., Keser, M., Morgounov, A., Peker, K., Bagci, S., Akin, M., Küçükçongar, M., Kan, M., Karabak, S., Semerci, A., Altikat, A., Yaktubay, S. 2009. Adoption and Impacts of Improved Winter and Spring Wheat Varieties in Turkey. ICARDA, Aleppo, Syria.

Nizam, D. and Yenal, Z. 2020. Seed politics in Turkey: the awakening of a landrace wheat and its prospects. Journal of Peasant Studies 47(4), 741–766. https://doi.org/10.1080/03066150.2019.1708725

OECD. 2011. Evaluation of Agricultural Policy Reforms in Turkey. OECD, Paris, France.

OECD. 2017. Agricultural Policy Monitoring and Evaluation 2017. OECD, Paris, France.

OECD. 2020. Agricultural Policy Monitoring and Evaluation 2020. OECD, Paris, France.

Official Gazette. 2007. (Amendment in the Law on Soil Conservation and Land Use, Article 8). Available at: https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5403-20070131.pdf [Accessed 15/03/2020].

Official Gazette. 2010. https://www.resmigazete.gov.tr/eskiler/2010/12/20101224-13.htm[Accessed 16/12/2019].

Official Gazette. 2013. https://www.resmigazete.gov.tr/eskiler/2013/06/20130621-12.htm[Accessed 16/12/2019].

Official Gazette. 2018. https://www.resmigazete.gov.tr/eskiler/2018/04/20180412-6.pdf [Accessed 16/12/2019].

Öniş, Z. and Şenses, F. 2007. Global dynamics, domestic coalitions and a reactive state: Major policy shifts in post-war Turkish economic development METU Economic Research Center Working Paper No. 20636 Available at: SSRN:https://ssrn.com/abstract=1019997 or http://dx.doi.org/10.2139/ssrn.1019997

Ozbag, N. 2016. Food and agricultural import regulations and standards - Narrative, FAIRS Country Report for Turkey, USDA Foreign Agricultural Service, GAIN Report, TR6017. USDA Foreign Agricultural Service, Ankara, Turkey.

Özçelik, A. and Özer, O. 2006. Analysis of correlation of wheat production and prices with Koyck models in Turkey, Journal of Agricultural Sciences 12(4):333–339.

Pray, C.E. 1997. Public policy, public investment, and private investment in seed supply—-experiences in Turkey and India. Pages 211-228 in Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van

Gastel, A.J.G., eds.). Patancheru 502 324. ICRISAT, Andhra Pradesh, India,

TAGEM. 2018. Tohumculuk Sektör Politika Belgesi 2018-2022 [Seed Sector Policy Document 2018-2022]. TAGEM, Ankara, Turkey.

Tatlıdil, F. F., Dellal, İ. and Bayramoğlu, Z. 2013. Food Losses and Waste in Turkey.

TİGEM. 2016. 2016 Tohumculuk Sektör Raporu [Seed Sector Report 2016]. TİGEM, Ankara, Turkey.

TMO. 2017. Hububat Raporu 2017 [Cereals Report 2017]. TMO, Ankara, Turkey. http://www.tmo.gov.tr/Upload/Document/hububat/HububatRaporu2017.pdf

TMO. 2021. Hububat Raporu 2020 [Cereals Report 2020]. TMO, Ankara, Turkey. Available at:

https://www.tmo.gov.tr/Upload/Document/sektorraporlari/hububat2020.pdf. *[Accessed on November 4, 2021]*

TSÜAB. 2017a. Tohum Sanayicileri ve Üreticileri Ulusal Strateji Raporu [National Strategy Report of Seed Industrialists and Producers]. Available at: http://www.tsuab.org.tr/ckfinder/userfiles/files/tussidetsuabrapor.pdf. *[Accessed on November 4, 2021]*

TÜİK. 2001. General Agricultural Census Agricultural Holdings (Household) Survey. http://www.turkstat.gov.tr/VeriBilgi.do?alt_id=1003. Accessed 26/12/2017.

TÜİK. 2017. Labor Force Statistics. http://www.turkstat.gov.tr/PreTablo.do?alt_id=1007. Accessed 17/11/2017.

TÜİK. 2018. Press Release, 2018. http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=24869. Accessed 12/03/2020.

TÜİK. 2021a. Cereal Statistics, 2021. https://data.tuik.gov.tr/. Accessed 7/09/2021.

TÜİK. 2021b. Production and Sales of Industrial Products, 2005–2020. http://www.turkstat.gov.tr/PreTablo.do?alt_id=1066. Accessed 8/09/2021.

TÜİK. 2021c. Crop Products Balance Sheets, 2019-2020, Cereals and Other Crop Products Balance Sheets at Statistical Tables.

https://data.tuik.gov.tr/Bulten/Index?p=Crop-Products-Balance-Sheets-2019-2020-37246.

Accessed 14/04/2021.

Turkish Presidency. 2019. On Birinci Kalkinma Plani (2019-2023) [Eleventh Development Plan]. Turkish Presidency, Ankara, Turkey.

TÜRKTOB. 2017. TÜRKTOB Başkanı Kamil Yılmaz, TZYMB'in 'Tohum Geleceğimizdir' Panelinde konuştu. http://www.turktob.org.tr/tr/turktob-baskani-kamil-yilmaz-tzymbin-tohum-gelecegimizdir-panelinde-konustu/24332. [Accessed on 1/01/2017].

TÜRKTOB. 2021. Seed Sector Report 2021. http://turktob.org.tr/public/img/turkiyes-seed-sector-report-2020.pdf. Accessed 8/09/2021.

TÜRKTOB. 2021a. TÜRKTOB Magazine, Issue: 36 April-August 2021, Ankara, Turkey.

Uyanık, M and Z. Bishaw. 2008. Seed sector privatization in Turkey. Report for project Strengthening the Seed Supply in ECO Region FAO-ECO TCP (TCP/INT/3102 ©), ICARDA, Aleppo, Syria (unpublished).

Uyanik, M. 2008. Status of Seed Sector Privatization in Turkey: A Review (unpublished).

World Bank. 2020. Turkey: GDP share of Agriculture. Available at: https://www.theglobaleconomy.com/Turkey/share_of_agriculture/.

CHAPTER II

VARIETY DEVELOPMENT AND EVALUATION

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Introduction with Historical Context

Both spring and facultative winter bread and durum wheat varieties are grown in Turkey. Formal plant breeding began in 1926, when six crop research stations were established (Bozkurt and Engiz, 2001). In 1967, a National Wheat Release and Training Project was established, which contributed to the foundation of a 'green revolution' in Turkey (Kan et al., 2015). According to Pray (1997), the demand for commercial seed in Turkey was created by imports and local development of improved varieties, particularly for wheat varieties produced in the late 1960s and 70s. During this time, in collaboration with the International Center for Maize and Wheat Improvement (CIMMYT), the USA, Russia and Europe, Turkish Government institutes introduced varieties of semidwarf spring wheat, improved winter wheat, and other crops. As discussed above, TAGEM has been responsible for plant breeding and variety development since 1975. It currently comprises a network of 49 agricultural research institutions operating in different agro-ecologies and regions; of these, 12 are involved in wheat breeding. Although early breeding efforts made use of locally-sourced germplasm, by the 2000s, a substantial proportion of germplasm came from foreign sources (Kan et al., 2015). In 1986, the Government of Turkey and CIMMYT established the International Winter Wheat Improvement Program (IWWIP), which was joined by the International Center for Agricultural Research in the Dry Areas (ICARDA), and contributes to the national and global wheat improvement effort.

Regulatory Frameworks

The 2006 Seed Law and the 2008 Regulation on Registration of Plant Varieties provide the main institutional framework governing variety development, evaluation and release. Additionally, the 2004 Law on Protection of Breeder's Rights of New Plant Varieties, and its accompanying regulations, provide the framework for PVP. The 2010 Biosafety Law and the 2010 Regulation on GMOs and Products introduced strict control systems over the development of GMOs. Although commercial production of transgenic plants is prohibited, there is no ban on R&D. Researchers are required to inform TOB about their research, and they require permission from TAGEM if they wish to import transgenic material. However, the import of transgenic seeds is forbidden since the 2017 Circular on the Implementation of Rules for Seed Import. As such, certificates must be issued for seed imports to demonstrate that they do not contain any transgenic material.

The 2014 'Regulation Concerning the Transfer of Plant Varieties, Candidate Varieties and Breeding Materials to Seed Organizations, and the Sale of Seed Production and Marketing Rights', is now in place to enable the transfer of advanced breeding lines to private seed companies to test and release them as varieties under their own brands (Official Gazette, 2014). The main purpose of this regulation is to make new varieties available to farmers quickly and widely, and to enable private seed companies to further develop new varieties. The regulation is envisaged to determine the procedures and

principles regarding the transfer of plant varieties, candidate varieties and breeding materials developed by public research institutions to seed companies, the sale of seed production and marketing rights, and the use of variety development. According to this regulation, seed production and marketing rights of a variety or a candidate variety is sold for a maximum of 10 years. At the end of the agreement, the research institution may re-sell the variety. The breeding material sales are made only to seed companies that are authorized to conduct research by the TOB, regardless of whether the crops are self-pollinated or not. As mentioned in the strategic document of the sub-unions, most BİSAB and TSÜAB members are satisfied with the implementation of this regulation (TSUAB, 2017).

Institutional Arrangements

TAGEM coordinates agricultural research in the country. Currently, there are 12 public agricultural research institutes (ARIs), known locally as Kamu Tarimsal Araştirma Enstitüleri. ARIs are involved in wheat improvement and are part of the National Agricultural Research System (NARS), working under the auspices of TAGEM (Table 2.1). These ARIs are collaborating in wheat research with CIMMYT and ICARDA. ICARDA and CIMMYT annually distribute advanced germplasm of bread and durum wheat in the form of international nurseries to the ARIs, universities and private companies, which undertake adaptation testing and release in Turkey. The joint Turkey-CIMMYT-ICARDA IWWIP is also responsible for developing and distributing elite winter wheat germplasm for adaptation testing to about 40 countries globally.

ARIs dominated the variety development landscape up until the 2000s, after which, five public universities and about 45 domestic and foreign private seed companies have been authorized to undertake wheat research and are now involved in wheat variety development in the country. The five public universities that are working on wheat breeding through their faculties of agriculture are: Çukurova University (Adana), Harran University (Şanliurfa), Selcuk University (Konya), Namık Kemal University (Edrine), and Uludağ University (Bursa) (TTSM, 2018).

Table 2.1: Public ARIs working on wheat improvement in Turkey

No	*Institute*	*Location*	*Latitude*	*Longitude*	*Altitude (masl)*
1	Thrace ARI	Edrine	41.65 N	26.60 E	42
2	Aegean ARI	Izmir	38.61 N	27.10 E	31
3	Maize ARI	Sakarya	40.73 N	30.36 E	34
4	Transitional Zone ARI	Eskisehir	39.77 N	30.40 E	801
5	Central Research Institute for Field Crops	Ankara	39.62 N	32.69 E	1069
6	Bahri Dagdas International ARI	Konya	37.85 N	32.58 E	1007
7	East Mediterranean ARI	Adana	36.85 N	35.35 E	11

No	*Institute*	*Location*	*Latitude*	*Longitude*	*Altitude (masl)*
8	East Mediterranean Transitional Zone ARI	Kahramamaras	37.54 N	36.92 E	462
9	GAP ARI	Sanlıurfa	36.89 N	38.92 E	381
10	GAP International Agricultural Research and Training Center	Diyarbakır	37.94 N	40.25 E	601
11	Black Sea ARI	Samsun	41.58 N	35.90 E	17
12	East Anatolian ARI	Erzurum	39.98 N	41.62 E	1686

Note: The West Mediterranean (Bati Akdeniz) ARI is occasionally involved in wheat breeding and recently released three bread wheat varieties.

Technical Procedures

Wheat varieties were primarily bred by the public research system (ARIs), along with contributions from public universities and the international agricultural research centers, such as CIMMYT and ICARDA. The NARS, which consists of ARIs, universities and private research centers (affiliated with seed companies), is established within the country and are purely funded by local resources. The NARS have national breeding programs using germplasm from domestic sources, such as the two national gene banks, and bilateral cooperation with national, regional or international organizations.

Wheat improvement remains a key priority for TAGEM as it is a major staple crop in the country. The breeding objectives and priorities include developing wheat varieties with tolerance to biotic and abiotic stresses, and high grain quality for processing and/or consumption by end users (TAGEM, 2016). While detailed analysis of the convergence/divergence between TAGEM's breeding objectives and farmers' and end users' preferences is needed, Mazid et al. (2009) reported that farmers' preferences revolve around local adaptation, drought resistance, frost resistance, grain yield, grain quality, and grain price, indicating possible alignment between TAGEM and farmers.

Although the private sector has been involved in agricultural research since the mid-1980s (Bozkurt and Engiz, 2001), it was not active in wheat breeding until recently. The role of the private sector, which has expanded rapidly since 2006, is mainly concentrated on introducing and registering foreign varieties for domestic use. Currently, there are several private companies engaged in R&D – development, release and commercialization (including production of original seed) of proprietary wheat varieties.

Wheat seed can only be imported for further multiplication and not directly for grain production (Karabina, 2017b). ARIs, universities, CIMMYT, ICARDA, and seed producers may import up to 200 kg annum-1 of seed of varieties not registered in Turkey for research and testing. For varieties released elsewhere, import of seed of up to 1,000 kg annum-1 is allowed for demonstration purposes. In practice, such wheat seed imports are very limited. In 2016, for example, only 1,193 tons were imported by all institutions involved (TİGEM, 2016). These imports are subject to customs and quarantine control.

The government publishes import and export circulars annually, setting out the relevant rules and procedures.

The scheme and timeline for variety development in Turkey is as shown in Figure 2.1 and Table 2.2. Detailed procedures and the requirements for submission of varieties for testing and release have been established (TTSM, 2018). Following the crossing and selection of segregating materials, the variety should go through several stages of variety evaluation: (i) Observation nursery (one year and one location); (ii) preliminary yield trial in one or two locations for one year; (iii) yield trials in two to three locations for one year; (iv) regional yield trials (one to two years and in four-six locations); and (v) release trials, which include registration trials for DUS in one location for two growing seasons, and performance trials for VCU for two years in 6-10 target locations at the same time. Thereafter, the best performing varieties across years and locations will be submitted by TTSM for registration and release, with the consent of the breeding program. If a breeder submits a variety for specific adaptation or trait (e.g., resistance to soil-borne mosaic virus), it is possible to have it tested only in the target agro-ecologies and released accordingly.

Table 2.2: Timeline for variety development and commercialization in Turkey

Steps	***Variety trial stages***	***Timeline (year)***	***No of locations***
1	Crossing	0	1
2	Selecting segregating populations	1-5	1
3	Observation nursery (selection + introduction*)	6	1
4	Preliminary yield trial	7	1-2
5	First yield trial	8	2-3
6	Advanced yield trial	9	2-3
7	Regional yield trial	10	4-6
8	Registration trials	11-12	6-10
9	Seed multiplication and demonstration	12-14	
10	Commercialization	~15	

*Note: * Elite germplasm introduced from CIMMYT and ICARDA may directly enter observation nurseries*

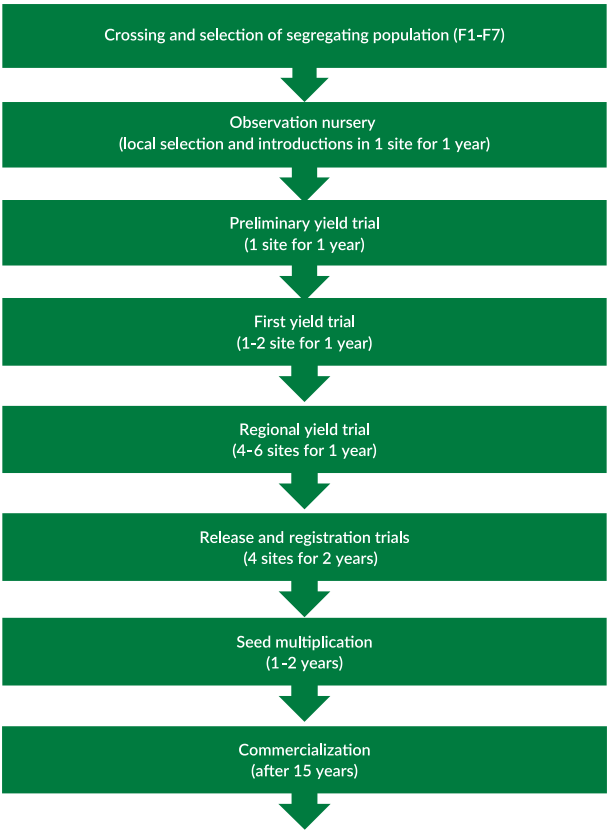

Figure 2.1: Variety development, evaluation and release scheme in Turkey

Major Achievements

From 1971 to 1989, two varieties, namely, 'Bezostaya-1' (a widely grown cultivar from the former Soviet Union) and 'Hawk', a variety obtained from the USA were introduced, but the portfolio of varieties expanded gradually. At the time of publication, a total of 487 bread and durum wheat varieties have been listed in the National Varieties List (NVL), although, the actual total number of varieties released over time is more than that published on the TTSM website (TTSM, 2021). Registration for field crops is valid for 10 years and it must be renewed or otherwise would be delisted as per the 2008 Regulation on Registration of Plant Varieties. Any variety older than 10 years, and where the owner does not want to keep it in the list, is then dropped from the NVL. Once the variety is delisted from the catalogue, its seed cannot be produced and commercialized by seed companies. As documented by Keser and Cakmak (2021), a total of 611 varieties

have been released in Turkey between 1925 (when wheat breeding started) and 2021 (Annex 4A). The average varietal release rate increased from about 0.35 per year for the period before 1980, to about 31.1 per year between 2011 and 2020. Moreover, the varieties released from the private sector drastically increased from only 0.2 per year between 1991 to 2000, to 20.9 varieties per year between 2011 and 2020 (Figures 2.2-2.4). The selection history and key traits of some of the varieties under cultivation during the 2015 survey, and others in the NVL are also provided in Annex 4B.

Apart from developing improved varieties, significant achievements were made in new crop management technologies and practices, such as use of fertilizers, irrigation and new planting techniques in wheat production (Kan et al., 2015). The speed and level of adoption of new varieties depends not only on the level of efforts for breeding and registration in the national catalogue, but more importantly, on the production and distribution of adequate quantity and quality seed reaching the majority of farmers (see section on Seed Production and Commercialization).

Apart from wheat improvement, Turkey has an important role to play globally in the conservation of genetic resources of wheat landraces and wild relatives, especially as the South Eastern region of modern-day Turkey is the origin of wheat. The country is an important source of wheat progenitors, where over 18,000 wheat types have been identified (Gokgol, 1939). Much of the in-situ preservation of these resources is carried out informally by smaller household farms (see below). With the support of ICARDA and CIMMYT, Turkey is involved in ex-situ conservation of these genetic resources in its two gene banks in Ankara and Izmir.

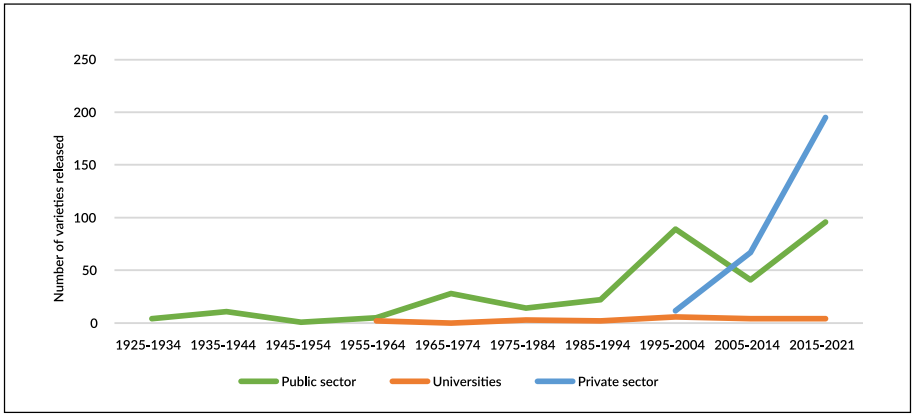

Figure 2.2: Wheat varietal release by the public sector, private sector, and universities in Turkey by decade(2)

Source: Figures 2.2, 2.3 and 2.4 are derived from Annex 4A.

Note: includes varieties which were released before the NVL existed and those which were included in the list but have been de-registered after finishing their term.

(2) Note that the final data point includes only six years (2015-2021). Despite this, it still indicates a large increase in the rate of varietal release.

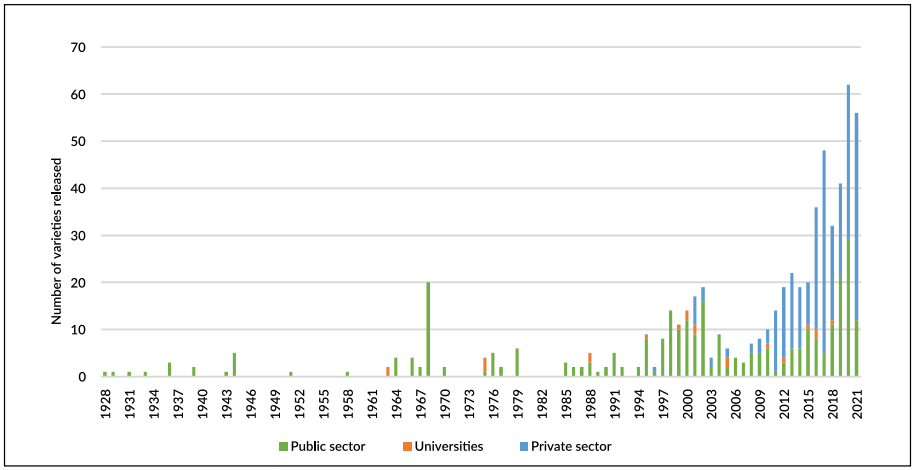

Figure 2.3: Wheat varietal release and registration in the NVL by the public sector, private sector, and universities in Turkey by year

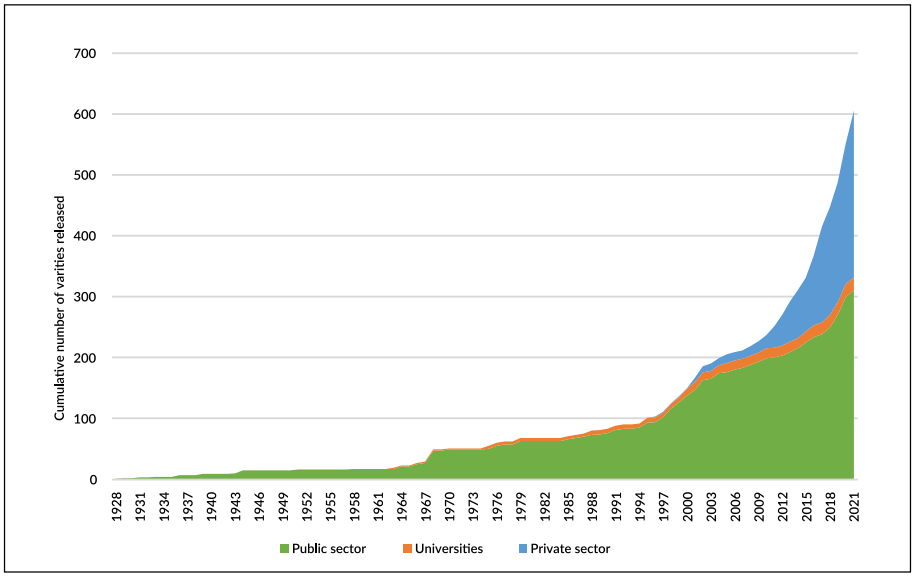

Figure 2.4: Cumulative wheat varietal release and registration in the NVL by the public sector, private sector, and universities in Turkey

Note: See Annex 4A for the full list of varieties

Key Challenges

Although some farmers continue to grow landraces in Turkey, genetic diversity is increasingly under threat as the uptake of improved varieties accelerates. Today, landraces make up for less than 13% of the wheat production area and 3% of land holdings. Farms growing only landraces tend to have older household heads and be located in less-developed highland regions that are far away from markets. This is also reflected in the fact that landraces are cultivated by 9.04% of winter wheat producers but only by 3.83% of spring wheat producing farmers. Landrace wheat is almost entirely consumed at the household level (93%), and does not enter national market channels (Kan et al., 2015).

Until recently, according to the Seed Law of 2006, the trading of landraces was prohibited and the varieties cannot be registered because they do not constitute pure and uniform lines (Kan et al., 2015); this threatened in-situ conservation. Recently, however, a new regulation has been issued to allow the registration of landraces. The Regulation on the Registration, Production and Marketing of Landraces was published in the Official Gazette # 30877 on 3 September 2019 and entered into force immediately. The regulation aims to protect the landraces of field crops, vineyards, horticulture, and other plant species and to prevent their genetic erosion. The regulation contains provisions on the registration, reproduction, propagation, marketing, maintenance and sustainable use of seeds of landraces. As of 2021, three varieties selected from landrace populations have been registered, two of which are now under seed multiplication. For the release of landrace varieties, DUS tests are not as strict and stringent as for improved varieties. The regulation allows the seed of landraces to be placed on the market, traded, and controlled within the production and certification system. Seed samples for landraces are sent to public certification directorates and subjected to analysis. However, the standards applied in field controls and laboratories are lowered by 10% compared to formal sector varieties, where the standard certification procedures are applied accordingly.

Although Turkey has a very diverse set of bread and durum landraces, the extent of utilization of their desirable traits, such as resilience to climate change, is limited in breeding programs. Currently, the number of varieties introduced and released by the private sector is overtaking varieties released through domestic breeding programs. Concerted efforts are required to characterize and identify desirable traits and incorporate them into new improved varieties. These efforts will ensure the adaptation and acceptance of newly developed wheat varieties. Moreover, the cultivation of these varieties is limited to only few areas in specific provinces. Wheat production is instead dominated in most provinces by commercial production of a narrow range of improved varieties which may possess limited genetic diversity but have traits that are demanded in the market. With systematic popularization and cultivation of these landraces, farmers in these provinces could mitigate high risks associated with the effects of climate change, which is progressing rapidly in the West Asia and North Africa region (WANA).

The yield gain through genetic and agronomic improvements in rainfed environments is modest compared to varieties developed for irrigated agro-ecologies. While there is generally improvement in the speed of variety replacement, there are still some very old varieties such as 'Bezostaya' (winter wheat released in 1968), 'Adana99' and 'Ceyhan99' (both spring bread wheat released in 1999), which cover substantial land area. In 2016, Ceyhan99 was the number one from 112 bread wheat cultivars for certified seed sale with 15,146 tons and Bezostaya was the second with 5,119 tons (unpublished seed production data). The usage of different varieties is discussed further in Chapter 6.

Another major challenge in wheat production relates to diseases and pest control. For example, wheat rusts continue to threaten wheat production in the country. The genetic basis for disease and insect resistance in the country is not yet well understood, and hence, chemical controls are currently the main means for controlling/preventing disease and insect epidemics. It is imperative to undertake further study in this area, including developing a pest distribution map, and strategies and management options.

Breeding programs are developing and releasing varieties with good quality traits. However, all farmers do not apply the recommended agronomic practices, leading to lower quality wheat produced in the country. The fluctuation of rainfall in purely rainfed areas is also contributing to inconsistency of wheat grain quality across years.

Lessons Learned

The New Seed Law and Plant Variety Protection (PVP) law provided an enabling environment for the private sector to be involved in variety development and registration. Seeds of many wheat varieties are available in the market for the farmers to select, based on their varietal/trait preferences. However, the effective implementation of these laws and regulations, and addressing new and emerging bottlenecks that affect farmers' access to their preferred varieties, remains critical. A participatory approach that ensures the involvement of all stakeholders in the seed sector for revising regulations is valuable. This would allow for the identification of current and emerging opportunities and bottlenecks in private sector variety development and registration, and the reforms needed to address them; and would contribute to regulatory compliance and effective implementation.

Given the limited resources available to small research centers and variety release institutions, most of their personnel lack needed skills and knowhow. There is a need to meet the demand for qualified technical personnel in public institutions who are well trained in both variety registration and seed certification processes. This is even more important now with the increasing interest of the private sector in wheat seed, and expanding the seed production area. For example, failures in field control may adversely affect certification.

Foreign-bred varieties of both bread and durum wheat have rapidly increased their market share over the years in the country. However, Turkey is rich in genetic resources and landraces which can be utilized in the development of locally-adapted varieties.

National breeders should consider utilizing these valuable resources in their breeding programs, particularly to develop well-adapted and climate-resilient varieties in tackling the negative impacts of climate change.

Recommendations

Even though there are many bread wheat varieties in the market, there are fewer durum wheat varieties, limiting farmers' economic (income generation) and social (risk management) options. Most private sector variety registrations have been for bread wheat. Thus, breeding programs in the country need to generate new durum wheat varieties that will fit some of the major agro-ecologies – and with specific traits that are desirable in the market.

Concerted efforts are needed to meet the growing demand for qualified and skilled human resources and need to be comprehensively reviewed with the relevant organizations. This can be addressed by working with the relevant agricultural universities and the Council of Higher Education. Current post-graduate courses in breeding and agronomy departments may be enriched or new curriculum developed, to produce graduates with better knowledge and skills in latest advances in plant breeding and variety development.

The availability of adequate and high-quality data is important for researchers, seed companies and policymakers. Therefore, more efforts are needed to collect, compile, and make all seed-related data readily available, preferably in one database, for use by all interested in the seed sector of Turkey. While the TVYS represents a good first step, further development is required.

References

Bozkurt, B. and Engiz, M. 2001. Focus on Seed Programs: The Seed Industry in Turkey. ICARDA, Aleppo, Syria.

Gokgol, M. 1939. Turkish Wheat. Istanbul (in Turkish). Available at: https://turktob.org.tr/upload/SEKTOR_RAPORU_2019_TURKTOB_WEB_ICIN.pdf

Kan, M., Küçükçongar, M., Keser, M., Morgounov, A., Muminjanov, H., Özdemir, F. and Qualset, C. 2015. Wheat landraces in farmers' fields in Turkey: National survey, collection, and conservation, 2009-2014. FAO, Ankara, Turkey. Available at: https://www.fao.org/documents/card/en/c/2fb32baa-8fca-499e-86d2-96cfa7c787a6/. [Accessed on November 3, 2021]

Karabina, K. 2017b. Turkey Planting Seeds Sector Overview, GAIN Report, TR7008. USDA Foreign Agricultural Service, Ankara, Turkey. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Turkey%20Planting%20Seeds%20Sector%20Overview_Ankara_Turkey_3-15-2017.pdf. [Accessed on November 3, 2021]

Keser, M. and Cakmak, M. 2021. Wheat Variety Development in Turkey; outcome of about one century of wheat breeding endeavor, 1925-2021. Paper presented at the International Congress for Agriculture in Alanya and in the world. 29-31October, 2021. Alanya/Turkey

Official Gazette. 2019. Available at: https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=33763&MevzuatTur=7&MevzuatTertip=5. [Accessed 9/09/2021]

Pray, C.E. 1997. Public policy, public investment, and private investment in seed supply—experiences in Turkey and India. Pages 211-228 in Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: ICRISAT

TAGEM. 2016. Tarımsal Araştırma Mastır Planı 2016-2020 [Agricultural Research Master Plan 2016-2020], TAGEM, Ankara, Turkey.

TİGEM. 2016. 2016 Tohumculuk Sektör Raporu [Seed Sector Report 2016], TİGEM, Ankara, Turkey.

TSÜAB. 2017. Tohum Sanayicileri ve Üreticileri Ulusal Strateji Raporu [National Strategy Report of Seed Industrialists and Producers]. http://www.tsuab.org.tr/ckfinder/userfiles/files/tussidetsuabrapor.pdf

TTSM. 2021. Number of wheat varieties registered in Turkey https://www.tarimorman.gov.tr/BUGEM/TTSM/Sayfalar/Detay.aspx?SayfaId=85. Accessed 9/09/2021

TÜRKTOB. 2019. Tohumculuk Sektör Raporu [Seed Sector Report, 2019].

CHAPTER III

Variety Release and Protection

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Variety Registration and Release

Introduction with historical context

The most important outcome of the investment in agricultural research is the official release of improved varieties for cultivation by farmers. The development and release of winter/facultative wheat varieties started as early as 1931 (Keser et al., 2017), which was exclusively based on selection from the wheat landraces grown by farmers. However, under the current variety release system overseen by TTSM, varieties should go through a rigorous evaluation process before they are released. Currently, all certified seed of wheat produced and marketed in Turkey must be of registered varieties only, with no exception.

During the registration process, a temporary production permit which allows the import, production and distribution of seed may be granted prior to full registration. This includes transferring seed production rights from the breeders to seed producers[3] , covering only research institutes under TOB, and domestic varieties – not foreign ones.

Regulatory frameworks

Previously, the variety registration and release system operated within the framework of Seed Law No. 308 and its amendment (Seed Registration, Control and Certification No. 3976 of 21 February 1994). Currently, it is governed within the framework of Seed Law No. 5553 and by the regulation on Registration of Plant Varieties (2008). The key element of this regulation is that to register a plant variety, the owner of the variety must apply to TTSM, preparing an application file which consists of: (i) Application form to be filled for registration; (ii) Technical information and documents of the variety (morphological, phenological, etc.); (iii) Receipts of fees paid for variety release and registration trials; and (iv) Verification of application file for registration from the TTSM. If the registration committee finds any missing technical information or documents, then the committee may reject the variety submitted for registration.

According to the Regulation on Registration of Plant Varieties, a variety can only be registered by a public ARI, authorized private research institute, university, an authorized seed producer, or an affiliated individual with a specified level of education and experience. The registrant must also be a member of the relevant sub-union of TÜRKTOB. Seed producers may be able to register plant varieties which are bred by legal persons or research institutions. For such a purpose, they make an agreement with a research institution to conduct the trials, prepare the report, and based on the results, apply for registration.

Legal persons meeting the following criteria can seek the service of a research institution to conduct the trials and prepare the reports for the varieties bred by them for registration. They must either: (i) Be a graduate from an agricultural university with four-year education program in Turkey or abroad and have at least three years' work experience in plant breeding; (ii) Have participated in a three-month theoretical and

practical course on plant breeding organized by the TOB or an institution authorized by TOB; or (iii) Have an MSc or PhD in plant breeding but not currently work in any public or private research institute.

Institutional arrangements

TTSM is responsible for overseeing variety release and registration. TTSM, with its headquarters in Ankara, undertakes DUS tests, while VCU tests may be conducted by TTSM or in collaboration with ARIs, private seed companies or universities. TTSM has one variety testing station based at its headquarters in Ankara.

The operational expenses for conducting DUS and VCU trials are covered by the fees paid by the applicants. For example, in 2018, the application fees were TRY 2,720 (US$563.38) for VCU and TRY 3,980 (US$824.36) for DUS per entry. For PVP, including the technical inspection fees, the cost was TRY 5,552 per entry for two years for field crops, including wheat. In addition, for variety protection alone, the fee for the applicant is TRY 200-450 annually. Detailed information on fees is available on the TTSM website.

Technical procedures

For wheat varieties to be commercialized, two types of tests are required in Turkey: registration and performance tests. The registration or descriptive tests establish the identity or DUS of the variety, based on its morphological characteristics. The performance tests establish its VCU based on agronomic traits of the new variety (such as grain yield and quality, pest and disease resistance).

Application

Applications for variety release from both the public and private sector are submitted to TTSM. The application calendar and procedures are available on the TTSM website. The applicants are expected to fill out an application form and provide 25 kg of seed to be used for the DUS and VCU tests, out of which 4 kg is kept as a reference sample. The fees for conducting the trials are paid in advance. The applicants should provide at least a year's worth of variety performance data. Before applying for registration, varieties must undergo a pre-application trial conducted by a research institute (public or private). For annual crops, including wheat, these must be conducted either in two locations for one growing season, or in one location for two growing seasons.

Testing procedures

Descriptive trials are conducted by TTSM in at least one location for two growing seasons, with the possibility of extending the testing for one or more seasons if needed. The DUS trial is not necessary if the variety is already registered in another country in accordance with UPOV requirements, or if it is already a protected variety under the 2004 Law on Protection of Breeder's Rights (discussed below) – in which case, only performance trials are conducted. However, if the varietal characteristics in the performance trials do not match those on its Variety Property Certificate, the descriptive

test is also required. The DUS trials for winter wheat are conducted in Ankara, while for spring wheat, the location can be in Istanbul or Manisa.

Performance trials take place for at least two growing seasons in a minimum of three locations for annual crops, or three growing seasons in three locations for perennial crops. For these trials, the applicant is required to provide seed of the candidate variety and the names and seed of the popular check varieties under commercial production if needed, or otherwise, TTSM will decide the standard checks. It is not necessary for a variety to outperform all the other standard checks in all traits to be released. For a variety to be released, it should outperform all existing varieties in at least one trait.

Both DUS and VCU trials are supposed to be conducted by the TTSM. However, where resources are insufficient, TTSM may delegate VCU trials, under its supervision, to the ARIs (public or private) or universities. TTSM is still responsible for preparing the final reports of the trials and presenting the results to the Field Crops Registration Committee for review and approval.

The Field Crops Registration Committee makes decisions for variety registration. The Committee consists of two representatives from TTSM and one representative from: BÜGEM, an agricultural faculty of a university, an agricultural research institute, TSÜAB, BİSAB, the crop-related industrial sector, and the Turkish Union of Chambers of Agriculture. A two-thirds majority on the Committee is required to register a new variety and enter it on the NVL. Alongside the NVL, a recommendation list is also published showing the registered varieties and the regions for which they are suitable (including spring/winter wheat growing areas and rainfed/irrigated growing conditions).

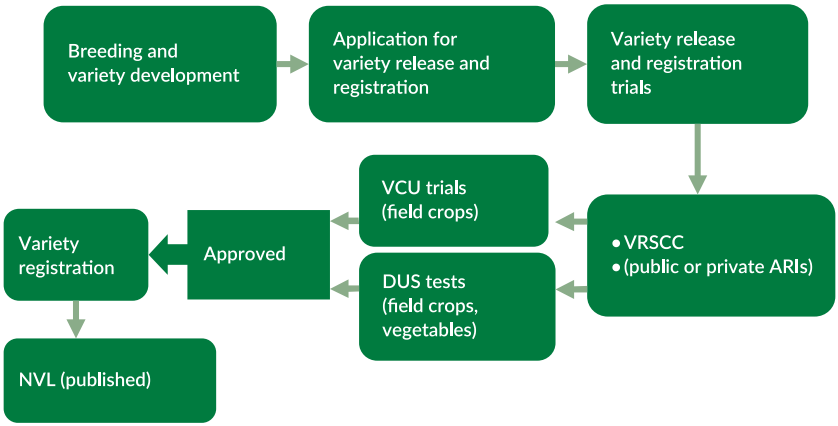

Figure 3.1: Variety release and registration scheme in Turkey

The organization registering a variety becomes responsible for its maintenance and breeder seed production (Regulation on Plant Variety Registration of 2008). Varieties are registered for a period of 10 years and variety owners can apply for renewal every

10 years. According to the regulation, varieties are removed from the NVL if the registration is not renewed upon completion of its 10-year validity. For the extension, TTSM must consider the scale of production and/or the economic value of the variety to grant extension. Request for extension by variety owners may not be granted if the variety does not meet the DUS requirements established previously. Registered varieties can also be removed from the list if they fail to meet variety purity tests for three consecutive years. Once removed, the seed of that variety cannot be legally produced and certified. However, farmers may continue to informally produce, save, and use the seed of the variety.

However, the NVL contains many varieties that have been registered for more than 10 years and may not be under cultivation by farmers for various reasons. For example, farmers may no longer have the demand for these varieties because there are other varieties with better traits, making their seed production and marketing less attractive to seed companies.

Figures 2.2-2.4, however, present a comprehensive list of released varieties in Turkey. Provided historical data is available on the pedigree, selection history, and specific desirable traits of these obsolete varieties, there might be opportunities for using them in future breeding programs for developing new improved varieties to address emerging stresses. Therefore, in addition to the list, which contains all the currently registered varieties, keeping a separate list for all varieties released in the country – including those expired – might be useful.

Major achievements

The variety registration and release processes are simplified with easy and clear procedures to follow. One of the main objectives of the variety registration reforms in the 2000s was to accelerate the variety registration process and to ensure timely benefits from plant breeding outputs. The revised accelerated variety release mechanism, accompanied by an enabling environment for seed production, ensured quick variety transfer, release and commercialization. Following the reduced time for performance tests, the entry of foreign varieties into the country, and the development of more domestic varieties by private companies, were accelerated. The variety registration regulation was aligned with EU legislation.

Currently, the new varieties in Turkey are registered and released under three different procedures. DUS and VCU trials are required for regular registration in all field crops (compulsory registration), but only DUS trials are mandatory for vegetables and fruit tree varieties, while DUS testing is optional for ornamentals. The regular field crop variety registration is a continuation of the old compulsory variety release procedure – similar to pre-reform years (Gisselquist, Nash and Pray, 2001) – but now it takes less time, and the requirements are relatively easy for private companies to comply with.

Following the reforms, the number of varieties registered annually through the regular procedure has increased over the years. The NVL is a valuable source of information for the sector and is regularly updated. In 2001, there were a total of 118

wheat (85 bread and 33 durum) varieties registered for commercial production (Bozkurt and Engiz, 2001). In 2021, a total of 487 wheat (including 386 bread and 97 durum) varieties were in the variety release register (Figure 3.2). Most of the increase is due to registration from the private sector, particularly for bread wheat varieties.

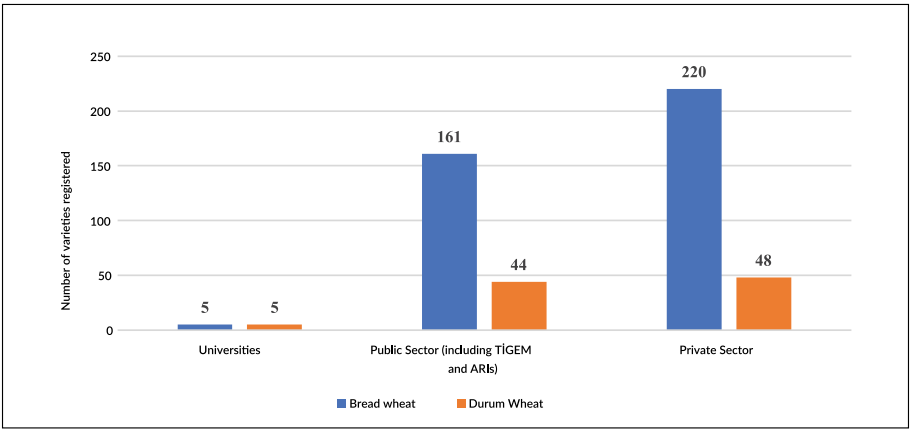

Figure 3.2: Number of wheat varieties registered in Turkey

Source: TTSM (2021)

From 2008 to 2018, 281 candidate wheat varieties were submitted for release, of which, 45 (16%) were rejected mainly because they failed to meet the DUS requirements (Table 3.1). Foreign private companies appear to dominate, accounting for more than 50% of applications and approvals. The domestic private sector is also catching up with the public sector, which has dominated the industry for a long time.

Table 3.1: Number of wheat varieties registered by public and private sectors in Turkey: 2008–2018

Institutes	***Bread wheat***		***Durum wheat***		***Total***		***% Total***	
	Applied	Approved	Applied	Approved	Applied	Approved	Applied	Approved
Public ARIs	52	47	20	18	72	65	25.6	27.5
Universities	3	3	3	3	6	6	2.1	2.5
Domestic private sector	48	39	5	5	53	44	18.9	18.6
Foreign private sector	124	100	26	21	150	121	53.4	51.3
Total	227	189	54	47	281	236	100	100

Key challenges

The variety registration system works well with no specific major problems. However, the high level of fees set by the TOB for variety testing and registration is likely to be unwelcome by seed companies (especially small, private companies). Where possible, replacement or change of the technical staff assigned for the field trials should be avoided, particularly during the testing season. Moreover, administrative issues, such as annual or maternity leave, have led to a lack of enough controllers with expertise in certain crop species for field trials that are run in public or private research institutions, causing undue delays in the registration process.

For the registration of foreign varieties, documents from foreign agencies that are equivalent to the TTSM are required. TTSM should make the necessary arrangements to accept these documents electronically (e.g. Italy sends DUS test reports and 'variety description documents' only electronically).

Currently the crop variety registration committee is dominated by representatives from the research institutions (ARIs). Seed companies want to have balanced public/private representation in the field crops registration committees to ensure that public/political interests don't override all economic rationale. Currently, private seed companies are represented by two individuals only.

Lessons learned

It is important to provide support for the production and export of domestic variety seed registered in the country – in line with the Seed Sector Policy Document (2018-2022) issued by TAGEM. Most of the national seed companies believe that providing more incentives and support for domestic varieties over foreign varieties will create a strong effect in domestic seed production, and export initiatives. Whenever they get the opportunity, many stakeholders from public organizations and NGOs also emphasize this expectation in almost all fora.

BÜGEM's seed department publishes a Seed Services Application Instruction document, which is regularly updated every year. In order to prevent discrepancies in the interpretation of the legislation and to ensure the integrity and uniformity of its implementation, BÜGEM organizes a three-four-day meeting before publishing the instruction booklet. This meeting is held with the broad participation of almost all public employees working in the seed sector, and representatives of the private sector and professional organizations/NGOs. During the meeting, both the application instructions and the technical instructions for VCU trials and tests – issued for each plant species group – are discussed and finalized by consensus among the participants. For example, for registration, the deadlines for stock notifications of varieties to register, production permit or expiry of standard seed registration, selection of location for DUS tests, selection of check varieties, etc. are discussed between the public employees and private sector representatives. In addition, seed certification, marketing and import/export regulations are handled extensively.

In recent years, the TVYS has been fairly used in seed certification, but it is not utilized yet for control and monitoring of seed movements to collect royalties. The use of TVYS for variety registration and release, including royalty collection practices, has some drawbacks of monitoring and control. Several additional legal regulations are required in the Seed Law and the PVP Law for this system to be used extensively for this purpose.

Recommendations

Registration procedures should be further simplified and aligned to those of the EU seed regulations. This would increase the efficiency and acceptability of Turkish seed exports by other countries. Moreover, having bilateral agreements with registration institutions of target export countries can increase the opportunities of exporting seed of domestic varieties to those countries. Mainstreaming the responsibilities of different departments/units working on seed, such as the seed department, plant health control, registration and certification offices, under one umbrella under TOB could further simplify and facilitate the variety registration process in particular, and hence, accelerate the development of the national seed sector.

There is a need for seed companies to train and update their technical staff working in variety registration so that they can prepare the application documents clearly and accurately, thereby making it easy for the reviewers, and hence, expedite the registration process. It would also be beneficial if TOB regularly collected opinions of all private and public seed companies on the registration process and organized human capacity development programs for staff working on variety registration – specifically addressing the issues raised by seed companies.

While there is a merit to keeping high fees for varietal testing, in terms of discouraging speculative and excessive applications, it might be limiting the ability of small private seed companies and individual persons to register their varieties. The fees should not be prohibitively high. Considering differentiated fees with some provisions for individual and small companies might help in solving this problem. Regularly reviewing the fees paid by different companies for registration by TOB, and adjusting them in accordance with current situations, might also help in addressing this issue.

For domestic breeding and seed companies, the government should consider supporting them in variety registration and promotion activities abroad to encourage the export of seed to other countries. This can open a new source of export revenue for the country.

Plant Variety Protection

Introduction with historical context

Previously, variety development, testing and release predominantly remained in the hands of the public sector. With the liberalization of the seed sector since the 1980s,

and the subsequent entry of the private sector into crop improvement in the 2000s, the issue of intellectual property rights (IPR) protection became apparent. Apart from registering a variety, a breeder may apply to have the variety protected in the form of an IPR. In 1994, Turkey attempted to introduce plant breeders' rights and become a member of UPOV. However, the country did not succeed due to lack of compliance with the UPOV convention (Bozkurt and Engiz, 2001). After resolving the compliance issues, it became a full member of UPOV in 2007 (BÜGEM, 2016).

Regulatory frameworks

The current PVP regime was enacted in 2004 by Law No 5042 on Protection of Breeders' Rights for New Plant Varieties. The Law is based on both the 1991 UPOV Convention and the 2100/94/EC and 1768/95/EC directives on plant variety rights of the European Commission. Apart from the Law on Protection of Plant Breeders' Rights, three regulations were issued on the implementation of the law. These include: (i) Regulation on the Implementation Principles of Farmers' Exemption (August 12, 2004); (ii) Regulation on Payments to Plant Breeders in Public Institutes (April 30, 2005); and (iii) Regulation on the Transfer of Plant Variety, Candidate Variety and Breeding Material to Seed Institutions and the Sales of Seed Production and Marketing Right (2014). The 2019 regulation states that landrace varieties can only be released by public institutions, and original seed of the landrace varieties can only be produced by the public institutions. The regulation does not provide exclusive rights to the public institutions.

According to the PVP Law, the right holder is defined as "any breeder or his/her legal successors", and the right holder "shall be entitled to the breeders' rights of a variety." Principally, only the right holder or exclusive licensee has standing to bring an infringement lawsuit, but ordinary licensees have the right to notify the right holder of the infringement and demand court action. According to the criminal and PVP laws, infringements are prosecuted only if the right holder files a complaint. To date, there are specialized IPR Courts in Istanbul (eight), Ankara (two) and Izmir (two), whereas, in the other cities, the third civil court of first instance serves as the specialized IPR Court.

Institutional arrangements

BÜGEM is a competent authority for PVP where application, registration and publication are handled under TOB. As discussed in the previous section, the examination of varieties and DUS testing for registration are carried out by TTSM and its technical examination office, and the seed certification directorates. Moreover, the implementation of PVP is the sole responsibility of TTSM (GTHB, 2016; Bozkurt and Engiz, 2001).

Technical procedures

The PVP process goes hand-in-hand with that of variety registration (Figure 3.3). Applications are submitted to BÜGEM and varieties must undergo descriptive trials (DUS) for over two growing seasons. For a variety to be granted protection, it must meet the DUS requirements and an additional criterion for novelty. A variety is not

considered novel if it has been traded in Turkey by, or with the consent of, the breeder, for more than one year before the date of the application. When the law was initially introduced, a grace period of five years was allowed for already-registered varieties (12 wheat varieties were granted protection under this arrangement), which was intended to start the protection exercise. Once protection is granted, a wheat variety is protected for 25 years. During this period, the right holder is obliged to maintain the variety and pay the associated fees for PVP rights.

Application and testing for protection

Application for PVP can be made by the breeder or his/her legal agent or breeding institutions. The applicant should provide the following information and documents in accordance with Article 33 of the PVP Law No. 5042:

- Name and address of applicant or, where appropriate, his legal representative; and if the applicant is not the breeder himself, the name and address of the breeder and any relevant information and document indicating how the entitlement to the breeder's right came into his possession
- Turkish and Latin name of the variety in the botanical taxon
- The denomination proposed for the variety or provisional designation used by the breeder
- If priority right is requested for a previous application the date and office of such application
- Technical description of the variety; and where appropriate, details of any previous commercialization of the variety
- The document proving that the application fee has been paid; and
- The geographic origin of the variety.

The application for protection will be examined for the novelty and right for prioritization by a committee consisting of three members from BÜGEM, TTSM, and a legal advisor of TOB. Upon its approval, the Technical Examination Office of TTSM and the certification directorates will conduct the DUS testing. The final DUS results will be presented to the Plant Breeders' Rights Registration Committee, which is composed of six members representing BÜGEM, TTSM (two members), legal advisor of TOB, agricultural college, and public ARI. This allows the registration and publication in the Plant Varieties Bulletin published quarterly by BÜGEM, confirming the grant of the protection.

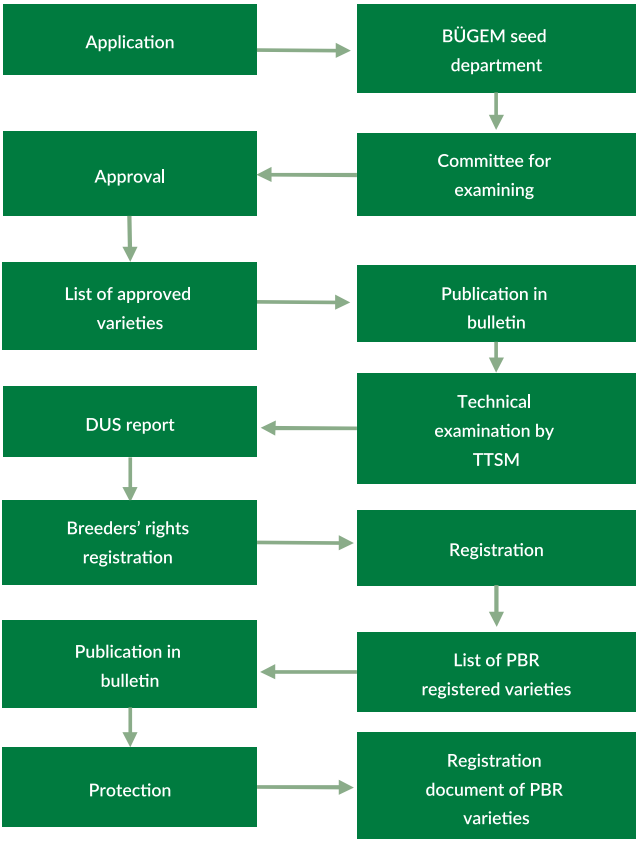

Figure 3.3: Plant variety protection scheme in Turkey

Granting protection

The protection entails a transferable and inheritable set of rights to control the use of the variety. It entails the exclusive right to production and reproduction, conditioning for multiplication, offering for sale, selling or other marketing, exporting, importing, and stocking. Right holders may license the variety contractually for use by third parties. After protection for three years, the right holder may be forced into compulsory licensing in cases of public interest, if the variety is not under commercial production. Accordingly, a third party who wishes to make use of a protected variety may apply to TOB to compel the variety owner to enter into an agreement to allow the use of the variety.

Article 17 of the PVP Law No. 5042 explicitly states that smallholder farmers (producing less than 92 tons of wheat) can re-use seed from a protected variety, but only if the use of seed is not contrary to the exclusive rights that protection imparts.

This suggests that a farmer may re-use seed from a protected variety, provided that the harvest from the re-used seed is not sold or stocked as seed, while it can be sold or stocked as grain. A separate clause states that protection does not apply to private and non-commercial use, suggesting that re-used seed can only supply household consumption and uses. In the absence of an effective tracking system for varieties planted by farmers, enforcement of the protection may be limited, especially because roughly two-thirds of farmers' seed needs are met through own saved seed and informal channels.

Major achievements

At the end of 2018, about 98 wheat varieties were granted PVP, showing that about one third (27.8%) of all registered wheat varieties are protected. Less than 60% of applications submitted for PVP are granted protection (Table 3.2). Among these, protection rights of only 12 wheat varieties are directly held by foreign companies where a Turkish proxy is registered with the protection. As of January 2020, a total of 158 wheat varieties were granted protection and included in the List of Protected Varieties, of which, nine are directly held by foreign companies. The 158 protected varieties belonged to 25 right owners. Looking at the figures in Table 3.2 below, the granting rate is lower than what one would expect for already released varieties. The possible reasons for this low protection rate include: some applications being rejected as they did not meet the criteria, failure to complete the application document in due time, withdrawal of the application by the owners or their legal entities, or failure to pay the mandatory fees on time for processing protection procedures.

Table 3.2: Number of wheat varieties granted with PVP: 2008–2018

Applicants	***Bread wheat***		***Durum wheat***		***Total***	
	Submitted	***Granted***	***Submitted***	***Granted***	***Submitted***	***Granted***
Public agricultural research institutes	46	39	17	15	63	54
Universities	3	3	1	1	4	4
Domestic private sector	63	24	5	4	68	28
Foreign private sector	31	11	5	1	36	12
Total	***143***	***77***	***28***	***21***	***171***	***98***

There is no detailed study on the impact of IPR on plant breeding and farming dynamics. Aydin (2010) argues that the new intellectual property right regime "simply pushes millions of farmers, who have been using traditional seed varieties for centuries, into the arms of transnational agribusiness companies" (p. 173). It is likely that PVP has been a major driver of the rapid acceleration in variety registration and certified seed production in the private sector, contributing to the development of the agricultural sector. However, the impact on traditional farming practices, particularly among smallholders, remains to be seen. More research is needed in this area to help inform future policy directions.

Royalty collection mechanism

In Turkey, royalty collection for protected varieties for both the public and private sectors is based on a license agreement between the variety owners and the seed producers. The royalty is collected in accordance with the articles/provisions of the agreement. For public sector varieties, almost 50% of the royalty collection goes to the institute which owns the variety, whilst, from the remaining 50%, the lion's share goes to the breeder and the rest to the technical research team involved in the development and release of the variety.

The royalty fee collection system is as depicted in Figure 3.4, where some of the common practices that are currently carried out include:

- A negotiated fee per ton for basic seed is paid to the owner of the variety; and royalties are collected based on the percentage specified in the license agreement considering the certified seed sales to farmers; or
- Alternatively, royalties are paid as a combination of fixed fees for licensing and prorated fee based on the volume of certified seed sales.

The unit price is higher for pre-basic and basic seeds although the royalty fees are maintained at the same rate for basic and certified seed. Royalty fees are determined by research institutes using two methods. First, if a variety is licensed to more than one company, a very low royalty fee (2% to 3%) is levied on sale of basic and certified seed. Second, if a variety is licensed with exclusive rights to one company only, it is granted by tender, and the bidder with the highest price gets the license. The royalties with exclusive rights range between 2% and 7%.

The royalty contracts for Turkish seed producers with foreign seed companies (e.g. Europe) are usually made based on a fixed fee per ton. The royalty fees levied on sales varied from about €40 per ton for basic seed to €15 per ton for certified seed, sometimes with substantial differences across varieties. In rare cases where companies are unable able to collect the royalty, they use a different marketing strategy whereby they keep the royalty costs of certified seed low but charge very high prices for basic seed.

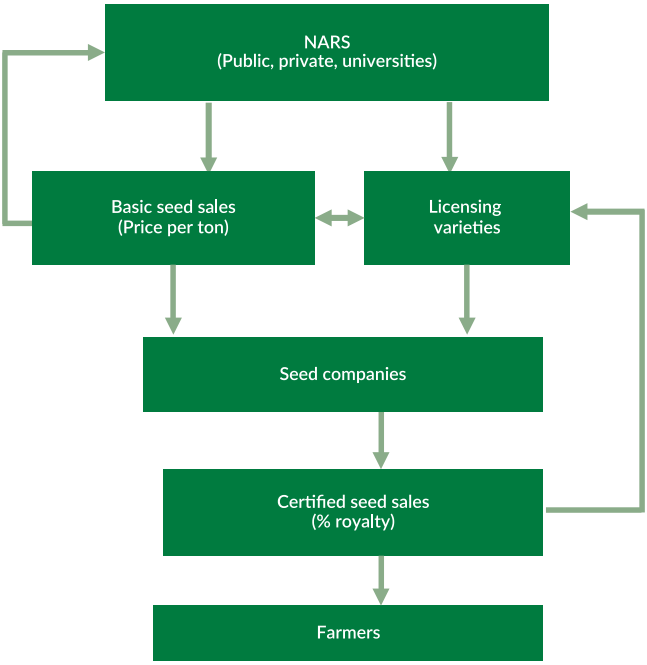

Figure 3.4: Mechanism of royalty collection for PVP

Key challenges

The royalty collection mechanism is functional in the country where both the public and the private sectors benefit from investment in plant breeding through the sale of basic seed or licensing, or a combination thereof, with some drawbacks since the system has been fully functional. Smallholder farmers can use farm-saved seed for own use, although farmers are generally not allowed to process their produce for sale as seed. Currently, local seed trade is carried out among farmers without any systematic control. This is contrary to PVP rules stipulated in the law. Seed producers are not happy with the exemption of farm-saved seed from royalty collection and complain that it has been abused by marketing the seed to others illegally – due to lack of control mechanisms – instead of being used only by the farmers themselves (TSÜAB, 2020). Though the seed producers would like to collect royalties from farm-saved seed, the Seed Law does prohibit this practice and there is clear government policy on this issue. It would in any case be impractical to monitor and charge royalties for saved seed, given the huge numbers of farmers involved and the hidden nature of such practices.

Another important drawback in royalty collection is the likely prevalence of malpractices among some wheat grain traders who are suspected to illegally process grain and sell it to farmers as seed (TSÜAB, 2020). This practice is a criminal offense

under the Seed Law, even if the variety is not protected. However, for a variety under protection, the owner has the right to claim the royalty and have the stipulations of the law enforced. There are serious penalties for those who illegally multiply the varieties under protection and offer them for sale where they are subject to imprisonment, including cancellation of license and closing the business. With all these stipulations, the enforcement is not effective due to the absence of an organized effort, which leaves individual variety owners in a weaker position.

There are different views from different seed sector actors on the royalty collection system. For example, seed companies who produce certified wheat seed believe that the royalty collection system is well established and is without any major problem for those who buy varieties from research institutes, and for those who sell varieties amongst companies themselves. The ARIs will collect the royalty fees as a percentage of sale prices of wheat seed set by TIGEM for the respective year. Since the companies agree on a price per ton in their contracts, they believe that royalty fees are generally being collected without any problem with few exceptions. On the other hand, government staff assume that there is misreporting of royalty collection. Although there is a list of licensed varieties which they can track, there is no mechanism to monitor the quantity of certified seed produced, partly because the contracts often take place without the involvement of TOB.

Lessons learned

Since its introduction, PVP, for both the public and private sectors, appears to be working in Turkey. There is greater interest for investment in research and an increase in the number of varieties protected, particularly from the private sector. These may create competitiveness in the wheat sector and varietal choices for farmers. A case study on PVP in Turkey may shed a light on this issue for future direction for countries contemplating the introduction of PVP for public-bred varieties.

Recommendations

The major challenges in the royalty collection system have been identified as listed above. The current royalty collection system needs to be incrementally improved and an effective and efficient system established in the country. Accurate data should also be collected and shared with variety owners and seed companies. The Ministry, TÜRKTOB, TSÜAB, BİSAB, TÜRK-TED and other relevant organizations should collaborate to create awareness on the royalty fee collection mechanism, and its importance for investment in agricultural R&D.

The variety owners, mainly public institutions, are less satisfied from the issues that emanate from royalty collections. The variety licensees think that to protect the variety rights and collection of royalties in Turkey, an organized and collective action by variety owners as in other countries (e.g. SICASOV in France) is needed in the country. This is believed to protect the rights and benefits of variety owners. It might be useful to institutionalize monitoring varietal use by individual farmers with active participation

of the extension services to minimize both leakages in royalty collections and simplify paperwork, and create a responsible body to deal with the issue.

After amendments of the relevant laws and regulations still in force, the TVYS is expected to enhance tracking varietal use and hence, resolve some of the prevailing problems related to royalty collection. The efficacy of TVYS in mitigating royalty collection-related problems may be enhanced even more by collecting seed purchases by individual farmers in addition to the seed sales data currently being collected from seed companies, thereby making verification of sales reports possible. Currently, good progress has been made for building a better and effective infrastructure where new software has been developed and is being tested. The system is expected to mitigate most of the problems listed above.

References

Aydin, Z. 2010. Neo-liberal transformation of Turkish agriculture. Journal of Agrarian Change 10(2): 149–187.

Bozkurt, B. and Engiz, M. 2001. Focus on Seed Programs: The Seed Industry in Turkey. ICARDA, Aleppo, Syria.

BÜGEM. 2016. Plant Breeder's Rights Report. BÜGEM, TOB, Ankara, Turkey.

Gisselquist, D., J. Nash and C. Pray. 2002. Deregulating the transfer of agricultural technology: lessons from Bangladesh, India, Turkey, and Zimbabwe. The World Bank Research Observer 17 (2): 237–265.

GTHB. 2016. Tohumculuk 2015: İstatistikler, Göstergeler, Çalıştaylar [Seed Production 2015: Statistics, Indicators, Workshops]. GTHB, Ankara, Turkey. Available at: https://www.turktob.org.tr/en/tohumculuk-2015-istatistikler-gostergeler-calistaylar-kitabi-yayimlandi/22524 *[Accessed on November 3, 2021]*

Keser, M., Gummadov, N., Akin, B., Belen, S., Mert, Z., Taner, S., Topal, A., Yazar, S., Morgounov, A., Sharma, R. C., Ozdemir, F. 2017. Genetic gains in wheat in Turkey: Winter wheat for dryland conditions, The Crop Journal. 5(6): 533–540.

TSÜAB. 2020. Enforcement Toolkit for Combatting Illegal Seed Practices. TSÜAB, Ankara, Turkey.

CHAPTER IV

Seed Production and Commercialization

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Seed Production

Introduction with historical context

The historical development of organized seed production goes back to the 1930s with the establishment of ARIs for crop improvement of cereals. The period also marked the establishment of the state farms (locally known as Devlet Üretme Ciftlikleri), which were responsible for the production and distribution of seeds to farmers of new varieties developed by the research institutes. Though Pray (1997) reported that wheat seed demand was met by importing high-yielding wheat varieties in the late 1960s, the majority of wheat seed was produced internally. State farms were re-organized as TİGEM (the General Directorate of Agricultural Enterprises) in 1951. TİGEM held a monopoly on certified seed production and the distribution of seed to farmers was handled through government-sponsored cooperatives. Until late 1990s, certified seed supply never reached more than 10% of total wheat seed used. In 2001, following the abolition of a provision for public seed supply, production fell as low as 3% (TİGEM, 2016). Since then, several reforms were introduced in the country which led to significant increase in the amount of certified wheat seed produced, primarily by the private sector. In 2020, combined public and private certified seed production met 36% of Turkey's estimated wheat seed requirement for that year (Figure 4.1).

BÜGEM's seed production plan assumes that farmers need to replace their seed every three years (BÜGEM, 2017b). Based on an average seed rate of 200 kg ha-1, certified seed production was estimated at 32-34% of the total seed use[(4)]. However, this aggregate figure masks considerable variation in seed replacement rates across regions and farmers. A study based on 2004 data showed, for example, that while certified seed use was 63% in Ankara province, it was only 25% in Karaman province (Küçükçongar et al., 2006). About 40% of all farmers hardly renew their seeds, and this can get as high as 90% in some regions (Kan et al., 2015).

Many farmers continue to use their own saved seed, and there is some evidence of farmers acquiring seed from neighbors and other informal trading networks. During a national workshop for all seed sector actors held in 2015, unauthorized actors, illegal seed production, and counterfeit seed packaging were identified as problematic issues in the seed sector (GTHB, 2016). According to TÜRKTOB, informal seed sale appears to be a problem in the Turkish seed sector (Bakir, 2017). However, with a seed replacement goal of 33%, it is believed that the use of own farm-saved seed is not considered a problem.

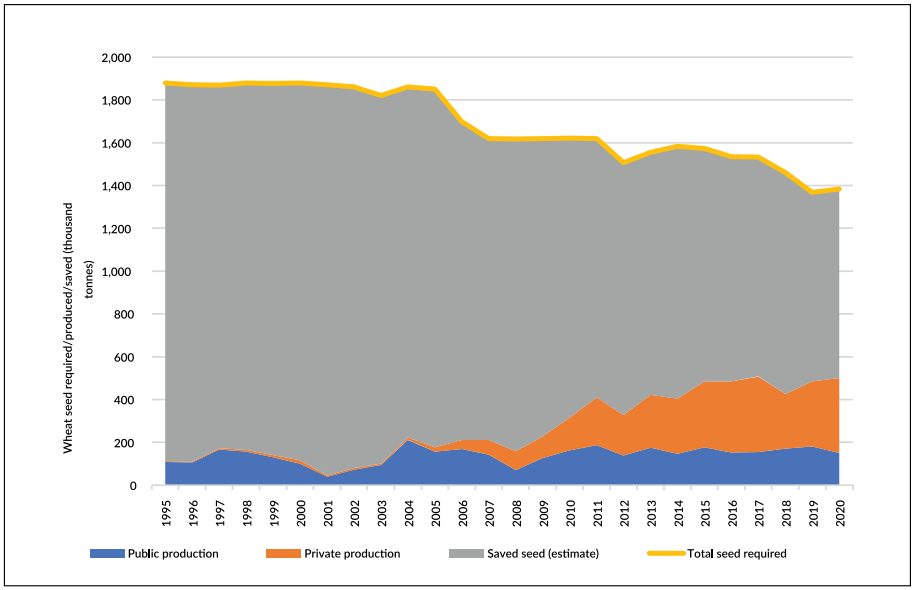

Figure 4.1: Potential wheat seed required and certified seed supply: 1995–2021
Source: BÜGEM (2021) and TÜİK (2021)
Note: Assumes an average seed rate of 200 kg ha^{-1}

Several reasons underpin the large increase in certified seed production and use. These include the introduction of certified seed subsidies – for usage in 2005 and for production in 2008. It is anticipated that as part of the MTP, other agricultural subsidies may be made conditional on using certified seed. This may lead to unnecessarily high seed demand, particularly in the case of wheat.

Regulatory frameworks

There are several regulations pertaining to seed production and marketing as per Seed Law No. 5553 of 2006 as follows:

- Regulation on Registration of Plant Varieties (2008)
- Regulation on Cereal Seed Certification and Marketing (2008)
- Regulation on the Delegation of Authority in Seed Services (2008)
- Regulation on Characteristics of Special Production Areas, where Growing Seeds and Determining the Principles to be Followed in these Areas (2008)
- Regulation on Authorization and Control in Seed Sector (2009)
- Regulation on the Transfer of Plant Variety, Candidate Variety and Breeding Material to Seed Institutions, the Sales of Seed Production and Marketing Right (2014)

- Regulation on the Registration, Production and Marketing of Landraces (2019)
- Circular on seed import and export updated annually

In Turkey, only registered varieties are used for formal seed production and marketing. Seed producers must get the approval to produce seed of a variety from the breeder or owner of the variety. This is mainly governed by the 2014 Regulation for Transfer of Plant Varieties and Sale of Seed Production and Marketing Rights. TAGEM is responsible for publishing a list of registered and candidate varieties and breeding materials that can be sold by the research institutions to the seed producers. Punitive measures, including fines and bans from businesses, are also introduced for those trading in uncertified seed (Aydin, 2010), which is also believed to have reduced the illegal seed trade.

Institutional arrangements

According to the Regulation on Authorization and Control in Seed Sector (2009) the following entities can be explicitly identified and defined : (i) **seed producer**: real or legal persons who produce seed by himself/herself and/or produce seed on contractual basis, process and market seeds; (ii) **seed grower**: real or legal persons who contractually grow seed on contract on behalf of seed producers; and (iii) **seed dealer**: real or legal persons authorized (by TOB) to market the seed as wholesale or retail in the country.

Seed production is carried out by ARIs, universities, public (TIGEM) and private seed companies and farmers' cooperatives. Elite seed is strictly produced by the variety owner, whereas original seed is produced either by the variety owner or on license and/or contract with seed producers. Certified seed can only be produced by registered seed producers/companies who are members of TSÜAB, which produce seed themselves on their own farm or under contract with seed growers. According to the provisions of the Seed Law, it is possible for a farmer to also be a member of TSÜAB (seed producers) and/or BİSAB (plant breeders) if he/she can meet requirements of the internal regulations of the unions.

Seed companies (also known as seed producers if they produce seed on their own land) set up contracts with seed growers who are members of TYAB. Almost all seed growers are farmers and members of the Union of Turkish Chambers of Agriculture (Türkiye Ziraat Odaları Birliği). A seed producer who is a TSÜAB member can be also a TYAB member if he/she grows seed on his/her land and is registered in the CKS database under TOB.

Technical procedures

Seed production

Three stages are critical in national wheat seed production: (i) early generation seed production by NARS to supply original seed for further multiplication; (ii) large scale multiplication to produce certified seed by seed producers; and (iii) marketing of certified seed to farmers by the public and/or private sector.

The liberalization of the agricultural sector in general brought about significant structural transformation, including for the wheat seed sector. Prior to 1980s, the public sector played a dominant role and the overall share of certified wheat seed in total seed use was less than 10%. Although the public sector continues to produce a significant quantity of wheat seed, mainly through TİGEM, the role of the private sector in wheat seed supply increased substantially over time. In 2017, the public sector produced only 125,193 tons of wheat seed (25% of the total certified wheat seed distributed) (Figure 4.1).

Seed export and import

Through a series of legislations that have been enacted over the years, the Turkish seed industry has grown rapidly and the trade volume in 2018 reached US$1.5 billion. Depending on government policies, the seed market is likely to increase in the coming years, particularly for forage crops and winter cereals. In terms of international trade, both import and export of wheat seed before the 1980s was extremely limited. Unauthorized importing or exporting of seeds is subject to the highest fine, with more severe sanctions for repeated violations.

Seed import: Prior to 2016, seed imports, worth only a couple of million dollars were largely made by public institutions (TİGEM, 2018). By 2002, this increased to US$55.3 million and reached US$178.9 million in 2018 (BÜGEM, 2018). However, the share of wheat was only 0.2%. Seed imports for multiplication remain quite low but vary considerably from year to year. As shown in Table 4.1, about 129 tons of wheat seed was imported in 2002, which increased to 612 tons in 2012 and decreased almost by half to 371 tons in 2018 (BÜGEM, 2018).

Table 4.1: Trends in wheat seed production, distribution, import and export: 2002–2019
Source: BÜGEM (2019)

Year	Wheat seed production (ton)	Wheat seed distribution (ton)	Import							Export						
			Wheat seed (ton)	Total seed (ton)	%	Value (US$ 1,000)	Total Value (US$ 1,000)	%	Unit price (US$ / ton)	Wheat seed (ton)	Total seed (ton)	%	Value (US$ 1,000)	Total Value (US$ 1,000)	%	Unit price (US$ / ton)
2002	80.107	80.089	129	19.227	0,7	46	55.292	0,1	357	20	8.112	0,2		17.320		
2003	100.101	99.101	1.453	16.341	8,9	586	71.249	0,8	403	300	16.095	1,9	160	21.451	0,7	533
2004	223.094	229.029	802	19.838	4,0	484	79.238	0,6	603		15.658			35.147		
2005	176.202	173.386	563	23.876	2,4	384	89.597	0,4	682		13.814			26.981		
2006	211.848	204.526	638	32.654	2,0	498	105.608	0,5	781	5.070	23.941	21,2	38	47.093	0,1	7
2007	210.044	173.045	1.146	34.374	3,3	373	130.581	0,3	325	3.305	21.335	15,5	111	49.886	0,2	34
2008	158.452	157.887	789	43.578	1,8	547	170.798	0,3	693	5.333	26.245	20,3	3.514	71.101	4,9	659
2009	227.852	211.894	719	30.243	2,4	528	158.366	0,3	734	1.567	21.816	7,2	578	70.766	0,8	369
2010	315.676	262.764	3.434	40.610	8,5	1.348	176.792	0,8	393	4.825	29.586	16,3	3.452	94.789	3,6	715
2011	410.766	356.328	1.269	36.754	3,5	1.226	178.121	0,7	966	3.444	30.554	11,3	1.832	108.948	1,7	532
2012	327.924	318.768	612	33.160	1,8	726	197.649	0,4	1.186	9.768	37.439	26,1	6.773	120.796	5,6	693
2013	421.588	419.431	892	36.056	2,5	1.134	194.286	0,6	1.271	3.049	33.320	9,2	2.369	126.073	1,9	777
2014	403.769	402.824	408	33.185	1,2	531	188.431	0,3	1.301	1.354	42.135	3,2	1.010	148.375	0,7	746
2015	484.204	483.819	756	56.539	1,3	809	202.181	0,4	1.070	964	26.708	3,6	776	102.717	0,8	805
2016	485.225	469.631	1.193	49.491	2,4	981	202.127	0,5	822	19.800	58.222	34,0	7.764	153.449	5,1	392
2017	508.191	504.271	619	39.288	1,6	640	189.002	0,3	1.034	4.789	44.078	10,9	1.955	137.077	1,4	408
2018	426.658	395.125	371	40.170	0,9	373	178.853	0,2	1.005	31.904	102.786	31,0	11.493	151.691	7,6	360
2019	483.951	448.882	449	37.204	1,2	397	177.333	0,2	884	35.524	74.703	47,6	16.543	155.427	10,6	466

Seed export: Prior to 1980, seed export was almost non-existent. However, over time, the country's seed export capacity has improved significantly. Joint seed production by TİGEM and private sector companies has contributed greatly to this development. Seed exports increased from US$17.3 million in 2002 to US$155.4 million in 2019, an increase of about nine-fold. However, for the last 10 years, the share of wheat in total value of seed export was between 1 and 10% (Table 4.1). Wheat seed export remains relatively low, with significant variation across years. In 2019, about 35,524 tons of wheat seed were exported, compared to 964 tons in 2015 (TİGEM, 2016; BÜGEM, 2019).

Between 2002 and 2018, the share of imported wheat in seed production and distribution was almost below 1% each year. This indicates that Turkey is not dependent on foreign wheat seed supply. However, only import of the pre-basic and basic seed is allowed by the Ministry based on the provisions of the circular for seed import, issued and updated annually by BÜGEM, for example, the Import Circular 2019. There are strict prohibitions in the circular against commercial imports and selling seed directly to farmers. However, the import of wheat seed (mostly pre-basic and basic) is permitted to produce or reproduce certified wheat seed.

Licensing varieties

Details for licensing and royalty collection are described in the previous chapter. The right to produce seed may only be transferred once the variety has been registered or has received a temporary production permission. In the case of ARIs, production rights are transferred to either TİGEM or private seed producers (TAGEM, 2016). PVP rights are transferred for a maximum of 10 years and are renewable. When production rights are sold to the private sector, ARIs may also transfer the production of elite and original seed to seed companies, optionally retaining a technical supervision role.

The seed company is subsequently required to produce and sell the seed according to the terms of the contractual agreement. If it fails to comply for two consecutive years, the agreement is automatically cancelled, and the rights are returned to the owner of the variety or the research institute. The requirement may be extended to three years in cases of *force majeure*. If a candidate variety with production permission is sold, but is rejected for full variety registration, the contract ends immediately. As discussed in the previous chapter, if a variety is not in production within three years of receiving PVP, a third party may apply to TOB to compel the sale of production rights.

Registration of seed companies and seed growers

Participation in seed production and marketing that falls into one or more of the three categories listed above (seed producers, growers, and dealers) must be authorized by TOB. In practice, authorization is given by the relevant provincial directorate of TOB, depending on where the land and facilities of the seed company are located. The provincial directorates also carry out annual inspections on all organizations to ensure that they continue to meet all the requirements. These organizations must also maintain membership in the relevant sub-unions. Communication between all relevant units of

TOB that are involved in activities related to certified seed production and use are mandatory, and hence, no unit is authorized to act unilaterally.

According to provisions in Articles 5 and 6 of the 2009 Regulation on Authorization and Control in Seed Sector (Tohumculuk Sektöründe Yetkilendirme ve Denetleme Yönetmeliği), published on the Official Gazette No. 27229 on May 15, 2009, a seed producer (or a seed company) is mandated to have "the Document of Seed Producer" given by BÜGEM. One of the conditions of having this document is that the producer herself/himself is an agricultural engineer or an agricultural technician (graduated from an agricultural high school). If not, the authorized technical personnel employed by the producer must be a graduate from an agricultural college or faculty as an agricultural engineer. Therefore, seed companies are required to have staff with minimum qualification or training in seed production. Seed companies must also either have their own processing plants and storage facilities or have an agreement with a seed processing and storage service providers. Seed companies may also be considered as seed processors (and must be authorized as such) if they process seed on behalf of other seed companies.

To be authorized for contracted seed production of field crops, including wheat, a seed grower must own or lease a minimum of 1 ha of land, be registered in the CKS and be a member of TYAB. Seed growers are authorized by the provincial directorate of TOB, and authorization is valid within the province. Likewise, as discussed in more detail below, seed dealers obtain permission to trade only within their respective locations and they must have qualified technical staff. They can only sell certified and labelled seed of registered varieties, without breaking the original packages. Unauthorized production, processing, distribution, and sale of seed, including the handling of uncertified seed are illegal and subject to severe financial penalties. Seed may be confiscated and destroyed and a fine of between TRY 3,000 and 25,000 imposed, depending on the level of infraction.

With liberalization, the Turkish seed industry became diverse in its type, size and constituents. Currently, it consists of various 'licensed seed establishments' and includes private seed companies, a large public seed company (TİGEM), agricultural cooperatives, and public research organizations, which produce and distribute certified seed (Uyanik and Bishaw, 2010). While there were only three companies in 1980, this number increased rapidly to 12 in 1984; 53 in 1992; 90 in 2000; and 186 in 2008. There were 215 licensed enterprises engaged in seed production and marketing in the late 2000s. Based on data from TOB and TSÜAB, as of September 2021, there were 1,034 authorized seed producers (companies and individuals), who are also TSÜAB members. Among these, 971 were domestic seed companies, while 40 and 20 of them were multinationals and joint ventures, respectively, by national and foreign international companies. Of the 1,034 TSÜAB members, 545 seed companies produced cereal seeds and of these, only 338 seed companies were engaged in certified seed production of bread and durum wheat (Table 4.2). Data from BÜGEM showed that as of September 2021, the number of authorized seed producers was 790 (much lower than the figure

reported by TSÜAB), out of which, 700 can produce field crops including wheat. The BÜGEM list only includes authorized seed companies eligible to benefit from seed production support and to import/export seed, and does not include those seed companies which have a seed producer certificate and are members of TSÜAB but are not authorized to import/export. This explains the discrepancy between the two lists.

In 2021, there were 247 private research organizations authorized by TOB in Turkey working on plant breeding and variety development at varying levels. Of these, 181 were authorized to conduct research on field crops such as wheat (BÜGEM, 2021). About 45 of these companies also produce wheat seed. They could be members of TSÜAB as seed producers if authorized by BÜGEM. Only a few private ARIs are members of BİSAB.

Table 4.2: Number of registered seed companies in 2021

Crops	***Number of companies****
Wheat (spring, winter and facultative bread and/or durum)	338
Cereals excluding wheat (barley, oat, rice, rye)	207
Legumes (bean, chickpea, lentil)	180
Industrial crops (maize, sunflower, soybean, sugar beet, cotton)	204
Tuber crops (potato)	185
Vegetables (cucumber, eggplant, melon, tomato, pepper, watermelon)	290
Fodder crops (clover, vetch, etc.)	161
Grasses and ornamental plants	49
Total	***1,614***

*Note: *A member can be active in more than one crop*

Seed production areas

According to the Seed Law, and the Regulation on Special Seed Production Areas and its rules and procedures, the seed of a variety can only be produced within pre-determined areas designated by TOB. These are determined to ensure producers have an appropriate agroecology for the seed to be grown, that they minimize risk of seed-borne diseases, and comply with any relevant seed production requirements such as isolation distances between varieties. A Seed Commission, led by the director of the relevant TOB provincial directorate, is responsible for determining the special production areas. Representatives from the local Chamber of Agriculture and TSÜAB, along with a relevant field inspector, participate in the Commission. Seed producers must obtain permission from the Commission to grow seed in these areas. However, given its characteristics and widespread production throughout Turkey, this is less relevant to wheat seed production.

Seed processing and storage

Kutay (1997), reported the total available seed processing capacity of 637,820 tons (50% utilized) of which 526,620 tons (47% utilized) belongs to the public sector

and 111,200 tons (64% utilized) to the private sector. Likewise, the total available seed storage capacity was 554,400 tons (69% utilized), of which, 441,600 tons (69% utilized) belongs to the public and 112,800 tons (68% utilized) to the private sector. Currently, most of the seed companies have processing and storage facilities of various sizes distributed across the country. As the private sector handles its own seed production, the processing capacity is much higher than the current amount of wheat seed produced. Although there are no official statistics, it is estimated that cereal seed processing capacity is around 1.5 million tons annually, dominated by the private sector.

Seed Commercialization

Introduction with historical context

Some 20-25 years ago, seed marketing referred only to the distribution of seed to farmers. Today, it means a commercial process involving several activities, including the packaging, labelling, pricing, and sale of seed. Before 1980, there were only two private seed companies, while the public sector played a major role in seed distribution. Seed was supplied to farmers through the following arrangements (Harmansah, 2016):

- Prepaid seed procurement: The direct procurement from TİGEM's distributors/ dealers or TİGEM's own enterprises by paying the seed price in advance
- Seed distribution through credits: Seed loans were provided through Ziraat Bank and Agricultural Credit Cooperatives, which still continues today
- In-kind seed distribution: In cases where the appropriation was not sufficient, in-kind distribution was activated according to Law No. 5254 and was financed by TİGEM. It was implemented by giving seed to farmers in return to a one-year notary bill
- Seed distribution for contract cereal production: Contract cereal production scheme of up to 100,000 ha was initiated by the state farms for distributing new varieties to farmers. and the scheme was continued for a limited time after the establishment of TİGEM
- 'Seed Aid to Needy Farmers': Seed aid was provided to farmers when more than 40% of their crop was damaged under the Law No. 5254. This law was repealed in 2001 as seed supply was abused.

Previously, the premium of the seed distribution was kept low in order not to increase seed prices, and seed distribution was considered a public service to farmers. After 1980, in line with the liberalization of the sector, the participation of private seed companies started to increase gradually. In 1985, with the Decision on the Promotion of Seed Production, the state monopoly (TİGEM and public research institutes) on seed production was removed. The sector was opened to the private sector and prices also started to increase, making certified seed beyond the financial means of some smallholder farmers. Cognizant of this problem, the government introduced in 2005 support for the use of certified seed for cereals, rice, legumes, and potatoes, which has increased the

demand for certified seed among farmers. Similarly, support for seed production, initiated for some strategic crops (since 2008) has led to an increase in participation of private seed companies and as a result, an increase in seed production. These include cereals (wheat, barley, rice, triticale, oats, rye), legumes (chickpeas, dry beans, lentils), oilseeds (safflower, soy, canola, sesame, peanut), forages (alfalfa, sainfoin, vetch) and potatoes,

Regulatory frameworks

TODAB Internal Regulations and Articles 22 to 24 of the Regulation on Authorization and Control in Seed Sector enacted in 2009 and currently in force, have some provisions regulating the benchmarks to become a seed dealer. As per Article 17 of the Seed Law No. 5553, natural and legal persons engaged in seed related activities shall be members of the sub-union related to their field of activity.

Institutional arrangements (seed dealers)

In accordance with the relevant rules, real and legal persons authorized to market seeds in wholesale or retail markets are designated as seed dealers. Seed dealer certificates are issued by the provincial directorates of TOB, provided they meet the criteria below, and are valid only at the address determined. Applications for more than one place are decided separately in locations where the applications are made. The applicant or person to be responsible for the dealership must be an agricultural engineer. A seed dealer that operates within the legal and ethical rules is considered as an important player in the seed value chain.

Real and legal persons who want to sell seed should have suitable storage and capacity for seed sales, a cooling unit for vegetable seeds, and a holding area suitable for seedling and seedling sales. The facilities are inspected on site by the provincial directorates, and those who comply with the regulation shall be authorized by receiving the Seed Dealer Certificate. Seed dealers are obliged to:

- Sell certified and labelled or standard seeds of registered varieties
- Participate in the training and meetings to be invited by TOB
- Not to sell imported seeds that do not contain information in Turkish
- Not to sell foodstuffs and feeds without special separation within the dealership
- To keep a copy of the certification documents of the seeds it sells
- Not damage original seed packages and not sell them open, and
- Provide information, documents, and seed samples to official inspectors on inspection visits.

Quality seed can be transformed into economic value for farmers, seed producers, and the national economy, only if it can be transferred into production. The Turkish seed sector reforms from the 1980s, a series of legislation since 2004, and the support provided have improved the efficiency in seed marketing and distribution through both domestic production and seed imports, particularly for wheat and barley seed. The private sector has also established its own marketing and sales networks to distribute seed produced locally or imported from foreign sources (Doğan, 2016).

The effectiveness of seed marketing and distribution is largely measured on performance of wheat and barley. Any adverse effect on these crops will affect the whole seed marketing system because wheat farming is one of the most important crops for Anatolian farmers. However, depending on the economic situation and general agricultural policies, there are occasional disruptions in the distribution of seeds of crops, the prices of which are not considered satisfactory (Doğan, 2016).

According to TODAB members, some farmers change their varietal preferences in response to prevalent factors that affect the season negatively. Since seed production programs are planned at least two years in advance, desired varieties may not be supplied in sufficient quantities, causing producers to revert to using their own saved seed.

Technical procedures

Seed marketing and distribution

Certified seed is marketed and distributed through several channels. Farmers' cooperatives, private seed dealers, and TİGEM all play key roles in seed marketing, while provincial directorates may freely distribute small amounts (an estimated 2-3%) of total seed supply to poor farmers. In 2018, there were more actors in the market and supply chain of wheat seed and grain than there were before the 2000s. In 2001, there were approximately 3,500 seed sale points (Bozkurt and Engiz, 2001). Since 2008, the enabling environment such as seed laws, variety protection, and policies for supporting certified seed production and use, led to a rapid increase in the number of private wheat seed companies. In 2018, there were 6,961 seed dealers which are members of TODAB (TODAB, 2021) and the number continues to grow as demand for quality seed continues to increase.

Entry of the private sector in the wheat seed value chain has led to significant developments in the market for wheat and its products and exports. The wheat value chain in Turkey has four distinct sectors, with the main players as listed below (see Figure 1.11):

- Breeding, seed production, and distribution: BİSAB members such as public and private research institutes, individual breeders, and members of TSÜAB, TİGEM, TYAB, TODAB and cooperatives
- Grain producers and primary wheat market: farmers, TMO, commodity exchanges, merchants
- Intermediate markets: food and feed industry
- End markets: wholesalers, retailers, food services and consumers.

Seed promotion

Multinational seed companies, large domestic seed companies and TİGEM have several specialized marketing and distribution departments. These companies regularly organize demonstrations and field days at village levels. They prepare booths, participate

in trade fairs, and use various promotional tools such as brochures, booklets, videos and social media. Public ARIs also allocate budgets to make maximum use of promotional tools and organize and participate in events. Small seed companies often use local or regional promotional opportunities such as the local radio or TV channels.

Since its establishment, TODAB has made great efforts to promote certified seed marketed and distributed by its members. Promotional videos for wheat seed and other crops are also available on the TODAB website. Also, a portal called "Where is the Seed?" (Tohum Nerede?) has been recently launched by TODAB. Those who want to buy seeds can easily find all the necessary information about certified seed sold by TODAB members through the portal.

In 2004, there was considerable provincial variation in how farmers sourced wheat seed (Küçükçongar et al., 2006). TİGEM, agricultural cooperatives and neighbors were found to be the main sources of seed, other than saved seed. However, there were stark differences between Ankara (where a third of farmers' seed came from TİGEM) and Konya (where only 7% came from TIGEM). To date, at least one third of total wheat seed is certified and purchased from seed companies.

Seed pricing

Turkey follows liberal economic policies where prices of all agricultural commodities, including seeds and grains, are in large part decided by the free market forces. However, there are two important public sector players in the wheat market. Wheat prices announced by TMO for grain and TİGEM for seed are the most important determinants of price movements. The grain purchase prices announced by TMO affect both the price of wheat stock exchanges and certified or uncertified wheat seed prices. Fluctuations in wheat seed and grain prices announced by TMO and TİGEM during the last six years were analyzed for bread and durum wheat (Table 4.3). To reflect the impacts of exchange rate fluctuations, price changes have been calculated both in TRY and US$ per ton. Domestic sales prices between 2014 and 2019 announced by TİGEM for certified seed of durum and bread wheat show that there were significant increases in TRY/ton in 2018 and 2019. The increase in world wheat prices has not only been reflected in the wheat grain prices but also the wheat seed prices in Turkey.

Table 4.3: Trends in domestic wheat seed prices set by TİGEM: 2014–2019

Year	Durum wheat seed						Bread wheat seed							
	Group 1^				Group 2^		Group 1				Group 2			
	Price (TRY/t)	Increase (%)	Price* (US$/t)	Increase (%)	Price (TRY/t)	Price* (US$/t)	Price (TRY/t)	Increase (%)	Price* (US$/t)	Increase (%)	Price (TRY/t)	Increase (%)	Price* (US$/t)	Increase (%)
2014	1,160		530		1,250 1,320 1,350		1,160		530		1,150		525	
2015	1,250	7.8	460	-13.2			7.8	460	-13.2	1,240	7.8	456	-13.2	
2016	1,350	8.0	447	-2.7			5.6	437	-4.9	1,310	5.6	434	-4.8	
2017	1,380	2.2	379	-15.2			2.3	371	-15.1	1,330	1.5	365	-15.8	
2018	1,600	15.9	333	-12.3	1,520	316	1,650	22.2	343	-7,5	1,500	12.8	312	-14.7
2019	2,100	31.3	370	11.3			1,900	15.2	335	-2.3				

Source: TİGEM

*Notes: *Values in Tables 4.3 and 4.4 are calculated considering average exchange rate of US$/TRY of the respective year. As these are nominal values, some of the changes may be caused by inflation*

^TİGEM makes evaluation of the supply-demand conditions of different wheat types (durum/bread) and specific varieties and set differentiated prices to help the market clear.

TİGEM makes an evaluation of the supply-demand conditions of different wheat types (durum/bread) and specific varieties and sets differentiated prices to help the market. The annual price increase of durum wheat seed, which was below 10% until 2018, has exceeded 30% for two years. The price increases for bread wheat seed is around 15-20% and is relatively low. This increase can be regarded as an advantage for certified seed producers. However, despite the support provided by the government, sources from TOB indicate a recent decrease in the use of certified wheat seed, which is believed to be a result of the the decline in the purchasing power of the farmer. However, due to the increase in the US$/TRY exchange rate, there has been up to a 15% decrease in the seed prices of both durum and bread wheat in terms of US$/ton. While the seed price of both durum and bread wheat was US$530/ton in 2014, it decreased by 2019 to US$370 for durum wheat and US$335/ton for bread wheat. The seed sale prices announced by TİGEM have a significant effect on the formation of wheat seed prices of the private sector. Depending on the varieties preferred by the farmer, private sector seed prices are sometimes slightly above TİGEM sale prices (e.g. 5-10%) and sometimes below.

Table 4.4 shows that TMO's intervention grain purchase prices of durum and bread wheat significantly increased in TRY/ton in 2018 and 2019. According to some policymakers of TOB, the most important reason for this increase is the price movement parallel to the increase in wheat grain prices in the world wheat stock exchanges, which may also be compunded by inflation and the devaluation of Turkish currency. Announcements made by TMO executives have significant effects on wheat grain price volatility. In 2018, wheat grain price increased when it was annouced that low production was expected due to climatic factors, particularly in the Southeastern Anatolian Region. In another TMO press release, a decrease in global wheat production triggered an increase in grain prices of up to 30% compared to the previous year.

Table 4.4: Trends in wheat purchase prices by TMO: 2014–2019

Year	Durum wheat								Bread wheat											
	Group 1				Group 2				Group 1				Group 2				Group 3			
	Price (TRY/t)	Increase (%)	Price (USD/t)	Increase (%)	Price (TRY/t)	Increase (%)	Price (USD/t)	Increase (%)	Price (TRY/t)	Increase (%)	Price (USD/t)	Increase (%)	Price (TRY/t)	Increase (%)	Price (USD/t)	Increase (%)	Price (TRY/t)	Increase (%)	Price (USD/t)	Increase (%)
2014	765		349		640		292		720		329		685		313		620		283	
2015	976	27.6	359	2.7	819	28.0	301	3.0	862	19.7	317	-3.6	819	19.6	301	-3.7	724	16.8	266	-6.0
2016	1,000	2.5	331	-7.7	840	2.6	278	-7.6	910	5.6	301	-4.9	865	5.6	286	-4.9	765	5.7	253	-4.8
2017	1,000	0.0	275	-17.0	840	0.0	231	-17.0	940	3.3	258	-14.3	895	3.5	246	-14.2	800	4.6	220	-13.2
2018	1,100	10.0	229	-16.8	920	9.5	191	-17.1	1,050	11.7	218	-15.5	1,000	11.7	208	-15.4	870	8.7	181	-17.7
2019	1,450	31.8	256	11.8	1,200	30.4	212	10.7	1,350	28.6	238	9.1	1,275	27.5	225	8.2	1125	29.3	198	9.7

Source: TMO

A review of grain price changes for durum wheat in US$ revealed that prices fell between 2015 and 2018; but there was an 11.8% increase in 2019. The most important reason for this situation is the significant increase in the US$/TRY exchange rate in Turkey. Fluctuations in bread wheat intervention grain prices announced by TMO are similar to durum wheat. However, while around a 31% grain price increase in TRY was seen in 2019 for both durum wheat types, it was also close to 30% for the prices of two groups of bread wheat in 2019 (Table 4.4).

Grain and certified seed prices of durum and bread wheat announced by TİGEM and TMO are compared in Table 4.5. Over six years, the difference in average price between the TİGEM group one durum wheat seed price and TMO grain purchase price for the same group is around 40%. For bread wheat, this difference is almost 49%. It is desirable to reduce this difference in order to increase the use of certified seed. Almost 10 years ago, TİGEM, a public sector entity, started an initiative with the slogan of "Selling seeds at the crop price!" to advance this concept. However, netiher the private sector nor the public sector adopted the approach as this was not in line with the open market policy advocated by the government.

There is no significant difference between the prices of durum and bread wheat seed sold by TİGEM, except in 2019, where durum wheat seed price was 10% higher. However, the differences between TMO purchase prices of both durum and bread wheat are more than the differences between wheat seed prices.

Table 4.5: Trends and comparison of wheat grain and seed prices: 2014–2019

Year	*Group 1 Durum wheat grain price (TRY/t)*			*Group 1 Bread wheat grain price (TRY/t)*			*TİGEM wheat seed price (TRY/t)*			*TMO wheat grain purchase price (TRY/t)*		
	TİGEM seed sale	TMO grain purchase	Difference (%)	TİGEM seed sale	TMO grain purchase	Difference (%)	Group 1 Durum wheat	Group 1 Bread wheat	Difference (%)	Group 1 Durum wheat	Group 1 Bread wheat	Difference (%)
2014	1,160	765	51.63	1,160	720	61.11	1,160	1,160	0.00	765	720	6.25
2015	1,250	976	28.07	1,250	862	45.01	1,250	1,250	0.00	976	862	13.23
2016	1,350	1,000	35.00	1,320	910	45.05	1,350	1,320	2.27	1,000	910	9.89
2017	1,380	1,000	38.00	1,350	940	43,62	1,380	1,350	2.22	1,000	940	6.38
2018	1,600	1,100	45.45	1,650	1,050	57.14	1,600	1,650	-3,03	1,100	1,050	4.76
2019	2,100	1,450	44.83	1,900	1,350	40.74	2,100	1,900	10.53	1,450	1,350	7.41

Source: TİGEM, TMO

Achievements

Pray (1997) reported that there was gradual entry and consolidation of the private sector in wheat seed supply in Turkey. The wheat seed supply by the private sector increased from zero in 1980 to about 10% by 1993, according to TÜRK-TED data. To date, significant progress has been achieved since the liberalization of the seed market, particularly with the enactment of Seed Law and PVP Law in 2006 and 2004, respectively, and their subsidiary implementing regulations. The number of private seed companies in wheat increased from 43 in 2007 to 249 in 2018, a six-fold increase (National Seed

Supply, Distribution and Production Program; BÜGEM, 2008, TSÜAB, 2017).

The establishment of the seed union and sub-unions in reorganization of the sector is a great success, as it has enhanced the synergistic effects and efficiency of the public and private sector in the national seed system. Subsidies for use of certified seed (2005) and subsidies for domestic production of certified seed (2008) both led to an increase in production, and higher use of certified seed. As indicated at the start of the chapter (Figure 4.1), certified seed production has increased from 3% of seed requirements in 2021 to 36% in 2020. This shows that the subsidy system has helped in achieving, on average, the seed replacement plan of TOB. Moreover, the share of the private sector in total seed supply increased from 3.2% in 1995 to 70% in 2020 (Figure 4.2 and Table 4.6).

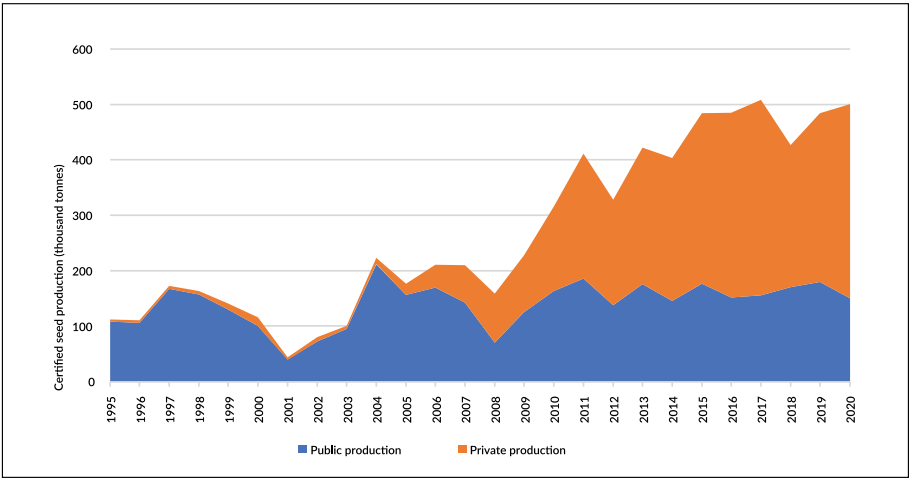

Figure 4.2: Certified seed production by the public and private sectors

Table 4.6: Wheat area planted, potential seed required and supplied by formal sector: 1995–2020

Year	*Area (ha)*	*Potential demand (t)*	*Public seed sector (t)*	*Private seed sector (t)*	*% certified seed1*	*% private sector2*
1995	9,400,000	1,880,000	108,169	3,541	5.9	3.2
1996	9,350,000	1,870,000	105,936	4,307	5.9	3.9
1997	9,340,000	1,868,000	166,913	5,382	9.2	3.1
1998	9,400,000	1,880,000	156,821	6,771	8.7	4.1
1999	9,380,000	1,876,000	129,664	11,288	7.5	8.0
2000	9,400,000	1,880,000	100,369	15,714	6.2	13.5
2001	9,350,000	1,870,000	39,494	4,421	2.3	10.1
2002	9,300,000	1,860,000	72,192	7,915	4.3	9.9

Year	*Area (ha)*	*Potential demand (t)*	*Public seed sector (t)*	*Private seed sector (t)*	*% certified seed1*	*% private sector2*
2003	9,100,000	1,820,000	94,588	5,513	5.5	5.5
2004	9,300,000	1,860,000	212,116	10,978	12.0	4.9
2005	9,250,000	1,850,000	156,395	19,774	9.5	11.2
2006	8,490,000	1,698,000	169,116	41,672	12.4	19.8
2007	8,097,700	1,619,540	141,856	68,188	13.0	32.5
2008	8,090,000	1,618,000	69,886	88,566	9.8	55.9
2009	8,100,000	1,620,000	125,275	102,577	14.1	45.0
2010	8,103,400	1,620,680	163,109	152,567	19.5	48.3
2011	8,096,000	1,619,200	185,974	224,792	25.4	54.7
2012	7,529,639	1,505,928	137,728	190,196	21.8	58.0
2013	7,772,600	1,554,520	175,360	246,228	27.1	58.4
2014	7,919,208	1,583,842	145,439	257,809	25.5	63.9
2015	7,866,887	1,573,377	176,588	307,616	30.8	63.5
2016	7,671,945	1,534,389	151,436	333,789	31.6	68.8
2017	7,668,879	1,533,776	155,283	352,908	33.1	69.4
2018	7,299,270	1,459,854	170,199	256,459	29.2	60.1
2019	68,463,271	1,369,265	179,717	304,240	35.3	62.9
2020	69,222,364	1,384,447	149,934	350,640	36.2	70.0

*Source: TUİK (*http://www.tuik.gov.tr/PreIstatistikTablo.do?istab_id=1562)

Note: 1Amount of certified seed supplied compared to total seed required for wheat area planted; 2Amount of certified seed supplied by private sector from a total certified seed from formal sector

Key Challenges

Unfair competition between public and private seed companies is believed to have had negative effects on the functioning of the seed sector. However, since 2006, unfair competition between public and private seed companies are believed to have been addressed (Karabina, 2017). For example, public companies are not eligible for subsidies, undermining their ability to undersell private companies, which also led to reduction in the market share of the public companies over the years.

With the expansion of the seed sector, finding larger field sizes for seed production has become more problematic. Large land holders usually prefer to store their harvest and sell at higher prices during the winter because of better prices than contractual seed production. These large farms may not be available for wheat seed production. Additional support to encourage farmers for contractual certified seed production has been suggested (TSÜAB, 2017b), which has been resolved, to some extent, by giving

additional incentives to certified seed producers (BÜGEM, 2018). Available support for certified seed use has remained unchanged for a long time. Moreover, support payments are made to the farmer about eight-nine months after planting. Unfortunately, this has a disincentive effect on farmers, which may inadvertently reduce demand for certified seed (TSUAB, 2017b).

The agriculture departments of provincial municipalities distribute seed cleaning machines to villages, but this service has been in decline recently due to opposition from the formal sector. Although setting up seed processing units in the villages is intended to upgrade seed quality by cleaning farm-saved seeds before planting, it may easily be misused by some dealers who may buy the seed from farmers and sell the seed. This would contradict the Seed Law and may affect seed sector development. It is important that the establishment of seed processing units is well planned and serves the intended purpose of improving the quality of seed used for planting by farmers. The price of certified seed should be commensurate with production costs, but should not promote inefficiency. Sometimes TİGEM sets low certified seed prices which affects the private sector negatively. Such complaints have been received from relevant sub-union members (TÜRK-TED, 2016; TSÜAB, 2017b and 2017a).

The e-trading of seed is not well regulated and this creates loopholes for illegal trade. The unavailability of certified seed of some varieties desired by farmers is one of the problems exposing some farmers to become prey for illegal seed dealers – where the seed origin and identity may not be genuine. Government extension agents are expected to play some role in promoting the uptake of new varieties and use of certified seed by farmers, along with breeding and seed companies. Many farmers however remain unaware of new varieties or face challenges in accessing quality certified seed.

Another challenge is that until 2006, the seeds of some varieties are sold in regions for which they are not adapted and recommended (Küçükçongar et al., 2006), though considerable progress has been made ever since. Matching varieties to their recommended domains is critical for getting maximum potential out of the variety. A concerted effort is required to ensure varieties are used in their adpated areas.

Lessons Learned

In the Turkish seed system, the creation of an enabling environment through formulation of policies and enactment of relevant laws, regulations, guidelines and enforcement mechanisms is an important ingredient for creating a better functioning, and more effective, seed sector. All these measures paved the way and facilitated the entry of the private sector to play its major role in seed production and supply. Simplifying the organizational structure of the seed system might also contribute to the enhancement of the seed system's efficacy.

With the increase in the number of varieties imported from abroad, there has been an increase in the number of variety choices preferred by farmers. However, efforts must be made to produce sufficient quantities of certified seed for the most preferred

wheat varieties, and to make them available in the market. This will help in regulating the increasing sale of uncontrolled seeds, which is disrupting market controls (TÜRKTOB, 2019).

BÜGEM compiles and publishes seed-related data officially, but the details of each cultivar (including selection history) are not revealed due to some sensitivities in disclosing company secrets, especially of the private companies. Currently, seed-related data is aggregated by respective institutions, and the information is diffused among different institutions with no coordination among actors. TOB is working to further develop the existing TVYS software, and if this database becomes available, it will not only serve for seed subsidies, but also for collecting data for plant breeding and variety development. While this effort is commendable, it may not meet all the data demand for business development, research, and policy decisions in the sector.

The introduction of subsidies and incentives both for seed users and seed producers, including subsidiary incentives for investments by farmers and seed producers, enabled the take-off of the national seed industry in general, and the wheat seed sector in particular in the country. After new seed laws came into force, more actors began to take part in the seed and grain value chains in Turkey.

Recommendations

Subsidies for the production and use of certified wheat seed can result in the increased use of certified seed in ways that might escalate production but compromise quality. Too many companies, most of them small, mushroomed in the seed business, despite the high cost of initial infrastructure investments. These small seed companies need to use their experience and combine their infrastructure to lower the cost, work more efficiently, and be competitive in the market. The public institutions involved in the seed sector should draw lessons from the dynamic promotion and marketing strategies of the private sector and adopt and adapt some of them for creating better access for farmers. They should also ensure efficient use of the varieties developed by the public institutions.

In view of the shortage of qualified seed experts, the country could benefit from allowing or authorizing former employees and retired public research staff to take part in seed businesses, especially in original seed production. This may enhance the efficiency and quality of original seed production. Moreover, efforts should be made for specialized education and training in seed technology, and enterprise development and management, to lead and manage the seed sector.

Market controls to curb the production and marketing of illegal seed should be increased. Institutionalizing and delegating responsibility for a market control to a public institution or if necessary, establishing a private company with the enforcement service, would be more effective in reducing the illegal seed trade. This task should be carried by a public or private institution, and the financial cost expected to be covered by charging the owners of the varieties for the services provided. Establishing new and/

or strengthening existing efforts to maintain a comprehensive database (TYVS) on area, crop, variety, type and quantity of input use could be effective, and can also serve other purposes, such as assessing impact of supports, bank loans used by farmers, production plans for some strategic crops, and for making better polices. Once such a database is established, access to all or selected data should be facilitated, and the statistics on wheat and wheat seed production be readily available for use by all stakeholders.

References

Aydin, Z. 2010. Neo-liberal transformation of Turkish agriculture. Journal of Agrarian Change 10(2): 149–187.

Bakir, S. 2017 Informal sales of seeds. https://seedturkey.wordpress.com/2017/07/25/informal-sales-of-seeds/. Accessed 05/12/2017.

BÜGEM. 2017b. Why Certified Seed?. http://www.tarim.gov.tr/Konular/Plant-Production/Seed-Production. Accessed 1/12/2017.

BÜGEM. 2018. Tohumculuk İstatistikleri [Seed statistics]. Available at : https://www.tarimorman.gov.tr/BUGEM/Belgeler/Bitkisel%20%C3%9Cretim/Tohumculuk/%C4%B0statistikler/ithalat_miktar_parasal_deger.pdf. [Accessed 9/09/2021]

BÜGEM. 2021. Tohumculuk İstatistikleri [Seed statistics]. Available at : https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim/Tohumculuk/Tohumculuk-Istatistikleri. [Accessed 9/09/2021].

Doğan, M. 2016. Ülkemizde Sertifikalı Tohumluğun Pazarlanması ve Denetimi. TÜRKTOB Dergisi (TÜRKTOB Magazine), Issue: 19. TÜRKTOB, Ankara, Turkey. Available at: http://www.turktob.org.tr/dergi/makaleler/dergi19/21-28.pdf. [Accessed on November 3, 2021].

GTHB. 2016. Tohumculuk 2015: İstatistikler, Göstergeler, Çalıştaylar [Seed Production 2015: Statistics, Indicators, Workshops]. GTHB, Ankara, Turkey. Available at: https://www.turktob.org.tr/en/tohumculuk-2015-istatistikler-gostergeler-calistaylar-kitabi-yayimlandi/22524. [Accessed on November 3, 2021]

Harmansah, F. 2016. Ülkemizde Tohumluk Pazarlaması, Karşılaşılan Sorunlar ve Çözüm Önerileri. TÜRKTOB Dergisi (TÜRKTOB Magazine), Issue: 19 year: TÜRKTOB, Ankara, Turkey. Available at: http://www.turktob.org.tr/dergi/makaleler/dergi19/14-17.pdf. [Accessed on November 3, 2021]

Kan, M., Küçükçongar, M., Keser, M., Morgounov, A., Muminjanov, H., Özdemir, F. and Qualset, C. 2015. Wheat landraces in farmers' fields in Turkey: National survey, collection, and conservation, 2009-2014. FAO, Ankara, Turkey. Available at: https://www.fao.org/documents/card/en/c/2fb32baa-8fca-499e-86d2-96cfa7c787a6/. [Accessed on November 3, 2021]

Karabina, K. 2017. Turkey Grain and Feed Annual Report, GAIN Report, TR7014. USDA Foreign Agricultural Service, Ankara, Turkey. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Ankara_Turkey_4-5-2017.pdf. [Accessed on November 3, 2021]

Küçükçongar, M., Cevher, C., Kan, M., Kan, A., Taner, S., Hekimhan, H., Arısoy, Z., Taner, A., Kaya, Y., Karabak, S., Atalay, A., Bolat, N., Çekiç, C., Atmaca, E. and Avcıoğlu, R. 2006. Determination of Technologies on Wheat Production in Central Anatolia and Transitional Zone of Turkey. Unpublished Report.

Kutay, A. 1997. The private seed sector in Turkey. Pages 49-53 in Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa-and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, ICRISAT

Pray, C.E. 1997. Public policy, public investment, and private investment in seed supply -experiences in Turkey and India. Pages 211-228 in Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: ICRISAT

TİGEM. 2016. 2016 Tohumculuk Sektör Raporu [Seed Sector Report 2016]. TİGEM, Ankara, Turkey. Available at: https://dergipark.org.tr/tr/download/article-file/350349. [Accessed on November 3, 2021].

TODAB. 2021. Tanıtım [Introduction]. https://todab.org.tr/tr/sayfalar?altsayfa=1. Accessed 1/11/2021.

TSÜAB. 2017a. Tohum Sanayicileri ve Üreticileri Ulusal Strateji Raporu [National Strategy Report of Seed Industrialists and Producers]. Available at : http://www.tsuab.org.tr/ckfinder/userfiles/files/tussidet-suabrapor.pdf. [Accessed 05/12/2017].

TSÜAB. 2017b. TSÜAB Çalişma Gruplarinin 2016 Yili Raporlari (TSUAB Working Groups' Reports of 2016). http://tsuab.org.tr/ckfinder/userfiles/files/calismagruburaporlari.pdf. Accessed 05/12/2017. [Accessed on November 3, 2021].

TÜİK. 2021. Crop Production Statistics. http://www.turkstat.gov.tr/PreTablo.do?alt_id=1001. [Accessed on 9/9/2021].

TÜRK-TED. 2016. Türkiye Tohumculuk Sektörünün Sorunlari ve Çözüm Önerileri Hakkinda Rapor (2008–2016) (Report on the Issues and Solutions of the Turkish Seed Sector (2008-2016). http://www.turkted.org.tr/SORUNLAR_ONERILER_TURKTED.pdf. [Accessed on 05/12/2017].

Uyanık, M and Z. Bishaw. 2008. Seed sector privatization in Turkey. Report for project Strengthening the Seed Supply in ECO Region FAO-ECO TCP (TCP/INT/3102), ICARDA, Aleppo, Syria (unpublished).

Chapter V

Seed Quality Assurance and Certification

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BÜGEM, through TTSM and the provincial directorates, is responsible for plant variety registration and/or seed certification. TTSM is responsible for seed quality assurance and certification. Furthermore, seed companies are also accredited for seed quality control and certification. Out of all the seed companies in the country, 16 are authorized to undertake field inspection (e.g. few forage species not including cereal seeds) and laboratory control of their own seed (species determined by BÜGEM). Inspections of private laboratories are periodically carried out by the expert staff of TTSM, regional certification centers affiliated to BÜGEM, and the ministerial plant health laboratories in accordance with the provisions of the Regulation on Delegation of Authority in Seed Services enacted in 2008 and amended twice in 2008 and 2012. Seed companies are penalized according to the provisions of Seed Law for any failure to meet the minimum quality standards of the seed classes. In the extreme case, the penalty could be the loss of license by the companies. While there could be some such cases for wheat seeds, this is more common for vegetable seeds.

Introduction with Historical Context

Seed certification started in 1959, when the Seed Control and Certification Institute was established. Seed certification became compulsory in 1963, when the first Seed Law was enacted. However, the institutional framework to implement certification was slow to develop. In 1968, Turkey signed up to the OECD Seed Schemes, which established various minimum requirements for field inspections and laboratory controls. TTSM was reorganized into its current structure in 1987. Currently, Turkey is a member of the OECD Seed Schemes for varietal certification of: (i) grasses and legumes; (ii) oil or fibre species (sunflower, soya, cotton); (iii) cereals; (iv) sugar beet; (v) maize; (vi) sorghum; and (vii) vegetables (OECD, 2021).

In 1989, Turkey attained equivalence with the EU for seed certification, a necessary condition for exporting seed to the EU. For some crops, such as maize and sugar beet, all seed used in the country, especially since 2000, has been certified (Bozkurt and Engiz, 2001). In 2001, the Central Seed Testing Laboratory of TTSM was accredited by the International Seed Testing Association (ISTA) and remains the only institution accredited by ISTA in Turkey for seed testing. Accreditation of TTSM is renewed every three years by the ISTA audit.

Regulatory Frameworks

Currently, seed quality control and certification is implemented through the following regulations as subsidiaries of Seed Law No. 5553 of 2006:

- Regulation on Characteristics of Specific Production Areas for Growing Seeds and Determining the Principles to be Followed in these Areas (2008)
- Regulation on Cereal Seed Certification and Marketing (2008)
- Regulation on the Delegation of Authority in Seed Services (2008)

- Regulation on Authorization and Control in Seed Sector (2009)
- Regulation on Seed Controller (2010)
- Regulation on Plant Passport System and Registration of Operators (2011)
- Rules for Seed Import (2017)

Institutional Arrangements

TTSM has been the main agency responsible for seed certification since 1987, when it replaced the Seed Control and Certification Institute. TTSM has five regional seed certification directorates in Antalya, Diyarbakir, Izmir, Mersin and Samsun (GTHB, 2016; Bozkurt and Engiz, 2001). In addition, the seed certification and testing directorates (Adana, Adiyaman, Antalya, Beydere, Çayirova, Edremit, Karacabey and Samsun) and provincial directorates of BÜGEM (seed units) are responsible for seed certification. Details about institutional arrangements and facilities of TTSM are given in the variety registration section and Figure 5.1 below. In addition, 16 seed companies are accredited for seed certification, as mentioned above.

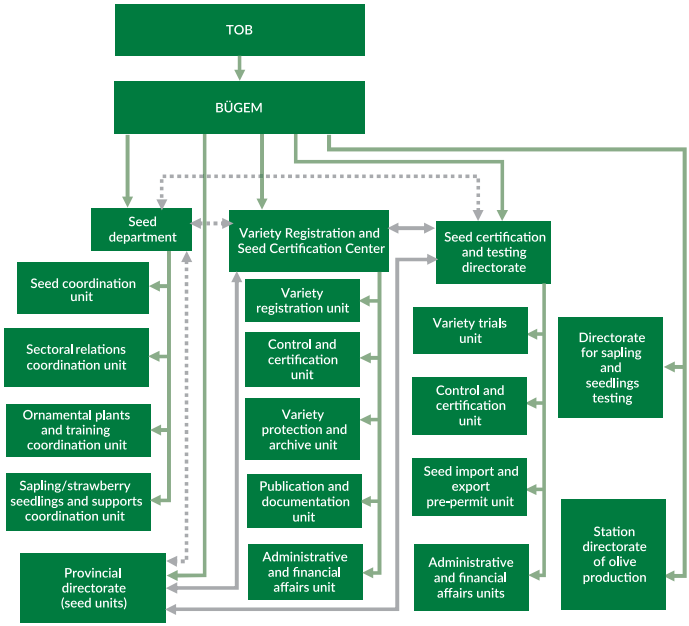

Figure 5.1: Linkages among ministerial seed certification organizations

Note: <---> Directives and circulars from the seed department to regional and provincial units; reports, data, test results, etc. from provincial, regional units to seed department

<——>Mutual coordination and cooperation registration trails, certification, post-control tests, field control, entering data to TVYS, market control, etc.

Technical Procedures

In Turkey, three seed classes are recognized: elite seed, original seed, and certified seed (C1, C2 C3). Elite seed forms the basis of a nucleus seed of a variety and is maintained by the breeder. Original seed is the progeny of elite seed (or of itself), and can only be grown by breeders, research institutes, or private companies with research rights under breeders' supervision. Certified seed is the progeny of original seed, which has been certified according to specific procedures, and is produced by public and/or private seed companies under contract with growers or sometimes on own farms.

All seed produced in the country from registered varieties whose production is permitted must be certified according to their respective seed classes. Wheat seed can only be imported into Turkey for breeding or multiplication purposes and hence, only elite breeding materials or elite and original seed can be imported. Elite and original seeds must comply with national regulations and be accompanied by an OECD and ISTA certificate. The importing organization must submit an application to TTSM for receiving an import permit. Importing transgenic seed is prohibited by the Circular on the Implementation of Rules for Seed Import (2017), which is still in effect.

Certification involves both field inspection and laboratory seed testing (Figure 5.2). In general, field inspections are carried out by official field inspectors who are employees of TOB and are located in provincial directorates and trained by TTSM. Laboratory analysis, on the other hand, is carried out by TTSM or one of the laboratories of the seed certification and testing directorates of TOB. In the case of seed produced for export, only TTSM or BÜGEM staff can carry out field inspections and seed sampling; seed testing is done by an accredited laboratory. The fees for field inspections and seed testing services are set annually by TOB.

Field and seed standards

There are field and seed standards for agricultural and horticultural crops. The field standards include land requirement, cropping history and isolation distance, as well as the allowable level of contamination with off-types and other varieties, other crop species, noxious weeds and plants infected with seed-borne diseases. Wheat fields should be rotated with legume crops and isolated by at least 1 m from any other wheat fields of other varieties. The purity, germination, and seed health are also prescribed by the regulation.

Field inspection

First, the seed company prepares and submits a declaration for each physically contiguous production area for the same variety by a certain date, from March to May each year, depending on the region. Declarations are submitted to the provincial directorate or authorized private seed companies with accreditation by TTSM.

Once declarations are submitted, seed controllers (field inspectors) carry out inspection of seed production fields. Seed controllers are either 'official' (BÜGEM or

TTSM staff), or private professionals (for controls other than field inspections) associated with the sub-unions or other professional associations. They are required to have a BSc or MSc qualification – preferably in agronomy or horticulture – from recognized departments of agricultural colleges, have attended relevant training, and carry a Seed Controller Card issued by BÜGEM or a relevant professional association.

Field Control Reports are issued online in the TVYS and printed out and approved by the controllers whose names have been specified on the form that makes part of the report, since the controllers are already registered in the system, and it is clear which parcels they are responsible for inspecting. The field inspection establishes the seed class and assesses that planting conditions are appropriate to maintain the identity and purity of the variety. This includes assessing if different varieties are adequately isolated, and that the mixture of other varieties/species, noxious weeds, and seed-borne diseases do not exceed specified thresholds prescribed by the standards.

Laboratory seed testing

After field inspection and approval, labels are supplied by TTSM and TÜRKTOB based on estimates of expected production. The approved seed production fields will be harvested, processed, packaged, and labelled on a seed lot basis according to the regulations. Seed controllers take samples from these seed lots for laboratory analysis. For wheat, a single lot must not be more than 30 tons, from which a minimum of 1 kg is taken as a sample. Detailed guidelines for seed sampling are published by TTSM (TTSM, 2018).

Laboratory analysis is carried to assess physical purity, germination and seed health. The seed must have at least 98% and 97% physical purity for original and certified seed, respectively. If the sample passes the laboratory analysis, the laboratory issues a seed report and certificate for the seed lot from which the sample was taken and analyzed. If the seed sample fails the laboratory analysis, seed producers may request a repeat analysis on a new sample. If the certifying agency is not TTSM, producers may appeal to TTSM. TTSM is responsible for issuing labels and international seed certificates. Certification is valid for one year, but seed may be sold after the certificate expires, in which case, the seed must be tested again and pass germination tests.

Private organizations cannot conduct field inspection and seed sampling for original or elite seed classes, or seed that is for export. Field inspection and sampling activities cannot be delegated to seed producers, but laboratory analysis and documentation activities may be. In these cases, the seed producer may only analyze and certify their own seed. Although allowing seed producers to certify their own seed has the potential to undermine confidence in the system, it is in line with the EU equivalence standards. In 2018, about 32 seed producers were authorized to self-certify their seed, 16 (including TİGEM) of which were authorized for wheat. At the same time, only one non-seed producing company was authorized to certify seed, including wheat (TOB, 2018).

Control plot tests

TTSM also carries out post-control tests from certified seed samples to test varietal purity – following the OECD Seed Scheme. Almost all original and elite seed and certified seed are subject to control plot tests which focus on varietal identity, purity and seed health.

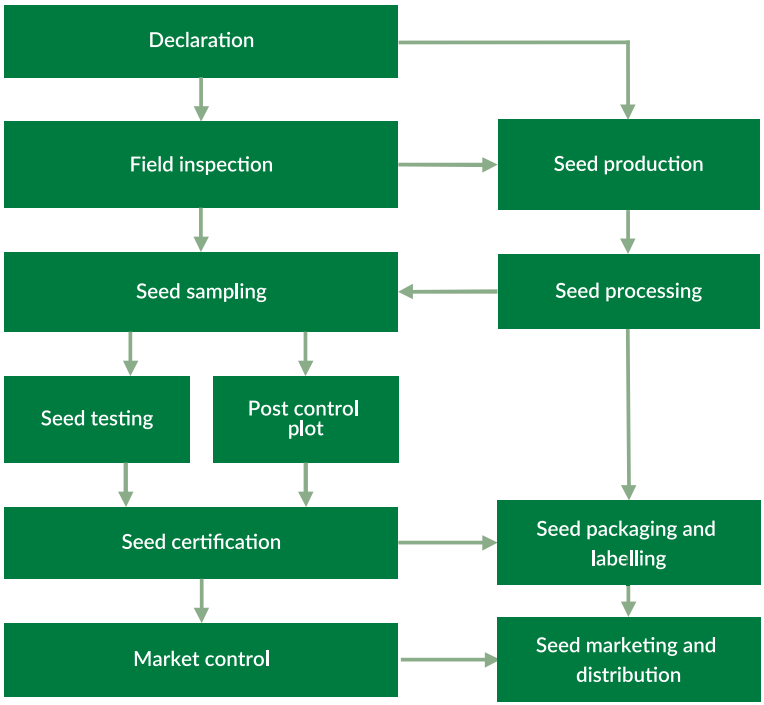

Figure 5.2: Seed certification and market control in Turkey

Major Achievements

During the last 10 years, there were major achievements in seed quality assurance and certification. With a substantial increase in certified seed supply and use in the country, there was a tremendous increase in the area dedicated to wheat seed production. For example, there was a substantial increase in the amount of certified seed of wheat produced from 2008 to 2019 – up from 158,452 tons to 483,951 tons – approximately a threefold increase in 10 years. This has an implication on area planted, inspected and approved, as well as on seed samples drawn, tested and approved for seed production by the seed certification agency.

The total average area of wheat seed production fields inspected during 2016-2019, for example, was 189,701 ha, of which, 181,614 ha was approved (Table 5.1). For bread wheat, about 146,869 ha was inspected and 141,466 ha was approved, whereas for durum wheat, about 42,832 ha was inspected and 40,148 ha was approved (Table 5.1). The average rejection levels were 3.7% and 5.8% for bread and durum wheat, respectively – leading to an overall average of 4.3%.

Table 5.1: Summary of bread and durum wheat field inspection: 2016-2019

Year	Bread wheat				Durum wheat				Total			
	Area inspected (ha)	Area approved (ha)	% rejected	Quantity of seed produced (t)	Area inspected (ha)	Area approved (ha)	% rejected	Quantity of seed produced (t)	Area inspected (ha)	Area approved (ha)	% rejected	Quantity of seed produced (t)
2016	137,409	132,341	3.7	356,750	42,097	39,631	5.9	128,475	179,506	171,972	4.2	485,225
2017	148,205	144,559	2.5	365,512	53,625	47,789	10.9	142,679	201,830	192,348	4.7	508,191
2018	134,020	127,974	4.5	332,307	42,448	41,198	2.9	94,351	176,468	169,172	4.1	426,658
2019	167,842	160,991	4.1	394,428	33,157	31,973	3.6	89,523	200,998	192,964	4.0	483,951
Average	146,869	141,466	3.7	362,249	42,832	40,148	5.8	113,757	189,701	181,614	4.3	476,006

Source: BÜGEM, TVYS

Similarly, there was an increasing trend in the number of samples analyzed

commensurate with the increase in wheat seed production. The same trend was observed for all wheat seed samples, for instance, there was an increase from 6,016 samples in 2013 (data not shown) to 17,503 samples in 2019, an increase of almost three times. For bread wheat, 5,147 seed samples were submitted for analysis in 2013 (data not shown) and this increased to 14,280 seed samples in 2019, an increase of 2.8 times. For durum wheat, the seed samples showed a fourfold increase – from 869 in 2013 (data not shown) to 3,444 in 2019 (Table 5.2). In total, during 2016-2019, about 17,503 wheat seed samples on average were tested, 16,827 seed samples were approved, and the rejection level was only 3.9%. The overall rejection level of all seed samples was below 10%, although higher rates were recorded for durum wheat, with an average of 8.6%, compared with bread wheat at 2.3%. Higher rejection rates were observed for durum wheat which may be related to the growing season (Grass and Tourkmani, 1999). Relatively higher rejection level for durum wheat was also reported in Morocco (Bishaw et al 2019).

These results of both field inspection and seed testing show the shift from a quality control to a quality assurance system is functioning well in Turkey.

Table 5.2: Summary of laboratory analyses results for seeds of bread and durum wheat: 2016-2019

Year	Bread wheat			Durum wheat			Total		
	# samples submitted	# samples approved	% rejected	# samples submitted	# samples approved	% rejected	# samples submitted	# samples approved	% rejected
2016	13,018	12,579	3.4	4,861	4,549	6.4	17,879	17,128	4.2
2017	13,025	12,750	2.1	5,464	5,017	8.2	18,489	17,767	3.9
2018	12,089	11,893	1.6	3,829	3,361	12.2	15,918	15,254	4.2
2019	14,280	13,980	2.1	3,444	3,179	7.7	17,724	17,159	3.2
Average	13,103	12,801	2.3	4,400	4,027	8.6	17,503	16,827	3.9

Source: BÜGEM, TVYS

Key Challenges

While it is functioning well, the Turkish seed quality assurance and certification system is not free of problems. Available documents (TÜRK-TED, 2017, TSÜAB, 2017b, and TSÜAB, 2017a) list some of the prevailing challenges and constraints to overcoming them. This includes the need to review seed quality – where laboratory standards for different seed classes need to be amended for wheat. Currently, the seed standards for certified seed 2 (C2) and certified seed 3 (C3) are the same. Options to remove the certified seed 3 (C3) class, like in the EU, or amendments of the standards, should be discussed. Amendments of the seed standards will improve the physical quality of certified seed as proposed by TÜRK-TED (Table 5.3). This needs to be jointly discussed among government institutions and the private sector to come up with new agreed standards that may improve the quality of certified seed (TÜRK-TED, 2016).

Table 5.3: Suggested wheat seed standards for different seed classes in Turkey

Current official seed standards					*Suggested seed standards**				
Factors	*Pre-basic*	*Basic*	*C1*	*C2 &C3*	*Pre-basic*	*Basic*	*C1*	*C2*	*C3*
Pure seed (min. %)	-	98	97	97	-	99	98	97	97
Other grain seeds (max. count/kg)	2	2	6	40	2	2	6	20	30
Other species & varieties (max. count/kg)	2	4	20	100	2	4	20	40	60

*Note: *Seed standards suggested by TÜRK-TED*

The land requirement provision of the Regulation on Cereal Seed Certification and Marketing does not allow cultivation of the same species for two consecutive years. This is one of the major constraints for the private sector as most of them specialize in one crop and hence, want to produce seed of the same crop year after year. This issue needs to be discussed with all stakeholders and a solution provided based on scientific evidence.

Cognizant of the increase in the amount of certified seed produced and planted, and the number of companies in the sector, the capacity of the certification system can no longer meet the needs of the sector. It takes 21-22 days to get the results once a seed sample has been withdrawn from the seed lot. This can be reduced to about 11-12 days by increasing the testing capacity of the TTSM. The delay has been partly solved by authorizing some private companies for seed certification.

The limited number of controllers deployed for field inspection and seed sampling causes delay in seed certification because field controls are done only by governmental organizations (i.e. TTSM and other public organizations). TSÜAB members demand market control to be made more efficient, the number of field controllers to be increased and their qualifications improved (TSÜAB, 2017a and 2017b).

It is quite difficult to produce pre-basic and basic seed classes under contracted farmer conditions. The desired purity may not be achieved if seed is produced in small and scattered plots, mainly due to the difficulties in both planting and harvesting production fields. The high rejection levels of very expensive pre-basic seed due to admixtures entails significant cost to the seed companies, leading to insufficient and expensive seed production (TÜRK-TED, 2016). Clustering small fields to increase the field sizes and for increasing isolation distance is one option when working with small farmers.

Certification and marketing regulations for seeds of various plant groups, including the Regulation on Cereal Seed Certification and Marketing enacted in 2008, need to be updated in consultation with all actors and experts in the sector (TSÜAB, 2017a). As the regulation has not been amended since 2012, TSÜAB and TÜRK-TED members wanted to make amendments to the regulation (including the reduction of current 1% membership fees and the high penalties for failure to meet minimum quality requirements), through negotiations with the full participation of representatives from public, private sector and professional organizations, such as TÜRKTOB, TÜRK-TED, TSÜAB, BISAB, TODAB and TYAB.

The maximum weight of a seed package is 50 kg according to the Regulation on Cereal Seed Certification and Marketing. This guideline brings an extra cost for large farms. The solution recommended by the seed companies is to change the maximum weight of the packaging in the relevant article of the Regulation to 500 kg (TSÜAB, 2017b) to serve large farms, while continue packaging at 50 kg for smallholder farms. When marketing, there is no information on agronomic traits of the variety on the seed package other than information on seed quality. The private sector requested that agronomic information be added to the label as a requirement as it will ensure the correct use of new varieties by farmers (TÜRK-TED, 2016).

The authority to print certified seed labels belongs only to TTSM and TÜRKTOB. However, the label delivery system is sometimes slow and may delay reaching seed producers. The issue could be solved by authorizing the printing of labels automatically during packaging by the seed companies based on the requirements laid down by TOB (TÜRK-TED, 2016).

Lessons Learned

Previously seed certification was solely carried out by TTSM. Since 2012, however, private sector laboratories are also authorized to undertake seed certification under the auspices of TTSM – mainly for their own production. This has increased the overall national capacity and reduced the waiting time for seed testing results and hence, enhanced timely distribution of certified seeds. In 2019, out of a total of 32 laboratories, about 16 private seed testing laboratories are authorized for wheat seed certification.

There are international organizations which develop and enforce the general use of global and regional rules, procedures, and methods that govern the production and commercialization of seeds. The existence of such organizations is believed to have enhanced the development of the seed sector in member countries. For example, Turkish membership to the OECD, the International Organization for Standards, and ISTA enhanced the country's capacity to operationalize the seed certification scheme, aligning it to international standards and making it more reputable, thereby facilitating greater involvement of the country in international seed trade.

Recommendations

TTSM and the affiliated directorates of TOB, as well as the private sector laboratories, are responsible for seed certification. However, the effectiveness of market control should be increased and tightened to reduce informal seed sales and sanction penalties (TSÜAB, 2017b). Current practices for market control should continue to be carried out by the provincial directorates of the Ministry and TODAB.

The accreditation standards of private seed laboratories should be periodically reviewed by the relevant agencies (e.g. Turkish Accreditation Agency). A mechanism should be put in place to ensure that the quality of their work meets the minimum

requirements. This is necessary to retain confidence in a regulatory system that permits commercial seed producers to self-assess their own seed.

Farm-saved seed is not subject to certification and cannot be sold legally in the market. Provincial directorates of TOB should focus on stopping this illegal practice without infringing on smallholder farmers' traditional rights to use their own saved seed as stipulated in the law.

The sale of counterfeit and illegal seeds causes unfair competition; violation of the rules must be stopped collectively by all stakeholders in the sector. This can be better achieved if the task of controlling seed trade and use is institutionalized within a central data repository system, which would make it easy for the owners of the varieties – especially individual breeders and small private seed companies – to control the use of their varieties.

References

Bishaw, Z., Yigezu, Y. A., Niane, A., Telleria, R. J., Najjar, D. (eds). 2019. Political Economy of the Wheat Sector in Morocco: Seed Systems, Varietal Adoption, and Impacts. International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon. 300 pp.

Bozkurt, B. and Engiz, M. 2001. Focus on Seed Programs: The Seed Industry in Turkey. ICARDA, Aleppo, Syria.

Grass, L. and M. Tourkmani. 1999. Mechanical damage assessment in rejected durum wheat seed lots in Morocco. Seed Science and Technology 27(3): 991–997.

GTHB. 2016. Tohumculuk 2015: İstatistikler, Göstergeler, Çalıştaylar [Seed Production 2015: Statistics, Indicators, Workshops]. GTHB, Ankara, Turkey. Available at: https://www.turktob.org.tr/en/tohumculuk-2015-istatistikler-gostergeler-calistaylar-kitabi-yayimlandi/22524. [Accessed on November 3, 2021]

OECD. 2021. Quality seeds for world needs. OECD Seed Schemes. Available at: https://www.oecd.org/agriculture/seeds/documents/oecd-seed-schemes-brochure.pdf. [Accessed on 1/11/2021].

TOB. 2018. T.C. TARIM VE ORMAN BAKANLIĞI. Available at : https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim/Tohumculuk/Laboratuvar-Yetki-Devri-Alan-Kuruluslar. [Accessed on 26/11/2018].

TSÜAB. 2017a. Tohum Sanayicileri ve Üreticileri Ulusal Strateji Raporu [National Strategy Report of Seed Industrialists and Producers]. Available at : http://www.tsuab.org.tr/ckfinder/userfiles/files/tussidetsuabrapor.pdf. [Accessed on 05/12/2017].

TSÜAB. 2017b. TSÜAB Çalişma Gruplarinin 2016 Yili Raporlari (TSUAB Working Groups' Reports of 2016). Available at : http://tsuab.org.tr/ckfinder/userfiles/files/calismagruburaporlari.pdf. [Accessed 05/12/2017].

TTSM. 2018. Number of Wheat Varieties Registered in Turkey. Available at: https://www.tarimorman.gov.tr/BUGEM/TTSM/Sayfalar/Detay.aspx?Sayfald=85. [Accessed on 26/11/2018].

TÜRK-TED. 2016. Türkiye Tohumculuk Sektörünün Sorunlari ve Çözüm Önerileri Hakkinda Rapor 2008–2016 [Report on the Issues and Solutions of the Turkish Seed Sector 2008-2016]. Available at: http://www.turkted.org.tr/SORUNLAR_ONERILER_TURKTED.pdf. [Accessed 05/12/2017].

Chapter VI

Adoption, Impacts and Seed Demand Analysis

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Summary

The seed sector in Turkey has grown rapidly since the new Seed Law entered into force in 2006. Both the public and private sectors' production capacity has increased with the help of government policies supporting domestic production of seed and certified seed usage. Despite the country's importance in terms of genetic diversity, size of the wheat improvement program, total wheat area, and its contribution to the world market, there has not been a comprehensive study to document the adoption and impacts of improved wheat varieties, their regional distribution, and farmers' seed demand. This study aims at providing: i) credible estimates of current national and provincial adoption levels of improved varieties with particular attention to their release dates; ii) analysis of factors influencing farmers' decision and intensity of adoption of improved wheat varieties; iii) estimates of impacts on farmers' livelihood indicators, particularly yield, gross margins, and wheat consumption; and iv) estimation of seed demand at farm, provincial and national levels. By doing so, the study aims at generating useful information and policy guidance for enhancing the viability, sustainability, and socio-economic benefits of wheat production in Turkey. To this effect, the study used a nationally representative sample of 2,560 farm households, drawn from 687 villages that are distributed across 123 districts and 27 provinces. This sample constitutes about 62% of the total 7.86 million hectares of national wheat area, and a similar percentage of the 1.04 million wheat-growing families in the country. Data analysis was carried out using descriptive statistics, a double hurdle model, and the instrumental variables (IV) regression approach.

Survey results show that 135 different wheat varieties were under cultivation by Turkish farmers during the 2014/2015 growing season. More than 80% of these varieties were either local landraces or more than 10-year-old improved varieties. Varieties released in the last 5, 10, and 15 years were cultivated by 14.8%, 20.4%, and 47.1% of all wheat growers, respectively, covering 19.14%, 25.3%, and 50.7% of the total national wheat area. About 14.5% of all farmers were still cultivating varieties that were at least 40 years old – on 11.12% of the total wheat-growing area. All these figures show that varietal replacement is slow in Turkey, with an area-weighted average varietal age of 20.82, which is much higher than the 12-14 years estimated in 2014 and shows that old varieties still dominate the wheat landscape in the country. The top 10 and top 5 wheat varieties are cultivated by 55.8% and 35.4% of wheat growers, respectively, on 58.2 % and 37.2% of the total wheat area, which, with the large number of varieties found in farmers hands, shows fairly high diversity of wheat varieties in the country[5]. Sadly, most (38%) of the top 10 varieties covering about 35.1% of the national wheat-growing area were released before 2000. The top three varieties in terms of the number of growers are CEYHAN99, ESPERİA, and BEZOSTAJA-1, which were cultivated by 23.3% of all Turkish farmers. The top three varieties in terms of area coverage are CEYHAN99, ESPERIA, and ÇEŞİT1252 which are cultivated on 25.6% of the total wheat area.

The Consultative Group for International Agricultural Research (CGIAR) through

its two centers, namely CIMMYT and ICARDA have been actively working in Turkey supporting the country's efforts to develop improved wheat varieties. Particularly, the joint ICARDA, CIMMITY, and Turkey International Winter Wheat Improvement Program (IWWIP) based in Turkey has been actively developing winter wheat varieties some of which were released in Turkey and other countries in the CWANA region. During the survey, a total of 27 CGIAR varieties (14 from CIMMYT, 1 from ICARDA, and 12 from IWWIP) were found in Turkish farmers' hands with a total combined area coverage of 20.33% of the total wheat area. The top 5 CGIAR varieties in Turkey are Ceyhan99, Konya2002, Firat93, Ekiz, and Sönmez2001, which together are cultivated on 16.65% of total wheat area in the country. Particularly, with an area coverage of 10.18% of total wheat area in the country, Ceyhan99 ranks 1st from among all varieties under cultivation in the country. These results clearly show the importance of the Turkey-CGIAR collaboration.

Among many other factors, access to credit has a significant effect on adopting improved wheat varieties, as farmers with better access to credit facilities are likely to have the needed financial liquidity to purchase certified seeds and other complementary inputs. Therefore, policymakers need to improve current credit systems to ensure that smallholders can have better access to credit. Hosting demonstration trials on farmers' own farms and the number of farmer contacts with extension personnel, specifically targeting wheat production, increase farmers' propensity to adopt improved wheat varieties.

The adoption of improved wheat varieties leads to a 1,136kg/ha (32.4%) increase in yields, a TRY 1,282.2 Turkish Lira or US$337.4 (41.7%) per ha increase in gross margins[6], and a 11.5 kg/capita/year (19.7%) increase in wheat consumption from own production – all clearly showing that the improved varieties are contributing to livelihood improvements. Nationally, the introduction of improved wheat varieties has led to the additional production of 4.53 million tons of wheat every year, which is associated with an increase in wheat availability from domestic production of about 56.8 kg/capita/year, and a total national income gain of about TRY 5.11 billion or US$1.346 billion per year.

The average seeding rate for wheat in Turkey is 182.5kg/ha, which, given the total area of 7.84 million hectare of wheat in 2015, translates to a national seed utilization rate of 1.43 million tons per year. Official certified seed distribution data shows that a total of 484,204 tons (176,588 tons from the public and 307,616 tons from the private sectors) was distributed in 2015. This shows that certified seed use rate in the country is only 33.93%, indicating an average seed replacement rate of once every three years. Of the total seed utilized, Konya leads all other provinces using 148 thousand tons of wheat seed, followed by Diyarbakır, Yozgat, Sivas, and Çorum, which have used 80, 70, 60, 50, and 40 thousand tons of wheat seed respectively. CEYHAN99, ESPERIA, ÇEŞİT1252, KIZILTAN91 and BAYRAKTAR2000 are the top five varieties with the highest seed use in Turkey. These results are consistent with the official statistics on the total amount of certified seed produced and distributed.

During the survey year, about 47.67% of Turkish wheat farmers purchased certified

(6) The exchange rate in 2016-2017 was: 1 US$ = 3.8 Turkish Lira (TRY) while in 2021, 1 US$ = 7.5 (TRY)

seed for one or more of their wheat fields. The area-weighted average seed replacement rate in a given wheat field is 2.1[7] years, where seed is being replaced every year in most fields (18.3%), while seed is not replaced for over 10 years on 25.7% of the fields. Farmers stated that absence or non-availability of seeds in sufficient quantities in the market at the right time, followed by the absence of varieties suitable for the changing climate, and seeds that can withstand disease and pests as the most critical seed-related problems.

Farmers proposed the following solutions to solve the current seed-related problems: i) choosing the right varieties for the climate (31%); ii) timely distribution of seed (25.6%); iii) purchasing seeds from 'special companies', which we suspect as meaning 'private companies'(16.5%) – with which farmers emphasized on the need for strengthening the informal sector to fill the gap; and iv) government action to solve all seed-related problems (12%).

Introduction

Due to its favorable climate, geographic position, rich soils, and biological diversity, agriculture plays a vital role in Turkey, both in social and economic terms. With a total of over 24.4 million hectares of arable land (of which 18.4% has access to irrigation), Turkey is one of the few food self-sufficient countries in the world (FAOSTAT, 2020). Despite the decreasing share in GDP from about 55% in the 1960s to 5.82% in 2018, the total volume and value of agricultural production rose throughout the period, where the total value reached 86.4 billion Turkish lira (TRY) in 2018 (TÜİK, 2018; FAOSTAT, 2020).

In 2011, Turkey was the world's seventh largest agricultural producer and one of the biggest producers of a wide range of agricultural commodities (Handan, 2012). The country is believed to have maintained its global leadership position, as attested by its rising exports in almost every agricultural product. As a result, the sector continues to play a vital role in foreign trade. The Turkish agricultural sector also employs about 5 million people, which constitutes approximately 20% of total employment in Turkey (TÜİK, 2021) – providing means of livelihoods to a sizeable size of the population directly or indirectly.

Currently, 67.8% (16.3 million hectares) of total arable land is under cultivation, of which, 74.2% (12.1 million hectares) is sown with cereals. With a share of 66.9% of the total cereal area (8.21 million hectares), wheat ranks first among all crops cultivated in the country (FAOSTAT, 2020).

Wheat is one of Turkey's most important agricultural commodities both in terms of area and value, and the country ranks among the top 10 producers in the world. It is a strategic crop because it is a staple and an essential food in the Turkish diet, consumed primarily as bread, bulgur, yufka (flat bread), and cookies. Approximately 21.5 million tons of wheat are produced every year (FAOSTAT, 2020).

The trend in wheat area, production, and yield in Turkey since the 1960s is shown

(7) This is slightly less than the three years calculated above using the total certified seed production and the total wheat area in the country. These results are consistent because the official statistics do not include seed used from unofficial sources which, if included, would increase the speed of seed replacement (i.e. reduce the number of years before seed is replaced).

in Figure 6.1. Relative to the levels in 1961, while the cultivated area has decreased by 2.35%, yield levels have seen dramatic increases of over 208%, leading to increased total production by over 200%. The wheat area was about 8 million hectares in 1961, which expanded until the mid-90s, reaching a little over 9 million in 1994. Between 1994 and 2017, the cultivated area reduced by 21.3%, while yield increased by 56.11%, resulting in an overall production increase of 22.86%.

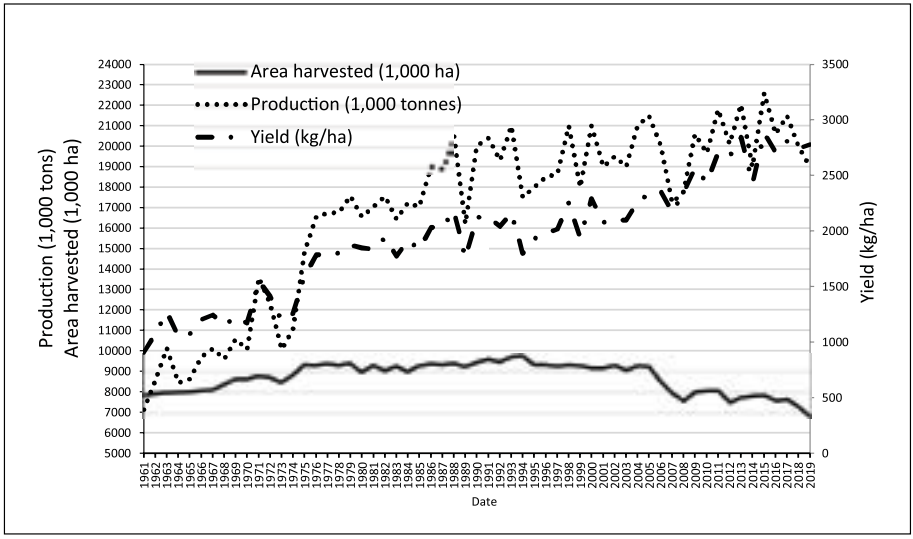

Figure 6.1: The changes in wheat cultivation area, yield, and the total production in Turkey

Source: (FAOSTAT, 2020)

The Turkish Government's agricultural support programs also played an essential role in enhancing the speed and extent of growth in productivity and total production. Grain production in Turkey is highly dependent on governmental policies because grains are considered strategic commodities and hence, are within the scope of state support procurements. As a result, different field-based agricultural subsidies are implemented in Turkey (TUGEM, 2012; Giray, 2012). The combination of public policy support, national and international research, and national and international market developments have made grains the most important crop group in Turkey, accounting for over 20% of the total value of national agricultural production (TÜİK, 2012).

A goal of national self-sufficiency in wheat production and stability of bread prices are always hot topics and important indicators among politicians for the performance of agricultural policies. Consequently, Turkish Government administrations have been formulating and implementing special policies on wheat, including agricultural subsidies, intervention prices, and high protective tariffs. As part of such interventions, the Government of Turkey continues to support wheat production with production premium programs. According to the 2018 production bonus announcements, the

wheat premium remained at TRY 50/MT (equivalent to US$13/MT). The government also provides several other benefits to farmers, including subsidies for the use of certified seed, soil analysis, diesel and fertilizer (Table 6.1).

The deficiency payment premiums were determined based on the supported crops for every basin, and suitable products were supported in their basins (GTHB, 2012). According to the model, wheat is a unique crop supported in every basin in Turkey (USDA, 2018a).

Table 6.1: Government support program for wheat (TRY/MT)

Year	*Certified seed (TRY/ha)*	*Price support from government (TRY/ton)*	*Soil analysis (TRY/ton)*	*Diesel (TRY/ha)*	*Fertilizer (TRY/ton)*
2009	50	45	22.5	29.3	38.3
2010	50	50	25	32.5	42.5
2011	60	50	25	37.5	47.5
2012	60	50	25	40	50
2013	75	50	25	43	55
2014	75	50	25	46	60
2015	85	50	25	48.5	66
2016	85	50	110*		
2017	85	50	8	130	40
2018	85	50	8	150	40

Source: Turkish Official Gazette

*Note: * The Government of Turkey paid TRY110 for these three categories combined in 2016.*

In addition to government incentives promoting wheat, the growth in yield and total production volume over the years is attributed to the growing use of new improved varieties and the adoption of planting techniques, irrigation, fertilization, and plant protection technologies (Altuntaş and Demirtola 2004). The scientific advances made by national public and international research centers were instrumental in making the needed technologies available. From the beginning of its 'green revolution' in 1969 (Kan et al., 2015), Turkey made major changes transitioning from a predominantly public to a private sector-led seed industry, and from heavy reliance on seed imports to domestic production involving both public and private plant breeding programs. With its research infrastructure and a core of well-trained scientists, Turkey has released several improved wheat varieties which are adopted by farmers (Kan et al., 2015). The implementation of new agricultural policies in the 1980s in particular enabled private companies and public agencies to introduce several new varieties at an accelerated rate. After 1990, many

new cultivars which are high yielding and possess good quality traits such as resistance to yellow rust (caused by Puccinia striiformis Westend. f.sp. tritici) were released (Akar et al., 2007).

A new seed law entered into force in Turkey in 2006 led to the rapid growth of the seed sector in the succeeding years. The new policy supported certified seed usage and helped increase the production capacity of both the government and private seed sectors. Within 10 years of its introduction, the new policy succeeded in increasing certified seed production by about threefold – from 169.116 tons in 2006 to 484,204 tons in 2015, covering about an equivalent of 32.3% of total annual seed requirement for the year. During the same period, the private sector share in total wheat seed production increased from 20% in 2006 to about 64% in 2015 (USDA, 2018b). The amounts of seed saved from own production by Turkish farmers for the following years' planting season have consistently reduced for all crops. However, own-saved seeds still represent over half of the wheat seed planted every year, although wheat seed is the largest amount of certified seed produced in 2015 – which is no surprise as it is the most widely grown crop in Turkey.

Quality seed is an agricultural input and an income-generating product produced and processed using advanced technologies (Adem et al., 2017; Güngör et al., 2016). Given the strategic nature of seeds, every country tries to be self-sufficient in the seeds of important crops (Adem et al., 2017). In terms of producing more reliable, less costly, and more competitive and quality products, along with increasing the yield and production of agricultural products, quality seed is important (Adem et al., 2017; Hazneci and Ceyhan, 2016). Quality seed can help in increasing productivity by up to 20–30% (Elçi, 2000).

Despite the success in transforming the seed sector and hence, the development and dissemination of several improved varieties of wheat, and the increase in the amount of certified seeds produced and sold by both the public and private sectors in the country, there has been no systematic nationwide monitoring of the adoption of improved varieties. As such, there has also been no estimation of their socio-economic impacts, and more importantly, the impacts of certified wheat seeds on producers, particularly smallholders. Though there are some studies conducted on this issue at the regional or district level, key socio-economic questions remain unanswered at the national level. The present study will focus on proving credible evidence on: i) the levels of adoption of improved wheat varieties at national, regional, and district levels; ii) if there are regional and/or agro-ecological differences in general and variety-specific adoption of improved varieties; and; iii) whether these improved varieties and the wider use of certified seeds have contributed to productivity growth, and if so, by how much; and iv) the impacts of adoption of improved technologies on the livelihoods of smallholder famers.

Objective of the Study

This report aims at generating credible statements of the current levels of adoption of improved wheat varieties, and the use of certified seeds and their impacts using statistically representative national data. Particularly, the report attempts to:

- Provide an exhaustive list of varieties that are in farmers' hands and try to determine whether they are improved or landraces by comparing them with the list in the national variety release catalogue.
- Determine the current levels of use (in terms of both % of area and % of farmers) of each improved variety and local landrace that is currently under cultivation at national, provincial, and agro-ecological levels.
- Identify the major determinants of the decision and intensity of adoption of improved wheat varieties.
- Determine the types (certified vs. uncertified) and quantities of seed from the different sources used by farmers and the reasons for farmers' decision to use these sources.
- Determine the total national seed use.
- Measure the impacts of adopting new improved wheat varieties on wheat productivity, gross margins, farm household income, and wheat consumption from own production.

Survey Design

This study is based on data collected using a large nationally representative sample household survey carried out in Turkey in 2015. All the 79 major wheat-producing provinces of Turkey were grouped using a combination of three stratification criteria, namely: i) source of water (irrigated vs. rainfed); ii) types of wheat produced (bread wheat vs. durum wheat); and ii) agro-ecology or season of wheat production (spring, facultative, or winter). Based on these stratification criteria, the 29 top wheat-growing provinces representing 65% of the total wheat area and equivalent percentage of farmers in the country were systematically selected for inclusion into the sample, with due attention to the need for ensuring a fair representation of each stratum in the sample.

Using power analysis, the minimum sample size required to ensure 95% confidence and at least 2% precision levels for capturing up to 50% adoption of improved wheat varieties (an estimate by experts prior to the survey) from among a total of 657,067 farmers in the 29 sample provinces was determined to be 2,393 households. The sample was inflated upwards by about 18% to buffer the effects of possible higher adoption levels, missing values, non-response, erroneous entries, and to ensure a certain minimum sample size at the village level, which is the primary sampling unit. Therefore, a sample of 2,928 farm households was determined to be the minimum sample size needed. Proportional to the number of wheat farmers in each administrative unit, the sample was then distributed among 128 districts and 691 villages. Shortly after the survey started, the study team decided to drop two provinces, namely Adana and Mersin, in the eastern parts of the country close to the Syrian border for security reasons. Therefore, the total number of provinces covered by the sample became 27, representing 62% of the total national wheat area. The sample size was also reduced to 2,560, which was then distributed (proportional to size) into 123 districts and 687 villages (Table 6.2).

Table 6.2: Distribution of sample households for the wheat adoption study

Province	Wheat area (ha)	Total number of wheat growers	Sample statistics				
			No. of districts	No of villages	Number of households		
					Female-headed	Male headed	Total
Adıyaman	87,192	34,415	3	10	0	72	72
Afyon	165,811	45,937	9	51	2	107	109
Aksaray	85,881	23,642	6	11	0	51	51
Amasya	107,653	22,289	3	13	0	62	62
Ankara	456,804	48,167	6	51	2	187	189
Antalya	105,871	35,007	4	29	1	76	77
Balıkesir	117,376	49,269	6	19	0	98	98
Çorum	221,475	45,028	4	39	0	122	122
Diyarbakır	386,714	47,944	5	22	0	170	170
Edirne	137,236	31,937	3	17	0	86	86
Eskişehir	182,736	29,108	9	37	1	91	92
Erzurum	115,705	36,938	5	18	0	82	82
İzmir	33,540	44,988	8	22	1	43	44
Kahramanmaraş	137,523	31,991	3	23	0	79	79
Karaman	103,769	17,941	3	12	0	30	30
Kayseri	157,743	31,700	5	66	1	85	86
Konya	719,393	109,585	14	64	0	238	238
Kütahya	139,449	26,691	4	15	0	79	79
Manisa	104,290	71,286	6	33	2	69	71
Nevşehir	112,439	24,167	4	10	0	46	46
Niğde	69,356	15,139	3	8	0	43	43
Samsun	108,2,35	61,542	3	38	0	105	105
Sivas	296,708	33,010	4	22	1	123	124
Tekirdağ	184,184	27,713	3	18	0	88	88
Tokat	129,961	33,989	3	17	0	84	84
Van	80,494	36,871	3	8	0	68	68
Yozgat	326,753	50,591	6	60	0	165	165
Total sample	4,874,290 4.874.289	1,066,885	123	687	11	2,549	2,560

Methodology

Determination of the levels of adoption

Adoption degrees (as % of the wheat area) are generated first at household levels, which are then aggregated to generate the village level estimates of adoption degrees using the wheat area cultivated by each sample farmer as weight. The adoption rate at the village level is generated as the ratio of the number of adopters to the total sample size from the village converted into a percentage. The village level estimates of adoption rates and adoption degrees are then aggregated up to district levels using the district-level total wheat farmer population and total wheat area as weights. The same procedure is used to aggregate the district-level estimates into provincial, and ultimately, into national levels.

Explaining farmers' adoption decisions

Previous empirical studies on the adoption and diffusion of agricultural innovations found that a wide variety of different factors affect farmers' adoption decisions (Akinbode et al., 2015; Finger and Benni, 2013; Mariano et al., 2013; Mignouna et al., 2011; Asfaw et al., 2011). Particularly, literacy level and farming experience (Okunlola et al., 2011), household size (Uaiene et al., 2009; Wiggins, 2009), physical and financial capital, including access to credit (Muzari et al., 2012; Simtowe & Zeller, 2006); landholding size (Uaiene et al., 2009; Wiggins, 2009) are important determinants of adoption. Moreover, farm income (Diiro, 2013), availability and accessibility of the technology components such as seeds, and distance to input sources (Tefera et al., 2016) also influence adoption decisions.

Diiro (2013), Doss (2003), and Wale and Yallew (2007) hypothesized that the probability of adoption of a new technology would depend on farmers' ability to perceive its advantages and compatibility with their existing socioeconomic conditions. There is a general agreement that farmers' level of knowledge on improved agricultural technologies influences their technology preference. For example, Doss (2003) reported that adopters had a better understanding of fertilizer application than non-adopters. Farmers' attitude towards risk, access to information on the productivity effects of the technology, and yield and price stability are all critical factors (Muzari et al., 2012). Those technologies that involve lower risk have a greater appeal to smallholders who tend to be more risk-averse (Meinzen-Dick et al. 2004).

Many studies, including Mignouna et al. (2011) and Akudugu et al. (2012) have reported a positive relationship between extension services and technology adoption. This is the case because extension agents usually target specific farmers who are recognized as progressive and hence, have higher chances of adopting. Moreover, such farmers tend to be opinion leaders exerting direct or indirect influences on their peers and the whole population of farmers in their respective areas (Genius et al., 2010).

The use of binomial and multinomial qualitative choice models in the analysis of

the adoption of technologies is well established in the adoption literature (Ahmed, 2015). One purpose of qualitative choice models is to determine the probability that an individual with a given set of attributes will make one choice rather than an alternative (Green, 2000). The two most popular functional forms used for adoption models are the probit and logit models (Finger and Benni, 2013; Mariano et al., 2012; Ahmed, 2015; Wafula et al., 2015). Feder et al. (1985) define individual adoption (adoption at the level of the farm or firm) as the degree of use of new technology in the long-run equilibrium – when the farmer has full information about the new technology and its potential. Dimara and Skuras (2003) argued that the basic tenet of a single stage decision-making process, characterizing dichotomous adoption decision models, is a direct consequence of the complete information assumption embedded in the definition of adoption. However, the full information assumption is often violated and hence, analysis of the adoption decision using logit, probit, and the associated tobit models may suffer from model misspecification.

Over the years, many authors have tried to overcome these limitations in several ways. Byerlee and de Polanco (1986) suggested a sequential adoption decision model. Assuming that previous adoption models did not adequately consider the dynamic learning process, Abadi and Pannell (1999) suggested using a dynamic adoption decision model, including farmers' perceptions, managerial abilities, and risk preferences. Dimara and Skuras (2003) proposed a partial observability model based on the assumption that adoption of innovations is a multistage process. The sample population in previous adoption studies did not have the necessary information and awareness concerning the new technology (violating the complete information assumption).

In order to account for differential exposure among farmers, Diagne and Demont (2007) used the 'treatment effect' framework to consistently estimate population adoption rates and their determinants for new rice varieties in Côte d'Ivoire. This study applied the two-stage regression method to correct for selectivity bias and endogeneity problems in the data, which represents an improvement compared to past technology adoption and impact studies. Accordingly, the estimates of the probability of adoption is derived from the first-stage estimation, which accounts for farmers' prior exposure to the new varieties by including a participation variable. Results are subsequently used to correct for the treatment effect in a second-stage income equation.

In this study, we used the double hurdle model approach (Cragg, 1971) to identify the determinants of farmers' decision-making process and intensity of adoption. Unlike dichotomous choice models, this method permits the determination of the intensity of use of agricultural technology once the decision to adopt has been made. The double hurdle approach, which perceives the adoption decision as a two-step decision, first analyses the causal relationship between the adoption decision and different factors, including farm and farmer characteristics, institutions, policy, infrastructure, and other factors. In the first stage, the model uses a binary outcome dependent variable, which takes a value of 1 when a given farmer's observed decision is to adopt and 0 if the farmer is observed to have not adopted the improved varieties under consideration.

Then, in the second stage, the model estimates a regression model with a continuous variable (in our case, the wheat area cultivated using the improved varieties under consideration) as the dependent variable with the same or different factors used in the first step as explanatory variables. In the second stage regression, the coefficients on each of the explanatory variables are estimated as the extent of change in the area used for the improved varieties in response to a unit change in the value of a given variable (factor), conditional on the fact that the farmer has already made the decision to use the improved varieties. This means farmers who have made the decision not to use the improved varieties or those who would not adopt the improved varieties (i.e. farmers with propensity score of zero) in the first step are, in effect, excluded from the analysis in the second step.

Several studies used the double hurdle approach to study adoption of different agricultural technologies (Kapalasa, 2014; Mignouna et al., 2011; Asfaw et al., 2010; Getachew et al., 2009; Shiferaw et al., 2008). In our case, the decision to adopt an improved variety is modeled as a binary variable; the latent variable underlying a household's decision to use the improved variety IT_i^* is specified as:

$$IT_i^* = x'_{1i}\beta_1 + \varepsilon_{1i} \quad (1)$$

Where the vector x'_{1i} constitutes determinants of the adoption decision, are β parameters, and ε_{1i} is a normally distributed error term with mean zero and constant variance. The corresponding probit is estimated on the observed outcome $IT_i^*=1$ if $IT_i^*>0$ and 0 otherwise. Area planted to the improved variety (A_i^*)is also an unobserved latent value that can be specified as:

$$A_i^* = x'_{2i}\beta_2 + \varepsilon_{2i} \quad (2)$$

Where x_{2i}' are determinants of the decision on the area allocated to the improved varieties of wheat, β_2 are parameters. Since A_i^* is a latent variable, we work with observed area (A_i). $A_i = A_i^*$ if $IT_i^*>0$ and $A_i=0$ if $IT_i^* \leq 0$. Because we use observed area, the error term (ε_{2i}) is assumed to have a truncated normal distribution. The parameters β_1 and β_2 can be estimated separately because the Cragg likelihood function is separable.

Measuring the impacts of improved wheat varieties

Estimation of treatment effects (Imbens and Angrist, 1994) has been the focus of the program evaluation literature. One of the main challenges in this pursuit is establishing counterfactuals as selection bias is often inherent in program participation. Several econometric approaches can be used to address selection bias in program evaluation using quasi-experimental and observational data. Imbens and Wooldridge (2009) provide a good review of the literature and the developments in causal inference and impact assessment. Propensity score matching (Rosenbaum and Robin, 1983) is by far the most widely used for improving causal inference and estimation of average

treatment effects (El-Shater et al., 2016; Morgan and Winship, 2014; Henderson and Chatfield, 2011; Jalan and Ravallion, 2003). Propensity score matching helps correct biases introduced only by observable covariates (Heckman and Vytlacil, 2007). Therefore, results from propensity score matching can sometimes be misleading – since unobservable factors such as skills and motivation can influence the outcome and the program participation decision, thereby leading to confounding errors (See Austin 2008 for critical review of propensity score matching). The endogenous switching regression (Maddala and Nelson, 1975) and IVs (Angrist and Pischke, 2009) have been proposed to overcome this problem. Both methods account for the endogeneity of the participation decision and are potent to correct selection bias introduced by both observable and unobservable factors.

In this study, the IV regression approach is used to estimate the impacts of adoption of improved varieties among Turkish farmers. IV is designed to remove both overt and hidden biases and deal with the problem of endogenous treatment in the estimation of causal effects of a treatment on an outcome (Angrist and Rubin, 1996). IV methods are becoming common in program evaluation and comparative effectiveness research (He and Perloff, 2016; Kumar and Mangyo, 2011; Heckman and Vytlacil, 2005; Manski and Pepper, 2000). The IV method requires that the 'instrument' meets three important conditions: (i) the instrument has to be associated with the treatment, (ii) the instrument does not affect the outcome except through the treatment – also known as the exclusion restriction assumption, and (iii) there aren't omitted variables which affect both the instrument and the outcome variables. The reliability of the results from IV regression depends on the fitness of the instrument in fulfilling the above conditions (Imbens, 2004). Therefore, for measuring the impacts of agricultural technologies, it is important to identify an instrument(s) which is (are) correlated with the decision to adopt but is (are) uncorrelated with the unobserved factors that influence the outcome (Shiferaw et al. 2014; Alene and Manyong, 2007; Heckman, 1996).

Suppose that there is endogeneity between the treatment variable X and the outcome variable Y. Suppose also that Z is a matrix of exogenous covariates which qualify as valid instruments for X. Then the IV model can be described by equations 1 and 2.

$$y = X\beta + \vartheta \qquad (1)$$

$$X = Z\Pi + \mu \qquad (2)$$

Where β and Π are vectors of coefficients and ϑ and μ are the error terms; and, $E[X^T \vartheta] \neq 0$, $E[Z^T \mu] = E[Z^T \vartheta] = 0$, $Var(\vartheta) = \sigma\vartheta^2$, $Var(\mu) = \sigma\mu^2$ and $Cov(\vartheta,\mu) = \sigma\mu\vartheta$ which is a measure of the level of endogeneity between the treatment and outcome variables. The two-stage least squares (2SLS) estimation procedure is then used to estimate equations 1 and 2 jointly, where equation 2 is estimated first and then the predicted values used in equation 1 in place of the observed values of X.

To estimate a variant of the Cobb-Douglas production function, which takes a log-linear form, a logarithmic transformation has been made on all continuous variables such as gross margins, consumption, farmer age, years of education, wheat area, and

all quantities of inputs included either as dependent or explanatory variables in the IV regression. Several factors such as the amounts of fertilizers, seed, and labor are important in determining yield, affecting income and consumption. Therefore, all these variables are included as explanatory variables in the model.

Tests of over-identifying restrictions are also carried out to test two different things simultaneously. First, it is used to test whether the instruments are uncorrelated with the error term. Second, the test is used to detect if the equation is mis-specified and that one or more of the excluded exogenous variables should be included in the structural equation. Thus, a significant test statistic could represent either an invalid instrument or an incorrectly specified structural equation. The Hausman test for endogeneity and the Durbin (1954) and Wu-Hausman (Wu, 1974; Hausman, 1978) statistics, which are reported after 2SLS estimation with a robust variance-covariance matrix (VCE) were also evaluated if endogeneity is a problem. In all cases, if the test statistic is significant and hence, the null hypothesis of exogenous treatment is rejected, then the treatment variable must be treated as endogenous – justifying the use of the IV or any other approach which is potent in correcting for endogeneity. Version 15 of the Stata software (StataCorp, 2017) was used for all econometric estimations in this study.

Results

Characterization of the sample households

Out of the total sample of 2,560 households, only 11 (0.4 %) were women-headed. The vast majority of the household heads were relatively old and married men. For more than 76.8 % of the households, agriculture is their main source of employment. Most (64.9 %) of the household heads were members of local organizations and/or associations, while only 13.3% had community leadership roles (Table 6.3).

Table 6.3: Characteristics of household heads

Variable	*Minimum*	*Average*	*Maximum*
Percentage of respondents which are household heads		97.7%	
Percentage of female household heads		0.4%	
Percentage of married household heads		95.4%	
Percentage of household heads for which agriculture is the main source of employment		76.8%	
Is the household head a member of any community leadership		13.3%	
Is the household head a member of any organization or association		64.9%	
Age of household head (years)	18	48	87
Number of years the respondent has been living in this village	1	50.2	85

The average family size is 4.84, out of which, 51.9% are male and 48.1% female. The age structure is an important indicator to know the proportions of the producer and dependent populations. The typical Turkish farm household is composed of family members in a wide range of age distribution where the majority, i.e. an average of 3.3

(about 68%) are in the productive age of 15-65 years of age, which are the economically active and able to work (Table 6.4).

Table 6.4: Household demographics

Age group	*Minimum*	*Mean*	*Maximum*
Family size	1	4.84	34
<7 years old	0	0.41	10
8–15 years old	0	0.75	10
15–65 years old	0	3.3	14
>65 years old	0	0.4	10
Total Male	1	2.51	16
male <7 years old	0	0.22	6
male 8–15 years old	0	0.39	7
male 15–65 years old	0	1.72	9
male > 65 years old	0	0.2	5
Total female	0	2.3	18
Female <7 years old	0	0.2	5
Female 8–15 years old	0	0.4	7
Female 15–65 years old	0	1.6	8
Female >65 years old	0	0.22	10

The majority (76.8%) of the wheat-growing farm households in the sample derive their income mainly from agriculture. For some households in the survey, the contribution of agriculture to family income goes up to as high as 100%, while for few others, it goes as low as only 5% (Table 6.5). For the typical wheat-growing sample farm household, crop production constitutes 63.5% of total family income from agriculture. For the wheat-growing households, wheat represents 62.5% of their total income from the cultivation of all crops.

Table 6.5: Share of agriculture in family income

	Minimum	*Mean*	*Maximum*
Share of agriculture in total family income	5	76.8	100
Share of crop production in total agricultural income (%)	5	63.5	100
Share of income from wheat production in total crop production	5	62.5	100

Adoption of improved wheat varieties

Adoption rates (percentage of farmers cultivating improved varieties)

Adoption rate by variety

Out of the 135 wheat varieties found to be used by farmers, the top 10 varieties are being cultivated by 55.8% of wheat growers. The majority (61.6%) of the top 10 varieties were released after 1999, while only 20.64% of the top 10 varieties were released after 2004. Similarly, the top five varieties are being cultivated by 35.4% of farmers. The top three varieties with the highest number of growers are Ceyhan99 (released in 1999), Esperia (released in 2011), and Bezostaja-1 (released in 1968), which have a combined adoption rate of 23.3%, i.e. 23.3% of all Turkish farmers are cultivating these three varieties (Annex 5).

Adoption rate by province

The adoption rate for varieties released in, and after, 2000 (i.e. less than 15-year-old varieties) is the highest (84.6 %) in the Tekirdağ province, followed by Edirne, Sivas and Samsun, which have adoption rates for such varieties of 83.6%, 82%, and 73.9 % respectively (Table 6.6). Whereas, the adoption rate for varieties released in the last 10 years was the highest (79.5%) in Edirne, which is in line with the findings of Mazid et al. (2015) followed by Tekirdağ and Ankara, which have adoption rates of 72.1% and 53.8 % respectively. Likewise, the adoption rate for more recently released varieties is the highest in Ankara, with 52.3 % of farmers cultivating varieties released within the previous five years, followed by Tekirdağ, Niğde, and Edirne, which have adoption rates for such varieties of 45.6%, 42.2%, and 33.6 % respectively. On the contrary, Erzurum is the province most dominated by very old varieties, where 62.5% of growers are cultivating more than 40-year-old varieties (Table 6.7).

Van is the province most dominated by landraces, where 100% of growers are cultivating landraces. This is consistent with the recent research (Morgounov et al., 2016), which found that wheat production in this area is challenging because of severe cold in winter and short and hot summers. The bread wheat landraces Kırik and Karakılçık are predominantly cultivated on relatively large scales in Van as a result of their specific adaptation and excellent grain quality.

Adoption rate – national level

The national adoption rates for more recent varieties generally stand at low levels. Out of the total 1.07 million wheat growing families in the country, only 158,000 (14.8%) cultivated varieties were released in the last preceding five years (after 2010). The adoption rate for varieties released in the previous 10 years also stands at a low level of 20.4%. The national adoption rate for varieties released in the past 15 years (after 2000) is 47.1% while about 14.5% of Turkish wheat growers are still cultivating varieties that were released over 40 years ago (Table 6.7).

Table 6.6: Cumulative percentage of farmers planting wheat varieties released in or after a given date – by province

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
landrace	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1967	90.4	98.8	100	98.6	95.6	85.3	98.9	83.5	99.4	100	100	87.5	95.5	97.1	87.5	97.4	98.4	99.7	100	98.4	98.6	91.9	97.4	100	85.9	0	99.2
1968	90.4	98.8	100	98.6	95.6	85.3	98.9	83.5	99.4	100	100	87.5	95.5	97.1	70.6	97.4	98.4	99.7	100	98.4	98.6	91.9	97.4	100	85.9	0	99.2
1970	78.7	98.8	100	86.4	94.1	80.4	83.6	60.4	99.4	98.1	100	50.7	95.5	90.0	70.6	94.7	81.4	97.5	100	64.1	94.5	87.2	89.6	100	71.1	0	90.2
1976	78.7	98.8	100	86.4	94.1	80.4	83.2	60.4	99.4	98.1	100	37.5	95.5	87.1	70.6	94.7	81.4	97.5	100	62.5	94.5	87.2	89.6	100	71.1	0	90.2
1979	78.7	91.7	100	86.4	94.1	80.4	83.2	41.7	99.4	98.1	100	37.5	95.5	85.9	70.6	94.7	81.4	97.5	89.2	62.5	94.5	87.2	89.6	100	71.1	0	90.2
1984	78.7	91.7	100	84.4	83.8	80.4	83.2	41.7	99.4	98.1	100	36.0	93.6	82.9	69.9	94.7	78.3	96.7	89.2	62.5	75.3	84.8	89.6	100	71.1	0	88.6
1985	78.7	91.7	100	84.4	83.8	80.4	83.2	41.7	98.8	98.1	100	36.0	93.6	82.9	69.9	94.7	78.3	96.7	89.2	62.5	75.3	84.8	89.6	100	71.1	0	88.6
1990	78.7	91.7	100	83.0	83.8	80.4	83.2	41.7	98.8	98.1	100	36.0	91.0	82.4	69.1	94.7	78.3	96.7	89.2	62.5	75.3	84.8	89.6	100	71.1	0	88.6
1991	73.4	91.7	100	83.0	83.8	80.4	82.8	41.7	98.8	98.1	100	25.7	91.0	82.4	69.1	94.7	78.3	96.7	89.2	62.5	75.3	84.8	89.6	100	71.1	0	88.6
1994	67.6	91.7	100	68.0	82.4	80.4	79.4	36.0	98.8	98.1	100	25.0	91.0	52.9	38.2	63.2	69.8	88.1	89.2	62.5	74.0	84.8	89.6	100	71.1	0	72.0
1995	67.6	91.7	100	68.0	82.4	80.4	79.4	36.0	98.8	98.1	100	25.0	91.0	45.3	38.2	63.2	69.8	87.8	89.2	62.5	74.0	84.8	89.6	100	71.1	0	70.5
1996	67.6	83.3	100	68.0	82.4	80.4	79.4	36.0	91.9	98.1	100	25.0	91.0	45.3	38.2	63.2	69.8	87.8	48.6	62.5	74.0	83.9	89.6	100	71.1	0	70.5
1997	67.6	83.3	100	66.0	77.9	80.4	79.4	36.0	91.9	98.1	100	25.0	91.0	45.3	38.2	63.2	68.2	87.8	48.6	62.5	74.0	83.9	89.6	100	71.1	0	65.9
1998	67.6	83.3	100	64.6	77.9	80.4	79.4	36.0	91.3	98.1	100	25.0	91.0	45.3	38.2	63.2	68.2	87.8	48.6	62.5	74.0	83.9	89.6	100	71.1	0	65.9
1999	52.1	83.3	96.7	63.9	76.5	76.5	70.2	35.3	75.0	80.6	98.6	25.0	53.2	45.3	38.2	63.2	68.2	84.2	46.8	62.5	49.3	83.9	89.6	99.3	67.2	0	31.1
2000	25.0	57.1	9.9	41.5	54.4	14.7	67.9	35.3	60.0	43.7	83.6	25.0	51.3	35.3	8.8	28.9	65.1	61.7	30.6	62.5	49.3	82.0	73.9	84.6	46.1	0	23.1
2001	23.9	56.0	9.9	29.9	44.1	13.7	65.3	31.7	60.0	43.7	82.9	25.0	48.7	14.1	6.6	23.7	20.9	48.3	29.7	57.8	23.3	24.6	53.0	84.6	42.2	0	21.6
2002	23.9	32.1	9.9	28.6	39.7	12.7	64.9	4.3	31.9	23.1	82.2	25.0	30.1	12.4	6.6	21.1	20.9	44.7	11.7	57.8	17.8	24.6	14.8	78.7	42.2	0	16.3
2003	23.9	29.8	0	25.2	38.2	12.7	64.9	4.3	30.0	9.7	82.2	25.0	30.1	8.8	6.6	21.1	19.4	34.2	5.4	57.8	17.8	24.6	14.8	77.9	42.2	0	16.3
2004	23.9	29.8	0	24.5	38.2	12.7	64.9	4.3	30.0	9.7	79.5	25.0	30.1	8.2	6.6	21.1	17.8	34.2	5.4	57.8	12.3	24.6	14.8	72.1	42.2	0	16.3
2005	19.1	29.8	0	8.2	27.9	4.9	53.8	4.3	30.0	9.7	79.5	25.0	26.3	4.1	5.9	2.6	10.1	30.3	5.4	42.2	11.0	3.8	11.3	72.1	10.9	0	4.2
2006	19.1	29.8	0	8.2	27.9	3.9	53.8	4.3	30.0	9.7	52.1	25.0	26.3	4.1	5.9	2.6	10.1	30.3	4.5	42.2	11.0	3.8	6.1	50.7	7.8	0	4.2
2007	19.1	11.9	0	8.2	27.9	3.9	53.8	4.3	30.0	9.7	52.1	25.0	26.3	4.1	5.9	2.6	10.1	30.3	4.5	42.2	11.0	3.8	6.1	50.7	7.8	0	4.2
2008	19.1	11.9	0	8.2	27.9	3.9	53.8	4.3	28.8	9.7	52.1	25.0	26.3	4.1	5.9	2.6	10.1	30.3	4.5	42.2	11.0	3.8	6.1	50.7	7.0	0	4.2
2009	17.6	11.9	0	6.8	25.0	2.0	53.1	2.9	28.8	6.3	51.4	16.9	25.0	4.1	5.9	2.6	7.0	27.2	4.5	42.2	1.4	0	6.1	50.7	7.0	0	3.4
2010	14.9	11.9	0	2.7	25.0	1	52.3	2.9	28.8	6.3	33.6	16.9	23.1	2.4	5.1	2.6	7.0	26.4	4.5	42.2	1.4	0	6.1	45.6	7.0	0	1.9
2011	13.8	11.9	0	2.0	23.5	1	52.3	2.2	28.8	6.3	29.5	16.9	23.1	2.4	5.1	2.6	7.0	26.4	4.5	42.2	1.4	0	6.1	41.9	7.0	0	1.9
2012	5.9	8.3	0	1.4	4.4	0	8.0	0	26.9	4.4	8.2	8.1	16.0	2.4	5.1	0	7.0	6.9	4.5	0	1.4	0	6.1	14.0	3.9	0	1.5
2013	4.8	8.3	0	1.4	4.4	0	7.6	0	9.4	4.4	1.4	8.1	3.8	2.4	5.1	0	7.0	5.0	4.5	0	1.4	0	6.1	5.1	1.6	0	1.5
2014	4.8	8.3	0	1.4	0	0	7.3	0	1.3	0.2	0.7	0	1.3	0	4.4	0	0.8	1.4	3.6	0	1.4	0	6.1	3.7	0.8	0	1.1
NA*(1)	4.8	7.1	0	0	0	0	6.9	0	0	0.2	0.0	0	1.3	0	4.4	0	0	0	3.6	0	0.0	0	5.2	2.2	0	0	1.1

Note: While there could be varieties which were released before 1967 in Turkey, the earliest improved variety found to be used by farmers was released in 1967

(1) NA stands for 'Not Applicable' as these are advanced lines which are not registered yet but are still used by farmers

Table 6.7: Percentage of farmers planting wheat varieties of different release dates and cumulative adoption rates – provincial and national figures

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	ERZURUM	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	National Total	Cumulative
Landraces	9.57	1.19	0	1.36	4.41	14.71	1.15	16.55	0.63	0	0	12.50	4.49	2.94	12.50	2.63	1.55	0.28	0	1.56	1.37	8.06	2.61	0	14.06	100	0.76	5.94	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16.91	0	0	0	0	0	0	0	0	0	0	0	0	0.56	94.06
1968	11.70	0	0	12.24	1.47	4.90	15.27	23.02	0	1.94	0	36.76	0	7.06	0	2.63	17.05	2.22	0	34.38	4.11	4.74	7.83	0	14.84	0	9.09	7.38	93.51
1970	0	0	0	0	0	0	0.38	0	0	0	0	13.24	0	2.94	0	0	0	0	0	1.56	0	0	0	0	0	0	0	0.60	86.12
1976	0	7.14	0	0	0	0	0	18.71	0	0	0	0	0	1.18	0	0	0	0	10.81	0	0	0	0	0	0	0	0	1.11	85.52
1979	0	0	0	2.04	10.29	0	0	0	0	0	0	1.47	1.92	2.94	0.74	0	3.10	0.83	0	0	19.18	2.37	0	0	0	0	1.52	1.23	84.41
1984	0	0	0	0	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02	83.18
1985	0	0	0	1.36	0	0	0	0	0	0	0	0	2.56	0.59	0.74	0	0	0	0	0	0	0	0	0	0	0	0	0.19	83.16
1990	5.32	0	0	0	0	0	0.38	0	0	0	0	10.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	82.96
1991	5.85	0	0	14.97	1.47	0	3.44	5.76	0	0	0	0.74	0	29.41	30.88	31.58	8.53	8.61	0	0	1.37	0	0	0	0	0	16.67	5.86	82.36
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	7.65	0	0	0	0.28	0	0	0	0	0	0	0	0	1.52	0.43	76.50
1995	0	8.33	0	0	0	0	0	0	6.88	0	0	0	0	0	0	0	0	0	40.54	0	0	0.95	0	0	0	0	0	1.57	76.06
1996	0	0	0	2.04	4.41	0	0	0	0	0	0	0	0	0	0	0	1.55	0	0	0	0	0	0	0	0	0	4.55	0.48	74.49
1997	0	0	0	1.36	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	74.01
1998	15.43	0	3.31	0.68	1.47	3.92	9.16	0.72	16.25	17.48	1.37	0	37.82	0	0	0	0	3.61	1.80	0	24.66	0	0	0.74	3.91	0	34.85	8.54	73.94
1999	27.13	26.19	86.78	22.45	22.06	61.76	2.29	0	15.00	36.89	15.07	0	1.92	10	29.41	34.21	3.10	22.50	16.22	0	0	1.90	15.65	14.71	21.09	0	7.95	18.32	65.40
2000	1.06	1.19	0	11.56	10.29	0.98	2.67	3.60	0	0	0.68	0	2.56	21.18	2.21	5.26	44.19	13.33	0.90	4.69	26.03	57.35	20.87	0	3.91	0	1.52	8.88	47.08
2001	0	23.81	0	1.36	4.41	0.98	0.38	27.34	28.13	20.63	0.68	0	18.59	1.76	0	2.63	0	3.61	18.02	0	5.48	0	38.26	5.88	0	0	5.30	8.01	38.20
2002	0	2.38	9.92	3.40	1.47	0	0	0	1.88	13.35	0	0	0	3.53	0	0	1.55	10.56	6.31	0	0	0	0	0.74	0	0	0	3.19	30.19
2003	0	0	0	0.68	0	0	0	0	0	0	2.74	0	0	0.59	0	0	1.55	0	0	0	5.48	0	0	5.88	0	0	0	0.48	27.00
2004	4.79	0	0	16.33	10.29	7.84	11.07	0	0	0	0	0	3.85	4.12	0.74	18.42	7.75	3.89	0	15.63	1.37	20.85	3.48	0	31.25	0	12.12	6.11	26.52
2005	0	0	0	0	0	0.98	0	0	0	0	27.40	0	0	0	0	0	0	0	0.90	0	0	0	5.22	21.32	3.13	0	0	1.95	20.42
2006	0	17.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.36	18.46
2007	0	0	0	0	0	0	0	0	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0.07	18.10
2008	1.60	0	0	1.36	2.94	1.96	0.76	1.44	0	3.40	0.68	8.09	1.28	0	0	0	3.10	3.06	0	0	9.59	3.79	0	0	0	0	0.76	1.76	18.03
2009	2.66	0	0	4.08	0	0.98	0.76	0	0	0	17.81	0	1.92	1.76	0.74	0	0	0.83	0	0	0	0	0	5.15	0	0	1.52	1.47	16.26
2010	1.06	0	0	0.68	1.47	0	0	0.72	0	0	4.11	0	0	0	0	0	0	0	0	0	0	0	0	3.68	0	0	0	0.39	14.79
2011	7.98	3.57	0	0.68	19.12	0.98	44.27	2.16	1.88	1.94	21.23	8.82	7.05	0	0	2.63	0	19.44	0	42.19	0	0	0	27.94	3.13	0	0.38	8.64	14.41
2012	1.06	0	0	0	0	0	0.38	0	17.50	0	6.85	0	12.18	0	0	0	0	1.94	0	0	0	0	0	8.82	2.34	0	0	1.98	5.77
2013	0	0	0	0	4.41	0	0.38	0	8.13	4.13	0.68	8.09	2.56	2.35	0.74	0	6.20	3.61	0.90	0	0	0	0	1.47	0.78	0	0.38	1.95	3.79
2014	0	1.19	0	1.36	0	0	0.38	0	1.25	0	0.68	0	0	0	0	0	0.78	1.39	0	0	1.37	0	0.87	1.47	0.78	0	0	0.43	1.83
NA	4.79	7.14	0	0	0	0	6.87	0	0	0.24	0	0	1.28	0	4.41	0	0	0	3.60	0	0	0	5.22	2.21	0	0	1.14	1.40	1.40

Note: national adoption rates are generated by using number of growers in each province as weights.

Adoption rate by agro-ecological zones

Among the three major wheat-growing agro-ecological zones in Turkey (i.e. spring wheat growing, winter wheat growing, and facultative wheat growing zones), the facultative zone is surprisingly leading the rest of the agro-ecologies in terms of the percentage of farmers cultivating the more recent varieties. For example, 25.4% of wheat growers in the facultative zone cultivate varieties that are 10 years old or less. The corresponding figure for the winter and spring zones is 20.2% and 10.54%, respectively. Likewise, the adoption rate for more recently released varieties is the highest in the winter agro-ecology, with 16.47% of farmers cultivating varieties released within the preceding five years, followed by facultative and spring, which have adoption rates for such varieties of 16.2% and 5.75%, respectively (Table 6.8).

The Consultative Group for International Agricultural Research (CGIAR) through its two centers, namely CIMMYT and ICARDA have been actively working in Turkey supporting the country's efforts to develop improved wheat varieties. Particularly, the joint ICARDA, CIMMITY, and Turkey International Winter Wheat Improvement Program (IWWIP) based in Turkey has been actively developing winter wheat varieties some of which were released in Turkey and other countries in the CWANA region. During the survey, a total of 27 CGIAR varieties (14 from CIMMYT, 1 from ICARDA, and 12 from IWWIP) were found in Turkish farmers' hands with a total combined area coverage of 20.33% of the total wheat area. The top 5 CGIAR varieties in Turkey are Ceyhan99, Konya2002, Firat93, Ekiz, and Sönmez2001, which together are cultivated on 16.65% of total wheat area in the country. Particularly, with an area coverage of 10.18% of total wheat area in the country, Ceyhan99 ranks 1st from among all varieties under cultivation in the country. These results clearly show the importance of the Turkey-CGIAR collaboration.

Table 6.8: Cumulative percentage of farmers planting wheat varieties released in or before a given date – by agro-ecological zone

	Agro-ecological zone		
Year of release	***Winter wheat growing***	***Spring wheat growing***	***Facultative wheat growing***
Landrace	100.00	100.00	100
1967	91.90	96.17	97
1968	91.63	96.17	95
1970	82.52	89.78	90
1976	81.42	89.78	90
1979	81.32	84.82	89
1984	79.58	84.82	88
1985	79.58	84.82	88
1990	79.25	84.82	88
1991	78.20	84.82	88
1994	69.96	83.55	84
1995	69.32	83.55	83
1996	69.32	82.43	79
1997	68.49	82.43	79
1998	68.40	82.43	79
1999	58.83	70.77	73.51
2000	45.81	42.97	51.04
2001	33.44	42.01	44.12
2002	30.54	19.65	34.52
2003	28.15	10.54	32.81
2004	27.83	10.54	31.85
2005	20.19	10.54	25.37
2006	20.15	10.54	19.42
2007	20.15	8.31	19.35
2008	20.15	8.31	19.12
2009	17.62	5.75	18.97
2010	16.47	5.75	16.29
2011	16.28	5.59	15.48
2012	5.38	3.35	7.51
2013	4.05	3.35	3.57
2014	1.98	0.64	2.16
NA	1.52	0.48	1.64

Table 6.9: Percentage of farmers planting wheat varieties of different release dates and cumulative adoption rates – by agro-ecological zone and national figures

Year of release	*Winter*	*Spring*	*Facultative*	*National total*	*Cumulative*
Landrace	8.10	3.83	3.42	5.94	100.00
1967	0.28	0.00	1.26	0.56	94.06
1968	9.11	6.39	5.06	7.38	93.51
1970	1.10	0.00	0.07	0.60	86.12
1976	0.09	4.95	0.97	1.11	85.52
1979	1.75	0.00	0.97	1.23	84.41
1984	0.00	0.00	0.07	0.02	83.18
1985	0.32	0.00	0.07	0.19	83.16
1990	1.06	0.00	0.15	0.60	82.96
1991	8.23	1.28	4.17	5.86	82.36
1994	0.64	0.00	0.30	0.43	76.50
1995	0.00	1.12	4.32	1.57	76.06
1996	0.83	0.00	0.15	0.48	74.49
1997	0.09	0.00	0.07	0.07	74.01
1998	9.57	11.66	5.43	8.54	73.94
1999	13.02	27.80	22.47	18.32	65.40
2000	12.37	0.96	6.92	8.88	47.08
2001	2.90	22.36	9.60	8.01	38.20
2002	2.39	9.11	1.71	3.19	30.19
2003	0.32	0.00	0.97	0.48	27.00
2004	7.64	0.00	6.47	6.11	26.52
2005	0.05	0.00	5.95	1.95	20.42
2006	0.00	2.24	0.07	0.36	18.46
2007	0.00	0.00	0.22	0.07	18.10
2008	2.53	2.56	0.15	1.76	18.03
2009	1.15	0.00	2.68	1.47	16.26
2010	0.18	0.16	0.82	0.39	14.79
2011	10.90	2.24	7.96	8.64	14.41
2012	1.33	0.00	3.94	1.98	5.77
2013	2.07	2.72	1.41	1.95	3.79
2014	0.46	0.16	0.52	0.43	1.83
NA	1.52	0.48	1.64	1.40	1.40

Note: As described in section 4.1, national adoption rates are generated by using number of growers in each agro-ecological zone as weights

Adoption rate – by wheat species

Provincial adoption levels for bread wheat varieties generally follow similar patterns with the provincial adoption levels for total wheat (regardless of species) reported in section 5.2.1.2 above. Edirne leads all provinces in terms of the percentage of farmers adopting recent bread wheat varieties (Table 6.10). 79.5% of the farmers in this province cultivate varieties that are 10 or less years old, followed by Tekirdağ (72.1%), Ankara (57.1%), and Konya (43.6%). Likewise, the adoption rate for more recently released varieties is the highest in Ankara, with 55.5 % of farmers cultivating varieties released within the previous 5 years, followed by Tekirdağ, Niğde, and Konya, which have adoption rates for such varieties of 44.6%, 42.2% and 38.2% respectively. When it comes to old varieties, 62.5% of farmers in Erzurum province still cultivate over 40 years old varieties, followed by Kahramanmaraş (60.7%).

At the national level, farmers cultivating improved bread wheat varieties of 5 or less years old account for 16.42% of the total national number of bread wheat growers. While the figure improves when the cut-off points increase to 10 years (22.2%) and 15 years (50.5%), more than 16.4% of the total national number of bread wheat growers still are cultivating varieties that are older than 40 years (Table 6.11).

Amasya, Antalya, Edirne, Erzurum, Eskişehir, Niğde, Sivas, Samsun, Tekirdağ, Tokat and Van planted only bread wheat, while the other provinces planted both bread and durum wheat. İzmir leads all provinces in terms of the percentage of farmers adopting recent durum wheat varieties (Table 6.12). Almost all farmers (100%) in this province cultivate five or less years old varieties, followed by Manisa (80%) and Diyarbakır (19.5%). With varieties that are 10 or less years old, İzmir and Balıkesir lead with 100 % of farmers cultivating durum varieties which are 10 or less years old, followed by Manisa (80%) and Nevşehir (37.5%).

The national figures show that adoption rates of improved durum wheat varieties released in the last 5 years (6.02%) are much lower (by 10 percentage points) compared to those for bread wheat (16.4%). However, when the cutoff is raised to 10 and 15 years, 10.8% of durum wheat farmers cultivate 10 or less years old varieties and 28.7% cultivate varieties that are 15 or less years old. In contrast, only (4%) are still cultivating varieties which are older than 40 years (Table 6.13).

Table 6.10: Cumulative Percentage of Farmers Planting Bread Wheat Varieties Released in or Before a Given Date – By Province

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
landrace	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1967	89.5	98.7	100	97.7	100.0	85.3	98.8	81.9	99.4	100	100	87.5	95.5	95.4	39.3	91.7	98.2	99.6	100.0	98.4	98.5	91.9	97.4	100	85.9	0	99.1
1968	89.5	98.7	100	97.7	100.0	85.3	98.8	81.9	99.4	100	100	87.5	95.5	95.4	39.3	91.7	98.2	99.6	100.0	98.4	98.5	91.9	97.4	100	85.9	0	99.1
1970	76.6	98.7	100	77.3	98.3	80.4	82.6	56.7	99.4	97.2	100	50.7	95.5	84.4	39.3	83.3	78.6	96.3	100.0	64.1	93.8	87.2	89.6	100	71.1	0	87.7
1976	76.6	98.7	100	77.3	98.3	80.4	82.2	56.7	99.4	97.2	100	37.5	95.5	79.8	39.3	83.3	78.6	96.3	100.0	62.5	93.8	87.2	89.6	100	71.1	0	87.7
1979	76.6	91.0	100	77.3	98.3	80.4	82.2	39.4	99.4	97.2	100	37.5	95.5	78.0	39.3	83.3	78.6	96.3	89.6	62.5	93.8	87.2	89.6	100	71.1	0	87.7
1984	76.6	91.0	100	73.9	86.7	80.4	82.2	39.4	99.4	97.2	100	36.0	93.6	73.4	35.7	83.3	75.0	95.0	89.6	62.5	72.3	84.8	89.6	100	71.1	0	85.8
1985	76.6	91.0	100	73.9	86.7	80.4	82.2	39.4	98.7	97.2	100	36.0	93.6	73.4	35.7	83.3	75.0	95.0	89.6	62.5	72.3	84.8	89.6	100	71.1	0	85.8
1990	76.6	91.0	100	71.6	86.7	80.4	82.2	39.4	98.7	97.2	100	36.0	91.0	72.5	32.1	83.3	75.0	95.0	89.6	62.5	72.3	84.8	89.6	100	71.1	0	85.8
1991	70.8	91.0	100	71.6	86.7	80.4	81.8	39.4	98.7	97.2	100	25.7	91.0	72.5	32.1	83.3	75.0	95.0	89.6	62.5	72.3	84.8	89.6	100	71.1	0	85.8
1994	70.8	91.0	100	71.6	86.7	80.4	81.8	39.4	98.7	97.2	100	25.0	91.0	72.5	32.1	83.3	75.0	95.0	89.6	62.5	72.3	84.8	89.6	100	71.1	0	85.3
1995	70.8	91.0	100	71.6	86.7	80.4	81.8	39.4	98.7	97.2	100	25.0	91.0	60.6	32.1	83.3	75.0	94.6	89.6	62.5	72.3	84.8	89.6	100	71.1	0	83.4
1996	70.8	82.1	100	71.6	86.7	80.4	81.8	39.4	91.8	97.2	100	25.0	91.0	60.6	32.1	83.3	75.0	94.6	47.2	62.5	72.3	83.9	89.6	100	71.1	0	83.4
1997	70.8	82.1	100	68.2	81.7	80.4	81.8	39.4	91.8	97.2	100	25.0	91.0	60.6	32.1	83.3	73.2	94.6	47.2	62.5	72.3	83.9	89.6	100	71.1	0	77.7
1998	70.8	82.1	100	68.2	81.7	80.4	81.8	39.4	91.1	97.2	100	25.0	91.0	60.6	32.1	83.3	73.2	94.6	47.2	62.5	72.3	83.9	89.6	100	71.1	0	77.7
1999	53.8	82.1	96.4	67.0	80.0	76.5	72.1	38.6	74.7	72.3	98.6	25.0	53.2	60.6	32.1	83.3	73.2	89.2	45.3	62.5	44.6	83.9	89.6	99.3	67.2	0	34.1
2000	25.1	53.8	2.7	61.4	60.0	14.7	72.1	38.6	59.5	19.7	83.6	25.0	51.3	52.3	32.1	83.3	73.2	88.0	28.3	62.5	44.6	82.0	73.9	84.6	46.1	0	27.0
2001	25.1	52.6	2.7	42.0	50.0	13.7	69.2	34.6	59.5	19.7	82.9	25.0	48.7	19.3	28.6	75.0	24.1	70.5	27.4	57.8	21.5	24.6	53.0	84.6	42.2	0	27.0
2002	25.1	26.9	2.7	39.8	45.0	12.7	68.8	4.7	31.0	0.7	82.2	25.0	30.1	16.5	28.6	66.7	24.1	65.1	8.5	57.8	15.4	24.6	14.8	78.7	42.2	0	20.4
2003	25.1	24.4	0	34.1	43.3	12.7	68.8	4.7	29.1	0.7	82.2	25.0	30.1	11.0	28.6	66.7	22.3	49.4	1.9	57.8	15.4	24.6	14.8	77.9	42.2	0	20.4
2004	25.1	24.4	0	33.0	43.3	12.7	68.8	4.7	29.1	0.7	79.5	25.0	30.1	10.1	28.6	66.7	20.5	49.4	1.9	57.8	9.2	24.6	14.8	72.1	42.2	0	20.4
2005	19.9	24.4	0	5.7	31.7	4.9	57.1	4.7	29.1	0.7	79.5	25.0	26.3	3.7	25.0	8.3	11.6	43.6	1.9	42.2	7.7	3.8	11.3	72.1	10.9	0	5.2
2006	19.9	24.4	0	5.7	31.7	3.9	57.1	4.7	29.1	0.7	52.1	25.0	26.3	3.7	25.0	8.3	11.6	43.6	0.9	42.2	7.7	3.8	6.1	50.7	7.8	0	5.2
2007	19.9	5.1	0	5.7	31.7	3.9	57.1	4.7	29.1	0.7	52.1	25.0	26.3	3.7	25.0	8.3	11.6	43.6	0.9	42.2	7.7	3.8	6.1	50.7	7.8	0	5.2
2008	19.9	5.1	0	5.7	31.7	3.9	57.1	4.7	29.1	0.7	52.1	25.0	26.3	3.7	25.0	8.3	11.6	43.6	0.9	42.2	7.7	3.8	6.1	50.7	7.0	0	5.2
2009	18.1	5.1	0	3.4	28.3	2.0	56.3	3.1	29.1	0.7	51.4	16.9	25.0	3.7	25.0	8.3	8.0	39.0	0.9	42.2	1.5	0	6.1	50.7	7.0	0	4.3
2010	16.4	5.1	0	2.3	28.3	1.0	55.5	3.1	29.1	0.7	33.6	16.9	23.1	3.7	25.0	8.3	8.0	38.2	0.9	42.2	1.5	0	6.1	45.6	7.0	0	2.4
2011	15.2	5.1	0	1.1	26.7	1.0	55.5	2.4	29.1	0.7	29.5	16.9	23.1	3.7	25.0	8.3	8.0	38.2	0.9	42.2	1.5	0	6.1	41.9	7.0	0	2.4
2012	6.4	1.3	0	0	5.0	0	8.5	0	27.2	0.7	8.2	8.1	16.0	3.7	25.0	0	8.0	9.1	0.9	0	1.5	0	6.1	14.0	3.9	0	1.9
2013	5.3	1.3	0	0	5.0	0	8.1	0	9.5	0.7	1.4	8.1	3.8	3.7	25.0	0	8.0	6.2	0.9	0	1.5	0	6.1	5.1	1.6	0	1.9
2014	5.3	1.3	0	0	0	0	7.7	0	1.3	0	0.7	0	1.3	0.0	21.4	0	0.9	2.1	0	0	1.5	0	6.1	3.7	0.8	0	1.4
NA	5.3	0	0	0	0	0	7.3	0	0	0	0	0	1.3	0.0	21.4	0	0	0	0	0	0	0	5.2	2.2	0.0	0	1.4

Table 6.11: Percentage of Farmers Planting Bread Wheat Varieties of Different Release Dates and Cumulative Adoption Rates – Provincial and National Figures

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	National Total	Cumulative
Landraces	10.53	1.28	0	2.27	0	14.71	1.21	18.11	0.63	0	0	12.50	4.49	4.59	60.71	8.33	1.79	0.41	0	1.56	1.54	8.06	2.61	0	14.06	100	0.95	6.95	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93.05
1968	12.87	0	0	20.45	1.67	4.90	16.19	25.20	0	2.77	0	36.76	0	11.01	0	8.33	19.64	3.32	0	34.38	4.62	4.74	7.83	0	14.84	0	11.37	8.75	93.05
1970	0	0	0	0	0	0	0.40	0	0	0	0	13.24	0	4.59	0	0	0	0	0	1.56	0	0	0	0	0	0	0	0.72	84.30
1976	0	7.69	0	0	0	0	0	17.32	0	0	0	0	0	1.83	0	0	0	0	10.38	0	0	0	0	0	0	0	0	1.17	83.58
1979	0	0	0	3.41	11.67	0	0	0	0	0	0	1.47	1.92	4.59	3.57	0	3.57	1.24	0	0	21.54	2.37	0	0	0	0	1.90	1.46	82.41
1984	0	0	0	0	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	80.95
1985	0	0	0	2.27	0	0	0	0	0	0	0	0	2.56	0.92	3.57	0	0	0	0	0	0	0	0	0	0	0	0	0.23	80.92
1990	5.85	0	0	0	0	0	0.40	0	0	0	0	10.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.72	80.69
1991	0	0	0	0	0	0	0	0	0	0	0	0.74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.47	0.06	79.98
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	11.93	0	0	0	0.41	0	0	0	0	0	0	0	0	1.90	0.51	79.92
1995	0	8.97	0	0	0	0	0	0	6.96	0	0	0	0	0	0	0	0	0	42.45	0	0	0.95	0	0	0	0	0	1.86	79.41
1996	0	0	0	3.41	5.00	0	0	0	0	0	0	0	0	0	0	0	1.79	0	0	0	0	0	0	0	0	0	5.69	0.57	77.55
1997	0	0	0	0	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	76.97
1998	16.96	0	3.57	1.14	1.67	3.92	9.72	0.79	16.46	24.91	1.37	0	37.82	0	0	0	0	5.39	1.89	0	27.69	0	0	0.74	3.91	0	43.60	10.13	76.95
1999	28.65	28.21	93.75	5.68	20	61.76	0	0	15.19	52.60	15.07	0	1.92	8.26	0	0	0	1.24	16.98	0	0	1.90	15.65	14.71	21.09	0	7.11	16.33	66.82
2000	0	1.28	0	19.32	10	0.98	2.83	3.94	0	0	0.68	0	2.56	33.03	3.57	8.33	49.11	17.43	0.94	4.69	23.08	57.35	20.87	0	3.91	0	0	9.90	50.49
2001	0	25.64	0	2.27	5.00	0.98	0.40	29.92	28.48	19.03	0.68	0	18.59	2.75	0	8.33	0	5.39	18.87	0	6.15	0	38.26	5.88	0	0	6.64	8.64	40.59
2002	0	2.56	2.68	5.68	1.67	0	0	0	1.90	0	0	0	0	5.50	0	0	1.79	15.77	6.60	0	0	0	0	0.74	0	0	0	1.95	31.95
2003	0	0	0	1.14	0	0	0	0	0	0	2.74	0	0	0.92	0	0	1.79	0	0	0	6.15	0	0	5.88	0	0	0	0.57	30.01
2004	5.26	0	0	27.27	11.67	7.84	11.74	0	0	0	0	0	3.85	6.42	3.57	58.33	8.93	5.81	0	15.63	1.54	20.85	3.48	0	31.25	0	15.17	7.24	29.43
2005	0	0	0	0	0	0.98	0	0	0	0	27.40	0	0	0	0	0	0	0	0.94	0	0	0	5.22	21.32	3.13	0	0	2.32	22.20
2006	0	19.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.43	19.88
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0.03	19.45
2008	1.75	0	0	2.27	3.33	1.96	0.81	1.57	0	0	0.68	8.09	1.28	0	0	0	3.57	4.56	0	0	6.15	3.79	0	0	0	0	0.95	1.60	19.42
2009	1.75	0	0	1.14	0	0.98	0.81	0	0	0	17.81	0	1.92	0	0	0	0	0.83	0	0	0	0	0	5.15	0	0	1.90	1.40	17.82
2010	1.17	0	0	1.14	1.67	0	0	0.79	0	0	4.11	0	0	0	0	0	0	0	0	0	0	0	0	3.68	0	0	0	0.46	16.42
2011	8.77	3.85	0	1.14	21.67	0.98	46.96	2.36	1.90	0	21.23	8.82	7.05	0	0	8.33	0	29.05	0	42.19	0	0	0	27.94	3.13	0	0.47	10.01	15.96
2012	1.17	0	0	0	0	0	0.40	0	17.72	0	6.85	0	12.18	0	0	0	0	2.90	0	0	0	0	0	8.82	2.34	0	0	2.35	5.95
2013	0	0	0	0	5.00	0	0.40	0	8.23	0.69	0.68	8.09	2.56	3.67	3.57	0	7.14	4.15	0.94	0	0	0	0	1.47	0.78	0	0.47	1.80	3.60
2014	0	1.28	0	0	0	0	0.40	0	1.27	0	0.68	0	0	0	0	0	0.89	2.07	0	0	1.54	0	0.87	1.47	0.78	0	0	0.46	1.80
NA	5.26	0	0	0	0	0	7.29	0	0	0	0	0	1.28	0	21.43	0	0	0	0	0	0	0	5.22	2.21	0	0	1.42	1.34	1.34

Note: National adoption rates are generated by using number of growers in each province as weights.

Table 6.12: Cumulative Percentage of Farmers Planting Durum Wheat Varieties Released in or Before a Given Date – By Province

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
landrace	100	100	100	100	100	0	100	0	100	100	0	0	0	100	100	100	100	100	100	0	100	0	0	0	0	0	100
1967	100	100	100	100	63	0	100	0	100	100	0	0	0	100	100	100	100	100	100	0	100	0	0	0	0	0	100
1968	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	100	0	100	0	0	0	0	0	100
1970	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	100	0	100	0	0	0	0	0	100
1976	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	100	0	100	0	0	0	0	0	100
1979	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	80	0	100	0	0	0	0	0	100
1984	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	80	0	100	0	0	0	0	0	100
1985	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	80	0	100	0	0	0	0	0	100
1990	100	100	100	100	63	0	100	0	100	100	0	0	0	100	79	100	100	100	80	0	100	0	0	0	0	0	100
1991	100	100	100	100	62.5	0	100.00	0	100	100	0	0	0	100	78.70	100	100	100	80	0	100	0	0	0	0	0	100
1994	35.29	100	100	62.71	50	0	40.00	0	100	100	0	0	0	18.03	39.81	53.85	35.29	73.95	80	0	87.50	0	0	0	0	0	18.87
1995	35.29	100	100	62.71	50	0	40.00	0	100	100	0	0	0	18.03	39.81	53.85	35.29	73.95	80	0	87.50	0	0	0	0	0	18.87
1996	35.29	100	100	62.71	50	0	40.00	0	100	100	0	0	0	18.03	39.81	53.85	35.29	73.95	80	0	87.50	0	0	0	0	0	18.87
1997	35.29	100	100	62.71	50	0	40.00	0	100	100	0	0	0	18.03	39.81	53.85	35.29	73.95	80	0	87.50	0	0	0	0	0	18.87
1998	35.29	100	100	59.32	50	0	40.00	0	100	100	0	0	0	18.03	39.81	53.85	35.29	73.95	80	0	87.50	0	0	0	0	0	18.87
1999	23.53	100	100	11.86	13	0	0.00	0	100	100	0	0	0	4.92	2.78	3.85	11.76	8.40	80	0	87.50	0	0	0	0	0	7.55
2000	23.53	100	100	11.86	12.5	0	0.00	0	100	100	0	0	0	4.92	2.78	3.85	11.76	8.40	80	0	87.50	0	0	0	0	0	7.55
2001	11.76	100	100	11.86	0	0	0	0	100	100	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2002	11.76	100	100	11.86	0	0	0	0	100	75.61	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2003	11.76	100	0	11.86	0	0	0	0	100	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2004	11.76	100	0	11.86	0	0	0	0	100	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2005	11.76	100	0	11.86	0	0	0	0	100	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2006	11.76	100	0	11.86	0	0	0	0	100	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2007	11.76	100	0	11.86	0	0	0	0	100	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2008	11.76	100	0	11.86	0	0	0	0	0	30.89	0	0	0	4.92	0.93	0	0	3.36	80	0	37.50	0	0	0	0	0	0
2009	11.76	100	0	11.86	0	0	0	0	0	19.51	0	0	0	4.92	0.93	0	0	3.36	80	0	0	0	0	0	0	0	0
2010	0.0	100	0	3.39	0	0	0	0	0	19.51	0	0	0	0	0	0	0	2.52	80	0	0	0	0	0	0	0	0
2011	0.0	100	0	3.39	0	0	0	0	0	19.51	0	0	0	0	0	0	0	2.52	80	0	0	0	0	0	0	0	0
2012	0.0	100	0	3.39	0	0	0	0	0	13.01	0	0	0	0	0	0	0	2.52	80	0	0	0	0	0	0	0	0
2013	0.0	100	0	3.39	0	0	0	0	0	13.01	0	0	0	0	0	0	0	2.52	80	0	0	0	0	0	0	0	0
2014	0.0	100	0	3.39	0	0	0	0	0	0.81	0	0	0	0	0	0	0	0.00	80	0	0	0	0	0	0	0	0
NA	0.0	100	0	0.00	0	0	0	0	0	0.81	0	0	0	0	0	0	0	0.00	80	0	0	0	0	0	0	0	0

Table 6.13: Percentage of Farmers Planting Durum Wheat Varieties of Different Release Dates and Cumulative Adoption Rates –Provincial and National Figures

Year of release	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	National Total	Cumulative
Landraces	0	0	0	0	37.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.46	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.30	0	0	0	0	0	0	0	0	0	0	0	0	3.55	99.54
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.99
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.99
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0.77	95.99
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.22
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.22
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.22
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95.22
1991	64.71	0	0	37.29	12.50	0	60	0	0	0	0	0	0	81.97	38.89	46.15	64.71	26.05	0	0	12.50	0	0	0	0	0	81.13	37.19	95.22
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58.02
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58.02
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58.02
1997	0	0	0	3.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.31	58.02
1998	11.76	0	0	47.46	37.50	0	40	0	0	0	0	0	0	13.11	37.04	50	23.53	65.55	0	0	0	0	0	0	0	0	11.32	29.01	57.72
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28.70
2000	11.76	0	0	0	12.50	0	0	0	0	0	0	0	0	0	1.85	3.85	11.76	5.04	0	0	50	0	0	0	0	0	7.55	3.40	28.70
2001	0	0	0	0	0	0	0	0	0	24.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.63	25.31
2002	0	0	100	0	0	0	0	0	0	44.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.88	20.68
2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.80
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.80
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.80
2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.80
2007	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.31	10.80
2008	0	0	0	0	0	0	0	0	0	11.38	0	0	0	0	0	0	0	0	0	0	37.50	0	0	0	0	0	0	2.62	10.49
2009	11.76	0	0	8.47	0	0	0	0	0	0	0	0	0	4.92	0.93	0	0	0.84	0	0	0	0	0	0	0	0	0	1.85	7.87
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.02
2011	0	0	0	0	0	0	0	0	0	6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.23	6.02
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.78
2013	0	0	0	0	0	0	0	0	0	12.20	0	0	0	0	0	0	0	2.52	0	0	0	0	0	0	0	0	2.78	4.78
2014	0	0	0	3.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.31	2.01
NA	0	100	0	0	0	0	0	0	0	0.81	0	0	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	1.70	1.70

Note: National adoption rates are generated by using number of growers in each province as weights.

Adoption degree (percentage of wheat area under improved varieties)

Adoption degree by variety

The top 10 varieties out of the total 135 found in the Turkish farmers' hands cover more than 58.2% of the total area. This finding is consistent with the result presented in section 5.1.1.1, in which 55.8 % of all farmers are cultivating the top 10 varieties. The balance in adoption rate and adoption degree indicates the absence of systematic differences between large and small farms in adopting improved wheat varieties. About 39.7% of the area covered by the top 10 varieties is under varieties released after 2000 – showing that older varieties still dominate the Turkish wheat fields. About 51.6% of the area under the top 10 varieties is covered by varieties released between 1991 and 1999. The top three varieties in terms of area are Seyhan99, Esperia and Çeşit1252. These three varieties together constitute over 25.6% of the total national wheat area. In terms of area coverage, Çeşit1252 is the third most important variety, replacing Bezostaja-1, which was the third most popular varieties in terms of number of farmers (Annex 5).

Adoption degree by province

With an adoption degree for improved wheat varieties released in or after 2000 (i.e. less than 15 years old varieties) of 88.5% of the total provincial wheat area, Tekirdağ is leading all the provinces, followed by Sivas (88.4%) and Edirne (87.13%). The adoption degree for varieties released in the last 10 years is the highest in Edrine (85.1%) – which is in line with the findings of Mazid et al. (2015) – followed by Tekirdağ (73.2%) and Ankara (63.5%). Likewise, regarding the adoption degree for varieties released more recently (within the previous five years), Ankara, Balıkesir, Tekirdağ have adoption degrees of 60.8%, 50.9%, and 48.5%, respectively, and are leading all other provinces. In contrast, Van is the only province where 100% of wheat area is cultivated with landrace varieties (Table 6.14).

Table 6.14: Cumulative percentage of wheat area under wheat varieties released in or after a specific year – by province

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balikesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
Landraces	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1967	93.41	98.66	100	99.87	98.37	91.24	99.73	88.36	99.85	100	100	91.86	96.26	98.17	91.87	99.81	97.82	99.82	100	99.05	97.75	94.38	98.29	100	89.32	0	99.49
1968	93.41	98.66	100	99.87	98.37	91.24	99.73	88.36	99.85	100	100	91.86	96.26	98.17	73.78	99.81	97.82	99.82	100	99.05	97.75	94.38	98.29	100	89.32	0	99.49
1970	88.75	98.66	100	94.42	97.57	88.90	89.68	58.84	99.85	98.91	100.00	60.13	96.26	91.37	73.78	97.95	84.03	96.72	100	74.81	94.59	91.78	89.63	100	74.89	0	93.91
1976	88.75	98.66	100	94.42	97.57	88.90	89.46	58.84	99.85	98.91	100.00	48.53	96.26	90.24	73.78	97.95	84.03	96.72	100	72.42	94.59	91.78	89.63	100	74.89	0	93.91
1979	88.75	95.04	100	94.42	97.57	88.90	89.46	45.99	99.85	98.91	100.00	48.53	96.26	89.95	73.78	97.95	84.03	96.72	94.30	72.42	94.59	91.78	89.63	100	74.89	0	93.91
1984	88.75	95.04	100	94.13	90.46	88.90	89.46	45.99	99.85	98.91	100.00	47.71	93.05	87.28	71.82	97.95	80.35	96.38	94.30	72.42	76.97	90.65	89.63	100	74.89	0	92.24
1985	88.75	95.04	100	94.13	90.46	88.90	89.46	45.99	99.43	98.91	100.00	47.71	93.05	87.28	71.82	97.95	80.35	96.38	94.30	72.42	76.97	90.65	89.63	100	74.89	0	92.24
1990	88.75	95.04	100	92.54	90.46	88.90	89.46	45.99	99.43	98.91	100.00	47.71	90.71	87.07	71.67	97.95	80.35	96.38	94.30	72.42	76.97	90.65	89.63	100	74.89	0	92.24
1991	83.94	95.04	100	92.54	90.46	88.90	89.19	45.99	99.43	98.91	100.00	26.81	90.71	87.07	71.67	97.95	80.35	96.38	94.30	72.42	76.97	90.65	89.63	100	74.89	0	92.24
1994	75.93	95.04	100	82.10	88.86	88.90	87.88	42.95	99.43	98.91	100.00	26.30	90.71	46.42	48.85	70.14	68.46	87.70	94.30	72.42	76.75	90.65	89.63	100	74.89	0	68.79
1995	75.93	95.04	100	82.10	88.86	88.90	87.88	42.95	99.43	98.91	100.00	26.30	90.71	41.54	48.85	70.14	68.46	87.54	94.30	72.42	76.75	90.65	89.63	100	74.89	0	68.47
1996	75.93	90.48	100	82.10	88.86	88.90	87.88	42.95	96.81	98.91	100.00	26.30	90.71	41.54	48.85	70.14	68.46	87.54	58.94	72.42	76.75	90.41	89.63	100	74.89	0	68.47
1997	75.93	90.48	100	80.43	87.25	88.90	87.88	42.95	96.81	98.91	100.00	26.30	90.71	41.54	48.85	70.14	67.47	87.54	58.94	72.42	76.75	90.41	89.63	100	74.89	0	64.78
1998	75.93	90.48	100	77.16	87.25	88.90	87.88	42.95	96.70	98.91	100.00	26.30	90.71	41.54	48.85	70.14	67.47	87.54	58.94	72.42	76.75	90.41	89.63	100	74.89	0	64.78
1999	66.73	90.48	96.76	76.95	82.93	84.41	82.53	42.42	87.04	81.81	99.33	26.30	44.69	41.54	48.85	70.14	67.47	83.10	57.96	72.42	49.17	90.41	89.63	99.39	72.59	0	37.11
2000	38.95	68.11	5.75	49.56	67.75	16.69	81.82	42.42	77.97	44.72	87.13	26.30	42.44	32.49	10.08	28.00	63.06	64.01	37.00	72.42	49.17	88.38	73.08	88.46	51.02	0	27.22
2001	37.90	66.00	5.75	42.45	39.73	16.02	80.70	38.23	77.97	44.72	86.66	26.30	40.21	15.16	6.93	23.03	17.40	53.00	36.34	68.61	21.05	18.33	51.16	88.46	47.38	0	25.84
2002	37.90	41.44	5.75	39.27	37.42	15.39	80.65	8.97	53.22	22.54	86.09	26.30	28.16	11.61	6.93	22.28	17.40	49.53	17.54	68.61	16.36	18.33	14.76	79.71	47.38	0	18.38
2003	37.90	37.54	0.00	36.43	35.82	15.39	80.65	8.97	51.75	12.67	86.09	26.30	28.16	8.90	6.93	22.28	16.26	36.00	5.12	68.61	16.36	18.33	14.76	77.68	47.38	0	18.38
2004	37.90	37.54	0.00	36.11	35.82	15.39	80.65	8.97	51.75	12.67	85.06	26.30	28.16	8.65	6.93	22.28	15.46	36.00	5.12	68.61	13.02	18.33	14.76	73.19	47.38	0	18.38
2005	34.72	37.54	0.00	14.29	28.55	7.55	63.54	8.97	51.75	12.67	85.06	26.30	25.59	4.90	6.39	3.10	7.34	30.15	5.12	38.55	12.53	5.26	10.01	73.19	9.19	0	3.00
2006	34.72	37.54	0.00	14.29	28.55	4.63	63.54	8.97	51.75	12.67	51.83	26.30	25.59	4.90	6.39	3.10	7.34	30.15	3.73	38.55	12.53	5.26	5.48	54.57	6.59	0	3.00
2007	34.72	15.37	0.00	14.29	28.55	4.63	63.54	8.97	51.75	12.67	51.83	26.30	25.59	4.90	6.39	3.10	7.34	30.15	3.73	38.55	12.53	5.26	5.48	54.57	6.59	0	3.00
2008	34.72	15.37	0.00	14.29	28.55	4.63	63.54	8.97	50.91	12.67	51.83	26.30	25.59	4.90	6.39	3.10	7.34	30.15	3.73	38.55	12.53	5.26	5.48	54.57	5.49	0	3.00
2009	32.99	15.37	0.00	11.75	25.35	1.26	62.10	6.08	50.91	9.35	51.19	17.46	24.60	4.90	6.39	3.10	3.37	27.64	3.73	38.55	1.80	0.00	5.48	54.57	5.49	0	2.09
2010	31.34	15.37	0.00	1.71	25.35	0.36	60.85	6.08	50.91	9.35	30.81	17.46	23.56	1.65	5.41	3.10	3.37	26.44	3.73	38.55	1.80	0.00	5.48	48.54	5.49	0	1.10
2011	30.64	15.37	0.00	1.67	24.55	0.36	60.85	5.56	50.91	9.35	20.62	17.46	23.56	1.65	5.41	3.10	3.37	26.44	3.73	38.55	1.80	0.00	5.48	44.72	5.49	0	1.10
2012	16.39	8.69	0.00	1.59	6.92	0.00	13.55	0.00	50.33	5.97	8.05	6.88	16.02	1.65	5.41	0.00	3.37	9.40	3.73	0.00	1.80	0.00	5.48	13.77	2.55	0	1.01
2013	11.38	8.69	0.00	1.59	6.92	0.00	10.83	0.00	17.80	5.97	0.59	6.88	2.20	1.65	5.41	0.00	3.37	8.16	3.73	0.00	1.80	0.00	5.48	6.36	1.30	0	1.01
2014	11.38	8.69	0.00	1.59	0.00	0.00	8.12	0.00	6.30	0.10	0.08	0.00	0.37	0.00	4.52	0.00	0.50	0.34	2.75	0.00	1.80	0.00	5.48	1.89	0.95	0	0.64
NA	11.38	5.90	0.00	0.00	0.00	0.00	8.01	0.00	0.00	0.10	0.00	0.00	0.37	0.00	4.52	0.00	0.00	0.00	2.75	0.00	0.00	0.00	4.36	1.08	0.00	0	0.64

Adoption degree (percentage of wheat area) – national level

Out of the total wheat area of 7.87 million hectares in Turkey, only 1.51 million hectares (19.14%) is estimated to be covered with varieties released in the past five years (Table 6.15). While the estimates increase to about 25.3% and 50.7% when the cutoff for varietal age is increased to 10 and 15 years, respectively, one can see that varietal replacement in the country is not as fast as breeders would like to see. Assuming that the landraces have been in the country for 100 years, varietal replacement rate, as proxied by area-weighted varietal age in the country, is 20.82 which is in contrast with the 8-10 years reported in Lantican et al. (2016). Given that our estimates are based on primary data from a large sized sample, representing above 62% of the total national wheat area, while the estimate in Lantican et al. (2016) is based on a global wheat impacts survey (mostly relying on expert estimates), we believe that our estimate is more reliable and credible.

Table 6.15: Area-weighted percentage of wheat area under varieties of different release dates – provincial and national figures

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	Total	Cumulative
Landraces	0.30	0.01	0	0	0.03	0.19	0.03	0.25	0	0	0	0.19	0.14	0.05	0.23	0	0.07	0.03	0	0.01	0.05	0.34	0.04	0	0.28	1.65	0.03	4.58	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.51	0	0	0	0	0	0	0	0	0	0	0	0	1.04	95.42
1968	0.21	0	0	0.19	0.01	0.05	0.94	0.64	0	0.09	0	0.75	0	0.19	0	0.04	0.45	0.46	0	0.34	0.07	0.16	0.19	0	0.38	0	0.37	5.03	94.38
1970	0	0	0	0	0	0	0.02	0	0	0	0	0.28	0	0.03	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0.57	89.35
1976	0	0.02	0	0	0	0	0	0.28	0	0	0	0	0	0.01	0	0	0	0	0.12	0	0	0	0	0	0	0	0	0.23	88.78
1979	0	0	0	0.01	0.13	0	0	0	0	0	0	0.02	0.12	0.08	0.06	0	0.12	0.05	0	0	0.41	0.07	0	0	0	0	0.11	0.94	88.55
1984	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	87.61
1985	0	0	0	0.05	0	0	0	0	0	0	0	0	0.09	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0.15	87.60
1990	0.22	0	0	0	0	0	0.03	0	0	0	0	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.14	87.45
1991	0.36	0	0	0.36	0.03	0	0.12	0.07	0	0	0	0.01	0	1.16	0.64	0.59	0.38	1.28	0	0	0.01	0	0	0	0	0	1.57	5.70	86.31
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0	0	0.02	0	0	0	0	0	0	0	0	0.02	0.10	80.61
1995	0	0.03	0	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0	0	0.76	0	0	0.01	0	0	0	0	0	0.43	80.51
1996	0	0	0	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0.25	0.34	80.08
1997	0	0	0	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.12	79.74
1998	0.42	0	0.06	0.01	0.08	0.10	0.50	0.01	0.23	1.36	0.02	0	1.73	0	0	0	0	0.66	0.02	0	0.64	0	0	0.02	0.06	0	1.85	8.58	79.62
1999	1.26	0.15	1.63	0.93	0.27	1.50	0.07	0	0.22	2.94	0.34	0	0.08	0.26	1.09	0.90	0.14	2.82	0.45	0	0	0.12	0.37	0.41	0.58	0	0.66	20.33	71.04
2000	0.05	0.01	0	0.24	0.49	0.01	0.10	0.09	0	0	0.01	0	0.08	0.50	0.09	0.11	1.48	1.62	0.01	0.05	0.65	4.26	0.49	0	0.10	0	0.09	7.78	50.71
2001	0	0.17	0	0.11	0.04	0.01	0.01	0.64	0.60	1.76	0.02	0	0.45	0.10	0	0.02	0	0.51	0.40	0	0.11	0	0.81	0.33	0	0	0.50	7.28	42.93
2002	0	0.03	0.10	0.10	0.03	0	0	0	0.04	0.78	0	0	0	0.08	0	0	0.04	2.00	0.27	0	0	0	0	0.08	0	0	0	3.85	35.65
2003	0	0	0	0.01	0	0	0	0	0	0	0.03	0	0	0.01	0	0	0.03	0	0	0	0.08	0	0	0.17	0	0	0	0.24	31.80
2004	0.14	0	0	0.74	0.13	0.17	1.60	0	0	0	0	0	0.10	0.11	0.02	0.41	0.26	0.86	0	0.43	0.01	0.80	0.11	0	1.02	0	1.03	6.31	31.57
2005	0	0	0	0	0	0.06	0	0	0	0	0.94	0	0	0	0	0	0	0	0.03	0	0	0	0.10	0.70	0.07	0	0	1.82	25.26
2006	0	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22	23.44
2007	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0.03	23.21
2008	0.08	0	0	0.09	0.06	0.07	0.14	0.06	0	0.26	0.02	0.21	0.04	0	0	0	0.13	0.37	0	0	0.25	0.32	0	0	0	0	0.06	2.25	23.18
2009	0.08	0	0	0.34	0	0.02	0.12	0	0	0	0.57	0	0.04	0.09	0.03	0	0	0.18	0	0	0	0	0	0.23	0	0	0.07	1.79	20.93
2010	0.03	0	0	0	0.01	0	0	0.01	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0	0	0.52	19.14
2011	0.65	0.05	0	0	0.31	0.01	4.43	0.12	0.01	0.27	0.35	0.25	0.28	0	0	0.07	0	2.52	0	0.55	0	0	0	1.17	0.08	0	0.01	10.76	18.63
2012	0.23	0	0	0	0	0	0.25	0	0.78	0	0.21	0	0.52	0	0	0	0	0.18	0	0	0	0	0	0.28	0.03	0	0	2.48	7.87
2013	0	0	0	0	0.12	0	0.25	0	0.28	0.47	0.01	0.16	0.07	0.05	0.02	0	0.09	1.15	0.02	0	0	0	0	0.17	0.01	0	0.02	3.28	5.39
2014	0	0.02	0	0.05	0	0	0.01	0	0.15	0	0	0	0	0	0	0	0.02	0.05	0	0	0.04	0	0.02	0.03	0.03	0	0	0.39	2.12
NA	0.52	0.04	0	0	0	0	0.75	0	0	0.01	0	0	0.01	0	0.13	0	0	0	0.06	0	0	0	0.10	0.04	0	0	0.04	1.73	1.73

Adoption degree (percentage of area) by agroecological zone

Similar to the number of growers presented in section 5.2.1.3, the facultative zone leads the rest of the agro-ecologies in terms of percentage of wheat area covered by more recent varieties. While 30.7% of all wheat areas in the facultative zone are planted with 10 years or younger varieties, only 26.8% and 13.7% of wheat areas in the winter and spring zones are covered with varieties released up to 10 years ago. In contrast, the adoption degree for more recently released varieties is the highest in the winter zone, with 22.4 % of farmers cultivating varieties released within the preceding five years, followed by facultative and spring agro-ecologies that have adoption degrees for such varieties of 18.94% and 9.4 %, respectively. In contrast, the winter zone has the largest proportion (14.7%) of wheat area growing old varieties of more than 40 years old, followed by the facultative zone, where the adoption rate of varieties older than 40 years stands at 8.9% (Table 6.16).

Table 6.16: Cumulative percentage area under wheat varieties released in or after a specific year –by agro-ecological zone

Year of release	*Winter*	*Spring*	*Facultative*
Landrace	100	100	100
1967	93.33	99.26	97.51
1968	93.13	99.26	93.60
1970	86.28	96.58	91.16
1976	85.32	96.58	91.10
1979	85.31	95.65	90.88
1984	83.94	95.65	90.28
1985	83.94	95.65	90.23
1990	83.69	95.65	90.19
1991	81.75	95.65	90.12
1994	74.15	95.47	84.72
1995	74.00	95.47	84.65
1996	74.00	95.23	83.01
1997	73.46	95.23	82.92
1998	73.26	95.23	82.91
1999	65.42	79.95	77.79
2000	52.43	45.67	50.48
2001	40.95	45.32	45.90
2002	38.48	22.67	38.93
2003	35.45	13.66	37.17
2004	35.33	13.66	36.47
2005	26.77	13.66	30.70
2006	26.71	13.66	23.13
2007	26.71	12.51	23.09
2008	26.71	12.51	22.95
2009	23.88	9.38	22.82
2010	22.37	9.38	18.94
2011	22.30	9.35	16.95
2012	7.79	5.65	9.83
2013	5.85	5.65	4.07
2014	2.69	0.42	2.06
NA	2.44	0.27	1.14

Table 6.17: Area-weighted percentage of wheat area under varieties of different release dates – by agro-ecological zone and national figures

Year of release	*Winter*	*Spring*	*Facultative*	*National total*	*Cumulative*
Landrace	4.56	0.08	0.52	4.58	100
1967	0.14	0.00	0.82	1.04	95.42
1968	4.68	0.28	0.51	5.03	94.38
1970	0.66	0.00	0.01	0.57	89.35
1976	0.00	0.10	0.04	0.23	88.78
1979	0.94	0.00	0.13	0.94	88.55
1984	0.00	0.00	0.01	0.01	87.61
1985	0.17	0.00	0.01	0.15	87.60
1990	1.32	0.00	0.01	1.14	87.45
1991	5.20	0.02	1.13	5.70	86.31
1994	0.10	0.00	0.01	0.10	80.61
1995	0.00	0.03	0.34	0.43	80.51
1996	0.37	0.00	0.02	0.34	80.08
1997	0.14	0.00	0.00	0.12	79.74
1998	5.36	1.62	1.07	8.58	79.62
1999	8.88	3.64	5.74	20.33	71.04
2000	7.85	0.04	0.96	7.78	50.71
2001	1.68	2.41	1.46	7.28	42.93
2002	2.07	0.96	0.37	3.85	35.65
2003	0.08	0.00	0.15	0.24	31.80
2004	5.85	0.00	1.21	6.31	31.57
2005	0.04	0.00	1.59	1.82	25.26
2006	0.00	0.12	0.01	0.22	23.44
2007	0.00	0.00	0.03	0.03	23.21
2008	1.94	0.33	0.03	2.25	23.18
2009	1.03	0.00	0.82	1.79	20.93
2010	0.05	0.00	0.42	0.52	19.14
2011	9.92	0.39	1.50	10.76	18.63
2012	1.32	0.00	1.21	2.48	7.87
2013	2.16	0.56	0.42	3.28	5.39
2014	0.17	0.02	0.19	0.39	2.12
NA	1.67	0.03	0.24	1.73	1.73

Adoption degree (percentage of area) – by wheat species

Bread wheat

With an adoption degree of 85.1%, Edirne leads all provinces in terms of the percentage of bread wheat fields covered by more recent varieties of 10 years old or less (Table 6.18). Tekirdağ, Ankara and Balıkesir follow with 73.2%, 64.8%, and 51.3%, respectively. The adoption degree for more recently released varieties is the highest in Ankara, where 62.1% of wheat areas are covered by varieties released within the previous five years, followed by Balıkesir, Tekirdağ and Niğde, which have adoption degrees for such varieties of 51.3%, 48.5% and 38.6 % respectively.

At the national level, the adoption degree for cultivating improved bread wheat varieties of five years old or less stands at 21.53% of total national bread wheat areas. While the figure improves when the cutoff increases to 10 years (27.74%) and 15 years (54.83%), more than 12.6% of the bread wheat areas are still covered by varieties older than 40 years (Table 6.19).

Durum wheat

İzmir leads all provinces in terms of the percentage of durum wheat areas cultivated with more recent varieties (Table 6.20) – with 100% of areas cultivating varieties that are five years old or younger. This is followed by Manisa (73.7%), Diyarbakır (29.5%) and Konya (4.2%). İzmir and Balıkesir also have the highest percentage of areas grown with durum varieties of 10 years old or younger (100%), followed by Manisa (73.7%) and Nevşehir (45.8%).

At the national level, the adoption degree for durum wheat varieties of five years old or less stands at a very low level of 9.11% (Table 6.21). A comparison between national degrees of adoption of durum wheat and bread wheat varieties shows that a relatively higher percentage of total bread wheat areas are covered with more recent varieties than durum wheat.

Table 6.18: Cumulative percentage of wheat area under bread wheat varieties released in or after a specific year – by province

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
Landraces	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1967	92.6	98.6	100	99.8	100.0	91.2	99.7	87.8	99.9	100	100	91.9	96.3	96.5	55.2	99.3	97.4	99.7	100.0	99.0	97.5	94.4	98.3	100.0	89.3	0	99.3
1968	92.6	98.6	100	99.8	100.0	91.2	99.7	87.8	99.9	100	100	91.9	96.3	96.5	55.2	99.3	97.4	99.7	100.0	99.0	97.5	94.4	98.3	100.0	89.3	0	99.3
1970	87.4	98.6	100	90.2	99.1	88.9	89.5	57.0	99.9	98.4	100	60.1	96.3	83.5	55.2	92.2	80.7	95.3	100.0	74.8	94.1	91.8	89.6	100.0	74.9	0	91.5
1976	87.4	98.6	100	90.2	99.1	88.9	89.2	57.0	99.9	98.4	100	48.5	96.3	81.3	55.2	92.2	80.7	95.3	100.0	72.4	94.1	91.8	89.6	100.0	74.9	0	91.5
1979	87.4	94.7	100	90.2	99.1	88.9	89.2	44.9	99.9	98.4	100	48.5	96.3	80.8	55.2	92.2	80.7	95.3	95.1	72.4	94.1	91.8	89.6	100.0	74.9	0	91.5
1984	87.4	94.7	100	89.7	91.5	88.9	89.2	44.9	99.9	98.4	100	47.7	93.0	75.7	44.4	92.2	76.3	94.8	95.1	72.4	74.8	90.7	89.6	100.0	74.9	0	89.1
1985	87.4	94.7	100	89.7	91.5	88.9	89.2	44.9	99.4	98.4	100	47.7	93.0	75.7	44.4	92.2	76.3	94.8	95.1	72.4	74.8	90.7	89.6	100.0	74.9	0	89.1
1990	87.4	94.7	100	86.9	91.5	88.9	89.2	44.9	99.4	98.4	100	47.7	90.7	75.3	43.6	92.2	76.3	94.8	95.1	72.4	74.8	90.7	89.6	100.0	74.9	0	89.1
1991	82.0	94.7	100	86.9	91.5	88.9	89.0	44.9	99.4	98.4	100	26.8	90.7	75.3	43.6	92.2	76.3	94.8	95.1	72.4	74.8	90.7	89.6	100	74.9	0	89.1
1994	82.0	94.7	100	86.9	91.5	88.9	89.0	44.9	99.4	98.4	100	26.3	90.7	75.3	43.6	92.2	76.3	94.8	95.1	72.4	74.8	90.7	89.6	100.0	74.9	0	89.0
1995	82.0	94.7	100	86.9	91.5	88.9	89.0	44.9	99.4	98.4	100	26.3	90.7	66.0	43.6	92.2	76.3	94.6	95.1	72.4	74.8	90.7	89.6	100.0	74.9	0	88.5
1996	82.0	89.9	100	86.9	91.5	88.9	89.0	44.9	96.8	98.4	100	26.3	90.7	66.0	43.6	92.2	76.3	94.6	58.4	72.4	74.8	90.4	89.6	100.0	74.9	0	88.5
1997	82.0	89.9	100	83.9	89.8	88.9	89.0	44.9	96.8	98.4	100	26.3	90.7	66.0	43.6	92.2	75.1	94.6	58.4	72.4	74.8	90.4	89.6	100.0	74.9	0	83.4
1998	82.0	89.9	100	83.9	89.8	88.9	89.0	44.9	96.7	98.4	100	26.3	90.7	66.0	43.6	92.2	75.1	94.6	58.4	72.4	74.8	90.4	89.6	100.0	74.9	0	83.4
1999	71.8	89.9	96.6	83.6	85.2	84.4	83.5	44.3	86.9	74.0	99.3	26.3	44.7	66.0	43.6	92.2	75.1	88.3	57.3	72.4	44.6	90.4	89.6	99.4	72.6	0	44.5
2000	41.3	66.1	1.6	68.7	72.0	16.7	83.5	44.3	77.8	21.0	87.1	26.3	42.4	55.9	43.6	92.2	75.1	87.1	35.6	72.4	44.6	88.4	73.1	88.5	51.0	0	36.2
2001	41.3	63.9	1.6	56.2	42.5	16.0	82.4	39.9	77.8	21.0	86.7	26.3	40.2	22.8	32.8	87.5	21.0	73.3	34.9	68.6	18.7	18.3	51.2	88.5	47.4	0	36.2
2002	41.3	37.8	1.6	50.6	40.1	15.4	82.3	9.4	52.8	0.7	86.1	26.3	28.2	16.0	32.8	84.7	21.0	68.4	15.4	68.6	13.6	18.3	14.8	79.7	47.4	0	25.8
2003	41.3	33.6	0	45.6	38.3	15.4	82.3	9.4	51.3	0.7	86.1	26.3	28.2	10.8	32.8	84.7	19.6	49.1	2.5	68.6	13.6	18.3	14.8	77.7	47.4	0	25.8
2004	41.3	33.6	0	45.0	38.3	15.4	82.3	9.4	51.3	0.7	85.1	26.3	28.2	10.3	32.8	84.7	18.6	49.1	2.5	68.6	9.9	18.3	14.8	73.2	47.4	0	25.8
2005	37.8	33.6	0	6.7	30.6	7.5	64.8	9.4	51.3	0.7	85.1	26.3	25.6	3.1	29.8	11.8	8.9	40.8	2.5	38.5	9.4	5.3	10.0	73.2	9.2	0	4.2
2006	37.8	33.6	0	6.7	30.6	4.6	64.8	9.4	51.3	0.7	51.8	26.3	25.6	3.1	29.8	11.8	8.9	40.8	1.0	38.5	9.4	5.3	5.5	54.6	6.6	0	4.2
2007	37.8	10.1	0	6.7	30.6	4.6	64.8	9.4	51.3	0.7	51.8	26.3	25.6	3.1	29.8	11.8	8.9	40.8	1.0	38.5	9.4	5.3	5.5	54.6	6.6	0	4.2
2008	37.8	10.1	0	6.7	30.6	4.6	64.8	9.4	51.3	0.7	51.8	26.3	25.6	3.1	29.8	11.8	8.9	40.8	1.0	38.5	9.4	5.3	5.5	54.6	5.5	0	4.2
2009	35.8	10.1	0	2.2	27.1	1.3	63.4	6.4	51.3	0.7	51.2	17.5	24.6	3.1	29.8	11.8	4.1	37.2	1.0	38.5	2.0	0	5.5	54.6	5.5	0	2.9
2010	35.0	10.1	0	0.2	27.1	0.4	62.1	6.4	51.3	0.7	30.8	17.5	23.6	3.1	29.8	11.8	4.1	35.9	1.0	38.5	2.0	0	5.5	48.5	5.5	0	1.5
2011	34.2	10.1	0	0.1	26.3	0.4	62.1	5.8	51.3	0.7	20.6	17.5	23.6	3.1	29.8	11.8	4.1	35.9	1.0	38.5	2.0	0	5.5	44.7	5.5	0	1.5
2012	18.3	3.0	0	0	7.4	0	13.8	0	50.8	0.7	8.1	6.9	16.0	3.1	29.8	0	4.1	11.6	1.0	0	2.0	0	5.5	13.8	2.5	0	1.4
2013	12.7	3.0	0	0	7.4	0	11.1	0	18.0	0.7	0.6	6.9	2.2	3.1	29.8	0	4.1	9.8	1.0	0	2.0	0	5.5	6.4	1.3	0	1.4
2014	12.7	3.0	0	0	0	0	8.3	0	6.4	0	0.1	0	0.4	0	24.9	0	0.6	0.5	0	0	2.0	0	5.5	1.9	0.9	0	0.9
NA	12.7	0	0	0	0	0	8.2	0	0	0	0	0	0.4	0	24.9	0	0	0	0	0	0	0	4.4	1.1	0	0	0.9

Table 6.19: Area-weighted percentage of wheat area under bread wheat varieties of different release dates – provincial and national figures

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	Total	Cumulative
Landraces	0.37	0.01	0	0.01	0	0.24	0.03	0.31	0	0	0	0.24	0.17	0.06	0.28	0	0.09	0.03	0	0.02	0.06	0.42	0.05	0	0.35	2.04	0.04	5.64	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.36
1968	0.26	0	0	0.23	0.02	0.06	1.17	0.79	0	0.11	0	0.93	0	0.24	0	0.05	0.55	0.57	0	0.43	0.09	0.20	0.24	0	0.48	0	0.46	6.23	94.36
1970	0	0	0	0	0	0	0.03	0	0	0	0	0.34	0	0.04	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0.70	88.13
1976	0	0.03	0	0	0	0	0	0.31	0	0	0	0	0	0.01	0	0	0	0	0.12	0	0	0	0	0	0	0	0	0.26	87.43
1979	0	0	0	0.01	0.16	0	0	0	0	0	0	0.02	0.15	0.09	0.07	0	0.15	0.06	0	0	0.50	0.08	0	0	0	0	0.14	1.16	87.17
1984	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	86.01
1985	0	0	0	0.07	0	0	0	0	0	0	0	0	0.11	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0.19	86.00
1990	0.27	0	0	0	0	0	0.03	0	0	0	0	0.61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.41	85.81
1991	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.03	84.40
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0	0.03	0	0	0	0	0	0	0	0	0.03	0.13	84.37
1995	0	0.04	0	0	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0.94	0	0	0.02	0	0	0	0	0	0.54	84.24
1996	0	0	0	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0.31	0.42	83.70
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83.29
1998	0.52	0	0.07	0.01	0.09	0.12	0.62	0.01	0.29	1.68	0.02	0	2.14	0	0	0	0	0.81	0.03	0	0.79	0	0	0.03	0.08	0	2.30	10.62	83.28
1999	1.53	0.19	2.02	0.36	0.27	1.85	0	0	0.27	3.64	0.43	0	0.10	0.19	0	0	0	0.15	0.56	0	0	0.15	0.45	0.51	0.71	0	0.49	17.83	72.66
2000	0	0.02	0	0.30	0.60	0.02	0.13	0.11	0	0	0.02	0	0.10	0.61	0.07	0.03	1.80	1.77	0.02	0.07	0.68	5.28	0.60	0	0.12	0	0	9.07	54.83
2001	0	0.21	0	0.13	0.05	0.02	0.01	0.79	0.74	1.40	0.02	0	0.56	0.13	0	0.02	0	0.64	0.50	0	0.13	0	1.00	0.41	0	0	0.62	7.38	45.76
2002	0	0.03	0.03	0.12	0.03	0	0	0	0.04	0	0	0	0	0.10	0	0	0.05	2.47	0.33	0	0	0	0	0.10	0	0	0	2.54	38.38
2003	0	0	0	0.01	0	0	0	0	0	0	0.04	0	0	0.01	0	0	0.03	0	0	0	0.10	0	0	0.21	0	0	0	0.29	35.84
2004	0.18	0	0	0.92	0.16	0.21	1.99	0	0	0	0	0	0.12	0.13	0.02	0.51	0.33	1.07	0	0.53	0.01	0.99	0.13	0	1.26	0	1.28	7.81	35.55
2005	0	0	0	0	0	0.08	0	0	0	0	1.16	0	0	0	0	0	0	0	0.04	0	0	0	0.12	0.87	0.09	0	0	2.26	27.74
2006	0	0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.28	25.49
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0.02	25.21
2008	0.10	0	0	0.11	0.07	0.09	0.17	0.08	0	0	0.02	0.26	0.05	0	0	0	0.16	0.46	0	0	0.19	0.40	0	0	0	0	0.08	2.04	25.19
2009	0.04	0	0	0.05	0	0.02	0.15	0	0	0	0.71	0	0.05	0	0	0	0	0.17	0	0	0	0	0	0.28	0	0	0.08	1.62	23.15
2010	0.04	0	0	0	0.02	0	0	0.01	0	0	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0.18	0	0	0	0.64	21.53
2011	0.80	0.06	0	0	0.38	0.01	5.49	0.15	0.02	0	0.44	0.31	0.35	0	0	0.08	0	3.11	0	0.68	0	0	0	1.45	0.10	0	0.01	12.62	20.90
2012	0.28	0	0	0	0	0	0.32	0	0.97	0	0.26	0	0.64	0	0	0	0	0.23	0	0	0	0	0	0.35	0.04	0	0	3.06	8.27
2013	0	0	0	0	0.15	0	0.32	0	0.34	0.05	0.02	0.20	0.09	0.06	0.03	0	0.12	1.20	0.03	0	0	0	0	0.21	0.01	0	0.03	2.78	5.21
2014	0	0.02	0	0	0	0	0.01	0	0.19	0	0	0	0	0	0	0	0.02	0.06	0	0	0.05	0	0.03	0.04	0.03	0	0	0.41	2.43
NA	0.64	0	0	0	0	0	0.93	0	0	0	0	0	0.02	0	0.16	0	0	0	0	0	0	0	0.12	0.05	0	0	0.05	2.02	2.02

Table 6.20: Cumulative percentage of wheat area under durum wheat varieties released in or after a specific year – by province

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balikesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat
Landraces	100	100	100	100	100	0	100	100	100	100	0	0	0	100	100	100	100	100	100	0	100	0	0	0	0	0	100
1967	100	100	100	100	75	0	100	100	100	100	0	0	0	100	100	100	100	100	100	0	100	0	0	0	0	0	100
1968	100	100	100	100	75	0	100	100	100	100	0	0	0	100	78	100	100	100	100	0	100	0	0	0	0	0	100
1970	100	100	100	100	75	0	100	100	100	100	0	0	0	100	78	100	100	100	100	0	100	0	0	0	0	0	100
1976	100	100	100	100	75	0	100	100	100	100	0	0	0	100	78	100	100	100	100	0	100	0	0	0	0	0	100
1979	100	100	100	100	75	0	100	72	100	100	0	0	0	100	78	100	100	100	74	0	100	0	0	0	0	0	100
1984	100	100	100	100	75	0	100	72	100	100	0	0	0	100	78	100	100	100	74	0	100	0	0	0	0	0	100
1985	100	100	100	100	75	0	100	72	100	100	0	0	0	100	78	100	100	100	74	0	100	0	0	0	0	0	100
1990	100	100	100	100	75	0	100	72	100	100	0	0	0	100	78	100	100	100	74	0	100	0	0	0	0	0	100
1991	100	100	100	100	75.12	0	100.00	71.60	100	100	0	0	0	100	77.90	100	100	100.00	73.68	0	100.00	0	0	0	0	0	100
1994	23.92	100	100	75.80	50.73	0	35.04	0.00	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
1995	23.92	100	100	75.80	50.73	0	35.04	0	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
1996	23.92	100	100	75.80	50.73	0	35.04	0	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
1997	23.92	100	100	75.80	50.73	0	35.04	0	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
1998	23.92	100	100	68.22	50.73	0	35.04	0	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
1999	23.92	100	100	68.22	50.73	0	35.04	0	100	100	0	0	0	14.77	50.02	62.26	30.15	70.83	73.68	0	97.40	0	0	0	0	0	18.63
2000	18.78	100	100	24.35	7.32	0	0	0	100	100	0	0	0	6.82	2.64	5.05	4.26	9.36	73.68	0	97.40	0	0	0	0	0	4.80
2001	8.80	100	100	24.35	0	0	0	0	100	100	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2002	8.80	100	100	24.35	0	0	0	0	100	73.43	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2003	8.80	100	0	24.35	0	0	0	0	100	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2004	8.80	100	0	24.35	0	0	0	0	100	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2005	8.80	100	0	24.35	0	0	0	0	100	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2006	8.80	100	0	24.35	0	0	0	0	100	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2007	8.80	100	0	24.35	0	0	0	0	100	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2008	8.80	100	0	24.35	0	0	0	0	0	40.55	0	0	0	6.82	1.20	0	0	5.00	73.68	0	45.83	0	0	0	0	0	0
2009	8.80	100	0	24.35	0	0	0	0	0	29.48	0	0	0	6.82	1.20	0	0	5.00	73.68	0	0	0	0	0	0	0	0
2010	0	100	0	3.68	0	0	0	0	0	29.48	0	0	0	0	0	0	0	4.18	73.68	0	0	0	0	0	0	0	0
2011	0	100	0	3.68	0	0	0	0	0	29.48	0	0	0	0	0	0	0	4.18	73.68	0	0	0	0	0	0	0	0
2012	0	100	0	3.68	0	0	0	0	0	18.20	0	0	0	0	0	0	0	4.18	73.68	0	0	0	0	0	0	0	0
2013	0	100	0	3.68	0	0	0	0	0	18.20	0	0	0	0	0	0	0	4.18	73.68	0	0	0	0	0	0	0	0
2014	0	100	0	3.68	0	0	0	0	0	0.34	0	0	0	0	0	0	0	0	73.68	0	0	0	0	0	0	0	0
NA	0	100	0	0.00	0	0	0	0	0	0.34	0	0	0	0	0	0	0	0	73.68	0	0	0	0	0	0	0	0

Table 6.21: Area-weighted percentage of wheat area under durum wheat varieties of different release dates – provincial and national figures

	Çorum	İzmir	Adıyaman	Afyon	Aksaray	Amasya	Ankara	Antalya	Balıkesir	Diyarbakır	Edirne	Erzurum	Eskişehir	Kütahya	Kahramanmaraş	Karaman	Kayseri	Konya	Manisa	Niğde	Nevşehir	Sivas	Samsun	Tekirdağ	Tokat	Van	Yozgat	Total	Cumulative
Landraces	0	0	0	0	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.15	100
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.65	0	0	0	0	0	0	0	0	0	0	0	0	5.39	99.85
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.46
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.46
1976	0	0	0	0	0	0	0	0.14	0	0	0	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0	0	0	0.11	94.46
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.35
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.35
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.35
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94.35
1991	1.89	0	0	1.85	0.15	0	1	0.34	0	0	0	0	0	6.05	3.35	3.08	2.00	6.66	0	0	0.03	0	0	0	0	0	8.15	29.51	94.35
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.83
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.83
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.83
1997	0	0	0	0.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	64.83
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.23
1999	0.13	0	0	3.35	0.26	0	0.34	0	0	0	0	0	0	0.56	5.69	4.67	0.74	14.04	0	0	0	0	0	0	0	0	1.38	30.82	64.23
2000	0.25	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0.17	0.41	0.12	1.00	0	0	0.54	0	0	0	0	0	0.48	2.37	33.41
2001	0	0	0	0	0	0	0	0	0	3.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.88	31.05
2002	0	0	0.39	0	0	0	0	0	0	4.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.33	24.17
2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.84
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.84
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.84
2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.84
2007	0	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.12	14.84
2008	0	0	0	0	0	0	0	0	0	1.37	0	0	0	0	0	0	0	0	0	0	0.48	0	0	0	0	0	0	3.12	14.72
2009	0.22	0	0	1.58	0	0	0	0	0	0	0	0	0	0.48	0.14	0	0	0.19	0	0	0	0	0	0	0	0	0	2.49	11.60
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.11
2011	0	0	0	0	0	0	0	0	0	1.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.92	9.11
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.18
2013	0	0	0	0	0	0	0	0	0	2.21	0	0	0	0	0	0	0	0.95	0	0	0	0	0	0	0	0	0	5.37	6.18
2014	0	0	0	0.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0.81
NA	0	0.21	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0.31	0	0	0	0	0	0	0	0	0.52	0.52

Factors affecting farmers' decision and intensity of adoption

Looking at the adoption levels reported in section 5.2 above, the number of farmers who have adopted varieties which are 10 years old or less is only 15.2% of total national growers. However, the adoption level for varieties released in the previous 15 years is 47%, which shows a sizeable number of farmers have cultivated them. Hence, using this cut-off point would provide a good representation of adopters and non-adopters in our sample. Therefore, for this study, improved varieties are defined as varieties released in or after 2000 (i.e. in the previous 15 years), and farmers who cultivate varieties released before 2000 are categorized as non-adopters.

Parameter estimates for the Double Hurdle model are provided in Table 6.22 below. Model results show that the size of total crop land owned and/or cultivated significantly affects farmers' decision on whether to adopt improved varieties of wheat. This result is consistent with the slightly higher adoption degree of 50% relative to the adoption rate of 47%. In Turkey's predominantly market-oriented production systems, with a price differentiation based on a functioning quality grading system, one would expect that larger commercial farms would find it worth investing in improved varieties. Such varieties are more responsive to fertilizers and easier to meet the minimum protein and gluten contents to fetch premium prices. Farmers oriented more towards subsistence would often stick to older improved varieties or landraces which possess specific quality traits important for their home consumption. This result is consistent with other past studies from Morocco (Yigezu et al., 2019) and Mozambique (Uaiene et al., 2009), which found that farmers with large farm sizes are likely to adopt a new technology, including improved varieties.

Table 6.22: Parameter estimates of the Double Hurdle Model for using improved varieties

Explanatory variables	***Double Hurdle-Tier1***		***Double Hurdle-Tier2***	
	Coef.	***Std. Err.***	***Coef.***	***Std. Err.***
Household experience (year)	-0.006	0.002***	-0.010	0.039
Number of years of education	-0.069	0.047	-0.022	0.042
Sex (1=male, 0=female)	0.014	0.311	-0.260	0.285
Hosted wheat demonstration/participatory variety selectin (PVS) trials (1=yes, 0=No)	0.333	0.100***	0.265	0.078***
Attended participatory wheat variety selection trials in the last three years	0.033	0.071	0.020	0.060
Number of extension visits specifically targeting wheat	0.099	0.009***	0.018	0.023
Distance to seed source (km)	0.010	0.002***	0.059	0.021***
Visited demonstration fields or attended field days	-0.113	0.071	-0.071	0.064
Seed price at farm gate (TRY/kg)	0.085	0.105	-0.124	0.199

Explanatory variables	*Double Hurdle-Tier1*		*Double Hurdle-Tier2*	
Irrigated (1=yes, 0=No)	-0.057	0.046	0.051	0.042
Wheat area (ha)	0.0001	0.0001		
Total cropped area (ha)	0.0004	0.0001***	0.437	0.018***
Did you buy the seed by credit? (1=yes, 0=no)	0.206	0.046**	-0.085	0.040**
Constant	-0.398	0.339	1.634	0.361***

*Note: *, **, *** represent significance at p< 0.01, 0.05, and 0.1 levels.*

Access to credit has a positive and significant effect on the decision on whether or not to adopt. This result is valid as farmers with better access to credit are also likely to be more inclined to adopt new varieties, as they will have the needed financial liquidity to cover the additional costs of adoption (including the purchase of certified seeds and other complementary inputs such as fertilizers, herbicides, pesticides, and the extra labor that might be required). Access to credit has also been reported by other studies as important in stimulating technology adoption (Mohamed and Temu, 2008). Simtowe and Zeller (2006) argue that access to credit promotes the adoption of risky technologies by relaxing the liquidity constraint and boosting household-risk-bearing ability.

Farmers who hosted demonstration trials on their farms also have a higher propensity to adopt improved wheat varieties, however, participating in field days alone does not significantly affect farmers' adoption decision. This result is also in line with the theoretical expectation as demonstration trials would give the farmer hands-on training and first-hand information about the pros and cons of the technology, while participation in field days would not fully answer the questions and clear the doubts farmers may have about the technologies.

A higher number of visits to or by extension agents specifically targeting wheat also increases farmer propensity to adopt improved wheat varieties. These results can be justified because farmers get to know the benefits of new technologies through their interaction with extension agents who are better informed about the technologies. Extension agents act as links between the innovators (researchers) of the technology and users of that technology (farmers). This linkage helps to reduce transaction costs incurred when passing on the information about the new technology to a large heterogeneous population of farmers (Genius et al., 2013). Farmers who purchase certified seed tend to adopt improved varieties more than those who use uncertified seeds. This indicates that certified seeds constitute improved varieties that are relatively more recent than uncertified seeds. This result is also reasonable because, generally, the seed system should play an important role in getting older varieties out of production. This is because, in a dynamic seed system, certified seed production focuses on more recent varieties.

Impacts of improved wheat varieties

In terms of the intensity of adoption, once the decision to adopt is made, farmers with relatively larger wheat farms are more likely to plant the improved varieties on larger areas, which is intuitive. They have land sizes which are not available to smaller farmers. Farmers who hosted demonstration trials on their farms also tend to cultivate larger areas of wheat using the new technologies. The counterintuitive result is that access to credit has a significantly negative effect on the area planted with new varieties. Theoretically, the same reasons that make access to credit increase farmers' propensity to adopt the technology are also expected to motivate farmers to adopt the improved varieties in larger areas. Explaining this result will require a qualitative study to bring the intricacies that cannot be captured by empirical analysis.

Impacts on yield

The 2SLS estimates of the IV regression model for yield are presented in Table 6.23. Quantities of nitrogen (N) and Di-amonium phosphate (DAP) fertilizers, as well as seed, pesticides and herbicide applied are found to have positive and significant effects on yield – consistent with theoretical expectations. In contrast, the quantity of composite fertilizer (which contains 20% N, 20% phosphate and 36% sulfite ion) didn't have significant effect on yield which, in the face of positive effects of N and DAP, cast doubt on the appropriateness of the composition for Turkey. The use of irrigation leads to higher yields than purely rainfed agriculture.

The results show that the adoption of improved varieties leads, on average, to yield gains of about 1136 kg/ha (32.4%). The results of the alternative ordinary least squares (OLS) estimation also showed comparable yield gains from the adoption of the improved wheat varieties, indicating the robustness of our results. This result is consistent with many studies which found a clear advantage of using improved varieties on crop productivity (Yigezu et al.2019, Mazid et al. 2015). In the rest of the analysis, we consider the results of the 2SLS as they are consistent and account for possible endogeneity of treatment in case the tests failed to capture it.

At the current average adoption level of 2.1 ha/family for varieties released in the last 15 years, each adopter farm household obtained additional wheat produce of 2,385.6 kg per year.

Table 6.23: 2SLS estimates of the IV model for yield (kg/ha)

Independent Variables	***Adoption of improved varieties (no=0, yes=1)***		***Yield***	
	Coef.	***Std.Er***	***Coef.***	***Std.Er***
Improved varieties (no=0, yes=1)			0.324	0.064***
Household experience (year)	-0.039	0.016***	0.037	0.011***
Sex (1=male, 0=female)	0.030	0.119	0.072	0.082
Number of years of education	-0.019	0.018	0.015	0.012
Wheat area (ha)	0.016	0.009*		
Total cropped area (ha)	0.037	0.009***		
Quantity of seed used (kg/ha)	-0.048	0.035	0.094	0.024***
Quantity of 33% composite fertilizer (kg/ha)	0.015	0.010	-0.004	0.007
Quantity of N fertilizer used (kg/ha)	0.015	0.010	0.026	0.007***
Quantity of DAP fertilizer used (kg/ha)	-0.008	0.007	0.030	0.005***
Quantity of herbicide (kg/ha)	0.159	0.038***	0.054	0.028**
Quantity of pesticide (kg/ha)	0.052	0.021**	0.080	0.015***
Irrigated (1=yes, 0=no)	-0.043	0.021**	0.651	0.014***
Hosted wheat demonstration plots in the last three years? 1= yes, 0=no	0.122	0.038***		
Visited demonstration fields for improved wheat varieties in the last three years? 1= yes, 0=no	-0.049	0.027*		
Attended participatory wheat variety selection trials in the last three years? 1= yes, 0=no	0.054	0.027**		
Price of seed	0.086	0.084		
Walking distance from seed sources (km)	0.040	0.009***		
Get a credit from a bank to buy seed (1=yes, 0=no)	0.090	0.018***		
Constant	0.147	0.180	4.863	0.119***

Impacts on gross margins

For this study, gross margin is defined as the difference between total revenue and total cost. However, in our total cost calculation, we didn't include the value or rental cost of land as heterogeneity of land complicates the valuation. As the main objective of

this study is to measure impact, results of the IV regression model for gross margins are discussed only briefly. The quantities of N and DAP fertilizers, pesticides and herbicides are all found to have positive and significant effects on wheat gross margins (Table 6.24). These results show that the values of marginal products of all these inputs are higher than their unit costs, which indicates that typical Turkish wheat farmers are producing at input levels below the marginal product-maximizing levels. Household experience (in years) and number of years of education also have positive and significant effects on gross margins.

Irrigated plots give higher gross margins than non-irrigated plots, which could be explained purely by the yield gains, which might offset any additional costs of irrigation. After controlling for all the confounding factors listed above, our results show that adoption of improved wheat varieties by the typical Turkish wheat farmers led to higher gross margins of around TRY 1,282.2 or US$337.4 (41.7%) per ha. Again, this is consistent with previous findings (Yigezu et al., 2019, Mazid et al., 2015).

Table 6.24: 2SLS estimates of the IV model for gross margins (TRY/ha)

Independent variables	***Adoption of improved varieties (no=0, yes=1)***		***Gross margins***	
	Coef.	***Std.Er***	***Coef.***	***Std.Er***
Improved varieties (no=0, yes=1)			0.425	0.099***
Household experience (year)	-0.039	0.016***	0.058	0.017***
Sex (1=male, 0=female)	0.030	0.119	0.118	0.127
Number of years of education	-0.019	0.018	0.030	0.019
Wheat area (ha)	0.016	0.009*		
Total cropped area (ha)	0.037	0.009***		
Quantity of seed used (kg/ha)	-0.048	0.035	0.043	0.037
Quantity of 33% composite fertilizer (kg/ha)	0.015	0.010	-0.023	0.011**
Quantity of N fertilizer used (kg/ha)	0.015	0.010	0.022	0.011**
Quantity of DAP fertilizer used (kg/ha)	-0.008	0.007	0.080	0.007***
Quantity of herbicide (kg/ha)	0.159	0.038***	0.076	0.044*
Quantity of pesticide (kg/ha)	0.052	0.021**	0.074	0.024***
Irrigated (1=yes, 0=no)	-0.043	0.021**	0.776	0.022***
Hosted wheat demonstration plots in the last three years? 1= yes, 0=No	0.122	0.038***		
Visited demonstration fields for improved wheat varieties in the last three years?	-0.049	0.027*		
Attended participatory wheat variety selection trials in the last three years? 1= yes, 0=no	0.054	0.027**		

Independent variables	*Adoption of improved varieties (no=0, yes=1)*		*Gross margins*	
	Coef.	*Std.Er*	*Coef.*	*Std.Er*
Price of seed	0.086	0.084		
Walking distance from seed sources (km)	0.040	0.009***		
Get a credit from a bank to buy seed (1=yes, 0=no)	0.090	0.018***		
Constant	0.147	0.180	4.656	0.184***

Impacts on consumption

Estimates of the IV regression model for consumption are provided in Table 6.25 below. The results show that adopters of varieties aged 15 years or younger, on average, consume about 11.5 kg/capita/year (19.7%) more wheat than the counterfactual. This shows that the yield and/or income gains of using more recent varieties also translated into improvements in food security.

Table 6.25: 2SLS estimates of the IV model for wheat consumption (kg/capita/year)

Independent variables	*Adoption of improved varieties (no=0, yes=1)*		*Wheat consumption (kg/capita/year)*	
	Coef.	*Std.Er*	*Coef.*	*Std.Er*
Improved varieties (no=0, yes=1)			0.197	0.046***
Household experience (year)	-0.039	0.016***	-0.043	0.008***
Sex (1=male, 0=female)	0.030	0.119	0.039	0.060
Number of years of education	-0.019	0.018	0.012	0.009
Wheat area (ha)	0.016	0.009*		
Total cropped area (ha)	0.037	0.009***		
Quantity of seed used (kg/ha)	-0.048	0.035	0.038	0.017**
Quantity of 33% composite fertilizer (kg/ha)	0.015	0.010	-0.007	0.005
Quantity of N fertilizer used (kg/ha)	0.015	0.010	0.006	0.005
Quantity of DAP fertilizer used (kg/ha)	-0.008	0.007	0.003	0.004
Quantity of herbicide (kg/ha)	0.159	0.038***	0.030	0.020
Quantity of pesticide (kg/ha)	0.052	0.021**	0.045	0.011***
Irrigated (1=yes, 0=no)	-0.043	0.021**	-0.004	0.010
Hosted wheat demonstration plots in the last three years? 1= yes, 0=no	0.122	0.038***		
Visited demonstration fields for improved wheat varieties in the last three years?	-0.049	0.027*		

Independent variables	*Adoption of improved varieties (no=0, yes=1)*		*Wheat consumption (kg/capita/year)*	
	Coef.	*Std.Er*	*Coef.*	*Std.Er*
Attended participatory wheat variety selection trials in the last three years? 1= yes, 0=no	0.054	0.027**		
Price of seed	0.086	0.084		
Walking distance from seed sources (km)	0.040	0.009***		
Get a credit from a bank to buy seed (1=yes, 0=no)	0.090	0.018***		
Constant	0.147	0.180	3.882	0.086***

National impacts at current adoption levels

The total wheat area in the 27 provinces covered by the survey is 4,874,290 ha, of which, 50.7% (2,471,265 ha) is under improved varieties that are 15 years old or younger. Given the average yield gain of 1,136 kg/ha, the introduction of improved wheat varieties has led to an additional 2.81 million tons of wheat in the 27 provinces, representing an annual production increase of about 16.43%. Assuming that, on average, adoption levels and yield impacts in the other wheat-growing areas not covered by the survey are the same, Turkey has been producing a total of 4.53 million tons (22.54% of total production in 2014/215) of additional wheat per year due to the adoption of improved varieties. This shows that even at the current level (50.7%) of adoption, improved wheat varieties are making a sizeable contribution to national food security, and to Turkey's effort to maintain its important role in the world market.

The 50.7% level of adoption of improved wheat varieties in the 27 survey provinces has led to a gain in total gross margins of around about TRY 2.17 billion (US$0.834 billion), which represents a gain of 21.5% to total national net income for the sampled provinces. Assuming that adoption levels and yield impacts in other wheat growing areas are the same as the average of the 27 provinces sampled, Turkey is earning a total additional net wheat income of about TRY 5.11 billion (US$1.346 billion) per year.

The total population of Turkey in 2017 was about 79.81 million. Therefore, the extra 4.53 million tons of wheat produced due to the adoption of improved wheat varieties translates to about 56.8 kg/capita/year of extra wheat availability for consumption. However, this calculation assumes out differences in terms of access and entitlement to the produced wheat, which is a very unrealistic assumption. Considering the average per-capita consumption from our survey of 58.6 kg/capita/year, the adoption of the improved wheat varieties has almost doubled the quantity of wheat that can be made available for local consumption (or equivalent amounts of exports).

Potential national impacts

While the adoption level of improved varieties is generally high, the current

adoption level of improved varieties aged less than 15 years is low. However, even disregarding the benefit generated from using varieties older than 15 years, the gain in total production and hence, contribution to national food security and Turkey's role in the world market, is still sizeable. Assuming the current modest yield gains per unit area, if the adoption of improved varieties aged less than 15 years increased to 100%, Turkey could almost double its current benefits (Table 6.26).

Table 6.26: Potential impacts of improved wheat varieties with different assumed adoption levels

Assumed adoption level	***Realized/potential gain***		
	Production (million tons)	***Gross margins (billion TYD)***	***Gross margins (billion US$)***
Current level (50.7%)	4.53	5.11	1.35
60%	5.36	6.05	1.59
70%	6.26	7.06	1.86
80%	7.15	8.07	2.12
90%	8.04	9.08	2.39
100%	8.94	10.09	2.65

More recent improved varieties might have even higher yield potentials. Hence, the country in general and individual farmers can expect even higher benefits in the future than are being realized at the moment – and higher than those hypothesized in Table 6.26 above. Table 6.27 provides data from the survey, which shows how grain yields vary based on the age of varieties, agro-ecologies and seasonal variation, and how net margins decrease with variety age. Therefore, given that the yield gain per unit area presented above was estimated considering varieties aged up to 15 years, if the most recent varieties (e.g. those released in the past five years) – and other new varieties with higher yield potential – were widely adopted, the country could more than double its total production and hence, income. These results show that any effort that induces the development of new varieties with even higher yield potentials, and/or enhances the adoption of more recent varieties in Turkey, is worthy.

Table 6.27: Yields and gross margins by year of release and agro-ecology

	Irrigated		***Rainfed***	
Year of release	***Yield (kg/ha)***	***Gross margins (TRY/ ha)***	***Yield (kg/ha)***	***Gross margins (TRY/ ha)***
Landrace	4,975	4,071	2,120	1,632
1967	5,751	5,028	2,484	2,110
1968	4,707	3,901	2,591	2,100
1970	4,000	3,640	2,542	2,067
1976	5,057	4,557	2,645	2,196
1979	3,793	2,843	2,523	2,017
1984	0	0	3,500	3,145
1985	5,097	4,442	2,000	1,483
1990	4,000	3,221	2,284	1,719
1991	5,031	4,302	2,414	1,908
1994	7,500	7,405	2,561	2,101
1995	6,032	5,549	2,827	2,414
1996	4,200	3,104	2,160	1,489
1997	4,854	4,283	2,500	2,330
1998	4,564	3,857	2,588	2,073
1999	5,129	4,512	2,728	2,273
2000	4,481	3,701	2,390	1,898
2001	4,661	4,061	3,080	2,665
2002	5,477	4,790	2,777	2,327
2003	0	0	3,143	2,723
2004	4,867	4,182	2,493	1,946
2005	4,996	4,306	3,825	3,547
2006	5,574	5,078	3,033	2,659
2007	0	0	3,500	3,129
2008	6,189	5,564	3,223	2,869
2009	6,233	5,649	3,706	3,380
2010	6,589	6,127	4,501	4,268
2011	6,661	5,958	4,254	4,016

Year of release	Irrigated		Rainfed	
	Yield (kg/ha)	Gross margins (TRY/ ha)	Yield (kg/ha)	Gross margins (TRY/ ha)
2012	6,973	6,271	4,490	4,289
2013	6,716	6,320	4,198	4,024
2014	6,831	6,430	4,698	4,496
NA	6,775	6,355	3,899	3,595
Average	5,340	4,669	2,864	2,424

Seed demand analysis

Amount of seed used by geographic and agro-ecological zones

Applying area weights to individual provinces, the amount of wheat seed applied by the typical sampled farmer in all 27 provinces is estimated at 182.5 kg per ha. Therefore, the total amount of seed used in the 27 provinces was estimated at 0.89 million tons per year (Table 6.28). In 2015, the national total wheat area in 2015 was 7.85 million hectares (FAOSTAT, 2020). Assuming the 27 sampled provinces are representative of the whole country, the total amount of seed used in Turkey in 2015 is estimated at 1.43 million tons.

Konya leads the provinces by using 148.26 million kg of wheat seed, followed by Ankara, Diyarbakır, Yozgat, Sivas and Çorum, which have used 78.33, 70, 56.5, 47.6, and 38.9 million kg of wheat seed, respectively. Karaman leads all other provinces at 217.4 kg/ha in terms of seeding rate, followed by Kahramanmaraş, Niğde and Afyon at 215.29, 212.66, and 211.22 kg/ha, respectively.

Table 6.28: Total seed use and average seeding rate by province (27 sample provinces)

Province	Area (ha)	Total seed used (million kg)	Rank in total amount of seed	Average seeding rate (kg/ha)	Rank in seeding rate
Karaman	103.769	24.02	13	217.37	1
Kahramanmaraş	137.523	28.34	10	215.29	2
Niğde	69.356	14.99	24	212.66	3
Afyon	165.811	33.34	8	211.22	4
Eskişehir	182.736	40.19	6	209.68	5
Konya	719.393	148.26	1	207.83	6
Aksaray	85.881	17.34	21	200.44	7
Amasya	107.653	21.35	18	196.27	8

Province	*Area (ha)*	*Total seed used (million kg)*	*Rank in total amount of seed*	*Average seeding rate (kg/ha)*	*Rank in seeding rate*
İzmir	33.54	6.74	27	195.83	9
Erzurum	115.705	21.89	17	194.71	10
Nevşehir	112.439	22.08	16	188.08	11
Manisa	104.29	20.09	19	186.49	12
Tokat	129.961	24.39	12	184.30	13
Diyarbakır	386.714	69.95	3	181.99	14
Çorum	221.475	38.93	7	177.50	15
Yozgat	326.753	56.46	4	175.80	16
Adıyaman	87.192	14.34	25	170.66	17
Kütahya	139.449	23.94	14	170.41	18
Ankara	456.804	78.33	2	169.16	19
Edirne	137.236	22.82	15	167.19	20
Kayseri	157.743	25.96	11	166.36	21
Tekirdağ	184.184	30.17	9	163.90	22
Sivas	296.708	47.60	5	163.74	23
Antalya	105.871	17.29	22	162.16	24
Van	80.494	12.81	26	160.91	25
Balıkesir	117.376	18.58	20	160.81	26
Samsun	108.235	17.21	23	159.39	27
Total Sample	4.874.289	893.65		182.5	

Amount of seed used by variety and by source

Ceyhan99, Esperia, Çeşit1252, Kiziltan91 and Bayraktar2000 are the top five varieties with the highest seed use in Turkey. These results are consistent with the adoption rate by variety reported in section 5.2.1.1 above except that these same varieties occupy the largest area in a slightly different order (Table 6.29).

Table 6.29: Total national seed use by variety (27 sampled provinces)

Rank	*Variety*	*Amount (in million kg) used in 2014*
1	CEYHAN99	88.35
2	Esperia	87.14
3	Çeşit1252	59.35
4	KIZILTAN91	52.46
5	BAYRAKTAR2000	46.93
6	BEZOSTAJA-1	45.88
7	Pehlivan	44.98
8	TOSUNBEY	38.58
9	Sagittario	29.85
10	Katea-1	28.38
11	FLAMURA85	24.72
12	Konya2002	17.96
13	ODESKAYA	14.93
14	Ekiz	14.36
15	FIRAT93	13.06
16	Sönmez2001	13.04
17	Quality	12.30
18	Svevo	12.16
19	Karakilçik	11.91
20	ALTAY2000	10.35
21	KUNDURU	10.29
22	UKRAYNA	10.22
23	Toros	9.89
24	Cesare	9.59
25	GEREK79	8.50
26	PANDAS	8.08
27	Doğu88	7.87
28	Tir	6.43
29	Selimiye	6.09
30	Tekirdağ	5.66
31	BURGAZ	4.98
32	Gelibolu	4.87

Rank	*Variety*	*Amount (in million kg) used in 2014*
33	RENAN	4.65
34	ADANA99	4.60
35	Kiraç66	4.54
36	Mirzabey	4.46
37	Eminbey	4.40
38	AYYILDIZ	4.27
39	NOTA	4.26
40	Kirik	3.98
41	Ankara yazlı	3.83
42	Harmankaya99	3.83
43	ARTUKLU	3.82
44	BEREKET	3.50
45	İridyum	3.38
46	Golia	3.35
47	Tina	3.30
48	Enola	3.14
49	Aglika	2.92
50	İkizce96	2.92
51	Rumeli	2.57
52	Anopa	2.54
53	Adelaide	2.38
54	Ahmetağa	2.18
55	Momtchill	2.14
56	Osmaniyem	2.12
57	ZERUN	2.09
58	MURATBEY	2.00
59	Basribey	1.97
60	Gönen	1.84
61	YUNUS	1.82
62	Genesi	1.78
63	Kaşifbey	1.73
64	Atay85	1.73
65	Cumhuriyet75	1.68

Rank	*Variety*	*Amount (in million kg) used in 2014*
66	KISABAŞAK	1.65
67	Mimmo	1.61
68	Tüten	1.37
69	SERT	1.36
70	Dropia	1.32
71	Selçuklu 97	1.30
72	Kaan	1.12
73	Yubileyna 100	1.11
74	Midas	1.05
75	Eyyubi	1.04
76	Polatli	1.02
77	Kocabuğday	0.96
78	Üveyik	0.95
79	ALPU 2001	0.94
80	Meta	0.90
81	Negev	0.90
82	Nina	0.87
83	TURAN	0.85
84	TT 601	0.78
85	Dağdaş94	0.73
86	Andino	0.64
87	KARAHAN99	0.63
88	Müfitbey	0.58
89	Çam buğdayi	0.54
90	ALDANE	0.54
91	Syrena odes'ka	0.50
92	Tiziana	0.49
93	KIRMIZI	0.48
94	Venka 1	0.47
95	Yüreğir	0.45
96	Dariel	0.41
97	Demir2000	0.41
98	Turkuaz	0.40

Rank	*Variety*	*Amount (in million kg) used in 2014*
99	Ankara güzeli	0.37
100	Meksika	0.33
101	Kale	0.32
102	Sivas	0.30
103	BANCAL	0.28
104	Karişik	0.28
105	Cömert	0.27
106	Doğanbey	0.27
107	Ziyabey	0.27
108	SOYER	0.27
109	MAKARNALIK	0.26
110	SARIBURSA	0.26
111	İveta	0.26
112	Gün91	0.23
113	Ari buğdayi	0.21
114	Akbuğday	0.21
115	Krasunia	0.19
116	Saribuğday	0.18
117	Gediz75	0.18
118	Hayta	0.17
119	Pinzon	0.15
120	Temiz	0.14
121	ANADOLU	0.14
122	Kutluk 94	0.11
123	Prima	0.10
124	Vittorio	0.10
125	BAŞAK	0.09
126	Sultan95	0.09
127	SADOVA	0.08
128	Adagio	0.08
129	UZUNBAŞAK	0.07
130	Kamci	0.04
131	DESTAN	0.03

Rank	*Variety*	*Amount (in million kg) used in 2014*
132	SOFU	0.02
133	KIRKPINAR	0.02
134	Renata	0.02
135	Martar	0.02
	Total	893.65

During the survey, farmers were asked if the seed they used on each of their fields was certified or not. When we summarized the data, we found out that the rate of use of certified seed was unrealistically high (over 60%). A closer look at the data (cross referenced with data on other variables) revealed that this question was understood differently by different farmers. While some responded correctly to the question, understanding it as meaning of whether or not they had purchased certified seed that year, others understood it as meaning if the original source was certified seed (even if it was purchased some years ago). Therefore, unfortunately we were not able to estimate the amount of certified seed used in Turkey. It is, however, reassuring to know that in Turkey, there exist reliable official statistics on quantities of certified seed used annually. From our assessment based on the data collected on certified seed use, we have estimated that in 2015 (the survey year), about 47.67% of Turkish wheat farmers purchased certified seed for one or more of their wheat fields (Table 6.30). The adoption rate and degrees of adoption estimated in the previous sections are comparable. Moreover, the official statistics showed that 33.93% of total wheat area is cultivated using certified seeds. Therefore, the rate of 47.67% for the purchase of certified seed indicates that about 7% of Turkish farmers who purchase certified seeds cultivate some of their fields with uncertified seed.

Table 6.30: Estimated frequency of certified seed purchases

Frequency group for seed replacement (in years)	*Percent*	*Cum.*	*Percentage of fields within this frequency group on which certified seed was likely to have been applied this year (calculated as 1/ frequency)*	*Percentage out of all fields on which certified seed was likely to have been used during the survey year (2015)*
None (not use certified seed)	26.35	26.35	0%	0.00
Every 1 year	28.5	54.85	100.00%	28.50
Every 2 years	27.78	82.63	50.00%	13.89
Every 3 years	13.15	95.78	33.33%	4.38
Every 4 years	2.46	98.24	25.00%	0.62
Every 5 years	1.13	99.37	20.00%	0.23
Every 6 years	0.17	99.54	16.67%	0.03

Frequency group for seed replacement (in years)	*Percent*	*Cum.*	*Percentage of fields within this frequency group on which certified seed was likely to have been applied this year (calculated as 1/ frequency)*	*Percentage out of all fields on which certified seed was likely to have been used during the survey year (2015)*
Every 7 years	0.17	99.71	14.29%	0.02
Every 8 years	0.05	99.76	12.50%	0.01
Total				47.67

Some farmers (47.5%) expressed that, once in a while, they engage in the exchange of seeds with other farmers, while a sizeable proportion (71.5%) said that they save seed from their own wheat grain production from the previous cropping season potentially indicating that about 28.5% are purchasing certified see. This is close to the 33% certified seed replacement target set for the country. Among the farmers who said they save seed from their own grain produce from the preceding year, only 23.9% reported that they treat their seed while the remaining 76.1% don't. Studies carried out in Syria show that this practice is also undertaken by farmers for the management of barley seed – but not for wheat (Bishaw, 2004).

In terms of storage, the majority (56.6%) of farmers said they store their own saved seed separately from regular wheat (Table 6.31). Most farmers (77.7%) store their seed in polypropylene bags and another 22.3% in jute bags, both of which are kept inside the house (Table 6.32). Studies from Ethiopia (Bishaw et al., 2010) and Syria (Bishaw et al., 2011) on wheat and barley showed that the majority of wheat and/or barley producers store their own saved seed. However, while jute bags or propylene bags are the most common form of storage in Syria, a traditional storage structure called gotera is common in Ethiopia.

Table 6.31: Own saved seed treatment and storage

	If farm-saved, did you treat your seed?	*Did you store seed separate from other grains?*
Yes	23.9%	56.6%
No	76.1%	43.4%
Total	100%	100%

Table 6.32: Mode of storage for own saved seed

Where do you store the seed?	*% of farmers*
In jute bags kept in house	22.3
In polypropylene bags kept in house	77.7
Total	100

Amount of seed used by type and analysis of farmers' seed choices

The average seed replacement rate is 2.1 years, with some farmers replacing every year and others not replacing for over 10 years. When asked about their most preferred variety, which they know or have heard about, Esperia, Bezostaja-1, Ceyhan99, Kiziltan91 and Bayraktar2000 were the top five wheat varieties mentioned by farmers.

Farmers were also asked about their trait preferences. Their responses showed that trait preferences vary substantially by wheat production environment (rainfed vs. irrigated) and by production ecology (winter, spring and facultative). For example, for farmers in the winter production ecology and purely rainfed areas, market demand for the variety (marketability) was rated by 87.4% of farmers to be the number one preferred trait, followed by grain yield (86.8%) and grain quality (85.9%). On the other hand, in the spring ecology of rainfed environments, grain yield was rated by 91.8% of farmers as the number one preferred trait, followed by taste in the preparation of different dishes (90.9%) and marketability (87.6%). The top three traits in the facultative rainfed ecosystems were grain yield, quality of the variety, and marketability (Annex 6).

In the irrigated environment, trait preferences also varied by production ecology. For example, in the winter ecology, grain yield, grain price and quality of the variety were the top three traits – showing a market-oriented emphasis. In the spring environment, yield stability was the third most important trait, and was not as important in the rainfed areas and the winter ecology of the irrigated environment, where marketability and grain yield were the first and second most preferred traits. In the facultative ecology, grain yield, quality of the variety, and price were the top three most important traits for farmers (Annex 7). These results show that agro-ecologies and production environments should target breeding and seed dissemination. Bishaw and Alemu (2017) found that grain yield, resistance to yellow and stem rusts, and tolerance to droughts, were attributes that were desired most by wheat farmers in Ethiopia, which indicates the farmers' challenges and production environments. The study found high variability in attainment indices (farmers perception of a given varietal trait and the availability of that trait in a given variety) among improved varieties for different attributes and suggested the need to develop and deploy varieties for different circumstances.

Farmers were asked if they cultivate their favorite varieties. The results showed that 95.5% of farmers responded "Yes" to cultivating their favorite wheat varieties – indicating that seed companies are actively supplying farmer-preferred varieties. However, whether the best varieties available from research and other sources are being made available cannot be confirmed with this data. Most farmers would not know if such varieties existed. For those who responded "No", the main reason was the absence or non-availability of seed in sufficient quantities in the market, followed by a lack of varieties that are well adapted to the changing climate, and to diseases and pests.

Farmers were also asked what they think would be the best way to solve the current seed-related problems. The main solutions proposed by the farmers in order of their importance were: 1) Choosing suitable varieties for the climate (31%); 2) Accessing the seed of required varieties on time (25.6%); 3) Purchasing the varieties from the preferred

companies (16.5%) – which we understand as farmers saying that the informal sector needs to be strengthened to fill this gap; 4) The Turkish Government should intervene and solve these problems (12%).

In response to the question about the problems or issues relating to the use of certified seeds, 74.8% of the farmers considered the high price of certified seeds among the key issues. In comparison, the unavailability of certified seeds of preferred varieties was an important issue for 15.7% of farmers. Farmers' perception of certified seed price should be put in context, as the seed is the least costly but critical input for crop production when compared to fertilizers and agro-chemicals. The majority of farmers traditionally plant more than the recommended seed rates (i.e. from 1.5 to 3 times), which can account for the high cost of use. These results are consistent with the results of studies on wheat and barley in Ethiopia and Syria, which showed that the majority of farmers use seed rates above the recommendation, both for irrigated and rainfed areas, particularly for wheat in Syria (Bishaw, 2004).

Regarding the quality of certified seeds sold in the market, from their own experience or from what they hear from other farmers, 53.9% and 54.2%, respectively said they are completely satisfied with its genetic purity and physical purity respectively. Concerning seed health and seed germination, about 56.4% and 57.1 % of the respondent farmers, respectively, said that they were completely satisfied.

Conclusions

Wheat is one of the most important agricultural commodities in Turkey, and the country ranks among the top 10 producers in the world. It is a strategic crop and an essential staple food in the Turkish diet. A goal of national self-sufficiency in wheat production, as well as the stability of bread prices, are always hot topics and indicators among politicians for the performance of agricultural policies. Turkish Government administrations formulate and implement particular policies on wheat, such as providing agricultural subsidies, intervention prices, price support and high protective tariffs.

According to the 2018 production bonus announcements, the price premium given to farmers by the Government of Turkey for wheat produce was TRY 50/MT (equivalent to US$13/MT). The government is continuing to provide other benefits to farmers, including price support for soil analysis, diesel and fertilizer.

Using a nationally representative sample of 2,560 farm households drawn from 27 provinces and distributed across 123 districts and 687 villages, this study attempted to provide reliable estimates of the current national, provincial, and agro-ecology-wise adoption levels of improved wheat varieties, with special attention to their release date. Analyses of the factors influencing adoption of improved wheat varieties and an estimation of farm, provincial and national-level seed demand, have been carried out. The study also attempted to measure the impacts of adopting improved varieties on the livelihoods of households cultivating wheat.

During the survey, 135 wheat varieties were found in farmers' hands. The top 10 varieties are being cultivated by 55.8% of wheat growers. However, 38.4% of the top 10 varieties were released before 1999, while only 20.64% of the top 10 varieties were released after 2004. Similarly, the top five varieties are being cultivated by 35.4% of farmers. The top three varieties, in terms of the number of growers, are Ceyhan99, Esperia and Bezostaja-1, which are cultivated by 23.3% of Turkish farmers.

The national adoption rates for more recent varieties generally stand at low levels. Out of the total 1,066,885 wheat-growing families in the 27 study governorates, only 158,000 (14.8%) cultivate varieties released in the previous five years. Varieties released in the previous 10 years also still stand at low levels in the Turkish farmers' portfolio, with more than 68.24% of the growers cultivating varieties older than 10 years. The national adoption rate for varieties released in or after 2000 (in the previous 15 years) is 47.1%. About 14.5% of the growers are still cultivating varieties that were released more than 40 years ago. Using area weights for upward aggregation, out of the total wheat area of 7.87 million hectares in Turkey, only 1.51 million hectares (19.14%) of the total national wheat area is covered with varieties released five years ago, or less. Adoption levels increase to about 25.3% and 50.7% when the cutoff points for the age of varieties increase to 10 and 15 years, respectively.

Access to credit has a significant effect on adoption of improved wheat varieties, as farmers will have the needed financial liquidity to purchase certified seeds and other complementary inputs. Therefore, policymakers need to improve current smallholder credit systems to ensure that a wider spectrum of smallholders can access credit. Farmers who hosted demonstration trials on their own farms, and those with higher numbers of extension visits (including the visits by extension agents) specifically targeting wheat, were found to have a higher propensity to adopt improved wheat varieties.

The adoption of improved wheat varieties leads to improvements in livelihood indicators, including 1,136 kg/ha (32.4%) higher yields, TRY 1,282.2 or US$337.4 (41.7%) per ha higher gross margins, and a 11.5 kg/capita/year (19.7%) increase in wheat consumption from own production. Conservatively assuming that the estimated adoption level was reached only in 2015, nationally, Turkey has been producing annually a total of 4.53 million tons per year more wheat due to the adoption of improved varieties since 2015, generating net wheat income gains of about TRY 5.11 billion or US$1.346 billion per year, and an increase of 56.8 kg/capita/year in the amount of wheat available for consumption from domestic production.

The average seeding rate for wheat in Turkey is 182.5 kg/ha, which translates to a national seed utilization rate of 0.89 million tons per year. Out of the total seed utilized, Konya leads the other provinces by using 148 thousand tons of wheat seed, followed by Diyarbakır, Yozgat, Sivas and Çorum, which have used 80, 70, 60, 50 and 40 thousand tons of wheat seed, respectively. Based on our survey results, Ceyhan99, Esperia, Çeşit1252, Kiziltan91 and Bayraktar2000 are the five varieties with the highest seed use in Turkey.

About 47.67% of Turkish wheat farmers purchased certified seed for one or more of

their wheat fields. The average seed replacement rate is 2.1 years, with some farmers replacing every year (18.3%) and others not replacing for over 10 years. Farmers stated that the absence or non-availability of certified seed in sufficient quantities in the market, followed by climate, and pests and disease, as the most critical problems regarding seed.

Therefore, based on these findings, we recommend that the introduction of new wheat varieties to farmers should go hand in hand with on-farm demonstrations, as this would help develop farmer confidence and reduce fears associated with the adoption of new varieties. Credit schemes should be strengthened to increase access of all farmer categories to credit to facilitate their adoption of improved agricultural technologies.

To enhance the adoption of improved wheat varieties by farmers, policymakers and technology developers must understand farmers' needs and trait preferences. Superiority in marketability and consumption qualities should make up the minimum breeding objectives if new improved varieties are to command high adoption and wider diffusion.

References

Abadi, G.A.K. and Pannell, D.J. 1999. A conceptual framework of adoption of an agricultural innovation. Agricultural Economics, 21(2):145–154.

Ahmed, M.H. 2015. Adoption of multiple agricultural technologies in maize production of the Central Rift Valley of Ethiopia. Studies in Agricultural Economics, 117,162–168.

Akar, T., Yazar, S., Donmez, E., Avcı, M. and Düşünceli. F. 2007. Current status of national winter wheat breeding in Turkey. J. Agric. Res. 45(1):1–8.

Akinbode, W.O. and Bamire, A.S. 2015. Determinants of adoption of improved maize varieties in Osun State, Nigeria. Journal of Agricultural Extension and Rural Development, Vol.7 (3):65–72.

Akudugu, M.A., Guo, E. and Dadzie, S.K. 2012. Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions. Journal of biology, agriculture and healthcare, Vol 2(3):1–14.

Altuntas, E. and Demirtola, H. 2004. Evaluation of agricultural mechanization level in our country based on geographical regions. GOÜ. Journal of Agricultural Faculty, 21 (2):63–70.

Angrist, J. and Pischke, J.S. 2009. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton, New Jersey, Princeton University Press.

Angrist, J., Imbens, G.W. and Rubin, D. 1996. Identification of Causal Effects Using Instrumental Variables (with discussion). Journal of the American Statistical Association, 91:444–472.

Asfaw, S., Shiferaw, B., Simtowe, F. and Haile, M.G. 2011. Agricultural technology adoption, seed access constraints, and commercialization in Ethiopia. Journal of Development and Agricultural Economics, Vol. 3(9):436–447.

Austin, P.C. 2008.The performance of different propensity score methods for estimating relative risks. Journal of Clinical Epidemiology. 2008a; 61:537–545. doi:10.1016/j.jclinepi.2007.07.011. [PubMed]

Bishaw, Z. 2004. Wheat and Barley Seed Systems in Ethiopia and Syria. PhD Thesis, Wageningen University, Wageningen, The Netherlands (with English and Dutch summaries). 383 pp.

Bishaw, Z. and Alemu, D. 2017. Farmers' perceptions on attributes of bread wheat varieties and formal

seed supply in Ethiopia. International Journal of Crop Improvement, 11(1): 117–130.

Bishaw, Z., Struik, P.C. and van Gastel, A.J.G. 2010. Wheat seed system in Ethiopia: Farmers' varietal perception, seed sources and seed management. Journal of New Seeds, 11 (4): 281–327.

Bishaw, Z., Struik, P.C. and van Gastel, A.J.G. 2011. Wheat seed system in Syria: Farmers' varietal perception, seed sources and seed management. International Journal of Plant Production, 5(4): 323–347.

Byerlee, D. and de Polanco, E.H. 1986. Farmers' stepwise adoption of technological packages: Evidence from the Mexican Alliplano. American Journal of Agricultural Economics, 68: 519–527.

Cragg, J. 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrica, 39:829–844.

Diagne, A. and Demont, M. 2007. Taking a new look at empirical models of adoption: Average treatment effect estimation of adoption rates and their determinants. Agricultural Economics, 37(2–3): 201–210.

Diiro, G. 2009. Impact of off-farm income on agricultural technology adoption intensity and productivity. International food policy research institute, 1–15.

Dimara, E. and Skuras, D. 2003. Adoption of agricultural innovations as a two-stage partial observability process. Agricultural Economics, 28(3), 187–96.

Doss, C.R. 2003. Understanding farm level technology adoption: lessons learned from CIMMYT's micro surveys in Eastern Africa. CIMMYT's Economics Working Paper, 03–07.

Elçi, A. 2000. Türkiye'de tohumculuğun durumu ve gelişimi. Türkiye Ziraat Mühendisliği V. Teknik Kongresi, 17–21. Unpubublished Report.

El-Shater, T., Yigezu, Y.A., Mugera, A., Piggin, C., Haddad, A., Khalil, Y., Loss, S. and Aw-Hassan, A. 2016. Does zero tillage improve the livelihoods of smallholder cropping farmers? Journal of Agricultural Economics, Vol. 67(1):154–172.

FAO. 2018. FAOSTAT Agricultural Production and Production Value Statistics. FAO, Rome, Italy. Available at: https://www.fao.org/faostat/en/#data/QCL. [Accessed on November 3, 2021]

Feder, G., Just, R.E. and Zilberman, D. 1985. Adoption of agricultural innovations in developing countries: A survey. Economic Development and Cultural Change, 33(2):255–98.

Finger, R. and Benni, N.E. 2013. Farmers' adoption of extensive wheat production-Determinants and implications. Land Use Policy, 30:206–213.

Genius, M., Koundouri, P., Nauges, C. and Tzouvelekas, V. 2013. Information transmission in irrigation technology adoption and diffusion: social learning, extension services, and spatial effects. American Journal of Agricultural Economics, 54:328–334.

Getachew, L., Langyintuo, A.S., Mwangi, W. Jaleta, M. and La Rovere, R. 2009. Household Resource Endowment and Determinants of Adoption of Drought Tolerant Maize Varieties: A Double-Hurdle Approach. Contribution Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing.16–22.

Giray, H. 2012. Turkish agriculture at a glance. Journal of Food Agriculture and Environment, 10:292–295.

Green, W.H. 2000. Economic Analysis, 4th ed. Prentice Hall, New Jersey, Prentice Hall.

GTHB. 2012. Information on Agricultural Basins. Available at: https://www.tarimorman.gov.tr/Konular/Plant-Production/Agricultural-Basins. [Accessed on November 3, 2021]

Güngör, H., Saraçoğlu, K.C. and Güngör, G. 2016. Türkiye'de tohumluk sektörü ve ayçiçeği üreticilerinin tohumluk satınalma davranışlarinin analizi: Trakya bölgesi örneği, XII. Ulusal Tarım Ekonomisi Kongresi 48(2):133–138.

Hausman, J.A. 1978, Specification tests in econometrics. Econometrica, 46:1251–1271.

Hazneci, K. and Ceyhan, V. 2016. Buğday tohumluğu üretiminde fiyat değişkenliğinin işletme organizasyonuna, etkisi. XII. Ulusal Tarım Ekonomisi Kongresi, 133–138.

Heckman, J. 1979. Sample selection bias as a specification error. Econometrica, 46, 1:153–161.

Heckman, J. and Vytlacil, E. 2005. Local instrumental variables and latent variable models for identifying and bounding treatment effects. Proceedings of the National Academy of Sciences, 96:4730–4734.

Heckman, J. and Vytlacil, E. 2007. Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Economic Estimators to Evaluate Social Programs and to Forecast Their Effects in New Environments. In Heckman, J. and Leamer, E. (eds). Handbook of Econometrics. 6B: 4875–5144. North-Holland.

Henderson, J. and Chatfield, S. 2011. Who matches? Propensity scores and bias in the causal effects of education on participation. Journal of Politics, 73(3): 646–58.

Imbens, G.W. and Wooldridge, J.M. 2009. Recent developments in the econometrics of program evaluation. J. Econ. Lit, 47(1):5–86.

Imbens, Gand Angrist, J. 1994. Identification and estimation of local average treatment effects. Econometrica, 62, 467–476.

Jalan, J. and Ravallion, M. 2003. Estimating the benefit incidence of an antipoverty program by propensity score matching. Journal of Business & Economic Statistics, American Statistical Association, Vol. 21(1):19–30.

Kan, M., Küçükçongar, M., Keser, M., Morgounov, A., Muminjanov, H., Özdemir, F., Qualset, C. 2015. Wheat Landraces in Farmers' Fields in Turkey: National Survey, Collection, and Conservation, 2009–2014. FAO, Ankara, Turkey.

Kapalasa, E.G. 2014. Assessing factors influencing farmer's adoption of improved soybean varieties in Malawi. Scholarly Journal of Agricultural Science, Vol. 4(6):339–349.

Kumar, L. and Eiji, M. 2011. Water accessibility and child health: Use of the leave-out strategy of instruments. Journal of Health Economics, 30 (5):1000–1010.

Lantican, M.A., Braun, H.J., Payne, T.S., Singh, R., Sonder, K., Baum, M., van Ginkel, M. and Erenstein, O. 2016. Impacts of International Wheat Improvement Research, 1994–2014. Technical Report. CIMMYT, Texcoco, Mexico.

Maddala, G.S. and Nelson, F.D. 1975. "Switching Regression Models with Exogenous and Endogenous Switching", Proceedings of the Business and Economic Statistics Section, American Statistical Association, 423426.

Manski, C.F. and. Peppe, J.V. 2000. Monotone instrumental variables: with an application to the returns to schooling. Econiometrica, 68 (4): 997–1010.

Mariano, M.J., Villano, R. and Fleming, E. 2012. Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. Agricultural System, 110, 41–53.

Mazid, A., Keser, M., Amegbeto, K.N., Morgounov, A., Bagcı, A., Peker, K., Akın, M., Kucujcongar, M., Kan, M., Semercei, A., Karabak, S., Altıkat, A. and Yaktubay, S. 2015. Measuring the impact of agricultural research: The case of new wheat varieties. Expl Agric., Vol 51 (2), 161–178.

Meinzen-Dick, R., Adato, M., Haddad, L. and Hazell. P. 2004. Science and Poverty: An Interdisciplinary Assessment of the Impact of Agricultural Research. 1-31. International Food Policy Research Institute, Washington DC, USA. Available at: https://core.ac.uk/reader/6289050. [Accessed on November 3, 2021].

Mignouna, B.D., Manyong, V.M., Mutabazi, K.D.S. and Senkondo, E.M. 2011. Determinants of adopting

imazapyr-resistance maize for Striga Control in Western Kenya: A double-hurdle approach. Journal of Development and Agricultural Economics, 3(11): 572–580.

Mohamed, K.S. and Temu, A.E. 2008. Access to credit and its effect on the adoption of agricultural technologies: the case of Zanzibar. African Review of Money Finance and Banking, 45–89.

Morgan, S.L. and Winship, C. 2014. Counterfactuals and Causal Inference: Methods and Principles for Social Research, 2nd edn. Cambridge University Press, Cambridge, England.

Morgounov. A, Keser, M., Kan, M., Küçükçongar, M., Özdemir, F., Gummadov, N., Muminjanov, H., Zuev, E. and Qualset, C.O. 2016. Wheat landraces currently grown in Turkey: Distribution, diversity, and use. Crop Science, 56(6), 3112-3124.

Muzari, W., Gatsi, W. and Muvhunzi, S. 2012. The impacts of technology adoption on smallholder agricultural productivity in Sub-Saharan Africa: A review. Journal of Sustainable Development, 5(8):57–69.

Okunlola, J., Oludare, A. and Akinwalere, B. 2011. Adoption of new technologies by fish farmers in Akure, Ondo state Nigeria. Journal of Agricultural Technology, 7(6):1539–1548.

Rosenbaum, P. and Rubin, D. 1983. The central role of the propensity score in observational studies for causal effects. Biometrika, 70: 41–55.

Shiferaw, B., Kassie, M., Jaleta, M., Yirga, C. 2014. Adoption of improved wheat varieties and impacts on household food security in Ethiopia. Food Policy, 44:272 –284.

Shiferaw, B.A., Kebede, A.T. and You, L. 2008. Technology adoption under seed access constraints and the economic impacts of improved pigeon pea varieties in Tanzania. Agricultural Economics, 39:1–15.

Simtowe, F. and Zeller, M. 2006. The impact of access to credit on the adoption of hybrid maize in Malawi: An empirical test of an agricultural household model under credit market failure. MPRA Paper, No. 45:1–29.

StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LP.

Tefera, T., Tesfay, G., Elias, E., Diro, M. and Koomen, I. 2016. Drivers for adoption of agricultural technologies and practices in Ethiopia. Cascape, Addis Ababa, Ethiopia.

TUGEM. 2012. Trade, Transportation, Customs, Education, Consultancy Ltd. Sti. https://www.tugem.com.tr/iletisim.

TÜİK. 2012. Production Statistics. Turkish Statistical Institute. Available at www.tuik.gov.tr. [Accessed 1/11/2021].

TÜİK. 2018. National Accounts: Gross National Product by Production Approach. Turkish Statistical Institute. Available at http://tuik.gov.tr [Accessed on 1/11/2021].

TÜİK. 2021. Labor Statistics. Turkish Statistical Institute. Available at http://tuik.gov.tr [Accessed on 1/11/2021].

Uaiene, R.N., Arndt, C. and Masters, W. 2009. Determinants of agricultural technology adoption in Mozambique. Discussion papers, 67.

USDA. 2018a. Turkey Grain and Feed Annual Report 2018. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Ankara_Turkey_3-27-2018.pdf. [Accessed on November 3, 2021]

USDA. 2018b.Turkey Planting Seeds Sector Overview. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Turkey%20Planting%20Seeds%20Sector%20Overview_Ankara_Turkey_3-15-2017.pdf. [Accessed on November 3, 2021]

Wafula, L., Oduol, J., Oluoch-Kosura, W., Muriuki, J., Okello, J. and Mowo, J. 2015. Does strengthening the technical capacity of smallholder farmers enhance adoption of conservation practices? The case of conservation agriculture with trees in Kenya. AgroforestSyst, 90:1045–1059.

Wale, E. and Yallew, A. 2007. Farmers' variety attributes preferences: Implications for breeding priority setting and agricultural extension policy in Ethiopia. African Development Review, 19 (2):379–396.

Wiggins, S. 2009. Can the Smallholder Model Deliver Poverty Reduction and Food Security? Available at: https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/2338/FAC_Working%20_Paper_08.pdf?sequence=1. [Accessed on November 3, 2021]

Wu, D.M. 1974. Alternative tests of independence between stochastic regressors and disturbances: Finite sample results. Econometrica, 42: 529–546.

Yigezu, Y.A., Boughlala, M., El-Shater, T., Najjar, D. and Bentaibi, A. 2019. Analysis of the adoption, impacts, and seed demand of improved varieties. In: Bishaw, Z., Y.A. Yigezu, A. Niane, R Telleria, D. Najjar (eds). Political Economy of the Wheat Sector in Morocco: Seed Systems, Varietal Adoption, and Impacts. International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon. 300 pp. http://dx.doi.org/20.500.11766/8505.

Chapter VII

The Wheat Sector in Turkey: Seed System, Varietal Adoption, and Impacts – a Synthesis

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Motivation

The main objectives of this book were: 1) To describe the historical developments and current status of the wheat sector in Turkey (agricultural and seed policies and institutions, including R&D that affect the wheat sector, wheat area, volume, and value of production, etc.); 2) To analyse the diversity in wheat fields by taking an inventory of all wheat varieties being cultivated in the country; 3) To provide credible estimates of adoption of the different varieties under cultivation by type of wheat (bread vs. durum), agro-ecology (winter, spring or facultative), and water source (irrigated or rainfed); 4) To identify factors that enhance or hinder the adoption of recent varieties; 5) To provide estimates of the impacts of the introduction of improved wheat varieties; and 6) To shed some light to some persistent questions about the governance and performance of the wheat seed sector; and 7) Synthesize lessons learned and the implications for designing and formulating effective interventions.

Several methods were used to achieve the objectives of this book. To depict the overall picture of the main changes, and the policy and institutional dynamics of the wheat sector, the studies presented in the preceding chapters offered a detailed review of the literature and took an inventory and critical analysis of the agricultural R&D issues. To analyse the performance of the public research and the private sector institutes in varietal development, release, and licensing, a review and analysis of the published literature, documentation, unpublished secondary data and consultations, with internal reports of concerned institutions, were carried out. Moreover, hard and soft copies of published and unpublished secondary data and reports, and internal documents of concerned institutions and companies were consulted to assess the seed sector performance from the seed supply side. Particular focus was given to the production and commercialization of certified seed, as well as seed quality assurance and certification. Data from a large nationally representative survey, involving over 2,500 farm households cultivating wheat across 27 provinces, was used to carry out different analyses on the demand side. This included determining the level of varietal adoption and influencing factors, impacts of adoption of recent varieties, and estimation of the amount of seed use. For the demand side, analysis of survey data was carried out using descriptive statistics, such as population and area-weighted averages and econometric models, including the double hurdle model for explaining adoption and the IV approach for measuring impacts of adoption.

The preceding chapters provide detailed analyses of the different topics and identify major challenges and opportunities within the limits of their individual thematic focus. However, making comprehensive conclusions, and policy and institutional recommendations, requires having a bird's eye view of the whole system and critically analysing the trade-offs, synergies, linkages, and intricacies of the whole wheat sector in Turkey. Therefore, this chapter provides a synthesis of the findings of the preceding chapters and is organized as follows: section 7.2.1 presents a synthesis of the trends, achievements, opportunities, and challenges of the wheat sector in Turkey. Section 7.2.2 provides a synthesis of the demand-side micro-level analysis focusing on varietal

adoption, impact, and seed demand patterns. Section 7.2.3 provides a brief synthesis of the wheat sector's overall development, focusing on the supply-side policy and institutional factors that affect farmers' access to seeds of recent varieties with their preferred traits. Section 7.2.4 provides a comprehensive synthesis combining both the supply and demand-side factors, and finally, section 7.3 concludes and makes recommendations for the way forward.

Analysis of the Wheat Sector in Turkey

Trends, achievements, opportunities, and challenges

Agriculture is of key importance to Turkey, both in social and economic terms. Despite the constantly rising shares of industry and services, agriculture remains the dominant occupation for most Turkish people. The country's fertile soil, favourable climate (for winter and summer crops to grow), and different patterns of rainfall, permit growing almost any kind of crop. With some variation in nature and intensity, farming is practiced in all regions where, in the mountainous eastern regions, for example, crop farming becomes less important while animal husbandry dominates.

Turkey has 40 million hectares of arable land, of which 60% is under cultivation. As such, Turkey is one of the top 15 countries with the largest agricultural lands in the world. A sizeable area (about 7.4 million hectares or 18.4%) of the cultivated land in Turkey is irrigated. Annual and perennial crop production (including agroforestry) accounts for 76% of the total agricultural area, followed by animal husbandry (24%). Fruits and field crops constitute most of the area. Wheat is the most important crop in Turkey in terms of land area, volume of production, and economic value. Over the last 30 years, though the cultivated area decreased from 9.3 million hectares to 6.8 million hectares, wheat production remained largely stable, with some annual variation (16-21 million tons/year), due to yield increase over time. In 2019, it accounted for about 44% of the total area under annual and perennial crops. Approximately 19 million tons of wheat worth around TRY 30 billion (US$5.6 billion) were produced on 6.8 million hectares.

The wheat sector in Turkey follows the historical trends of developed countries. Over the years, the area under cultivation and the percentage of the population deriving their livelihoods directly from agriculture have been on the decline. While Turkey has also been following suit in terms of consistent productivity increases, especially in the favourable environments, the overall average yield levels remain lower than the North American and European averages. Given the adequate precipitation in most parts of the country, access to irrigation for about 18% of the total wheat area, the favourable Mediterranean climate and fertile soils, low adoption of agricultural technologies, including newly released improved wheat varieties and sub-optimal agronomic practices (chapter 6) take some (if not the major part) of the blame for the yield gap in Turkey. Any endeavour to address this issue should therefore involve studies for identifying the main factors contributing to the low adoption of newly released improved varieties and agronomic practices. Chapters 2–5 shed some light on the supply side, macro-level

policy, and institutional factors that enhance/deter the adoption of improved wheat varieties. Chapter 6, on the other hand, provides a detailed analysis of the demand side, micro-level farm, and farmer-related factors affecting the adoption of improved wheat varieties, and sheds some light on the agronomic practices, including application levels of agricultural inputs, which are important in explaining yield differences in the country.

Adoption of agricultural mechanization in Turkey is generally known to be quite high. However, this book is limited to the analysis of factors that affect the adoption of improved wheat varieties, but not all other agricultural technologies and innovations, including mechanization and agronomy, which are also known to have a substantial role in enhancing productivity. While we acknowledge this limitation, we believe that addressing the macro-level policy and institutional challenges, as well as the micro-level farm and farmer problems in the wheat sector, can go a long way in mitigating the main constraints and achieving substantial productivity gains in the country.

Chapter 6 highlighted that 135 varieties were under cultivation on a total of 4.8 million hectares of wheat area in the 27 provinces included in the 2015 survey. This shows high varietal diversity (about 28.12 varieties per million hectares of wheat area) in the country, which is believed to be very high. For example, in 2013, a total of 40 varieties were cultivated by Moroccan farmers on a total of 2.9 million hectares of land, showing a varietal diversity of 13.79 per million hectares of wheat area in the country, which is about 51% lower than that of Turkey. A closer look at varietal distribution revealed that the top 10 varieties covered only 35% of the national wheat area, which is quite in contrast with that of Morocco where the top 10 varieties cover over 91% of total wheat area. This indicates that wheat production in Turkey is not dominated by only a few varieties and is further evidence of relatively high varietal diversity in the country. Out of the 135 varieties currently under cultivation in the 27 survey provinces, 23 (17%) are landraces covering only 4.58% of wheat area. While keeping some landraces is desirable for maintaining agrobiodiversity, more than 75% of the total wheat area is under old, improved varieties released more than10 years ago, which is a cause for concern. Despite the high varietal diversity and the commendable progress in the private sector participation, varietal replacement in Turkey is slow with an area-weighted average varietal age of 20.82. This figure shows that old, improved varieties still dominate the wheat landscape in the country and is in contrast with estimates of the weighted average age of 12 years reported by Lantican et al. (2016), which is overly optimistic. A good example is Bezostaja-1 (a variety of Russian origin) that was released in Turkey in 1968 and is still among the top three most popular varieties. The question is, therefore, why are old, improved varieties still dominating?

- Could it be because the number of new varieties being developed is not sufficient?
- Could it be that a good number of new varieties are being developed and successfully released, but seed companies are not multiplying and commercializing them for their own reasons? If this is the case, why do they not multiply seed of new varieties?
    - Could it be difficult/costly for them to promote/disseminate to the farmers?

- Could they be comfortable as the old varieties are already in demand by the farmers and they can easily market them to the farmers without extra investment/cost?
- What measurements/subsidies/promotions could be made/done to promote and achieve faster adoption of the new varieties that would have higher impacts?

- Could it be that a good number of new varieties are being developed and successfully released, and seed companies are multiplying and commercializing them, but farmers are not buying their seeds? If this is the case, then it in turn raises the following questions:

  - Could there be a discrepancy between the traits (or breeding objectives) of the new varieties and farmer/processor/end-user trait preferences?
  - Could it be that the traits of the new varieties are desirable to farmers, but their price or other institutional issues prevent farmers from purchasing their seeds?

Varietal adoption, impact, and seed demand

The impact of improved varieties, especially on achieving productivity gains at scale, is highly dependent on the level of farmers' adoption of recent varieties and their diffusion. This is evident in Turkey because the bivariate analysis results presented in Table 6.27 clearly show that varieties released between 2010 and 2014 provided their adopters with over 2.47 tons/ha (57%) and 2.13 tons/ha higher yields in the irrigated and rainfed areas, respectively, than those released in the 1970s. Results of the IV regression also showed that adopters of varieties aged less than 15 years old obtained over 1.13 tons/ha (32%) higher yields than those cultivating older varieties. Chapter 6 documented that out of 135 varieties under cultivation in the 27 surveyed provinces, 95.42% are improved, but most are old, with over 75% and 50% released before 10 and 15 years, respectively. Small landholdings, poor access to credit and extension services, and old age of the varieties for which certified seed is being produced, provide part of the explanation. These findings are consistent with other studies that document that liquidity constraints are a major caveat for agricultural production in Turkey, which is characterized by many small and highly fragmented and diversified farms with insufficient levels of agricultural investment (Akdemir et al., 2021). The effect of poor access to credit and extension service delivery can be explained by their implications on farmers' ability to use certified seeds. This is because the yield gains from improved varieties depend on whether certified seeds, which ensure the exploitation of the full potential of the genetic makeup of the new varieties, are used.

Farmers who are far from certified seed sources are also found to have a lower propensity to adopt more recent improved varieties. The fact is that over 43% of the farmers who save their seed don't treat it, indicating a lack of awareness on the need for maintaining seed quality among a good portion of the farmers. An important question that this study cannot answer is whether farmers' and end user`s preferences are matched with breeding objectives (and, more importantly, the traits of the varieties released by both the private and public sectors). Answering this question would require

a detailed comparison of farmers' preferences and all breeding objectives of the research centres. Another limitation of this study is that farmers' access to both the input and output markets, which is identified by other studies (Simtowe et al., 2019; Wossen et al., 2017; Minot et al., 2007; Kamara, 2004) as important in explaining farmers ability to adopt and benefit from recently released improved varieties, was not analysed in this paper. The study was also not able to shed light on whether farmers themselves actually see yield as their main priority, or whether they compromise yield for other reasons, e.g. to save money on buying seed, or other necessary inputs, or to avoid production risk on untried varieties etc.

Policies and institutions

The wheat seed sector in Turkey has seen considerable changes in the last 20 years. The most significant change has been the private sector's rapid expansion in variety registration and certified seed production. Historically, the public sector was either the only (until the turn of the century) or the dominant (between 2001 and 2010) source of varietal release. Varietal release and hence, the number of varieties currently on the NVL for the private sector, saw dramatic increases between 2001 and 2015. These changes are mainly attributed to the policy changes and structural transformation that led to Turkey's seed sector liberalization. Specifically, Agriculture Law No. 5488 and Seed Law No 5553, both instituted in 2006, and Protection of Breeders' Rights of New Plant Varieties Law No 5042, enacted in 2004, introduced a regulatory framework that encouraged private sector investment in the agricultural sector in general – and the seed sector in particular. Seed subsidies given for usage (farmers) starting in 2005, and for production (seed companies) at the beginning of 2008, have given further impetus to the expansion of the private sector. Moreover, subsidies anchored on certified seed extend to credit facilities on concessionary rates and infrastructure development for both parties. As a result, the private sector's share of seed production in wheat has increased from less than 5% in the mid-1990s to over 60% in 2019. Similarly, during the same period, the private sector's share of registered and protected varieties has increased just as dramatically – from only 2.3% to 50% (TTSM, 2017). However, the future of the wheat seed sector in the absence of such huge subsidies is uncertain. An *ex-ante* analysis involving the simulation of different scenarios might shed some light on the possible outcomes.

The private sector continues to be the dominant source of new varieties released in Turkey. However, after some dwindling between 2001 and 2010, varietal release and the number of varieties on the NVL by the public sector has rebounded after 2010 and is now catching up with the private sector. Contrary to the fear of the proponents of a dominant public sector that serves as the godfather of the agricultural sector, rapid growth in the wheat seed production by the private sector since the mid-2000s has not displaced the public sector's role, but rather increased overall numbers of registered varieties and levels of seed production. As such, the seed system has become much more formalized and diversified, and farmers now use far higher levels of certified seed. This trend aligns with the general formalization of the agricultural sector with CKS

and the introduction of subsidies. On average, farmers now replace their wheat seed every 2.1 years. Among those using certified seed, the average seed replacement rate is three years – consistent with both the scientific and government recommendations for certified seeds of self-pollinated crops. The success is not only in achieving an optimal seed replacement rate, but also in getting most farmers to use certified seed. For example, about 47.67% of Turkish wheat farmers purchased certified seed for one or more of their wheat fields in 2014/15, showing that about 15% (i.e., the difference between 47.67% and the government target coverage for certified seed of 33%) of certified seed-using farmers purchase certified seeds for their different plots in different years. These figures suggest that Turkey has achieved the goal it set for certified seed replacement.

The numbers of varieties released by both the private and public sectors are on the rise. However, this is happening at the expense of small private seed companies who are complaining about being left out because they could not afford the fees required for variety registration. Given that the varieties released by the private sector are mostly foreign, the increasing number of varieties from the public sector, which are mostly crosses coming from locally well-adapted germplasm, might be beneficial to the country. The NARS has good access to foreign germplasm through IWWIP, which is implemented by Turkey-CIMMYT-ICARDA in Turkey. However, whether this trend will create more demand for varieties from the public sector over those from the private sector, and if this will have disincentive effects to the private sector, is uncertain. Recently, some private companies started their own breeding programs with germplasm that are mainly obtained from NARS. The possible dominance in the future of varieties from the public sector may also have unfavourable implications on the share of the private sector in the seed market. But, overall, the average annual number of varieties released has shown a substantial (800%) increase from around four in the 90s (all from the public sector) to about 32 (with almost equal share of both private and public sectors) between 2011 and 2018. This translates to about 4.7 varieties being cultivated per million hectares of wheat area in the country – much higher than both the global average of 1.01 varieties and the WANA average of 1.45 varieties per million hectares (Lantican et al., 2016).

While varietal release has been on the rise, reaching a level much higher than the global and regional averages, what is not clear is whether there is correspondence between the breeding objectives of (and hence the traits of the varieties developed and released by) both the private and public sectors on one hand, and farmers' trait preferences, including end user`s preferences, on the other. This is even more important for Turkey, which is a large country with high social, economic, and agroecological diversity. As shown in Chapter 6, different varieties have varying levels of adoption across different agro-ecologies, showing the importance of targeted breeding. While the authors of this book did not have access to more detailed information in terms of the breeding objectives of both every private and public wheat research institute/company, they think that there are differences in terms of their relative social, economic, geographic, and agro-ecological focus. However, based on the criteria set for release, the authors believe that the primary breeding objective is high yield in both public and

private research sectors, limiting the potential to develop and increase the number of varieties with the farmers' preferred traits. As a result, some of these farmers/end-users might not have sufficient choices of varieties with their preferred production traits and consumption qualities. Given the greater yield potential of new and old, imported varieties, most research centres might gravitate towards selecting these varieties, potentially leaving local landraces orphaned. This is already the case in the high-yield potential areas, limiting the landraces to mountainous and remote areas. Such a trend might be detrimental because it might lead to the erosion of varietal diversity in Turkey – a country internationally recognized to be the hub of high biodiversity in wheat. Thus, the in- and/or *ex-situ* conservation of landraces needs to be considered separately from the regular variety development breeding programs. The value of having so many new varieties to the agricultural sector is also not well known. How unique all of the varieties are, and whether they represent really substantial choices available to farmers – or merely an illusion of choice – are questions that future studies need to address.

With the current rate of varietal release, an over-supply of varieties with many of them not being used is a major concern. This can be addressed through a demand-driven breeding program within the concept of product profile and market segmentation, where the quality of the varieties that are released match the objectives of the breeding programs and farmers' and end-users' trait preferences. Another concern is that currently, most private seed companies are releasing varieties coming from their own breeding programs or international research organizations, including the CGIAR. However, if the policies of CGIAR and other sources, such as public breeding material for the private sector, change, thereby limiting their access to such material, the private sector may be severely affected. This would adversely affect Turkey's achievements in increasing private sector participation.

With reforms of the seed sector and the emergence of private seed companies, the need for a sector association became evident to represent their interests. In 1985, a Turkish Seed Industry Association was established as an NGO to represent the interests of the emerging private sector. Following the enactment of Seed Law No 5553 in 2006, all individuals and organizations involved in the seed industry were organized under the umbrella of the Turkish Seed Union (TÜRKTOB) from 2006. Currently, seven sub-unions of TÜRKTOB and two associations are operating, which represent seed value chain actors including plant breeders, seed growers, seed suppliers and seed dealers. Although TOB still has some jurisdiction over TÜRKTOB, the existence of such a strong force is playing a vital role in advocating its interests and shaping government policy directions in the seed sector, which calls for the presence of such strong sectorial associations elsewhere in developing countries.

The agricultural subsidy program in the country is anchored on three key areas for agricultural production, domestic certified seed use, and certified seed production, which are announced and published annually for selected agricultural, horticultural and fruit tree crops. These are (i) The CKS – the agricultural database on which farmers are registered and structured by TOB; (ii) The Agriculture Information System – the system

in which data, information, documents, and processes of all agricultural activities are grouped, based on the type of activity for authorized users of system; (iii) The TVYS – this provides traceability for registered plant varieties and seed certification processes through certificates generated from the system. Apart from amending certain laws and regulations to make the platforms more functional (e.g., TVYS), capturing data and building an interoperable digital platform, which collectively addresses these issues, would be useful.

Variety development, release, and protection nexus

Although Turkey has a very diverse set of bread and durum landraces that are locally adapted, the extent of utilization of their desirable traits in breeding programs is limited. Moreover, foreign-bred varieties of both bread and durum wheat rapidly increased their market share over the years in the country. National breeders should consider utilizing these valuable resources in their breeding programs to develop well-adapted and climate-resilient varieties in tackling the negative impacts of climate change. This is in line with government policy and a new regulation issued to allow for the registration of landraces. The aim of the regulation was to protect the landraces of field crops, vineyards, horticulture and other plant species, and prevent their genetic erosion.

A compulsory variety registration and release system that makes it possible to trace the varieties released within the country currently operates in Turkey, and its implementation has had many positive outcomes. From the private sector point of view, first, for varieties introduced from UPOV member countries that already have DUS test results, only VCU tests are required for registration and release in the country. Second, many varieties are introduced and registered by the private sector, providing more varietal choices to farmers. And, to the extent possible for scientists and decision makers, varietal releases are tagged by agro-ecological zones, which may accommodate both wide and specific adaptation, though the details are unclear.

However, there are also a number of drawbacks to the varietal release system in the country. First, many varieties are being introduced and registered by the private sector, particularly from Europe, where registration procedures should be further simplified. This would facilitate Turkish seed exports of both introduced foreign and domestic varieties to those countries. Second, currently, representation of the national variety registration committee is dominated by the research institutions. Seed companies want to have more representation in the field crops registration committees to ensure that their interests are addressed; currently, they are only represented by two individuals.

Since the introduction of PVP, the royalty collection mechanism has been functional in the country, where both the public and the private sectors benefit from investment in plant breeding through the sale of basic seed or licensing, or a combination thereof, with some drawbacks in its implementation. These drawbacks include: (i) Continuous local seed trade where many farmers continue to save and trade seed of protected varieties as grain among themselves, and commercial use is prohibited; (ii) The existence of possible malpractices claimed by private seed companies, where some wheat grain

traders illegally process grain and sell as a seed to farmers (TSÜAB, 2020), which is a criminal offense; (iii) Under-reporting of certified seed produced and sold, which undercuts the variety owners and renders the royalty collection system ineffective. The current royalty collection system should be reorganized, and an effective and efficient system established in the country. Collaboration among breeding institutions, seed companies, seed sector associations and TOB remains critical to get accurate data; currently, with its limited capacity, the TVYS is trying to enhance tracking varietal use and hence, resolve some of the prevailing problems related to royalty collection. A case study on PVP in Turkey may also shed light on the future direction for countries contemplating, but reluctant, to introduce PVP for public-bred varieties, considered as national public goods. However, evidence from Canada (Sutherland et al., 2021) suggests that achieving the socially optimal level of private breeding, public breeding, and partnerships, requires a carefully implemented set of policies and incentives.

Turkey's structural transformation is closely related to changes in the agricultural policies of the government. In 1989, Turkey attained equivalence with the EU for seed certification through its membership in OECD Seed Schemes, a necessary condition for exporting seed to the EU. The pursuit of EU accession and interest from international organizations requires alignment with international norms and standards, guidelines on variety registration, PVP, and seed quality assurance and certification. Turkey is a member of several seed sector development-oriented international organizations such as: (i) OECD Seed Schemes covering all the schemes except one, which facilitates the movement of seed across countries; (ii) UPOV for protection of new varieties of plants; (iii) ISTA for adopting international rules for seed testing. All these memberships help in the development of the seed sector and Turkey's reputation as a player in the global seed industry. Thanks to these memberships, Turkey may stand to benefit more from international seed trade.

Seed production, commercialization and quality assurance

In 1951, the state farms were re-organized under one institution called the General Directorate of Agricultural Enterprises (TİGEM), which held a monopoly on certified seed production. In the new set up, the distribution of seed to farmers was handled through cooperatives. Until the late 1990s, certified wheat seed supply never reached more than 10% of total wheat seed used in the country. In 2001, following the abolition of the public sector's monopoly, seed supply fell as low as 3% of total wheat seed supply (TİGEM, 2016). Since then, several reforms were introduced in the country which led to a significant increase in the amount of certified wheat seed produced, primarily by the private sector. Data from TÜRK-TED showed that the wheat seed supply by the private sector increased from zero in 1980 to about 10% in 1993. In 2020, the combined total seed production from both the public and private sectors met 36% of Turkey's estimated wheat seed requirement for the year. The private sector provided about 70% of total certified wheat seed.

While TIGEM once enjoyed the monopoly of wheat seed supply, as one of the biggest seed farms in the world with over 20,000 ha of land, the number of private seed

companies and cooperatives involved in wheat research and seed supply continues to increase with the liberalization of the seed sector. Since 2008, the enabling environment including the enactment of the seed laws, variety protection, and policies for supporting certified seed production and use, led to rapid increase in the number of private wheat seed companies in wheat research and development. In 2021, of 247 private organizations authorized to conduct research and development by TOB in Turkey, 181 conduct research on field crops such as wheat (BÜGEM, 2021), 45 of which also produce wheat seed. Likewise, in 2021, about 338 private seed companies were involved in wheat seed production. Before the 1980s, TIGEM distributed wheat seed particularly through MoA's provincial directorates, cooperatives, and very small shops. However, the model was ineffective in meeting farmers' demands and for dissemination of new varieties through demonstration and promotions. As a result, farmers were often not satisfied with the quality and prices of the seeds delivered (SPO, 2001). However, the number of seed sale points (seed dealers, cooperatives) has also increased substantially from about 3,500 in 2001 (Bozkurt and Engiz, 2001) to about 6,961 seed dealers in 2021which are all members of TODAB. The number continues to grow as demand for quality seed continues to increase. The increase in number of seed companies and distribution points has extended seed delivery to the mobility zone of farmers.

During the last 10 years, there has been a tremendous increase in Turkey's area of land dedicated to wheat seed production. For example, the quantity of certified wheat seed produced increased from158,452 tons in 2008 to 483,951 tons in 2019 – approximately a threefold increase in 10 years. This has an implication for how much seed production area must be inspected and approved, as well as for the testing and approval of seed samples for seed production by the seed certification agency. Despite these increases, rejection levels remain below 5% in field inspection and seed testing, a remarkable achievement on seed quality. While it is functioning well, the Turkish seed quality assurance and certification system is not free of constraints. Such issues revolve around the following areas: (i) A need to review and amend seed quality standards for different seed classes for wheat and drop certified seed 3 (C3); (ii) Increase the maximum weight of a seed package to 500 kg for large farms while maintaining the current 50 kg package for small farms; (iii) The problem of land fragmentation to maintain seed quality during seed production; (iii) Authorization for labelling seed lots during seed processing; (iv) Increase the capacity of the certification system commensurate with an increase in the amount of certified seed produced and the number of companies in the sector.

The TTSM is responsible for seed quality assurance and certification, for the seed units of provincial directorates, and seed certification and testing directorates. Currently, about 16 seed companies were accredited to undertake field inspection (e.g. for few forage species only) and laboratory control of their own seed production (based on species determined by BÜGEM), with TTSM providing regularly monitoring. TTSM also monitors regional certification centers affiliated to BÜGEM and the ministerial plant health laboratories in accordance with the provisions of the Regulation on Delegation of Authority in Seed Services, which needed regular update in accordance with the development of both national and international seed regulations. Turkey is

among just a few countries that maintained an ISTA accredited seed testing laboratory in WANA, Egypt and Morocco being the two other countries. It would be more prudent to expand the accreditation of seed companies to ease the burden, and to enable the ISTA-accredited laboratory to play a testing role to maintain the standards of accredited laboratories.

The nexus between the supply and demand side factors

The yields produced from the most recently released varieties, that occupy a relatively small land area, are much higher than those of older varieties that dominate the wheat landscape. This indicates that the achievement of the country in releasing high number of varieties per million hectares of wheat field is undermined by low adoption of the most recent varieties. Even though we have not fully analysed market and trait preference issues in this study, limited access to the market and a possible divergence between farmers' trait preferences and breeders' objectives generally have demand- and supply-side dimensions. Otherwise, the analysis carried out in this book seems to point to institutional factors as the main culprits limiting farmers' demand for recent varieties and certified seeds – thereby preventing the country from achieving adoption and impacts at scale. The fact that the vast majority (95%) of farmers are cultivating improved wheat is encouraging. It is however paradoxical that most of them (more than 75%) are still holding on to varieties that are more than 10 years old. Understanding the underlying causes of this can help the country address the problems and speed up sluggish varietal replacement on wheat fields.

Analysis of the Turkish seed system's historical dynamics shows that creating an enabling environment through formulation and enactment of relevant laws, regulations, guidelines, and enforcement mechanisms is an important ingredient for creating a better functioning and more effective seed sector. It is also clear that the efficacy of such a comprehensive system of a regulatory framework is highly dependent on the existence of a simple, practical, and functional organizational structure, with well-qualified and trained personnel and well-developed and adept digital systems to ensure accountability.

Turkey is known to be the origin of wheat with a large diversity. Out of 135 varieties that are under cultivation, only 24 (17.7%) are landraces covering only less than 5% of the total wheat area in the 27 surveyed provinces. The much smaller area shares of landraces – relative to the relatively higher share in a total number of varieties under cultivation – shows that landraces are mostly cultivated in smaller fields. This trend leads to the erosion of varietal diversity. Van is the only province dominated by landraces, with none of the growers cultivating improved varieties. This is consistent with recent research (Morgounov et al., 2016.) which found that wheat production in this area is challenging because of severe cold in winter and short and hot summers. The bread wheat landraces Kırik and Karakılçık are predominantly cultivated on relatively large scales in Van because of their specific environmental adaptations, as well as the grain quality traits that align with home consumption preferences – most of the grain produced is used for household consumption. Finding ways to increase visibility and

awareness about the desirable consumption qualities of landraces may be needed to ensure the sustainability of such systems and prevent the landraces from extinction, which would also help for *in-situ* conservation of the landraces in farmers' field. This could be good strategy for Turkey's *in-situ* conservation of wheat landraces (Kan et al., 2015).

Conclusions and the Way Forward

Looking back: Turkey has made good progress in boosting productivity in wheat fields, which is attributed to the diffusion of many improved wheat varieties and agronomic practices. A closer look at the history of the wheat sector shows that a sharp increase in private sector participation, and the growing public investment in both varietal development and release and seed production and marketing, have been the driving forces. Turkey has succeeded in achieving high levels of varietal release and certified seed use rates. It is evident that there is a room to increase yields and boost production in the country. Low adoption of the most recent varieties provides a major part of the explanation behind low yields, as recent varieties in the country can provide up to 6.7 ton/ha. Given the high varietal release and certified seed use levels, a possible mismatch between farmers' trait preferences and breeders' objectives, and institutional factors such as poor access to credit and extension services, are likely reasons for the low adoption of recent varieties.

Turkey's seed system development went through several stages - from total domination by the public sector to a highly diversified system, where currently, the private sector is playing a significant and increasing role in the seed value chain. This remarkable journey happened over a very long and arduous path, through continued engagement between the public and private sector and policymakers, dictated by socio-economic and political discourse in the country. At present, the degree of sophistication and specialization in the seed sector is a result of the advances in agricultural science and technology, and the evolution of socio-economic and political realities on the ground. Whether policymakers and development planners in other countries will build on the lessons learned from Turkey and adapt and design an alternative path or follow somewhat the same course of evolution to develop and modernize their seed sector, remains to be seen. Moreover, these findings show that there are no short cuts to development.

Governance of the Turkish seed sector is a complex institutional set-up, where responsibilities and implementation lie with different departments of TOB and at provincial directorate levels. For example, while TTSM has overall responsibility for variety registration and seed certification with its own facilities, the provincial directorates and seed certification and testing directorates are equally involved in seed certification through their units. While such decentralization of operation is useful for big countries like Turkey, some consolidation of activities would simplify coordination among different players. Mainstreaming and streamlining the responsibilities of different departments/units such as the seed department, plant health control, registration

and certification offices under one umbrella under TOB could simplify and facilitate coordination, and accelerate the development of the national seed sector.

Apart from public breeding institutions, currently, five public universities and about 45 domestic and foreign private seed companies have been authorized to undertake wheat research and are now involved in wheat variety development in the country. Moreover, out of 450 seed companies producing cereal seeds, about 249 are engaged in certified seed production for bread and durum wheat. Although the shapes and sizes of these companies are not evident from this study, it shows a significant diversity of seed suppliers that exist in the country which may also reflect some degree of fragmentation. For example, in India, the private sector in wheat seed production and marketing is highly fragmented and consists of numerous small companies (Singh et al., 2017). In Morocco, there are only five private seed companies with only about 20% share in total wheat seed market, while a single large parastatal seed company claims the remaining 80% of market share (Yigezu et al., 2019). Given the current level of diversity and maturity attained by the Turkish seed sector in general, and the wheat seed sector in particular, it remains to be seen if the sector will grow to the consolidation phase as observed elsewhere in developed countries.

Looking forward: For Turkey to reap the full benefits of its investments and past achievements in the wheat sector, while maintaining its role as the hub of high varietal diversity for wheat, we recommend the following:

- Well-designed studies are needed to look at the impact of recent developments (regulations, institutions etc.) in the seed sector, i.e. changing from public to private sector dominance in the seed sector.
- Studies are needed to evidence the impact of subsidies on seed demand and supply, and the performance of the public and private seed sector.
- Well-designed studies are needed to develop a deeper understanding of the main factors responsible for the slow varietal replacement among farmers, and ultimately, to design and implement promotion measures.
- There is a big gap between on-station experimental yields (i.e. potential yields) and farmers' yield in the field. A well-designed study is needed to understand the main cause of this yield gap and identify how to narrow the gap.
- Another study focussing on farm-level use of certified seed, by variety and region, could help in future targeting for certified seed commercialization. The bulk of data coming from the CKS is held by TOB and needs scrutiny for future planning.
- A simplified institutional structure with a short hierarchy might help the seed sector in being more effective. Reducing the legal complexity will also be useful. Although legislative and regulatory reform in the 2000s has considerably improved the institutional framework governing the agricultural and seed sectors, it remains complicated. Ensuring accountability in the seed sector through improved qualifications and personnel training, and by putting in a digital system in place for monitoring, is important.
- Private seed companies need to train their technical personnel to be conversant with

the regulations and guidelines of the seed sector. To this effect, the introduction/strengthening of formal academic education in seed science and technology, with a more comprehensive curricula in local universities at both the graduate and post graduate levels, might be helpful for all seed value chain stakeholders.

- A strong farmers' union to represent the vested interest of farmers, and with strong negotiating power, is important to balancing out the influence and power of the public and private institutions.
- Targeted and tailored policies and interventions should be developed to meet specific regional needs. The MTP's introduction of 941 basins, which decreased to around 40, represents a great step forward in making policy responsive to specific environmental factors. Further work also needs to be done to ensure that the growing levels of certified seed production are reaching the right basins, and that research programs are responsive to the needs of remote regions.
- How variety developers set breeding objectives in Turkey is not documented in this study. If current varietal development in the private, and more importantly, in the public research centers, is not well-informed by good surveys, and neither are farmers' trait preferences in terms of agro-ecological, commercial and consumption aspects, a national committee that develops and regularly updates preferred traits (based on the development of product profiles in each region) for the use by research centers, may be beneficial. Such a national committee needs to be informed by regional committees, which, in consultation with breeding programs targeting specific ecologies in the region, should decide what the trait preferences of farmers and end users in these environments are, and what types of varieties need to be bred. The main change here is that the decision of what to breed should not be left solely to breeders, and objectives should be revised regularly. Achievements and discrepancies need to be reported/evidenced preferably by an external reviewer(s). Based on the review, the regional, and ultimately the national, committees will have to make the necessary adjustments to objectives and activities.
- A mandate for ensuring balance in the types and number of varieties developed in the country should be passed to the public research centers in each region, as they are engaged in wheat breeding. These centers should be paying special attention to remote and less privileged areas to enhance equity in varietal supply across all regions. Whether this problem is mitigated will also be checked during the review process.
- We agree with past suggestions that measures that may help in enhancing biodiversity include market-based mechanisms that favor the qualities of wheat landraces (such as geographical protections), or collaborative plant breeding approaches that link landrace-growing farmers with research institutes. In this regard, the public research centers need to advocate for some of their work to prioritize selecting pure lines from landraces that would help maintain, and even enhance, biodiversity in wheat.
- It is necessary to introduce policies and regulations to align domestic practices on biodiversity with international conventions to which Turkey is a signatory. Such

regulations should encourage *in-situ* conservation where possible, and *ex-situ* conservation to prevent loss of wheat genetic resources.

- Fortifying the extension system by providing basic training to extension agents on seed treatment and storage, especially using hermetic bags, would enable them to teach and train smallholder farmers, thereby increasing the quality of own-saved seed and subsequently, improving yield.
- Seed subsidies have created a lot of paperwork for extension services – to the point that the system is so overloaded with following up the subsidies. As a result, extension services are unable to carry out their main task of extension. Farmers need access to extension to learn how to use improved management practices that have clear yield advantages. A way if lessening the paperwork for the extension service would enable them to interact with farmers more.
- A comprehensive variety listing system that provides detailed information on the parentage of varieties, without compromising the business intelligence process of public and private seed companies, would bring the necessary transparency into the variety listing and licensing system.

The long-term consequences of these recommendations are difficult to assess, in part due to the challenges of projecting the evolution in the domestic and world markets – and due to gaps in data and existing knowledge. On the one hand, better access to new varieties and high-quality seeds can bridge the yield gap in Turkey, thereby increasing farmers' incomes and the dynamism of the wheat sector. On the other hand, Turkey has a rich diversity of wheat genetic resources, the conservation of which must be ensured by the government. In the face of growing pressure on famers to maximize profit, and in order to maintain the rapid growth of the formal seed sector in Turkey, the government's role should be double-fold – encouraging the use of more recent improved varieties and certified seeds on one hand and ensuring in-situ and ex-situ preservation of genetic resources and maintenance of agrobiodiversity on the other.

References

Akdemir, Ş. Miassi, Y., Açıksarı, Y.Ş., Keskin, F. 2021. Producers' access to agricultural credit in Turkey: the case of Adana province. Ciência Rural, Vol. 51:5.

Kamara, A.B. 2004. The impact of market access on input use and agricultural productivity: evidence from Machakos district, Kenya. Agrekon, Vol. 43(2):202–216.

Kan, M., Küçükçongar, M., Keser, M., Morgounov, A., Muminjanov, H., Özdemir, F. and Qualset, C. 2015. Wheat landraces in farmers' fields in Turkey: National survey, collection, and conservation, 2009–2014. FAO, Ankara, Turkey.

Lantican, M.A., H.J. Braun, T.S. Payne, R.P. Singh, K. Sonder, M. Baum, M. van Ginkel, and O. Erenstein. 2016. Impacts of International Wheat Improvement Research, 1994–2014. CIMMYT, Texcoco, Mexico.

Minot, N., Smale, M., Eicher, C., Jayne, T.S., Kling, J., Horna, D. and Myers, R. 2007. Seed Development Programs in Sub-Saharan Africa: A Review of Experiences. International Food Policy Research Institute, Washington DC, USA.

Morgounov, A., Keser, M., Kan, M., Küçükçongar, M., Özdemir, F., Gummadov, N., Muminjanov, H., Zuev, E. and Qualset C.O. 2016. Wheat landraces currently grown in Turkey: Distribution, diversity, and use. Crop Science, 56 (6). https://doi.org/10.2135/cropsci2016.03.0192

Simtowe, F., Marenya, P., Amondo, E., Worku, M., Rahut, D.B., Erenstein, O. 2019. Heterogeneous seed access and information exposure: implications for the adoption of drought-tolerant maize varieties in Uganda. Agric Econ, vol.7:15 https://doi.org/10.1186/s40100-019-0135-7

Singh, R.P., Agarwal, D.K., Prasad, S.R., Sripathy, K.V. and Jeevan Kumar, S.P. 2017. Varietal and seed Replacement in the Era of Climate Change. ICAR-Indian Institute of Seed Science, Delhi, India.

Smale, M. 2012. Farmers Gene Banks and Crop Breeding: Economic Analyses of Diversity in Wheat Maize and Rice. Springer Science & Business Media, Berlin, Germany

SPO. 2001. BİTKİSEL ÜRETİM ÖZEL İHTİSAS KOMİSYONU TOHUMCULUK ALT KOMİSYON RAPORU. State Planning Organization (SEKİZİNCİ BEŞ YILLIK KALKINMA PLANI). Ankara Turkey VIII. Available at: sbb.gov.tr. *[Accessed on 5 November 2021].*

Sutherland, C., Macall, D. and Smyth, S. 2021. Canadian plant breeder opinions regarding changes to plant breeders' rights. Journal of Plant Breeding and Crop Science, 13(2): 46–57.

TSÜAB. 2020. Enforcement Tool-Kit For Combatting Illegal Seed Practices. TSÜAB, Ankara, Turkey.

TTSM. 2018. Number of Wheat Varieties Registered in Turkey. Available at: https://www.tarimorman.gov.tr/BÜGEM/TTSM/Sayfalar/Detay.aspx?Sayfaid=85. Accessed on 26/11/2018.

Wossen, T., Abdoulaye, T., Alene, A., Haile, M.G., Feleke, S., Olanrewaju, A. and Manyong, V. 2017. Impacts of extension access and cooperative membership on technology adoption and household welfare. Journal of Rural Studies, 54: 223–233. https://doi.org/10.1016/j.jrurstud.2017.06.022

Yigezu, Y.A., Boughlala, M., El-Shater, T., Najjar, D., Bentaibi, A. 2019. Analysis of the adoption, impacts, and seed demand of improved varieties. In: Bishaw, Z., Y.A. Yigezu, A. Niane, R Telleria, D. Najjar (eds). Political Economy of the Wheat Sector in Morocco: Seed Systems, Varietal Adoption, and Impacts. International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon. 300 pp. http://dx.doi.org/20.500.11766/8505.

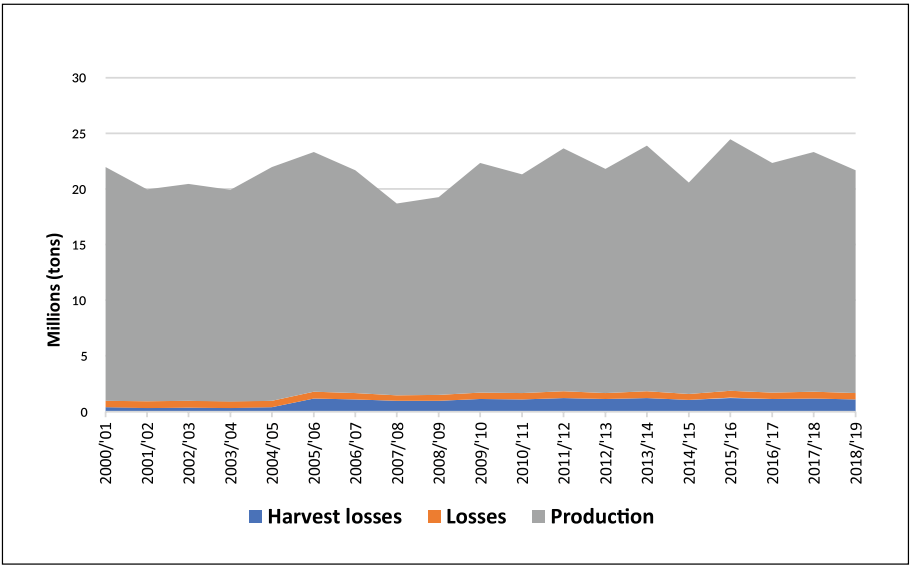
Annex 1: Wheat purchase price by TMO

Year	*Durum wheat (TRY/ton)*	*Increase (%)*	*Bread wheat (TRY/ton)*	*Increase (%)*	*Increase in producer price indices (%)*	*Durum wheat (US$/ton)*	*Bread wheat (US$/ton)*	*World bread wheat price* (Fob, US$/ton)*
2009	525	0	500	0	-1.86	341	325	238
2010	575	10	550	10	7.64	364	348	247
2011	640	11	605	10	10.19	389	368	331
2012	705	10	665	10	6.44	377	356	329
2013	765	9	720	8	5.23	405	381	324
2014	-	-	-	-	9.75	-	-	303
2015	976	28	862	20	6.73	357	315	233
2016	1.000	2,5	910	6	3.41	340	309	198
2017	1.000	0	940	3.3	14.9	277	260	213
2018	1.100	10	1.050	11.7	20.16	255	243	265

Source: TMO (2018) (http://www.tmo.gov.tr/Upload/Document/hububatsektorraporu2018.pdf)

Note: *World Bread Wheat Price is the price of US 2 Hard Red Winter wheat)

Annex 2: Post-harvest losses in Turkey



Source: TÜİK

Note: Harvest losses and post-harvest (other) losses for agricultural products is calculated and published by TÜİK. According to the TÜİK definitions, harvest losses correspond to the losses incurred during harvest and the transportation from the plot to the farmyard. Post-harvest (other) losses contain the losses incurred during storage, transportation, processing and packing after the product is brought to the homestead of the holding (link).

Annex 3: List of seed related laws, regulations and directives

Date	Number	Title (English)	Title (Turkish)
2004	5042	Law on Protection of Breeder's Rights of New Plant Varieties	Yeni Bitki Çeşitlerine Ait Islahçi Haklarinin Korunmasina İlişkin Kanun
2004	5262	Law on Organic Farming	Organik Tarım
2004		Protection of Breeders' Rights of New Plant Varieties	Yeni Bitki Çeşitlerine Ait Islahçi Haklarinin Korunmasina Dair Yönetmelik
2005	5300	Licensed Warehousing Law of Agricultural Products	Tarim Ürünleri Lisansli Depoculuk Kanunu
2005		Benefits from Breeders' Rights for Officials Working in Public Institutions and Organizations	Kamu Kurum ve Kuruluşlarinda Çalişan Görevlilerin Islahçi Hakkindan Yararlanmasina İlişkin Yönetmelik
2006	5488	Agriculture Law	Tarım Kanunu
2006	5553	Seed Law	Tohumculuk Kanunu
2008		Delegation of Authority of Seed Certification Processes	Tohumluk Sertifikasyon İşlemlerinde Yetki Devri Yönetmeliği
2008		Registration of Plant Varieties	Bitki Çeşitlerinin Kayit Altina Alinmasi Yönetmeliği
2008		Grain Seed Certification and Marketing	Tahil Tohumu Sertifikasyonu Ve Pazarlamasi Yönetmeliği
2008		Characteristics of Special Production Areas for Growing Seed and the Determination of Rules to be Applied in these Areas	Tohumluklarin Yetiştirileceği Özel Üretim Alanlarinin Özellikleri Ve Bu Alanlarda Uyulmasi Gereken Kurallarin Belirlenmesine Dair Yönetmelik
2009		Authorization and Inspection in the Seed Sector	Tohumculuk Sektöründe Yetkilendirme Ve Denetleme Yönetmeliği
2010	5977	Biosafety Law	Biyogüvenlik Kanunu
2010	5996	Veterinary Services, Plant Health, Food and Feed Law	Veteriner Hizmetleri, Bitki Sağliği, Gida ve Yem Kanunu
2010		Regulation on Genetically Modified Organisms and Products	Genetik Yapisi Değiştirilmiş Organizmalar Ve Ürünlerine Dair Yönetmelik
2010		Seed Controllers	Tohumluk Kontrolör Yönetmeliği
2011	639	Decree Law on the establishment and functions of the Ministry of Food Agriculture and Livestock	Gida, Tarim ve Hayvancilik Bakanliğinin Teşkkşlat ve Görevlerş Hakkinda Kanun Hükmünde Kararname
2014		Regulation Concerning the Transfer of Plant Varieties, Candidate Varieties and Breeding Materials to Seed Organizations, and the Sale of Seed Production and Marketing Rights	Bitki Çeşit, Çeşit Adayi Ve Islah Materyalinin Tohumculuk Kuruluşlarina Devri, Tohumluk Üretimi Ve Pazarlama Hakki Satişi Hakkinda Yönetmelik
2014		Farmer Registration System	Çiftçi Kayit Sistemi Yönetmeliği

Date	Number	Title (English)	Title (Turkish)
2016		Working Procedures and Principles for TTSM, the Regional Certification Testing Directorate and the Olive Production Station Directorate	Tohumluk Tescil Ve Sertifikasyon Merkez Müdürlüğü, Tohum Sertifikasyon Test Müdürlükleri İle Zeytincilik Üretme İstasyonu Müdürlüğü Çalişma Usül ve Esaslari Hakkinda Yönetmelik
2019		Regulation on the Registration, Production and Marketing of Landraces	Yerel Çeşitlerin Kayit Altina Alinmasi, Üretilmesi ve Pazarlamasina Dair Yönetmelik
Often updated		Circular on the Implementation of Rules for Seed Import	Tohumluk İthalatı Uygulama Genelgesi
Often updated		Circular on the Implementation of Rules for Seed Export	Tohumluk İhracatı Uygulama Genelgesi
Often updated		Implementation Instruction for Seed Services	Tohumculuk Hizmetleri Uygulama Talimati

Annex 4A: List of all varieties released in Turkey between 1928 and 2021

Source: Adapted from Keser and Cakmak, 2021

This list includes varieties that were registered in the NVL but have been de-registered after finishing their term

No	*Variety Name*	*Release Year*	*Species*	*Released by*
1	Karakılçık1133	1928	DW	Public
2	Sarı710	1929	DW	Public
3	Ak702	1931	BW	Public
4	Sivas111-33	1933	BW	Public
5	Cumhuriyet Buğdayı	1936	BW	Public
6	Kızılca6451	1936	BW	Public
7	Sertak52	1936	BW	Public
8	Köse220-39	1939	BW	Public
9	Yayla305	1939	BW	Public
10	Akbaşak7194	1943	DW	Public
11	Akbaşak073-44	1944	DW	Public
12	Ankara093/44	1944	BW	Public
13	Kunduru414/44	1944	DW	Public
14	Melez13	1944	BW	Public
15	Tunus Buğdayı	1944	BW	Public
16	Sürak1593-51	1951	BW	Public
17	Köse Melez1718	1958	BW	Public
18	Kırmızı5132	1963	DW	University
19	Sarıbursa7113	1963	DW	University
20	185-1	1964	DW	Public
21	4-11	1964	BW	Public
22	Akova B-1	1964	BW	Public
23	Mentana B-1	1964	BW	Public
24	4-22	1966	BW	Public
25	Floransa N4-8	1966	BW	Public
26	P8-6	1966	BW	Public
27	P8-8	1966	BW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
28	Berkmen469	1967	DW	Public
29	Kunduru1149	1967	DW	Public
30	Aköz867	1968	BW	Public
31	Bezostaja1	1968	BW	Public
32	Burt	1968	BW	Public
33	Gaines	1968	BW	Public
34	Inia66	1968	BW	Public
35	Jaral66	1968	BW	Public
36	Lerma Rojo64	1968	BW	Public
37	Mayo64	1968	BW	Public
38	Nadadores63	1968	BW	Public
39	Noroeste66	1968	BW	Public
40	Oviachic65	1968	DW	Public
41	Penjamo62	1968	BW	Public
42	Pitic62	1968	BW	Public
43	Siete Cerros66	1968	BW	Public
44	Sonora63	1968	BW	Public
45	SuperX (MEXIPAK66)	1968	BW	Public
46	Tevere	1968	BW	Public
47	Tobari66	1968	BW	Public
48	Wanser	1968	BW	Public
49	Yektay406	1968	BW	Public
50	Bolal2973	1970	BW	Public
51	Kıraç66	1970	BW	Public
52	Etoil De Choisy	1975	BW	Public
53	Tosun144	1975	BW	University
54	Tosun21	1975	BW	University
55	Tosun22	1975	BW	University
56	Cumhuriyet75	1976	BW	Public
57	Dicle74	1976	DW	Public
58	Gediz75	1976	DW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
59	Porsuk2800	1976	BW	Public
60	Sakarya75	1976	BW	Public
61	Lancer	1977	BW	Public
62	Orso (DURLU)	1977	BW	Public
63	Çakmak79	1979	DW	Public
64	Gerek79	1979	BW	Public
65	Gökgöl79	1979	DW	Public
66	Haymana79	1979	BW	Public
67	Kırkpınar79	1979	BW	Public
68	Tunca79	1979	DW	Public
69	Ata81	1985	BW	Public
70	Atay85	1985	BW	Public
71	İzmir85	1985	BW	Public
72	Çukurova86	1986	BW	Public
73	Marmara86	1986	BW	Public
74	Diyarbakır81	1987	DW	Public
75	Kop	1987	BW	Public
76	Balcalı85	1988	DW	University
77	Ege88	1988	DW	Public
78	Genç88	1988	BW	University
79	Kaklıç88	1988	BW	Public
80	KateA-1	1988	BW	Public
81	Creso	1989	DW	Public
82	Doğu 88	1990	BW	Public
83	Karasu90	1990	BW	Public
84	Doğankent1	1991	BW	Public
85	Gün91	1991	BW	Public
86	Kızıltan91	1991	DW	Public
87	Murat1	1991	BW	Public
88	Seri82	1991	BW	Public
89	Sham1(CHAM1)	1991	DW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
90	Salihli92	1992	DW	Public
91	Dağdaş94	1994	BW	Public
92	Kutluk94	1994	BW	Public
93	Altıntaş95	1995	DW	Public
94	Basribey95	1995	BW	Public
95	Başak95	1995	BW	University
96	Ceylan95	1995	DW	Public
97	Harran95	1995	DW	Public
98	Kaşifbey95	1995	BW	Public
99	Kırgız95	1995	BW	Public
100	Seyhan95	1995	BW	Public
101	Sultan 95	1995	BW	Public
102	İkizce 96	1996	BW	Public
103	Lirasa92	1996	BW	Private
104	Amanos97	1997	DW	Public
105	Bandırma97	1997	BW	Public
106	Karacabey97	1997	BW	Public
107	Kınacı97	1997	BW	Public
108	Palandöken97	1997	BW	Public
109	Pamukova97	1997	BW	Public
110	Selçuklu97	1997	DW	Public
111	Süzen97	1997	BW	Public
112	Altın40/98	1998	DW	Public
113	Altıntoprak98	1998	DW	Public
114	Ankara98	1998	DW	Public
115	Aytin98	1998	BW	Public
116	Gönen98	1998	BW	Public
117	Karacadağ98	1998	BW	Public
118	Mızrak98	1998	BW	Public
119	Pehlivan	1998	BW	Public
120	Sarıçanak98	1998	DW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
121	Türkmen	1998	BW	Public
122	Uzunyayla	1998	BW	Public
123	Yıldız98	1998	BW	Public
124	Yılmaz98	1998	DW	Public
125	Ziyabey98	1998	BW	Public
126	Adana99	1999	BW	Public
127	Ceyhan99	1999	BW	Public
128	Çeşit1252	1999	DW	Public
129	Flamura85	1999	BW	Public
130	Genç99	1999	BW	University
131	Golia	1999	BW	Public
132	Göksu99	1999	BW	Public
133	Harmankaya99	1999	BW	Public
134	Karahan99	1999	BW	Public
135	Prostor	1999	BW	Public
136	Saroz95	1999	BW	Public
137	Yakar99	1999	BW	Public
138	Aksel2000	2000	BW	Public
139	Altay2000	2000	BW	Public
140	Balatilla	2000	BW	University
141	Balcalı2000	2000	DW	University
142	Bayraktar2000	2000	BW	Public
143	Çetinel2000	2000	BW	Public
144	Demir2000	2000	BW	Public
145	Fuatbey2000	2000	DW	Public
146	Kümbet2000	2000	DW	Public
147	Mirzabey2000	2000	DW	Public
148	Momtchill	2000	BW	Public
149	Tahirova2000	2000	BW	Public
150	Yelken2000	2000	DW	Public
151	Alparslan	2001	BW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
152	Alpu2001	2001	BW	Public
153	Attila12	2001	BW	Public
154	Centauro	2001	BW	Private
155	İzgi2001	2001	BW	Public
156	Köksal2000	2001	BW	University
157	Martar	2001	BW	Private
158	Nenehatun	2001	BW	Public
159	Nurkent	2001	BW	Public
160	Pandas	2001	BW	Public
161	Pınar2001	2001	DW	University
162	Sagittario	2001	BW	Private
163	Saraybosna01	2001	BW	Public
164	Sönmez2001	2001	BW	Public
165	Svevo	2001	DW	Private
166	Turan	2001	BW	Private
167	Zenit	2001	DW	Private
168	Akçakale2000	2002	DW	Public
169	Atlı2002	2002	BW	Public
170	Aydın93	2002	DW	Public
171	Bağcı2002	2002	BW	Public
172	Daphan	2002	BW	Public
173	Dariel	2002	BW	Private
174	Fırat93	2002	DW	Public
175	Galil	2002	BW	Private
176	Konya2002	2002	BW	Public
177	Meram2002	2002	DW	Public
178	Meta2002	2002	BW	Public
179	Negev	2002	BW	Private
180	Sakin	2002	BW	Public
181	Soyer02	2002	BW	Public
182	Şölen2002	2002	DW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
183	Tüten2002	2002	DW	Public
184	Yıldırım	2002	BW	Public
185	Yüreğir89	2002	BW	Public
186	Zencirci-2002	2002	BW	Public
187	Canik 2003	2003	BW	Public
188	Dropia	2003	BW	Private
189	Eser	2003	BW	Public
190	Özdemirbey97	2003	BW	Private
191	Ahmetağa	2004	BW	Public
192	Alibey	2004	BW	Public
193	Ekiz	2004	BW	Public
194	Gap	2004	DW	Public
195	Menemen	2004	BW	Public
196	Özcan	2004	BW	Public
197	Seval	2004	BW	Public
198	Tosunbey	2004	BW	Public
199	Turabi	2004	DW	Public
200	Gelibolu	2005	BW	Public
201	Nina	2005	BW	Private
202	Özberk	2005	DW	University
203	Tekirdağ	2005	BW	Public
204	Tina	2005	BW	Private
205	Urfa2005	2005	DW	University
206	Dumlupınar	2006	DW	Public
207	Karatopak	2006	BW	Public
208	Müfitbey	2006	BW	Public
209	Osmaniyem	2006	BW	Public
210	Beşköprü	2007	BW	Public
211	Guadalupe	2007	BW	Public
212	Hanlı	2007	BW	Public
213	Artuklu	2008	DW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
214	Cemre	2008	BW	Public
215	Eyyubi	2008	DW	Public
216	Krasunia odes'ka	2008	BW	Private
217	Nacibey	2008	BW	Public
218	Syrena odes'ka	2008	BW	Private
219	Şahinbey	2008	DW	Public
220	Aldane	2009	BW	Public
221	Eminbey	2009	DW	Public
222	Hakan	2009	BW	Private
223	İmren	2009	DW	Public
224	Kaan	2009	BW	Private
225	Kenanbey	2009	BW	Public
226	Selimiye	2009	BW	Public
227	Yunak	2009	BW	Private
228	Bereket	2010	BW	Public
229	Colfiorito	2010	BW	Private
230	ES26	2010	BW	Public
231	Güney Yıldızı	2010	DW	Public
232	Kırik	2010	BW	Public
233	Lütfibey	2010	BW	Public
234	May8462	2010	BW	Private
235	Özkan	2010	BW	University
236	TT601	2010	BW	Private
237	Zühre	2010	DW	Public
238	Anapo	2011	BW	Private
239	Ayyıldız	2011	BW	Public
240	Botticelli	2011	BW	Private
241	Burgos	2011	DW	Private
242	Carisma	2011	BW	Private
243	Claudio	2011	DW	Private
244	Cömert2	2011	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
245	Esperia	2011	BW	Private
246	Geya1	2011	BW	Private
247	Levante	2011	DW	Private
248	Mane Nick	2011	BW	Private
249	OS Alka	2011	BW	Private
250	Pinzon	2011	BW	Private
251	Saragolla	2011	DW	Private
252	Aglika	2012	BW	Private
253	Altındane	2012	BW	Public
254	Andino	2012	BW	Private
255	B 52	2012	BW	Private
256	Bisante	2012	DW	Private
257	Charly Nick	2012	BW	Private
258	Eraybey	2012	BW	Public
259	Forblanc	2012	BW	Private
260	Gündaş	2012	DW	Public
261	Iridium	2012	BW	Private
262	LG59	2012	BW	Private
263	May8059	2012	BW	Private
264	Quality	2012	BW	Private
265	Rumeli	2012	BW	Private
266	Soylu	2012	DW	University
267	Turkuaz	2012	BW	Private
268	Vasilina	2012	BW	Private
269	Vittorio	2012	BW	Private
270	Yunus	2012	BW	Public
271	Zıtka	2012	DW	Private
272	Adagio	2013	BW	Private
273	Adelaide	2013	BW	Private
274	Altın Başak	2013	BW	Public
275	Antille	2013	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
276	Artico	2013	BW	Private
277	Avorio	2013	BW	Private
278	Bona dea	2013	BW	Private
279	Casanova	2013	DW	Private
280	Cesare	2013	DW	Private
281	Dinç	2013	BW	Public
282	Geronimo	2013	BW	Private
283	Gökkan	2013	BW	Public
284	Kırkayak	2013	BW	Private
285	Mesut	2013	BW	Public
286	Nota	2013	BW	Private
287	Pitagora	2013	DW	Private
288	Renan	2013	BW	Private
289	Sarı Başak	2013	DW	Public
290	Segor	2013	BW	Private
291	Seri2013	2013	BW	Public
292	Stendal	2013	BW	Private
293	Yubileynaya100	2013	BW	Private
294	Anforeta	2014	BW	Private
295	Astet	2014	BW	Private
296	Azul	2014	BW	Private
297	Biensur	2014	DW	Private
298	Bora	2014	BW	Private
299	Bozkır	2014	BW	Public
300	Delabrad2	2014	BW	Private
301	Faur F	2014	BW	Private
302	Galateya	2014	BW	Private
303	Genesi	2014	BW	Private
304	Glosa	2014	BW	Private
305	Kharus	2014	BW	Private
306	Masaccio	2014	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
307	Metin	2014	BW	Public
308	Midas	2014	BW	Private
309	Mihelca	2014	BW	Private
310	Nevzatbey	2014	BW	Public
311	Prima	2014	BW	Private
312	Saban	2014	BW	Public
313	Tekin	2014	BW	Public
314	Yakamoz	2014	BW	Public
315	Alada	2015	BW	Public
316	Alatay	2015	DW	Public
317	Altınöz	2015	BW	Public
318	Ayzer	2015	DW	Public
319	Cendere	2015	BW	Private
320	Efe	2015	BW	Public
321	Eker	2015	DW	Public
322	Hamza	2015	BW	Private
323	Hasanbey	2015	DW	Public
324	Kale	2015	BW	Public
325	Köprü	2015	BW	Public
326	Maestrale	2015	DW	Private
327	NKÜZiraat	2015	DW	University
328	Nusrat	2015	BW	Public
329	Perre	2015	DW	Private
330	Sarımustafa	2015	BW	Private
331	Sertori	2015	BW	Private
332	Solveig	2015	BW	Private
333	Tigre	2015	BW	Private
334	Uniya	2015	DW	Private
335	Acar	2016	BW	Public
336	Altuğ	2016	BW	Public
337	Ant	2016	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
338	Asuncion	2016	BW	Private
339	Beğendik	2016	BW	Private
340	Boema 1	2016	BW	Private
341	Destan	2016	BW	Private
342	Enola	2016	BW	Private
343	Ganos	2016	DW	Private
344	GK Szala	2016	BW	Private
345	Kaynarca	2016	BW	Public
346	Kayra	2016	BW	Public
347	Leuta	2016	BW	Private
348	Maden	2016	BW	Private
349	Massimo Meridio	2016	DW	Private
350	Miriana	2016	BW	Private
351	Natula	2016	BW	Private
352	NKU Ergene	2016	BW	University
353	NKU Lider	2016	BW	University
354	Nova	2016	DW	Private
355	NS40S	2016	BW	Private
356	Oscar	2016	BW	Private
357	Reis	2016	BW	Public
358	Renata	2016	BW	Private
359	Sobald	2016	BW	Private
360	Sollario	2016	BW	Private
361	Şanlı	2016	BW	Public
362	Tekir	2016	BW	Private
363	Toros1003	2016	BW	Private
364	Trionfo	2016	DW	Private
365	Tripudio	2016	DW	Private
366	Venka 1	2016	BW	Private
367	Yaren	2016	DW	Public
368	Yörük	2016	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
369	Yüksel	2016	BW	Public
370	Zümrüt	2016	BW	Private
371	Aliağa	2017	BW	Public
372	Alp1	2017	BW	Private
373	Andalusia	2017	BW	Private
374	Aslı	2017	BW	Private
375	Candaş	2017	BW	Public
376	Çeşmeli	2017	BW	Private
377	Çıfçıklı	2017	BW	Private
378	Dunaviya	2017	BW	Private
379	Duru17	2017	BW	Private
380	Ecem	2017	DW	Private
381	Edessa	2017	DW	Public
382	Ekinoks	2017	BW	Public
383	Energo	2017	BW	Private
384	Flamenko	2017	BW	Private
385	Ghayta	2017	BW	Private
386	Guappo vst	2017	BW	Private
387	Güdük	2017	BW	Private
388	Günberi	2017	DW	Public
389	Hacıveli	2017	BW	Private
390	Havabacı	2017	BW	Private
391	Hendrix	2017	BW	Private
392	Hisar	2017	BW	Private
393	Hüseyinbey	2017	BW	Private
394	İkbal	2017	BW	Private
395	Lazarka	2017	BW	Private
396	Lucilla	2017	BW	Private
397	Maria	2017	BW	Private
398	Maya	2017	BW	Private
399	Merilin	2017	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
400	Michelangelo	2017	BW	Private
401	Mimmo	2017	DW	Private
402	Misiia Odes'ka	2017	BW	Private
403	Musik	2017	BW	Private
404	Mv Taller	2017	BW	Private
405	Nomade	2017	BW	Private
406	OS Jelena	2017	BW	Private
407	Pannonia	2017	BW	Private
408	Paşa	2017	BW	Private
409	Pelit	2017	BW	Private
410	Rebelde	2017	BW	Private
411	Ronsard	2017	BW	Private
412	Sarıkerim	2017	BW	Private
413	Skerzzo	2017	BW	Private
414	Soledad	2017	BW	Private
415	Tiziana	2017	DW	Private
416	Troubadur	2017	DW	Private
417	Yiğit	2017	BW	Private
418	Zlatoglava	2017	BW	Private
419	Zolotko	2017	DW	Private
420	Adalı	2018	BW	Public
421	Albachiara	2018	BW	Private
422	Argeles	2018	DW	Private
423	Bc Anica	2018	BW	Private
424	Bojana	2018	BW	Private
425	Damla	2018	BW	Public
426	Dragana	2018	BW	Private
427	FDL Miranda	2018	BW	Private
428	Halis	2018	BW	Public
429	Hamitbey	2018	BW	Public
430	Iveta	2018	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
431	Kışla	2018	BW	Public
432	Koç2015	2018	BW	Public
433	Maja	2018	BW	Private
434	Meltem	2018	BW	Public
435	Milandur	2018	DW	Private
436	Muna	2018	BW	Private
437	NKU Asiya	2018	BW	University
438	Oktan	2018	BW	Private
439	Otilia	2018	BW	Private
440	Setan	2018	BW	Private
441	Severina	2018	DW	Private
442	Sultançayır	2018	BW	Private
443	Sümerli	2018	DW	Public
444	Şehzade1	2018	BW	Public
445	Taner	2018	BW	Public
446	Tekfen1013	2018	BW	Private
447	Topkapı	2018	BW	Private
448	Türköz1	2018	DW	Public
449	Viktoria	2018	BW	Private
450	Wafia	2018	BW	Private
451	ZT Ziyade	2018	BW	Private
452	Abide	2019	BW	Public
453	Adonis	2019	BW	Private
454	Ahıska	2019	BW	Public
455	Aleppo	2019	BW	Private
456	Almeria	2019	BW	Private
457	Anafarta	2019	BW	Public
458	Annie	2019	BW	Private
459	Anzele	2019	DW	Private
460	Arin	2019	BW	Private
461	Ayten Abla	2019	BW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
462	Başkurt	2019	BW	Public
463	Beyazhan	2019	BW	Private
464	Bilden	2019	BW	Public
465	Bohemia	2019	BW	Private
466	Calumet	2019	BW	Public
467	Çavuş	2019	BW	Public
468	Demirhan	2019	BW	Public
469	Ginseng	2019	DW	Private
470	Izvor	2019	BW	Private
471	İlkhan	2019	DW	Public
472	Karakalpak	2019	BW	Public
473	Kıpçak	2019	BW	Public
474	Lavoisier	2019	BW	Public
475	Mario	2019	DW	Private
476	Mirsa	2019	BW	Public
477	Ovidio	2019	DW	Private
478	Pandiya	2019	BW	Private
479	Peçenek	2019	BW	Public
480	Polathan	2019	BW	Public
481	Poyraz	2019	DW	Public
482	Salgado	2019	DW	Private
483	Somuncuoğlu	2019	BW	Public
484	Stoyana	2019	BW	Private
485	Tekfen1016	2019	BW	Private
486	Tekfen2038	2019	BW	Private
487	Teodorico	2019	DW	Private
488	Tigris	2019	DW	Private
489	Tuğra	2019	BW	Public
490	Vehbibey	2019	DW	Public
491	Waximum	2019	BW	Private
492	Yavuz	2019	BW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
493	Activus	2020	BW	Private
494	Afra	2020	BW	Private
495	Akça	2020	BW	Private
496	Akmira	2020	BW	Private
497	Aksungur	2020	BW	Public
498	Alturna	2020	BW	Public
499	Arifbey	2020	BW	Public
500	Aurelia	2020	BW	Private
501	Ayaz	2020	BW	Public
502	Babil	2020	BW	Private
503	Bagira	2020	BW	Public
504	Bayındır	2020	BW	Public
505	Bayram	2020	BW	Public
506	Beyhan	2020	BW	Public
507	Buhara	2020	BW	Public
508	Cemile	2020	BW	Private
509	Çağdaş	2020	BW	Private
510	Dekatlon	2020	BW	Private
511	Duronesse	2020	DW	Private
512	Durusa	2020	DW	Public
513	Ettore	2020	DW	Private
514	Eylül	2020	BW	Public
515	Ezgi	2020	BW	Private
516	Fazılbey	2020	BW	Public
517	Forcali	2020	BW	Private
518	Germenicia	2020	BW	Public
519	GK Futar	2020	BW	Private
520	Güçlü	2020	BW	Private
521	Hünkar	2020	BW	Private
522	İkonya	2020	BW	Public
523	Karmen	2020	BW	Public

No	*Variety Name*	*Release Year*	*Species*	*Released by*
524	Khersons'ka99	2020	BW	Private
525	Kirve	2020	BW	Public
526	Kobra59	2020	BW	Private
527	Kürşad	2020	BW	Public
528	Levent	2020	DW	Public
529	Meke	2020	BW	Public
530	Metropolis	2020	BW	Private
531	Mv Kepe	2020	BW	Private
532	Mv Kolo	2020	BW	Private
533	Mv Lucilla	2020	BW	Private
534	Mv Nemere	2020	BW	Private
535	Mv Pantlika	2020	BW	Private
536	Mv Toldi	2020	BW	Private
537	NE06545	2020	BW	Private
538	NKÜ Zirve	2020	BW	University
539	Payitaht	2020	BW	Private
540	Perge 07	2020	BW	Public
541	Seki 07	2020	BW	Public
542	Selamibey	2020	BW	Public
543	Selçuklu	2020	BW	Public
544	Sırçalı	2020	DW	Public
545	Simge	2020	BW	Public
546	Şahika	2020	BW	Public
547	Teb0693	2020	BW	Private
548	Tekfen1039	2020	BW	Private
549	Tekfen2001	2020	BW	Private
550	Tekfen2077	2020	BW	Private
551	Tekfen2095	2020	BW	Private
552	Yusuf Bey	2020	BW	Private
553	Zoria Ukrainy	2020	Tr. spelta	Private
554	Ağabey	2021	DW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
555	Akçabey	2021	BW	Private
556	Albaşak	2021	BW	Public
557	Albayrak	2021	BW	Private
558	Armağan	2021	BW	Public
559	Atasiyez	2021	Tr. monococcum	Public
560	Avşar	2021	BW	Public
561	Badin	2021	DW	Private
562	Balkoni	2021	DW	Private
563	Bengisu	2021	BW	Public
564	Beyaz1	2021	BW	Private
565	Bisanzio	2021	BW	Private
566	Boldane	2021	BW	Private
567	Bolkar	2021	BW	Private
568	Bozok	2021	BW	Public
569	Cudi63	2021	DW	Public
570	Cumakale	2021	DW	Private
571	Dar	2021	BW	Private
572	Enduro	2021	DW	Private
573	Enerji	2021	BW	Private
574	Erbaş	2021	BW	Public
575	Esmeray	2021	BW	Private
576	Eymenbey	2021	BW	Private
577	Fadime Ana	2021	BW	Private
578	Falado	2021	BW	Private
579	Grador	2021	DW	Private
580	Helina	2021	BW	Private
581	Hilar	2021	BW	Public
582	İsmetbey	2021	BW	Private
583	Kafkas	2021	Tr. turgidum	Public
584	Karaduman	2021	BW	Public
585	Karolina5	2021	BW	Private

No	*Variety Name*	*Release Year*	*Species*	*Released by*
586	Kılınç	2021	BW	Public
587	Koç1453	2021	BW	Public
588	Lancillotto	2021	BW	Private
589	Mergüze	2021	Tr. monococcum	Public
590	Mesut Özen	2021	BW	Private
591	Meya1	2021	DW	Private
592	Meya2	2021	DW	Private
593	Meya3	2021	BW	Private
594	Nizar	2021	BW	Private
595	NS Mila	2021	BW	Private
596	NS Obala	2021	BW	Private
597	Pamira	2021	BW	Private
598	Ramisbey	2021	BW	Public
599	Refikbey	2021	BW	Private
600	Saco 16	2021	BW	Private
601	Saco2018	2021	DW	Private
602	Selenivka	2021	BW	Private
603	Serince	2021	BW	Public
604	Sy Atlante	2021	DW	Private
605	Sy Leonardo	2021	DW	Private
606	Tekfen2064	2021	BW	Private
607	Tekfen2239	2021	BW	Private
608	Tılsım	2021	BW	Private
609	Tragen103	2021	BW	Private
610	Tufan	2021	BW	Private
611	Zorlu	2021	BW	Public

Annex 4B: Varieties included in the NVL as of September 2021

Definition of column labels and codes

Wheat type: WBW=Winter Bread Wheat; **SBW=**Spring Bread Wheat; WDW=Winter Durum Wheat; **SDW=**Spring Durum Wheat; FBW=Facultative Bread Wheat; and WLR = Landrace wheat

Institutional origin: refers to the institution by which crossing and/or selection was done, or the institution from which parent was obtained

Released by: type of institution/individual that released the variety: 1=Public and Universities; 2=Private sector

Desirable traits: refers to top-two desirable traits of the variety **other than yield**

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
1	Adagio	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2	WBW	2013	na	na			
2	Adana99	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	1999	PFAU/SERI-82//(SIB)BOBWHITE	CM-85295-101T-2M-0Y-0M-1Y-0Y-0SY	CIMMYT	Tolerant to yellow rust and septoria	70
3	Adelaide	Maro Tarım İnş. Tic. Ve San. A.Ş.	2	FBW	2013	na	na		Tolerant to fusarium and very high protein and gluten content	
4	Ahmetağa	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	2004					
5	Akbuğday			WLR		LV				
6	Aldane	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2009	BUL-2477-2/3/093-44/AVRORA//BEZOSTAYA-1	TE-5255-2T-1T-1T-0T	NARS	Tolerant to leaf rust	52
7	Alpu2001	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2001	ID-800994-W/VEERY	SWM15134-1WM-0WM-0SE-0YC-HRC*-6YC-0YC	IWWIP	Tolerant to all rusts	70
8	Altay2000	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2000	ES-14//YEKTAY/BLUEBOY-2	YE5470-0E-0E-0E-30E-0E	NARS	Tolerant to yellow rust and mosaic virus	32
9	Anadolu			na						
10	Andino	Limagrain Tohum Islah ve Üretim San.Tic.A.Ş	2	WBW	2012	MONCHO/IMURIS-79			Resistant to lodging	73
11	Ankara guzeli			WLR						
12	Ankara yazlığı			WLR						
13	Aglika	Tarar Un ve Gıda San. Tic. Ltd.Şti.	2	WBW	2012	GP-2558-128/PLISKA	N-285		High tolerance to black chaff disease and leaf rust	60

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
14	Anopa	Pioneer Tohumculuk Dağ ve Paz.Ltd. Şti.	2	SBW	2011	na				
15	Arı Buğdayı			WLR						
16	Artuklu	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2008	LAHN//GANSO/STORK	ICD-86-0471-ABL-0TR-8AP-0TR-20AP-0TR	ICARDA	Low flag leaf curl and tolerant to yellow rust	60
17	Atay85	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1985	HYSLOP/SIETE-CERROS-66	na	IWWIP	Tolerant to leaf rust and smut (Ustilago spp.)	35
18	AYYILDIZ	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	2011	NONGDA-146/4/YAMHILL/TOBARI-66//MCDERMID/3/LIRA/5/F-130-L-1-12	CIT935224-0SE-0YC-3YE-0YC-3YM-0YM	IWWIP	Tolerant to all rusts and smut (Ustilago spp.)	37
19	Bancal	Fito Tohumculuk Ticaret Ltd. Şti.	2	SBW		na				
20	BAŞAK			WBW		na				
21	Basribey	Ege Tarımsal Araştırma Enstitüsü-İZMİR.	1	SBW	1995	JUPATECO-73/(SIB)BLUEJAY//URES-81	CM67458 -4Y-1M-3Y-1M-2Y-0B	CIMMYT	Tolerant to yellow rust and stem rust	61
22	Bayraktar2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2000	CHISHOLM(CSM)/GEREK-79	YA-19484-0A-0A-2A-0A	NARS	Resistance to drought	35
23	Bereket	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2010	KIRAC-66/BEZOSTAYA-1//SUP/3/WEIQUE-RED-MACE(WRM)/2*HUACAMAYO/4/DONS/5/KATE/MVM/6/PRES	TE-5544-3T-1T-1T-0T	NARS	Resistant to drought and cold	67
24	Bezostaja-1	Mısır Araştırma İstasyonu Müd. / Sakarya	1	WBW	1968	LUTESCENS-17,UKR/SKOROSPELKA-2 (S) BEZOSTAYA-4		NARS	Tolerant to yellow rust and resistant to cold	57
25	BURGOS	Fito Tohumculuk Ticaret Ltd. Şti.	2	SDW	2011	na			Tolerant to yellow rust and leaf rust	

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
26	ÇAKMAK	Tarla Bitkileri Merkez Arş.Ens. Müd.	1		1979	UVEYIK-162/ND-61-130	TR-41074	NARS	Tolerant to cold and resistant to wheat rust	45
27	ÇAM BUĞDAYI			WLR						
28	CESARE	Progen Tohum A.Ş.	2	SDW	2013	IRIDE/OROBEL			Tolerant to septoria and rusts	
29	Çeşit1252	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	1999	61-130/ KUNDURU-414-44//377-2		NARS	Resistant wheat rust and to lodging	35
30	Çetinkaya			Unknown		na				
31	Ceyhan99	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	1999	BLUEJAY(SIB)/COCORAQUE-75	CM55651-4Y-2Y-1M-4Y-0M	CIMMYT	Tolerant to yellow rust and resistant to lodging	63
32	CÖMERT	Avesa Tarım Gıda ve Hay. Ltd.Şti.	2	WBW	2011				Resistant to wheat rust	68
33	CUMHURİYET75	Ege Tarımsal Araş. Ens. Müd.	1	SBW	1976	SONORA-64*2//TEZANOS-PINTOS-PRECOZ/YAQUI-54/3/ ANDES-64-A/4/2*FROCOR// YAQUI/KENTANA	II21406-6-2-0Y-0TUR	CIMMYT	Tolerant to leaf rust and stem rust	60
34	Dağdaş94	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	1994	ANKARA-093-44/AVRORA// SIHHE	YA-15662-10A-0A	NARS	Resistant to bunt and tolerant to root disease	35
35	DARİEL	Hazera Tohumculuk ve Tic. A.Ş.	2	SBW	2002	HORK/YAMHILL//KALYANSONA/ BLUEBIRD	CM-38212-0ISR		Resistant to leaf rust and septoria disease	
36	DELABRAD 2	Kartaş Tarım Ürünleri Tic. Ltd. Şti	2	WBW	2014	F-308-O-2-20/DROPIA				
37	DEMİR2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2000	II-21031/CO-652142//MARA,ITA/ SCOUT,USA/3/(PTP)PAI-YU-PAO	YA-19673-0A-0A-2A-0A	NARS	Tolerant to cold and lodging	40

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
38	DESTAN	Avesa Tarım Gıda ve Hay. Ltd.Şti.	2	WBW		na				
39	DİYARBAKIR81	GÜNEYDOĞU ANADOLU TARIMSAL ARŞ.ENS./ DİYARBAKIR	1	SDW	1987	LD-393//BELADI-116-E/2*TEHUACAN-60/3/ COCORIT-71	SE-364-1S-4S-0S	NARS	Resistant to smut and early wheat heading	
40	DOĞANBEY			Unknown						
41	DOĞU88	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	1990	BEZOSTAYA-1/DANNE//CO-725052	na	NARS	Tolerant to rust and smut disease	40
42	DROPİA	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2	WBW	2003	COLOTANA/F-2120-W-1	na		Tolerant to lodging and cold	
43	Ekiz	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	2004	F-885-K-1-1/SIOUXLAND	CIT-932072-0SE-OYC-8YE-8YC-0YC	IWWIP	Resistant to cold and moderately resistant disease	65
44	Eminbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	2009	CMK79//14-44/OVIACHIC-65/3/ BERKMEN/OVIACHIC-65/4/ KUNDURU-1149/5/LEEDS// DWARF-MUTANT/SARIBASAK	YA-22115-0A-0A-0A-0A-20A-0A	NARS	Resistant to lodging and resistant to seed shattering	30
45	Enola	Tarar Un ve Gıda San. Tic. Ltd.Şti.	2	WBW	2016	1518-4/KHERSONSKAYA-552	na		Resistant to crown rot and leaf rust	65
46	ERTUĞRUL	Tekcan Tohumculuk Gıda Ve Tarım Ürünleri San. Tic. Ltd. Şti.	2	WBW	2016	na	na			
47	ESPERİA	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	WBW	2011	B-16-3/LINEA-RUSSA	na		Highly resistant to leaf rust and septoria diseases	67

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
48	EYYUBİ	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2008	MORUS//ALTAR-84/ALONDRA	CD-86608-7M-030YRC-040PAP-4Y-1PAP-0Y[			
CIMMYT	Early maturity	60								
49	FIRAT93	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2002	SNIPE/3/JORI-C-69/ CRANE/GANSO/ANHINGA; ANHINGA(SIB)/(SIB)VOL//(SIB) FLAMINGO,MEX/3/SHAW	CM:2798 -6-1M-2Y-1Y-OM	CIMMYT	Tolerant to yellow rust and tillering potential	57
50	FLAMURA85	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2	WBW	1999	JUWEL/LOVRIN-32-A//2*FAMURA-80; (DER) FLAMURA-80; (ML) FLAMURA-80; RANNYAYA-12/ NADADORES-63//LOVRIN-12; LOVRIN-32/3/RANNYAYA-12/ NADADORES-63//LOVRIN-12	na		Drought resistant and resistant to diseases	42
51	Forblanc	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2		2012	na	na			30
52	Fuatbey 2000	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SDW	2000	na	na		Resistant to yellow rust and septoria diseases	67
53	Galateya	Tarar Un ve Gıda San. Tic. Ltd.Şti.	2	WBW	2014	PLISKA/2367-8			Resistant to lodging and highly resistance to diseases	60
54	Galil	Hazera Tohumculuk ve Tic. A.Ş.	2	SBW	2002	HORK/YAMHILL//KALYANSONA/ BLUEBIRD/3/BOBWHITE	na		Resistance to leaf rust and septoria disease	
55	Ganos	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WDW	2016	na	na		Tolerant to crown rot and leaf rust	67

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
56	GAP	Ege Tarımsal Araş. Ens. Müd.	1	SDW	2004	GEDIZ-75(SIB)/(SIB) FLAMINGO,MEX//(SIB)TEAL,MEX	CD-16707-G-3M-3Y-0M-BB-0Y	CIMMYT	Resistant to stem rust and tolerant to yellow rust	67
57	Gediz-75	Ege Tarımsal Araş. Ens. Müd.	1	SDW	1976	LD-357-E/2*TEHUACAN-60//(SIB) JORI-69	1M-1Y-1M-0Y	CIMMYT	Resistant to yellow and leaf russt	
58	Gelibolu	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2005	506/88-113	na	NARS	Tolerant to powdery mildew and resistant to lodging	62
59	Genesi	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	SBW	2014	COLFIORITO/HEREWARD	na		Resistant to lodging	72
60	Gerek 79	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1979	MENTANA/MAYO-48//4-11/3/ YAYLA-305	na	NARS	Resistant to leaf rust and tolerant to nematode	47
61	Geronimo	SASEED Tar. Tic. Ltd. Şti.	2	WBW	2013	BOLERO/MIETI	na		Resistant to lodging and tolerant to cold	40
62	Geya 1	Kartaş Tarım Ürünleri Tic. Ltd. Şti	2		2011	HYSLOP/HESBIGNON//SKITIYA	na		Tolerant to cold and diseases	75
63	GK Szala	Ziya Organik Tarım A.Ş.	2	WBW	2016	na	na			66
64	Glosa	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2	WBW	2014	DELABRAD(SIB)/F-508-U-1-1// (SIB)DELABRAD, F-508-U-1-1/ DELABRAD//BUCUR, F-135-U-2/F-508-U-1//BUKUR	na		Resistant to lodging and early wheat heading	89
65	Golia	Tarım İşletmeleri Genel Müdürlüğü	2	SBW	1999	MANITAL/ORSO			High resistance to lodging and tolerant to diseases	55

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
66	Gökkan	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2013	KRICHAUFF/FINSI	CMSA00M000204S-040POM-040Y-030M-30ZLM-12ZTY-0M-0SY	CIMMYT	Resistant to yellow and leaf rusts	70
67	Göksu-99	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	1999	AGRI/NACOZARI-76		IWWIP	Resistant to lodging and tolerant to rust diseases,	65
68	Gönen 98	Ege Tarımsal Araş. Ens. Müd.	1	SBW	1998	II-8156-R/MARA//BLUEBIRD		NARS	Tolerant to stem rust and resistant to lodging	75
69	Guadalupe	Tarım İşletmeleri Genel Müdürlüğü	1	SBW	2007	165613/RECITAL			Resistant to lodging and moderately tolerant to rust diseases	
70	Gün-91	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1991	F-35-70/MOCHIS-73	SWM7155-1A-1A-1A-0A	IWWIP	Resistant to cold and early maturity	32
71	Gündaş	GAP Tarımsal Araştırma Enstitüsü Müd./ Şanlıurfa	1	SDW	2012	LGT3/4/BICRE/3/CHAM-1// GAVIOTA/STARKE	ICD94-0918-C-12AP-0AP-4AP-0AP-3AP-0AP	ICARDA	Resistant to yellow rust and tolerant to cold and heat	63
72	Güney Yıldızı	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2010	RASCON-39/TILD-1	CDSS92B611-2M-OY-OM-OY-1B-OY	CIMMYT	Tolerant to yellow rust and good color quality	55
73	Hakan	Trakya Tarım ve Vet Tic. Ltd.Şti.	1	WBW	2009				Tolerant to powdery mildew	62
74	Hamza	Tekcan Tohumculuk Gıda Ve Tarım Ürünleri San. Tic. Ltd. Şti.	2	WBW	2015				Resistant to leaf rust and lodging resistant	60

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
75	Hanlı	Mısır Araştırma İstasyonu Müd. / Sakarya	1	SBW	2007	OK-82282//BOBWHITE/ NEELKANT/3/F-4105-W	CIT925169-0SE-0YC-5YC-0YC	IWWIP	Resistant to yellow rust and lodging	70
76	Harmankaya-99	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1999	FUNDULEA-29/2*LOVRIN-32	F-1502-W9-01	IWWIP	Tolerant to rust and smut	50
77	Hasanbey	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2015	AVILLO_1/SNITAN	CDSS97Y00205S-3Y-0M-0Y-0B-0B-1Y-0BLR-1Y-0B	CIMMYT	Tolerant to yellow rust and good color quality	60
78	Iridium	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2	WBW	2012	ORATORIO/SHANGO			Resistant to yellow and leaf rust	
79	İkizce 96	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1996	ARTHUR*2/SIETE-CERROS-66// BRIL, ARTHUR*2/SIETE-CERROS// BOLAL-2973	na	NARS	Moderately resistant to stem rust and resistant to yellow rust	30
80	İmren	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	2009	DF-21-72/GERARDO-VZ-466// ND-61-130/414-44/3/ ERGENE/4/DF-21-72//ND-61-130/UVEYIK-162/3/128-3	YA-07462-0A-0A-0A-0A20A-0A	NARS	Moderately resistant to stem rust and resistant to yellow rust	30
81	İzgi 2001	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2001	CA-8055/KUTLUK-94	ICWH900312-0AP-OYC-1YC-0YC-0E	IWWIP	Moderately resistant to yellow rust resistant to stem rust	40
82	Kaan	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2009	na			Resistant to lodging, winter, cold and drought	67
83	Kale	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SBW	2015	na	na	NARS	Resistant to yellow rust and bunt	51

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
84	Karacabey 97	Mısır Araştırma İstasyonu Müd. / Sakarya	1	SBW	1997	VEERY-5/PAVON-76/3/GOLDEN-VALLEY/AZTECA-67//MUSALA	CM79540-8Y-2M-6Y-1M-5Y-0B-0TUR	CIMMYT	Resistant to yellow and leaf rust, lodging, winter, cold and drought	65
85	Karacadağ 98	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SBW	1998	RED-RIVER-68/WW-15/3/BAJIO/2*OLESEN//BONANZA/4/NACOZARI-76	CM-65202-3M-2Y-3M-2Y-1Y-3M-0M	CIMMYT	Resistant to rotten root disease	51
86	Karahan-99	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	1999	C-126-15/COLLAFEN/3/NORIN-10-BREVOR/P-14//(P101) PULLMAN-101/4/KIRAC-66	YE-2957-4E-1E-1E-0E	NARS	Moderately resistant to yellow and leaf rust lodging resistance, winter, cold and drought	35
87	Karasu 90	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	1990	LOVRIN-11/BOLAL-2973//MIRONOVSKAYA-264	na	NARS	Second degree bread wheat	57
88	Karatopak	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2006	TESIA-79/VEERY(SIB)//SERI-82	SA-9030-1SA-0SA-0SA-14SA-0SA	NARS	Resistant to yellow rust and septoria and moderately resistant to leaf rust	76
89	Kate A-1	Trakya Tarımsal Araştırma Ens. Müd.	1	SBW	1998	KHEBROS/BEZOSTAYA-1	na	NARS	Resistant to yellow rust	62
90	Kayra	Ege Tarımsal Araş. Ens. Müd.	1	SBW	2016	SAAR	-099Y-099M-4Y-2M-3Y-0B-5S-0S		Moderately resistant to yellow, stem and leaf rusts	67

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
91	Kenanbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2009	GEREK-79//CO-652643/ KIRAC-66	na	NARS	Resistant to yellow rust, moderately resistant to stem rust	45
92	Kharus	İTAŞ	2	WBW	2014	DONSKAYA-POLUKARLIKOVAYA/ LUTESCENS-677//DONSKAYA-POLUKARLIKOVAYA// LUTESCENS-608/3/ ERYTHROSPERMUM-14-90				45
93	Kınacı-97	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	1997	YAMHILL/TOBARI-66// MCDERMID/3/LIRA	SWM-12289-7M-0M-8M-2M-0Y	IWWIP	Resistant to yellow, stem and leaf rusts	60
94	Kıraç 66	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1970	FLORANSA(FNA)/YAYLA-305	na	NARS	Moderately resistant to all rusts	30
95	Kırik	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WLR	2010	LV	na	NARS	Resistant to winter and summer stresses	20
96	Kırkayak	Ekiz Toh. Dan. Üret. Tic. Araş. Proj. Tar ve Gıd. Ltd. Şti.	2	WBW	2013	na	na		Resistant all rusts	44
97	Kızıltan 91	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	1991	UVEYIK-162/61-130//BARRIGON-YAQUI-ENANO*2/TE	na	NARS	Moderately resistant to yellow, stem and leaf rusts	35
98	Konya-2002	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WBW	2002	KANRED/ TENMARQ//P-211-6/3/2183/CO-652643/LANCER,USA	YE-2585-0E-0R-8R-2R-10R-0R	NARS	Lodging resistant, tolerance to winter conditions	60

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
99	Köksal-2000	Uludağ Üniversitesi Ziraat Fakültesi	1		2001	na	na	NARS	Resistant to yellow and stem rust moderately resistant to leaf rust	
100	Köprü	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2015	na	na	NARS	Resistant to powdery mildew and leaf and yellow rusts	89
101	Krasunia odes'ka	Marmara Tohum Geliştirme A.Ş.	2	WBW	2008	na	na		Resistant to powdery mildew and septoria, moderately resistant to leaf and yellow rusts	65
102	Kunduru 1149	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WDW	1967	LV		NARS	Moderately resistant to yellow rust	35
103	Kümbet 2000	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WDW	2000	ND-61-130//414-44/377-2/3/DF-15-72	YE02360-0E-0E-28E-0E	NARS		
104	Leuta	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2	WBW	2016	OSK-5-495-21-97/OSK-4-502-3-98	na		Resistant to powdery mildew, Septoria leaf spot and yellow rust	66
105	Levante	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	SDW	2011	G-80/PICENO//IONIO	na			
106	LG59	Limagrain Tohum Islah ve Üretim San.Tic.A.Ş	2	SDW	2012	na	na			

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
107	Lütfibey	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2010	HYSLOP/SIETE-CERROS-66//1593-51/3/P-101//II-50-18/STACAT/6/LOVRIN-11/BRILL//MIRONOVSKAYA-264/5/PONCA/CLIMAX//NE-61977/3/EAGLE-CHIEF/INIA//BBN-1/4/MEXIPAK//KANRED/FUNO/7/PEHLIVAN	na	NARS	Resistant to all diseases	
108	Maden	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2016	na	na		Resistant to powdery mildew, septoria and leaf rust	75
109	Maestrale	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	SDW	2015	IRIDE/SVEVO	na			
110	Mane Nick	Limagrain Tohum Islah ve Üretim San.Tic.A.Ş	2	SBW	2011	na	na			
111	Martar	Prof.Dr.Turan TATLIOĞLU	2	WBW	2001	na	na		Resistant to all diseases	
112	Masaccio	Progen Tohum A.Ş.	2	SBW	2014	ORATORIO/GENIO	na		Resistant to powdery mildew, septoria, yellow rust and leaf rust	60
113	Massimo Meridio	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2	SDW	2016	OROBEL//ARCOBALENO/SVEVO	na		Resistant to all diseases	61
114	May 8462	May-Agro Toh. San. ve Tic. A.Ş.	2	SBW	2010	na	na		Resistant to all rusts and drought	

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
115	May8059	May-Agro Toh. San. ve Tic. A.Ş.	2	SBW	2012	na	na		Resistant to powdery mildew modera-telyresis-tant to leaf rust disease	70
116	Menemen	Ege Tarımsal Araş. Ens. Müd.	1	SBW	2004	JUPATECO-73/BLUEJAY// URES-81	CM-67458-4Y-1m_3Y-1m-3Y-0B			
117	Meram-2002	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WDW	2002	ND-61-130/414-44//CAKMAK-79	CM-97550-0M-2Y-030H-3Y-3Y-0Y-1M-010Y-0FU	IWWIP	Moderately resistant to rust, bunt and root crown rot diseases	60
118	Mesut	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2013	MV-8/5/BEZOSTAYA-1// BEZOSTAYA-1/TEVERE/3/ KREMENA/LOVRIN-29/4/ KATYA-1	YE-11699-K-0E-0E-0E-6E-0E	NARS	Resistant to yellow rust and moderately resistant to stem rust	40
119	Meta 2002	Ege Tarımsal Araş. Ens. Müd.	1	SBW	2002	NORD-DESPREZ/VG-9144// KALYANSONA/BLUEBIRD/3/ YACO/4/VEERY-5	CM-85836-50Y-0M-0Y-3M-0Y	CIMMYT	Moderately resistant to yellow and leaf rusts	56
120	Metin	Mısır Araştırma İstasyonu Müd. / Sakarya	1		2014	HATUSHA/MUSTANG//TX-81-V-6614	-0YC-0YC-0YC-5YC-0YC-1SE-0YC-3YC-0YC	IWWIP		
121	Mızrak	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1998	POLYCROSS//C-126-15/C-47-6/3/ YESILKOY-1978-79-7	YA-17278-4A-2A-1A-2A-0A	NARS	Moderately resistant to rust diseases	46
122	Midas	Progen Tohum A.Ş.	2	WBW	2014	na	na		Bunt resistant	
123	Mihelca	BC Institüt Tar. Ür. Oto San ve Tic. Ltd. Şti.	2	WBW	2014	BC-1325-78/SO-1065	na		Resistant to all diseases and bunt	65

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
124	Miriana	Tekcan Tohumculuk Gıda Ve Tarım Ürünleri San. Tic. Ltd. Şti.	2	WBW	2016	na	na		Moderately resistant to powdery mildew and resistant to rust diseases	65
125	Mirzabey 2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	2000	GD-2/D-1184528	YA-04879-0A-6A-0A-3A-0A	NARS	Moderately resistant to yellow rust	22
126	Momtchill	Mısır Araştırma İstasyonu Müd. / Sakarya	1	WBW	2000	na	na	NARS	Resistant to all diseases and bunt	55
127	Müfitbey	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2006	NONGDA-146/4/YAMHILL/ TOBARI-66//MCDERMID/3/ LIRA/5/F-130-L-1-12	CIT935224-0SE-0YC-3YE-0YC-2YM-0YM	IWWIP	Resistant to all diseases	35
128	Nacibey	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2008	F-900-K/3/EAGLE,USA// BUCKBUCK/PAVON-76	CIT951179-0SE-0E-2E-0E	IWWIP	Resistant to all diseases	36
129	Natula	Bağlariçi Tohumculuk	2		2016	FLAIR/ELENA//ASTRON	na		Resistant to all diseases	68
130	Negev	Hazera Tohumculuk ve Tic. A.Ş.	2		2002	EWT-8913-0SE-2YC-0YC-1YC	na			72
131	Nenehatun	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	2001	NORD-DESPREZ(ND)/P-101/ BLUEBOY	SWM-584-0P-1P-2P-0H	IWWIP	Resistant to all diseases and bunt resistant	32
132	Nevzatbey	Karadeniz Tarımsal Arş.Enst. Müd.	1	SBW	2014	na	na	NARS	Resistant to yellow and leaf rusts and powdery mildew, and tolerant to stem rust; resistant to winter damage and lodging	70

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
133	Nina	BC Institüt Tar. Ür. Oto San ve Tic. Ltd. Şti.	2	WBW	2005	SANA(ZG-213-82)/GALA	na		Moderately resistant to yellow and leaf rusts and resistant to powdery mildew	
134	NKÜZiraat	Namık Kemal Ün. Ziraat Fakültesi	1		2015	na	na	NARS		
135	Nota	Marmara Tohum Geliştirme A.Ş.	2	WBW	2013	LUTESCENS-2618-G-26465/ LUTESCENS-5056-h-44-3// LUTESCENS-5056-h-44-3	na		Moderately resistant to yellow and leaf rust, powdery mildew, septoria and fusarium	75
136	Nova	Trakya Tarım ve Vet Tic. Ltd.Şti.	2		2016	na	na		Moderately resistant to yellow and leaf rusts and resistant to powdery mildew	75
137	Nurkent	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SBW	2001	HD-1220/3*KALYANSONA// NACOZARI-76	CM-40454-11M-4Y-2M-3Y-1Y-0M		Tolerant to root rot	35
138	Nusrat	Mısır Araştırma İstasyonu Müd. / Sakarya	1	SBW	2015	MILAN/6/KAUZ*2/4/CAR//KAL/ BB/3/NAC/5/KAUZ	CMSS98Y05414S-099Y-099M-4Y-2M-3Y-0B-5S-0S	CIMMYT	Tolerant to powdery mildew and rust	70
139	OS Alka	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2		2011	na	na			
140	Oscar	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	SBW	2016	ATLAS-66/BEZOSTAYA-1//MEC	na		Resistant to leaf rust and septoria	77

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
141	Osmaniyem	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2006	TUI(SIB)/ONELTO	CMBW 89 Y 2368 -0SA-0SA-0SA-5SA-0SA	CIMMYT	Resistant to yellow rust and septoria	63
142	Özberk	Harran Üniversitesi Ziraat Fakültesi	1	WDW	2005	FLAMINGO,MEX/GARZA//CANDEAL-1/GREBE/3/CENTRIFEN/FLAMINGO,MEX/PETREL,MEX/5/AKBASAK-073-44/YERLI/6/CAR	na	CIMMYT		
143	Özcan	Karadeniz Tarımsal Arş.Enst. Müd.	1	WBW	2004	K-8,FRA/MM-2, K-8/MM-2	na	CIMMYT	Tolerant to rust diseases and moderately resistant to powdery mildew	75
144	Özkan	Çukurova Üniversitesi Ziraat Fakültesi	1	SBW	2010	VORONA/CIANO-79//KAUZ	CMBW-89-Y3166-8Y-010M-1Y-0M	CIMMYT	Resistant to septoria and yellow rust and leaf rusts	65
145	Palandöken 97	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	1997	AVRORA//YAKTANA-54*2/NORIN-10-BREVOR/3/II-8260/5/PONCA(PNC)/CM//NB-6977/3/CORRECAMINOS/INIA-66//BLUEBIRD/4/MEXIPAK/IKR/FUNO	na	NARS	Moderately resistant to leaf rust and resistant to yellow rust and stem rust	
146	Pamukova 97	Mısır Araştırma İstasyonu Müd. / Sakarya	1	SBW	1997	VEERY/PAJONAL	CM76719-42Y-01M-08Y-1B-2Y-0B	CIMMYT	Resistant to wheat rust	67
147	Pandas	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2001	ORSO//BEZOSTAYA-1/S-1/3/GENEROSO-7/CONTO-MARZOTTO, BEZOSTAYA-1/S-1//GENEROSO-7/CONTO-MARZOTTO	na	CIMMYT	Resistant to yellow rust and septoria	53
148	Pehlivan	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	1998	BEZOSTAYA-1/TEVERE/5/CENTRIFEN/BEZOSTAYA-1//SUWEON-92/CI-13645/3/NAINARI-60/4/(SIB)EMU	TE-2376-6T-3T-1T-0T	NARS	Tolerant to yellow rust and lodging resistant	57

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
149	Perre	Olgunlar Turizm Tarım Enerji Üretim Tic. Pazarlama Ltd. Şti.	2	SBW	2015	na	na		Resistant to wheat rusts and resistant to (winter and drought)	64
150	Pınar-2001	Uludağ Üniversitesi Ziraat Fakültesi	1		2001	na	na	NARS		
151	Pinzon	Fito Tohumculuk Ticaret Ltd. Şti.	2	SBW	2011	PERGAMINO-GABOTO-MAG/ KLEIN-LUCERO	na		Resistant to rust disease and lodging resistant	
152	Pitagora	Maro Tarım İnş. Tic. Ve San. A.Ş.	2		2013	na	na		Resistant to rust disease and septoria	
153	Prima	BC Institüt Tar. Ür. Oto San ve Tic. Ltd. Şti.	2		2014	TOBARI-66/KAVKAZ//NOVA-BANATKA/3/NS-3143/4/RANA-NISKA/5/NS-3985-1	NS-2-2675-4			
154	Prostor	Trakya Tarımsal Araştırma Ens. Müd.	1		1999	RUSALKA-PODOBRENA/ NADADORES-63	na			
155	Quality	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2		2012	(S)QUALITY	na			
156	Renan	Alfa Toh. Tar. Gıd. İnş. Hay. Paz. San. Tic. Ltd. Şti	2	WBW	2013	MIRONOVSKAYA-808/ MARIS-HUNTSMAN//VPM-1/MOISSON/3/COURTOT, MIRONOVSKAYA-808/ MARIS-HUNTSMAN/3/VPM-1/MOISSON//COURTOT, MIRONOVSKAYA-808/ MARIS-HUNTSMAN/3/VPM-1/ MOISSON//9*COURTOT	na		Tolerant to rust diseases and tolerant to crown rot disease	
157	Renata	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	2	WBW	2016	ZITARKA//OSK-7-5-4-82/KB-160-86/3/SRPANJKA	na			
158	Rumeli	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2012	na	na		Resistant to leaf rust and septoria	75

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
159	Saban	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2014	TRAKIYA/3/MV-C-410-90/GK-KALAKA//MV-C-410-90/FTM-11	na		Tolerant to powdery mildew and lodging resistant	83
160	Sagittario	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	1	SBW	2001	ADAM/VZ-282, ADAM/Z-282	na		Resistant to rust diseases and septoria	
161	Sakin	Karadeniz Tarımsal Arş.Enst. Müd.	1	WBW	2002	PITIC-62(PI)/2*FUNO//VALDIVIA/3/CO-723595	SWO802012-4WM-0WM-3N-1N-0N	IWWIP	Tolerant to rust diseases and powdery mildew	65
162	Salihli 92	Ege Tarımsal Araş. Ens. Müd.	1	SDW	1992	SHWA//21563/ANHINGA/3/EGE-88, B.BAL//BARRIGON-YAQUI-ENANO*2/TEHUACAN-60	CD27672 -4AP-4AP-1AP-4AP-0AP	ICARDA	Resistant to stem rust, tolerant to yellow rust and moderately resistant to leaf rust)	
163	Saragolla	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2		2011	na	na		Lodging resistant	
164	Saraybosna	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2001	OSJECKA-20/OSK-4.216-2-76	na	NARS	Lodging resistant	68
165	Sarı Başak	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SDW	2013	STOT//ALTAR 84/ALD/3/SNITAN	CDSS99Y00619S-0M-0Y-14Y-0M-0Y-0B	CIMMYT	Resistant to septoria and bend-resistant	70
166	Sarıçanak 98	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	1998	DACKIYE/GEDIZ-75//USDA-575	CD19606	ICARDA	Moderately tolerant yellow rust	50
167	Sarımustafa	Sarı Tohumculuk San. ve Tic. Ltd. Şti.	2		2015	na	na		Resistant to yellow and leaf rust	80

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
168	Saroz-95	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	1999	COR-71-11460/3/PKG/ LOVRIN-13//JINGSWON-3	TE-2682-1T-5T-1T-1T-0T	NARS	Resistant to powdery mildew and lodging	
169	Segor	Agro Teknik Zir. Ür.San.Tic.A.Ş.	2		2013	na	na			
170	Selçuklu-97	Bahri Dağdaş Uluslararası Tar. Araş. Ens. M.	1	WDW	1997	073-44*2/OVIACHIC-65/3/DF-21-72//ND-61-130/UVEYIK-162	YA-039862-1A-1A-5A-6A-0A	NARS	Moderately resistance to rust diseases and lodging	55
171	Selimiye	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2009	LAU/AGD/3/ODESSKAYA-95// OLVIYA/B16	TE-5402-4T-1T-2T-0T	NARS	Tolerant to leaf rust and powdery mildew	62
172	Seri 2013	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2009	WEAVER/4/NACOZARI-76/ THATCHER/AC//3*PAVON-76/3/ MIRLO/BUCKBUCK	na	CIMMYT	Resistant to yellow rust and septoria	72
173	Seri 82	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	1991	KAVKAZ/(SIB)BUHO// KALYANSONA/BLUEBIRD	CM-33027-F-15M-500Y-OM-87B-OY-0BGD	CIMMYT		62
174	Sertori	Agro Teknik Zir. Ür.San.Tic.A.Ş.	2		2015	na	na			
175	Seval	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2004	BOLAL-2973/NO64/3/ ARTHUR*2/SIETE-CERROS-66// BOLAL-2973	YA-19535-0A-0A-7A-1A-0A	NARS	Resistant to yellow and stem rusts	42
176	Sham-1	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SDW	1991	PELICANO/RUFF//GAVIOTA/ ROLETTE		ICARDA	Tolerant to septoria and bend-resistant	50
177	Sobald	Caussade Tohumculuk Tarım Ltd. Şti.	2	WBW	2016	ISENGRAIN/KINTO	na		Late spike emergence and short plan heightt	76
178	Sollario	Caussade Tohumculuk Tarım Ltd. Şti.	2	WBW	2016	na	na		Late spike emergence and short plant height	75

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
179	Solveig	Caussade Tohumculuk Tarım Ltd. Şti.	2	WBW	2015	LUTESCENS-41-69-32/ LUTESCENS-36-72	na		Early spike emergence and short plant height	86
180	Soyer02	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2002	ATAY-85/GALVEZ-S-87	SWM17632-OSE-4YC-OYC-2YC-OYC-1YC-OYC	IWWIP	Resistant to yellow and wheat rusts	45
181	Soylu	Selçuk Ün.Ziraat Fakültesi	1	WDW	2012	na	na	NARS	Resistant to cold	40
182	Sönmez 2001	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2001	BEZOSTAYA-1//BEZOSTAYA-1/ TEVERE/3/KREMENA/ LOVRIN-29/4/KATYA-1	TE4732-0T-0YC-0YC-5YC-0YC	IWWIP	Resistant to yellow and leaf rust	50
183	Stendal	Progen Tohum A.Ş.	2	WBW	2013	VIII-221/V-33	na		Tolerant to septoria and leaf rust	
184	Süzen 97	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1997	C126-15/COFN"S"/3/N10B// P101/4/KRC66	YE2957-7E-1E-0E	NARS	Resistant to stem rust and soil-borne wheat moisaic vairus (SBWMV)	
185	Svevo	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	SDW	2001	CIMMYT-SELECTION/ZENIT	na		Early spike and high yield potantial	
186	Syrena odes'ka	Marmara Tohum Geliştirme A.Ş.	2	WBW	2008	ALBATROS-ODESSKII/LINE-1183-84	na		Resistant to root disease and tolerant to septoria	65
187	Şahinbey	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2008	Şahinbey	TOPDY-4-CD-84785-3B-030YRL-040-PAP-1Y-0PAP	CIMMYT	Tolerant to yellow rust and early spike emrgence	55

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
188	Şölen 2002	Ege Tarımsal Araş. Ens. Müd.	1	SDW	2002	STERNA,MEX/ALTAR-84/3/GANSO/FLAMINGO,MEX//CANDO	CD-72067-A-1S-0S-1S-4S-2S-0S	CIMMYT	Resistant to stem rust and moderately resistant to yellow and leaf rusts	75
189	Tahirova 2000	Mısır Araştırma İstasyonu Müd. / Sakarya	1	SBW	2000	PARULA(SIB)/VEERY-6//MYNA(SIB)/(SIB)VULTURE	CM90722 -22Y-0M-0Y-5M-0Y	CIMMYT	Resistant to powdery mildew and resistant to yellow and leaf rusts	70
190	Tekin	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SBW	2014	WEEBILL-1*2/TUKURU	GGSSOOB00173T-099TOPY-099M-099Y-099M-1CEL-0B	CIMMYT	Tolerant to yellow rust and lodging resistant	60
191	Tekir	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	SBW	2016	88-ZHONG-257//CIANO-T-79/PARULA	CMSW-90-M-419	CIMMYT	Resistant to leaf rust and septoria	75
192	Tekirdağ	Trakya Tarımsal Araştırma Ens. Müd.	2	WBW	2005	Tekirdağ	1518-38-K	NARS	Tolerant to leaf rust and powdery mildew	60
193	Tigre	Alfa Toh. Tar. Gıd. İnş. Hay. Paz. San. Tic. Ltd. Şti	2	WBW	2015	na	na		Tolerant to powdery mildew	53
194	Tina	BC Institüt Tar. Ür. Oto San ve Tic. Ltd. Şti.	2	WBW	2005	SANA/GALA	ZG-123-88		Resistant to leaf rust and tolerant to powdery mildew	70
195	Toros1003	Toros Tarım San. Ve Ticaret A.Ş.	2	SBW	2016	na	na		Resistant to leaf rust and septoria	77
196	Tosunbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2004	ECVD-12/KIRAC-66//(SIB)CROW	YA-20688-0A-0A-0A-0A-9A-0A	NARS	Resistant to yellow and leaf rusts	52

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
197	Tripudio	Aksoy Turizm ve Gıda San. Tic. Ltd. Şti.	2	SDW	2016	na	na		Moderately resistant to yellow rust and early spike emergence	58
198	TT 601	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2010	na	na		Resistant to leaf rust and powdery mildew	70
199	Tunca 79	Trakya Tarımsal Araştırma Ens. Müd.	1	WDW	1979	FATA(SEL.181-1)/ND-61-130// LEEDS	C-27-16	NARS		
200	Turabi	Ege Tarımsal Araş. Ens. Müd.	1	SDW	2004	CRESO/CRANE	na	NARS		
201	Turan	Prof.Dr.Turan TATLIOĞLU	2	FBW	2001	na	na		Resistant to powdery mildew and yellow, leaf and stem rusts	
202	Turkuaz	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2012	na	na		Resistant to leaf rust and powdery mildew	70
203	Türkmen	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1998	ECVD-12/BEZOSTAYA-1	YA-18956-3A-4A-1A-0A	NARS		
204	Tüten 2002	Ege Tarımsal Araş. Ens. Müd.	1	SDW	2002	ALTAR-84/(ALD)AVETORO/3/ GANSO/FLAMINGO,MEX// CANDO	CD72352-A-1S-11S-3S-5S-0S	CIMMYT	Resistant to stem rust and moderately resistant to yellow and leaf rusts	70
205	Uniya	Marmara Tohum Geliştirme A.Ş.	2	WDW	2015	ALYI-PARUS(TR.DR)/(TR.AE)YUNA	na		White spike	64

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
206	Urfa 2005	Harran Üniversitesi Ziraat Fakültesi	1	WDW	2005	na	na	CIMMYT		
207	Uzunyayla	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1998	HYSLOP/SIETE-CERROS-66// YAYLA-305/6/NADADORES-63/ CO-652643/4/NAINARI-60/ MAYO-54//NAINARI-60/ KADAS/3/NS-220/5/HYSLOP/ SIETE-CERROS-66	YA-18368-3A-4A-2A-2A-0A	NARS		
208	Vasilina	İTAŞ	2	WBW	2012	na	na			
209	Venka 1	CTO Ekin Tarım	2	WBW	2016	na	na			59
210	Vittorio	Progen Tohum A.Ş.	2	WBW	2012	LANCOTA/KALYANSONA//JE-4-B	na		Tolerant to powdery mildew and tolerant to rust disease (yellow rust and leaf rust)	
211	Yakamoz	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2014	BL-1496/MILAN/3/CROC-1/(205) TR.TA//KAUZ	CMSS97M03600T-040Y-040M-020Y-030M-015Y-80M-3Y-2M-0Y	CIMMYT	Resistant to septoria and moderately resistant to yellow and leaf rusts	65
212	Yakar-99	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	1999	ES-14/5/63-122/4/66-2/ NOROESTE-66/3/LOVRIN-21// KAVKAZ/HYSLOP	YA-19281-0A-0A-0A-4A-0A	NARS		
213	Yaren	Ege Tarımsal Araş. Ens. Müd.	1	SDW	2016	ARAS1//MRF1/STJ2	ICD99-0362-T-0AP-3S-0S-6S-0S	ICARDA	Resistant to yellow and leaf rusts	68
214	Yelken 2000	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WDW	2000	ZF/LEEDS//FORAT/3/ND-61-130/LEEDS/4/(TR.SE)AU-107/5/ GERARDO	YE02405-0E-0E-13E-0E	NARS	Resistant to yellow and leaf rusts	42
215	Yıldırım	Doğu Anadolu Tarımsal Araştırma Ens. M.	1	WBW	2002	ID-800994.W/VEERY	SWM-15134-1WM-0WM-0SE	IWWIP	Resistant to rusts	55

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
216	Yıldız 98	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	1998	SEL.55-1744/P-101//MAYA-74/3/MUSALA/(PRM)PRIMO//MAYA-74/(SIB)ALONDRA	SWM834058*7F-1P-0TE-23YA-0E	IWWIP	Resistant to stem and leaf rusts	65
217	Yılmaz 98	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WDW	1998	DF-9-71/3/V-2466//ND-61-130/414-44/4/ERGENE	TE-01061-2A-1A-1A-0A	NARS		
218	YÖRÜK	Ekiz Toh. Dan. Üret. Tic. Araş. Proj. Tar ve Gıd. Ltd. Şti.	2	SBW	2016	na	na		Resistant to powdery mildew and all wheat rusts	71
219	Yubileynaya 100	Marmara Tohum Geliştirme A.Ş.	2	WBW	2013	na	na		Resistant to crown rot and tolerant to yellow rust	70
220	Yunak	Trakya Tarım ve Vet Tic. Ltd.Şti.	2	WBW	2009	MOMCHIL/KATYA	na		Tolerant to leaf rust and powdery mildew	57
221	Yunus	Geçit Kuşağı Tarımsal Arşt. Enst.Müd.	1	WBW	2012	SG-S1915/FANDANGO	YE-12153S-OE-OE-OE-11E-OE	NARS	Resistant to yellow rust and lodging	71
222	Yüksel	Trakya Tarımsal Araştırma Ens. Müd.	1	WBW	2016	OK81306/STAR	CMSW92WM00167S-17WM-05WM-015WM-010WM-3WM-0WM	IWWIP	Resistant to yellow and leaf rusts	80
223	Yüreğir-89	Doğu Akdeniz Tarımsal Arş.Enst. Müd.	1	SBW	2002	HD-1220/3*KALYANSONA//NACOZARI-76	CM40454-11M-4Y-1M-1Y-4M-1Y-0M	CIMMYT	Resistant to yellow rust and septoria	62
224	Zencirci-2002	Tarla Bitkileri Merkez Arş.Ens. Müd.	1	WBW	2002	STURDY/KIRAC-66	YA-21481-0A-0A-0A-20A-0A	NARS	Middle resistant to yellow rust and high yield potential	33
225	Zenit	Tasaco Tarım Sanayi ve Tic. Ltd.Şti.	2	WDW	2001	VALRICCARDO/VIC	na		Resistant to septoria and powdery mildew	

No.	Variety	Breeder or title holder	Released by	Wheat type	Release year	Genetic background (pedigree)	Breeding history	Institutional origin	Desirable traits	Potential on-farm yield (quintal/ha)
226	Zıtka	Ata Tohumculuk İşl.San. ve Tic.A.Ş.	2		2012	na	na			
227	Ziyabey 98	Ege Tarımsal Araş. Ens. Müd.	1	SBW	1998	NORD-DESPREZ/VG-9144// KALYANSONA/BLUEBIRD/3/ YACO/4/VEERY-5	CM 85836-50Y-0M-0Y-3M-0Y	CIMMYT	Resistant to yellow rust and wheat rust	73
228	Zühre	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1	SDW	2010	SN-TURK-M-183-84-375/(SIB) NIGRIS-5//TANTLO-1	CD 94483 -A-3Y-040M-030Y-2PAP-4Y-OB	CIMMYT	Tolerant to yellow rust and early spike emergence	63
229	ZÜMRÜT	Ekiz Toh. Dan. Üret. Tic. Araş. Proj. Tar ve Gıd. Ltd. Şti.	2	SBW	2016	na	na		Resistant to yellow rust and leaf rust	67

Annex 5: Adoption rate (% of growers) and adoption degree (% of area) by variety

Colour codes for CGIAR varieties: IWWIP ICARDA CIMMYT

Adoption rate (AR) as % of total number of wheat farmers					Adoption degree (AD) as % of total wheat area				
1	Ceyhan99	1999	8.08	8.08	1	Ceyhan99	1999	10.18	10.18
2	Esperia	2011	7.84	15.92	2	Esperia	2011	9.54	19.72
3	Bezostaja-1	1968	7.38	23.3	3	Çeşit1252	1999	5.92	25.64
4	Bayraktar2000	2000	6.27	29.57	4	Bayraktar2000	2000	5.85	31.49
5	Kiziltan91	1991	5.82	35.39	5	Kiziltan91	1991	5.67	37.16
6	Pehlivan	1998	4.85	40.24	6	Pehlivan	1998	5.34	42.5
7	Çeşit1252	1999	4.54	44.78	7	Bezostaja-1	1968	5.03	47.53
8	Flamura85	1999	4.01	48.79	8	Tosunbey	2004	4.5	52.03
9	Tosunbey	2004	3.67	52.46	9	Sagittario	2001	3.25	55.28
10	Katea-1	1998	3.31	55.77	10	Katea-1	1998	2.93	58.21
11	Sagittario	2001	3.23	59	11	Flamura85	1999	2.84	61.05
12	Pandas	2001	2.1	61.1	12	Konya2002	2002	1.76	62.81
13	Ekiz	2004	1.95	63.05	13	Firat93	2002	1.64	64.45
14	Sönmez2001	2001	1.67	64.72	14	Odeskaya	2008	1.57	66.02
15	Karakilçik	Landrace	1.42	66.14	15	Ekiz	2004	1.57	67.59
16	Firat93	2002	1.33	67.47	16	Sönmez2001	2001	1.5	69.09
17	Odeskaya	2008	1.28	68.75	17	Karakilçik	Landrace	1.49	70.58
18	Gerek79	1979	1.23	69.98	18	Quality	2012	1.35	71.93
19	Altay2000	2000	1.21	71.19	19	Svevo	2001	1.32	73.25
20	Konya2002	2002	1.16	72.35	20	Ukrayna	NA	1.28	74.53
21	Quality	2012	1.09	73.44	21	Altay2000	2000	1.11	75.64
22	Cumhuriyet75	1976	0.99	74.43	22	Kunduru	1967	1.04	76.68
23	Basribey	1995	0.8	75.23	23	Pandas	2001	1.01	77.69
24	Kaşifbey	1995	0.72	75.95	24	Gerek79	1979	0.94	78.63
25	Momtchill	2000	0.72	76.67	25	Doğu88	1990	0.93	79.56
26	Svevo	2001	0.72	77.39	26	Tir	Landrace	0.9	80.46
27	Ukrayna	NA	0.72	78.11	27	Cesare	2013	0.89	81.35

Adoption rate (AR) as % of total number of wheat farmers					Adoption degree (AD) as % of total wheat area				
28	Tekirdağ	2005	0.68	78.79	28	Toros	2013	0.78	82.13
29	Golia	1999	0.65	79.44	29	Selimiye	2009	0.74	82.87
30	Tir	Landrace	0.65	80.09	30	Tekirdağ	2005	0.71	83.58
31	Adana99	1999	0.63	80.72	31	Gelibolu	2005	0.59	84.17
32	Renan	2013	0.63	81.35	32	Kiraç66	1970	0.57	84.74
33	Kiraç66	1970	0.6	81.95	33	Burgaz	2011	0.56	85.3
34	Tina	2005	0.58	82.53	34	Adana99	1999	0.54	85.84
35	Kocabuğday	Landrace	0.56	83.09	35	Renan	2013	0.5	86.34
36	Kunduru	1967	0.56	83.65	36	Kirik	Landrace	0.49	86.83
37	Selimiye	2009	0.56	84.21	37	Artuklu	2008	0.48	87.31
38	Mirzabey	2000	0.53	84.74	38	Eminbey	2009	0.48	87.79
39	Gelibolu	2005	0.51	85.25	39	Ayyildiz	2011	0.47	88.26
40	Kirik	Landrace	0.51	85.76	40	Ankara yazlığı	Landrace	0.47	88.73
41	Ahmetağa	2004	0.48	86.24	41	Mirzabey	2000	0.45	89.18
42	İkizce96	1996	0.48	86.72	42	Nota	2013	0.44	89.62
43	Enola	2009	0.46	87.18	43	Tina	2005	0.42	90.04
44	Anopa	2011	0.46	87.64	44	Harmankaya99	1999	0.41	90.45
45	Zerun	Landrace	0.43	88.07	45	Bereket	2010	0.4	90.85
46	Ankara yazlığı	Landrace	0.41	88.48	46	Golia	1999	0.37	91.22
47	Artuklu	2008	0.36	88.84	47	Enola	2009	0.36	91.58
48	Cesare	2013	0.36	89.2	48	İridyum	2012	0.35	91.93
49	Dağdaş94	1994	0.36	89.56	49	Aglika	2012	0.34	92.27
50	Gönen	1998	0.36	89.92	50	İkizce	1996	0.34	92.61
51	Harmankaya99	1999	0.36	90.28	51	Rumeli	2012	0.33	92.94
52	Osmaniyem	2006	0.36	90.64	52	Adelaide	2013	0.31	93.25
53	Üveyik	Landrace	0.36	91	53	Momtchill	2000	0.27	93.52
54	Doğu88	1990	0.34	91.34	54	Zerun	Landrace	0.26	93.78
55	Sert	Landrace	0.34	91.68	55	Anopa	2011	0.24	94.02
56	Adelaide	2013	0.31	91.99	56	Ahmetağa	2004	0.23	94.25
57	Çam buğdayi	Landrace	0.31	92.3	57	Gönen	1998	0.23	94.48

Adoption rate (AR) as % of total number of wheat farmers					Adoption degree (AD) as % of total wheat area				
58	Ayyildiz	2011	0.29	92.59	58	Osmaniyem	2006	0.22	94.7
59	Dropia	2003	0.29	92.88	59	Basribey	1995	0.21	94.91
60	Eminbey	2009	0.29	93.17	60	Genesi	2014	0.21	95.12
61	Rumeli	2012	0.29	93.46	61	Kaşifbey	1995	0.21	95.33
62	Aglika	2012	0.27	93.73	62	Cumhuriyet75	1976	0.21	95.54
63	KISABAŞAK	1990	0.27	94	63	KISABAŞAK	1990	0.2	95.74
64	Bereket	2010	0.24	94.24	64	Sert	Landrace	0.17	95.91
65	Midas	2014	0.24	94.48	65	Dropia	2003	0.16	96.07
66	Toros	2013	0.24	94.72	66	Muratbey	NA	0.16	96.23
67	Meta	2002	0.22	94.94	67	Tüten	2002	0.16	96.39
68	Turan	2001	0.22	95.16	68	Atay85	1985	0.15	96.54
69	Tüten	2002	0.22	95.38	69	Mimmo	2013	0.14	96.68
70	Yunus	2012	0.22	95.6	70	Yunus	2012	0.14	96.82
71	Andino	2012	0.19	95.79	71	Kaan	2009	0.14	96.96
72	Atay85	1985	0.19	95.98	72	Kocabuğday	Landrace	0.13	97.09
73	Burgaz	2011	0.19	96.17	73	Eyyubi	2008	0.12	97.21
74	Müfitbey	2003	0.19	96.36	74	Polatli	NA	0.12	97.33
75	Nina	2005	0.19	96.55	75	Yubileyna 100	2013	0.12	97.45
76	Meksika	NA	0.14	96.69	76	Selçuklu 97	1997	0.12	97.57
77	Ari buğdayi	Landrace	0.12	96.81	77	Turan	2001	0.11	97.68
78	Gediz75	1976	0.12	96.93	78	Üveyik	Landrace	0.11	97.79
79	Genesi	2014	0.12	97.05	79	Meta	2002	0.11	97.9
80	Nota	2013	0.12	97.17	80	Midas	2014	0.11	98.01
81	Polatli	NA	0.12	97.29	81	Nina	2005	0.1	98.11
82	Saribuğday	Landrace	0.12	97.41	82	Negev	2002	0.1	98.21
83	Aldane	2009	0.1	97.51	83	Tt 601	2010	0.09	98.3
84	Negev	2002	0.1	97.61	84	Dağdaş94	1994	0.09	98.39
85	Soyer	2002	0.1	97.71	85	Alpu 2001	2001	0.08	98.47
86	Tt 601	2010	0.1	97.81	86	Karahan99	1998	0.08	98.55
87	Yubileyna 100	2013	0.1	97.91	87	Müfitbey	2003	0.07	98.62

Adoption rate (AR) as % of total number of wheat farmers					Adoption degree (AD) as % of total wheat area				
88	Akbuğday	Landrace	0.07	97.98	88	Çam buğdayi	Landrace	0.07	98.69
89	Bancal	2007	0.07	98.05	89	Kirmizi	Landrace	0.06	98.75
90	Cömert	2011	0.07	98.12	90	Andino	2012	0.06	98.81
91	Dariel	2002	0.07	98.19	91	Aldane	2009	0.06	98.87
92	İridyum	2012	0.07	98.26	92	Dariel	2002	0.06	98.93
93	Kaan	2009	0.07	98.33	93	Syrena odes'ka	2008	0.06	98.99
94	Kutluk 94	1994	0.07	98.4	94	Tiziana	2014	0.06	99.05
95	Makarnalik	Landrace	0.07	98.47	95	Yüreğir	1999	0.06	99.11
96	Mimmo	2013	0.07	98.54	96	Venka 1	2013	0.05	99.16
97	Muratbey	NA	0.07	98.61	97	Ankara güzeli	Landrace	0.05	99.21
98	Temiz	Landrace	0.07	98.68	98	Meksika	NA	0.04	99.25
99	Alpu 2001	2001	0.05	98.73	99	Demir2000	2000	0.04	99.29
100	Demir2000	2000	0.05	98.78	100	Kale	2013	0.04	99.33
101	Destan	2013	0.05	98.83	101	Bancal	2007	0.03	99.36
102	Doğanbey	NA	0.05	98.88	102	Cömert	2011	0.03	99.39
103	Eyyubi	2008	0.05	98.93	103	Sivas	Landrace	0.03	99.42
104	Gün91	1991	0.05	98.98	104	Soyer	2002	0.03	99.45
105	İveta	2000	0.05	99.03	105	İveta	2000	0.03	99.48
106	Kirmizi	Landrace	0.05	99.08	106	Makarnalik	Landrace	0.03	99.51
107	Pinzon	2011	0.05	99.13	107	Gün91	1991	0.03	99.54
108	Selçuklu 97	1997	0.05	99.18	108	Saribursa	Landrace	0.03	99.57
109	Sivas	Landrace	0.05	99.23	109	Turkuaz	2012	0.03	99.6
110	Sultan95	1995	0.05	99.28	110	Ziyabey	2000	0.03	99.63
111	Syrena odes'ka	2008	0.05	99.33	111	Akbuğday	Landrace	0.03	99.66
112	Tiziana	2014	0.05	99.38	112	Ari buğdayi	Landrace	0.02	99.68
113	Vittorio	2012	0.05	99.43	113	Saribuğday	Landrace	0.02	99.7
114	Yüreğir	1999	0.05	99.48	114	Doğanbey	NA	0.02	99.72
115	Ziyabey	2000	0.05	99.53	115	Krasunia	2008	0.02	99.74
116	Adagio	2013	0.03	99.56	116	Gediz75	1976	0.02	99.76
117	Anadolu	Landrace	0.03	99.59	117	Karişik	Landrace	0.02	99.78

Adoption rate (AR) as % of total number of wheat farmers					Adoption degree (AD) as % of total wheat area				
118	Ankara güzeli	Landrace	0.03	99.62	118	Temiz	Landrace	0.02	99.8
119	BAŞAK	NA	0.03	99.65	119	Anadolu	Landrace	0.02	99.82
120	Hayta	2010	0.03	99.68	120	Hayta	2010	0.02	99.84
121	Kale	2013	0.03	99.71	121	Pinzon	2011	0.02	99.86
122	Kamci	Landrace	0.03	99.74	122	Kutluk 94	1994	0.01	99.87
123	Karahan99	1998	0.02	99.76	123	Vittorio	2012	0.01	99.88
124	Karişik	Landrace	0.02	99.78	124	BAŞAK	NA	0.01	99.89
125	Kirkpinar	1997	0.02	99.8	125	Prima	2014	0.01	99.9
126	Krasunia	2008	0.02	99.82	126	Sadova	1984	0.01	99.91
127	Martar	2001	0.02	99.84	127	Sultan95	1995	0.01	99.92
128	Prima	2014	0.02	99.86	128	Uzunbacak	Landrace	0.01	99.93
129	Renata	2010	0.02	99.88	129	Adagio	2013	0.01	99.94
130	Sadova	1984	0.02	99.9	130	Kamci	Landrace	0.01	99.95
131	Saribursa	Landrace	0.02	99.92	131	Destan	2013	0.01	99.96
132	Sofu	Landrace	0.02	99.94	132	KIRKPINAR	1997	0.01	99.97
133	Turkuaz	2012	0.02	99.96	133	SOFU	Landrace	0.01	99.98
134	Uzunbacak	Landrace	0.02	99.98	134	Martar	2001	0.01	99.99
135	Venka 1	2013	0.02	100	135	Renata	2010	0.01	100

Annex 6: Farmers' trait preference ranking by agro-ecological zone for rain-fed environments

5 = most important and 1= least important: Each cell represents the percentage of farmers who gave the particular trait the corresponding rating in row 2.

	Winter agro-ecology					Spring agro-ecology					Facultative agro-ecology				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Grain yield	0.2	0.1	2.4	10.5	86.8	0.0	0.0	0.5	7.8	91.8	0.4	0.0	1.7	31.5	66.4
Grain yield stability	3.4	1.5	10.1	20.6	64.4	0.5	0.0	2.3	11.0	86.2	1.8	1.4	5.8	35.7	55.2
Grain color	5.2	2.6	9.2	15.7	67.4	1.4	1.8	6.9	15.1	74.8	6.7	3.1	7.5	34.3	48.4
Grain size	2.7	2.9	9.0	15.3	70.1	1.4	0.9	5.5	16.9	75.3	2.7	3.4	6.1	37.5	50.4
Straw yield	15.7	10.8	14.1	14.2	45.4	0.9	0.9	6.4	25.9	65.9	5.9	6.9	7.1	32.8	47.3
Tillering ability	2.7	1.1	7.5	20.9	67.9	0.9	0.9	6.0	24.0	68.2	1.0	1.1	6.9	39.0	51.9
Shattering tolerance	3.9	2.0	8.1	21.3	64.7	0.0	0.5	5.5	30.0	64.1	1.8	1.0	6.7	38.7	51.8
Guaranteed minimum yield	3.2	2.3	6.7	12.9	74.9	0.0	0.0	4.1	17.7	78.2	1.3	1.3	5.8	36.8	54.8
Palatability of straw	13.1	10.7	12.6	13.4	50.1	0.5	1.4	5.9	27.4	64.8	6.9	6.2	7.9	32.2	46.7
Drought tolerance	3.4	2.5	5.4	11.8	76.9	0.0	0.0	9.6	11.9	78.5	2.0	1.1	10.5	34.3	52.1
Cold/winter tolerance	2.2	1.2	5.3	14.3	77.0	1.4	1.4	5.5	11.0	80.8	2.1	1.8	6.8	38.8	50.5
lodging tolerance	6.0	1.8	6.4	19.8	66.0	0.5	0.0	2.7	16.4	80.4	3.0	1.3	9.1	35.2	51.5
Disease tolerance	3.4	1.5	9.2	18.1	67.8	0.0	0.5	2.3	24.7	72.6	1.3	1.1	11.9	35.4	50.4
Insect tolerance	4.4	2.5	10.3	16.4	66.4	0.9	0.5	7.8	27.4	63.5	1.6	1.7	12.0	35.9	48.8
Early maturity	11.4	7.6	12.5	15.0	53.5	1.4	0.0	5.9	25.6	67.1	10.6	7.4	14.4	32.2	35.4
Less fertilizer demand	7.2	2.8	10.5	13.7	65.8	2.7	1.8	3.2	24.7	67.6	3.1	4.0	18.4	31.5	43.0
Quality of the variety	1.3	0.4	3.6	8.7	85.9	0.5	0.0	4.1	18.7	76.7	1.3	0.9	3.3	37.0	57.6
Marketability (demand)	0.8	0.3	2.5	9.0	87.4	0.5	0.0	0.9	11.0	87.6	2.1	1.1	3.1	36.1	57.5
Better grain price (TRY/unit)	1.8	0.5	5.1	7.5	85.0	0.5	0.0	2.8	13.8	83.0	2.3	1.1	7.7	31.6	57.3
Storability	3.0	0.7	4.9	17.4	74.1	0.6	0.6	0.6	19.5	78.6	5.5	1.2	6.3	35.0	52.0
Taste for different dishes	2.1	0.2	3.0	21.9	72.7	0.0	0.0	0.6	8.4	90.9	4.7	1.2	14.2	25.6	54.3
Bread making quality	2.3	0.0	2.8	15.5	79.3	0.6	0.0	1.9	11.0	86.4	4.0	0.8	8.0	31.1	56.2
Bulgur making quality	6.5	1.2	6.5	18.0	67.9	7.9	1.3	6.6	36.4	47.7	22.2	2.5	21.3	12.1	41.8

Annex 7: Farmers' trait preference ranking by agro-ecological zone for irrigated environments

5 = most important and 1= least important: Each cell represents the percentage of farmers who gave the particular trait the corresponding rating in row 2.

	Winter agro-ecology					***Spring agro-ecology***					***Facultative agro-ecology***				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Grain yield	0.5	0.0	1.2	15.8	82.6	0.0	0.0	0.0	8.3	91.7	0.0	0.0	1.4	21.8	76.9
Grain yield stability	4.1	1.8	9.4	37.5	47.2	0.0	0.0	1.7	6.8	91.5	7.6	4.8	6.2	27.6	53.8
Grain color	6.3	1.2	7.2	25.8	59.5	15.3	0.0	10.2	3.4	71.2	7.5	2.0	8.8	28.6	53.1
Grain size	4.8	1.0	7.7	23.4	63.1	10.2	6.8	3.4	6.8	72.9	4.1	1.4	8.2	25.9	60.5
Straw yield	13.4	10.0	10.7	26.5	39.4	0.0	5.0	1.7	10.0	83.3	11.6	6.1	10.9	23.1	48.3
Tillering ability	1.9	1.0	6.6	36.7	53.8	0.0	0.0	0.0	8.6	91.4	5.5	2.1	4.1	27.6	60.7
Shattering tolerance	3.8	1.5	11.6	32.7	50.4	0.0	0.0	0.0	13.6	86.4	8.3	2.8	8.3	33.1	47.6
Guaranteed minimum yield	4.3	1.5	8.9	21.7	63.5	0.0	3.4	3.4	11.9	81.4	7.0	2.1	9.9	28.9	52.1
Palatability of straw	13.3	10.7	10.5	28.4	37.1	3.4	1.7	1.7	6.8	86.4	11.6	8.9	13.0	25.3	41.1
Drought tolerance	6.0	3.6	7.9	26.7	55.8	3.4	0.0	1.7	10.2	84.7	7.4	2.0	6.1	23.6	60.8
Cold/winter tolerance	4.6	1.7	5.8	29.1	58.9	3.4	1.7	6.8	10.2	78.0	2.7	1.4	9.6	22.6	63.7
lodging tolerance	4.2	1.7	8.5	33.6	52.0	0.0	0.0	0.0	11.9	88.1	8.2	3.4	5.5	23.3	59.6
Disease tolerance	2.9	1.0	9.5	32.9	53.7	0.0	1.7	0.0	13.6	84.7	5.4	3.4	7.5	25.2	58.5
Insect tolerance	7.6	2.0	11.1	32.7	46.6	3.4	0.0	0.0	10.2	86.4	6.9	2.1	13.1	22.8	55.2
Early maturity	13.0	7.8	13.5	30.1	35.6	5.1	3.4	1.7	16.9	72.9	16.3	8.8	19.0	19.7	36.1
Less fertilizer demand	10.7	3.8	9.9	23.2	52.3	10.3	6.9	6.9	10.3	65.5	12.4	9.7	16.6	16.6	44.8
Quality of the variety	0.7	0.5	3.8	16.7	78.3	0.0	1.7	1.7	10.2	86.4	5.4	1.4	3.4	16.2	73.6
Marketability (demand)	4.3	0.2	3.6	15.7	76.2	0.0	1.7	1.7	3.3	93.3	2.0	2.0	2.0	23.8	70.1
Better grain price (TRY/unit)	2.1	0.5	3.1	14.0	80.2	1.7	0.0	3.3	6.7	88.3	4.8	2.0	6.8	14.3	72.1
Storability	5.3	1.2	8.8	43.5	41.2	0.0	3.2	3.2	6.5	87.1	5.2	3.4	5.2	37.9	48.3
Taste for different dishes	5.6	0.6	3.9	41.9	48.0	0.0	0.0	3.2	9.7	87.1	5.1	3.4	1.7	40.7	49.2
Bread making quality	7.6	0.6	4.1	25.3	62.4	0.0	0.0	3.4	6.9	89.7	6.9	3.4	5.2	34.5	50.0

Political Economy of the Wheat Sector in Turkey: Seed Systems, Varietal Adoption, and Impacts

Over the last four decades, the seed system in Turkey has seen substantial changes. Some policy changes started in the 1980s which opened the door for private sector participation. The seed sector reached its climax in the mid-2000s following the enactment of the new Seed Law and Law of Plant Breeders' Rights. This enabled the country to substantially increase the varietal development and release rates as well as to increase the absolute volume and relative share of the private sector in seed sales. These were followed by an increase in certified seed use in the country which has reached the optimal recommended seed replacement rate of 33%, i.e., the typical Turkish wheat farmer is purchasing certified seed once every three years. While these are all good, some old varieties from the 1960s are known to occupy large proportion of wheat area. Moreover, no comprehensive studies which provide sound analyses of the individual components and more importantly the entire seed value chain exist in the country. As a result, the performances of the different stakeholders in the seed value chain and particularly their implications on farmers' varietal adoption decisions are not well known.

The authors of this book set out with an ambitious goal of carrying out a comprehensive analysis of the wheat seed system in Turkey. The study covered the entire variety development, release, licensing, and protection, seed production, quality assurance, marketing, and the policies, institutions, laws, and regulatory frameworks governing them, as well as the estimation of the level and determinants of varietal adoption and the associated livelihood impacts. This was carried through the review of published and unpublished literature and reports, analysis of secondary data collected from different sources, and using a large dataset collected from a representative sample of 2,560 wheat-growing farm households drawn from 27 major wheat producing provinces – accounting over 70% of total wheat area and 75% of wheat production in the country. By doing so, the book documents the historical evolution of the institutional and policy environment and provides critical analysis of their performance thereby allowing the reader to have a good picture of the supply side of the seed sector. It also carries rigorous analysis of the demand side of the seed sector where estimates of varietal adoption by farmers is generated by variety name, wheat type (durum vs. bread), growing environment (winter, spring, facultative), and also their impact on the livelihoods of the farm households. This book, I believe, is one of its kind in Turkey. Given the amount of data and information it contains and the analysis it provides, I believe that it will not only provide guidance for necessary institutional, regulatory, and policy reforms, but will also be the single most important reference material regarding the wheat seed sector in Turkey for many years to come. The methodological background and the results reported in this book could also inspire targeted studies to answer one or more of the questions the book raised as well as similar work in other crops and in other countries.

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