Food and Agriculture
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WHEAT LANDRACES IN FARMERS' FIELDS IN TURKEY

NATIONAL SURVEY, COLLECTION AND CONSERVATION, 2009-2014

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CONTENTS

LIST OF FIGURES AND PHOTOS

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

BV	Botanical Variety
CIMMYT	International Maize and Wheat Improvement Center
CGR	Crop of Genetic Resources
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDAR	General Directorate of Agricultural Research and Policies
GDP	Gross Domestic Product
GEF	Global Environment Facility
GI	Geograhical Indication
HR	Head Rows
ICARDA	International Center for Agricultural Research in the Dry Areas
LR	Landraces
MEU	Ministry of Environment and Urbanization
MFAL	Ministry of Food, Agriculture and Livestock
MV	Modern Varieties
NGO	Nongovernment Organization
OECD	Organization for Economic Co-operation and Development
SGP	Small Grants Program
TRY	Turkish Lira
TSI	Turkish Statistics Institute
TTSM	Variety Registration and Seed Certification Center
TUBITAK	Turkish Scientific and Technological Council
UNDP	United Nations Development Programme
WWF	World Wide Fund for Nature

ACKNOWLEDGEMENTS

This research was conducted in 65 provinces between the years 2009 to 2014 with wheat landrace producers in Turkey and 1,873 questionnaire forms were completed.

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EXECUTIVE SUMMARY

Turkey is located at a unique position from the view point of plant genetic diversity. Due to its great variety in geomorphology, topography, and climate, Turkey has a large diversity of habitats so it is very rich in plant species and endemism. One plant, perhaps the most important one, is wheat. Wheat is one of the most important agricultural commodities in Turkey, and the country ranks among the top ten wheat producers in the world. Wheat is a staple and strategic crop and an essential food in the Turkish diet, consumed mostly as bread, but also as bulgur, yufka (flat bread), and cookies. Total annual wheat production is estimated at 19.6 million metric tons, valued at approximately US$6.9 billion in 2010. Total production area is approximately 8 million ha (FAO, 2012). Value addition via processing makes the wheat industry one of the major sectors in the economy.

Turkey, both in terms of environmental conditions and in terms of culture, is very suitable for wheat cultivation. At the same time Turkey is the mother land of wheat. Wheat is generally produced in Thrace and Mediterranean, Aegean, and Marmara seaside places as a spring type and in other places it is produced as a winter type. The average yield of wheat is 2,441 kg/ha in Turkey (FAO, 2012).

The cultivation of wheat in Turkey for over 8,000 years has resulted in a large number of named wheat varieties (landraces) in addition to the existing wild and semi-domesticated wheat relatives. Modern (improved) varieties have been available in Turkey since the early part of the 20th century and semi-dwarf varieties were introduced from Mexico in 1966; however, the level of their adoption varies greatly from region to region. After the introduction of new varieties there was a big increase in wheat yield. At the same time these results were an indication of an increase in the use of inputs such as fertilizers and pesticides as well as in the use of modern wheat varieties.

Now Turkey has achieved self-sufficiency in many products such as wheat and it is also one of the wheat exporting countries. In this case, improved new varieties and production techniques have made a great contribution. While on the one hand increasing wheat production as a result of high yield potential can be seen as a positive development, on the other hand, incorporating new wheat varieties into the production process has led to the reduction of genetic resources (local wheat varieties/landraces). Some research reports from Turkey showed that the share of modern wheat varieties in Turkish agriculture was very high and the share of local landraces was under 1% percent of the total wheat production area in the country (Mazid et al., 2009). Thus there has been a decline in genetic diversity in the Turkish wheat crop.

Turkey is one of the centers of origin of wheat and wheat has been grown on about 8.5 million ha with production of around 20 million metric tons annually. Though modern varieties are widely grown in most areas, some landraces (LRs) are still being planted in some niches, especially in remote and mountainous areas, mainly for home consumption with little marketing. Studies have shown the average elevation of currently grown wheat landrace populations is 1,133 m and it was determined that 93% of the landrace production is for houshold uses.

The data from the research reported here were derived primarily from questionnaires completed by the researchers in collaboration with wheat landrace producers. In 2009, with the collaboration of CIMMYT, ICARDA, and Turkey, surveys were initiated to address the questions of where and why LRs were still being planted. Surveys and field collections of LRs were made from 2009 to 2014. FAO contributed and supported in 2012 and 2013. Botanical variety (BV) descriptions were made for each collected sample and single head rows (HR) of all collections were planted accordingly with BV groupings during 2009 to 2014. Selected HRs were harvested and planted in yield trials using modern varieties as checks in years 2009 to 2013.

The study can be divided into two parts. In the first part, the work was carried out by CIMMYT-ICARDA and Turkey partnerships under the name "Improvement of traditional wheat varieties and landraces in drylands of Turkey through utilization of modern breeding tools and participatory selection" in 2009, 2010, and 2011. In the second part, in 2012 and 2013, FAO joined the collaboration and in 2014, the project was completed with CIMMYT-ICARDA and Turkey collaboration. In total, 1,873 questionaire forms were completed with wheat landrace producers via face-to-face interviews in 65 provinces of Turkey. These places were determined by information from different sources such as NGOs, universities, Provincial Directorates of the Ministry of Food, Agriculture and Livestock, and local farmers. Wheat landraces were found in generally remote areas far away from main centers and in high plateau area. As a result of the survey, a total 1,587 wheat landrace samples were collected from farmers' fields (1,400 spike samples and 187 seed samples). One-hundred-sixty-two local wheat landrace names were identified. The socio-economic results from the survey were summarized and presented in this study. The main aim of the research was to determine the general condition of wheat landraces in Turkey and seek answers to the questions:

- "Where are the wheat landraces being produced?",
- "Why and how are the farmers producing landraces?", and
- "How can production of wheat landraces be maintained (*in situ* conservation)?".

The study is reported in seven chapters. In the first, "Introduction", Turkey agriculture and its geographical and historical position are introduced. In the second, "The status of wheat diversity", brief information on wheat in Turkey is explained with its historical process. In the third, "National inventory and mapping of wheat landraces", the research area was introduced and the general situation of the collected wheat landraces were described. The wheat landrace producers were divided into two groups as "Producers of only wheat landraces (1,320 farmers)" and "Producers of both wheat landraces and modern varieties (468 farmers)" and all analyses were done according to this classification. In the fourth, "Farmer practices and decision making concerning wheat landraces", the producers' agronomic practices were compared by region. It is seen that wheat landraces are mostly produced by the farmers in harsh conditions with basic equipment. In the fifth, "Valuing of local wheat landraces", the answer to the question—which factors inform the decision of farmers—was studied. The statistically significant factors were found to be age and education level of farmers, the size of the household, the share of wheat landraces in the total area, marketing distance, elevation, socio-economic index of the district, and pre-trial status of modern wheat varieties. In the sixth, "NGOs and the sustainability of wheat landraces", we evaluated the position of NGOs on maintenance of wheat landrace production at the farm level (*ex situ* conservation). In the last chapter, "Conclusions and recommendations", we did SWOT analysis and tried to present new approaches for preventing genetic erosion of wheat landraces.

Briefly, the study showed that wheat landraces are being produced by farmers in generally remote areas for subsistence farming. The number of farmers producing wheat landraces and different wheat landrace populations are likely decreasing. As a country, we have a good strategy to conserve them in gene banks (*ex situ* conservation), but we should focus more on their maintenance under farmers' conditions (*in situ* conservation) and improve conservation and sustainability strategies using organic farming practices, geographical indicators, mountainous production practices, and emphasis on local products,. We also need to raise public awareness of the importance of genetic resources and strategies for their valuation.

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Chapter 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1. Country and Geographical Information

Turkey lies in the Northern hemisphere near the center of the "Old World Continents", i.e. Asia, Africa, and Europe. More specifically, it lies near the western and central part of the European and North African countries. Turkey also occupies a middle position between the North Pole and the Equator. With this geographical position, Turkey extends between the 36°N and 42°N latitudes and between the 25°40'E and 44°49'E longitudes. In the west, it borders on Greece and Bulgaria, in the east on Georgia, Armenia, Nakhchevan, and Iran, and in the south on Iraq and Syria (Anonymous, 2012a).

Turkey's area is 774,815 km^2, 97% of which lies in Asia (the Anatolian Plateau) and the remaining 3% in Europe (Thrace). The Turkish shoreline stretches for 8,210 km along the Mediterranean in the south, the Aegean in the west, and the Black Sea in the north. In the northwest there is also the important inland Sea of Marmara, between the straits of the Dardanelles and the Bosphorus, important waterways that connect the Black Sea with the rest of the world. The country is roughly rectangular in shape, measuring 1,600 km from east to west, and 650 km from north to south (Anonymous, 2012a).

The high plateau region of Anatolia rises progressively towards the east and is divided by valleys formed by 15 rivers, including the Tigris and Euphrates, which originate in eastern Anatolia and flow southward to the Persian Gulf through Syria and Iraq. The largest river entirely within Turkey is the Kızılırmak, which flows northward past Ankara into the Black Sea. Among the numerous lakes there are some, such as Lake Van, which are as large as inland seas (Anonymous, 2012a).

With its geographically important position, its vast land, and its constantly increasing population, Turkey is a powerful entity and a valuable element of stability especially in this part of the world.Turkey's borders are very long and bear various characteristics. Its land borders are 2,753 km long and its sea borders are 6,000 km long. Turkey's borders measure 877 km with Syria, 331 km with Iraq, 454 km with Iran, 610 km with the former Soviet Union (Georgia, Armenia, Nakchevan), 212 km with Greece, and 269 km with Bulgaria (Anonymous, 2012b).

It is a country of high elevation with an average elevation of 1,132 masl. Mountain ranges extend from the west to the east along the northern and southern coasts. There are, however, many plains, plateaus, highlands, and basins (Anonymous, 2012b).

With 81 administrative provinces, Turkey also has seven geographical regions (Marmara, Black Sea, Mediterranean, Eastern Anatolia, Aegean, Southeastern Anatolia, and Central Anatolia, each of which possesses unique climatic and ecological features.

Although Turkey is situated in the large Mediterranean geographical area where climatic conditions are quite temperate, the diverse nature of the landscape, and the existence of mountains that parallel the coasts, result in significant differences in climatic conditions from one region to other. While the coastal areas enjoy milder climates, the inland Anatolian plateau experiences extremes of hot summers and cold winters with limited rainfall (Sensoy et al., 2012).

Turkey receives most of its rainfall in the winter season, when mean temperature usually is below 5°C and there is not much evaporation. But summer rainfall is very limited and cannot counter the water deficit resulting from increased temperature and evaporation (Sensoy et al., 2012).

The Aegean and Mediterranean coasts have cool, rainy winters and hot, moderately dry summers. Annual precipitation in those areas varies from 580 to 1,300 mm, depending on location. The Black Sea coast receives the greatest amount of rainfall. The eastern part near Rize and Hopa receives 2,200 mm annually and is the only region of Turkey that receives rainfall throughout the year (Sensoy et al., 2012). Inland from the Black Sea coast, near Konya and Iğdır, there is only 250 to 300 mm annual rainfall.

Turkey's diverse regions have different climates because of irregular topography. The Taurus Mountains are near the coast and rain clouds cannot penetrate to the interior part of the country and therefore drop most of their water on the coastal area. In the Eastern Anatolia region, the elevation of mountains exceeds 2,500 to 3,000 m. The Northern Black Sea Mountains and Caucasian Mountains hold the rain clouds, and therefore the inland area has a continental climate with long and very cold winters with heavy snowfall. Minimum temperatures of -30 to -38°C are observed in the mountainous areas in the east, and snow may lie on the ground 120 days of the year. Villages in the region remain isolated for several days during winter storms (Sensoy et al., 2012).

According to the Thornthwaite climate classification method (Sensoy et al., 2012); inland Anatolia has semi-dry areas (Iğdır and Şanlıurfa); the eastern Black Sea region has a very wet climate; and the Black Sea coasts and around Bitlis and Muğla have humid climates. The other large areas of Turkey have a semi-dry – less-humid climate.

Soil is a heterogeneous system whereby various characteristics dynamically affect one another. Physical features of the soil include different aspects, such as depth of the soil, granularity, internal structure of the soil, texture and related water content, soil air, soil temperature, and color (Kantarcı, 1987). In characterizing vegetation, all of these features are jointly evaluated with topographic and climatic conditions (Musaoglu, 1999).

The total area of Turkey is about 78 million ha of which about 16 million ha are physically suitable for cultivation and 4 million ha for irrigation. Alluvials constitute the most important group of arable soils. The dominant soils of central Turkey belong to the reddish brown and brown groups, most of which are devoted to the growing of cereal grains. Grumusol and rendzina soil groups are found in Thrace and south of the Marmara Sea (Oakes, 1959). Climate, topographical, vegetational, and geological diversities of Turkey affect soil formation and diversity (Aksoy et al., 2010).

Although Turkey is in the subtropical belt having a semi-arid climate with extremes in temperatures, the diverse nature of the landscape and particularly the existence of mountains results in great differences in climatic conditions from region to region (Özden et al., 1998). Actually there are two main climatic types in Turkey (Temperate and Mediterranean); there are also 10 subdivisions of these two main climatic types due to effect of topography on climate. (Figure 1.1)

Major causes of topographic diversity are due to the tectonic movements of the recent geologic periods and the accumulation of volcanic products, which have created an elevated mass with an average elevation of 1,132 masl. Thus, plains at 0 to 250 m elevation cover only one tenth of the country, whereas regions higher than 800 m cover two-thirds, and regions higher than 1,000 m cover one-half of the country (Özden et al, 2001) (Figure 1.2). Most mountain ranges extend from west to east and great ranges appear in forms of arches. The Taurus Mountains in the south can be considered a good example of this type. The highlands and basins among the mountains have formed similar geomorphologic features.

1.2. Agricultural Sector in Turkey

Turkey is considered to be one of the leading countries in the world in agriculture and related industries with its favorable climate and geographical conditions, rich soil sources, and biological diversity. Its position is attested by rising exports in many kinds of agricultural products, placing the country amongst the world's largest producers. Agriculture is of key importance to Turkey, both in social and economic terms. Agriculture is still the occupation of the majority of Turkish people, despite the constantly rising share of industry and services. Turkey is one of the few self-sufficient countries in the world in terms of food. Turkey's fertile soil, adequate climate, and abundant rainfall permit growing almost any kind of crops. Farming is conducted in all regions in Turkey, but it is less practiced in the mountainous eastern regions where the main activity is based on

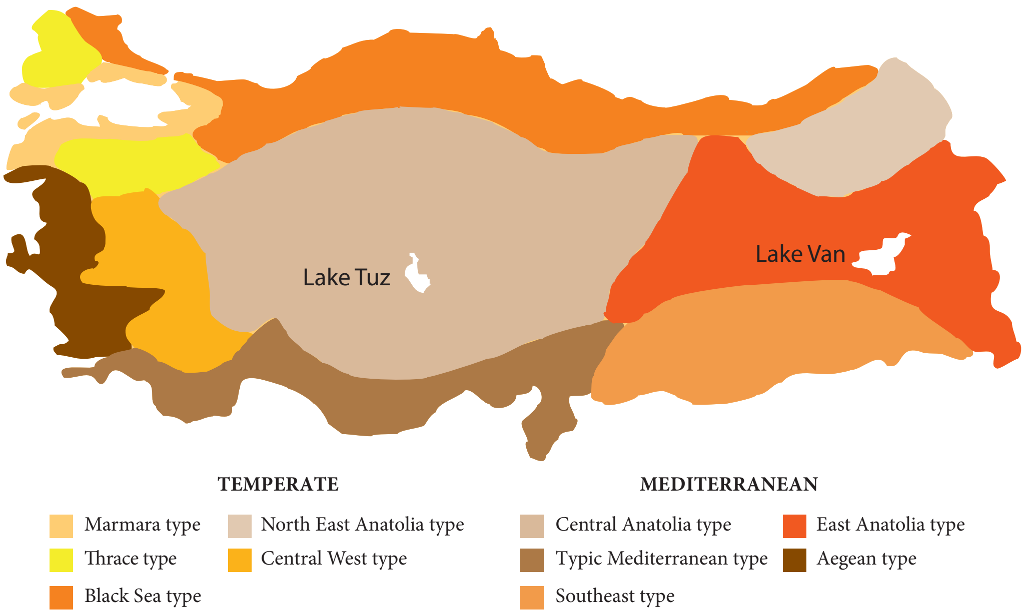

Figure 1.1 Climatic regions (Kapur et al., 2003)
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

animal husbandry (Anonymous, 2012c). The rapid industrialization of Turkey after the 1930s and government policies caused agriculture's share to decline in overall income. The share of the agricultural sector in the GDP was almost 50% in 1950, 25% in 1980, 15.3% in 1990, 10.1% in 2000, and 8.0% in 2011. During this period, Turkey continued its economic transformation from agriculture towards industrial and service sectors. Despite the decreasing share in GDP, agricultural production has been rising. Agricultural production in 2011 was TRY 103 billion (Figure 1.3)

The Turkish agriculture sector employs 6.5 million people which constitutes approximately 25% of the total employment in Turkey. Employment in agriculture

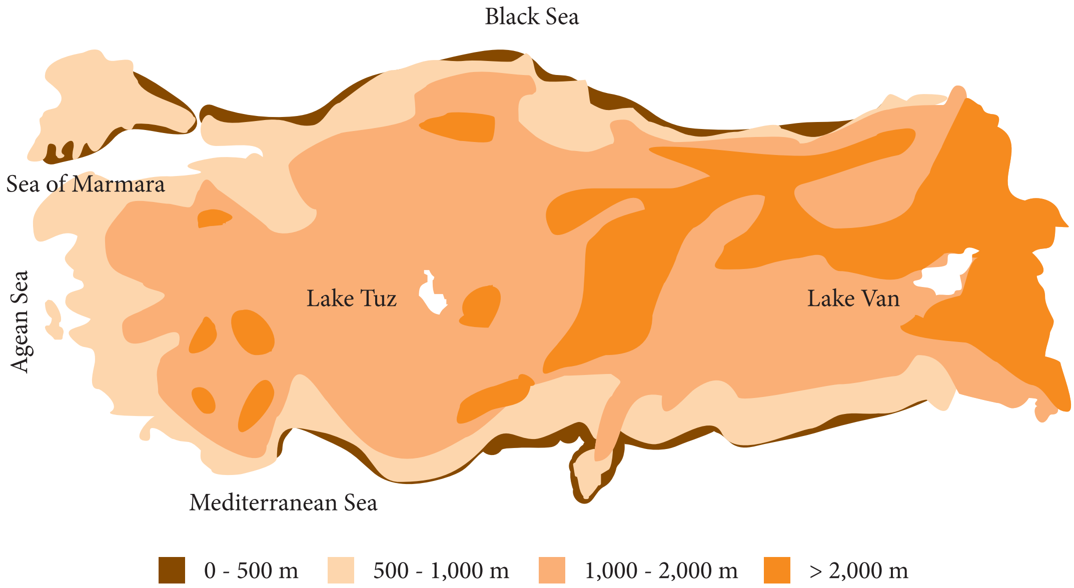

Figure 1.2 Average elevations (Kapur et al., 2003)
Source: Ministry of Food, Agriculture and Livestock, Turkey

has been declining, from approximately 29% in 2004 to 25% Q2 in 2012 (Figure 1.4). Considering the increase in the production during the same period, the efficiency of the agricultural sector in Turkey has risen significantly (ISPA, 2010).

In terms of agricultural lands, Turkey is also one of the largest countries in the world. Total land utilized for agriculture in Turkey is 39,011 thousand ha, 16,333 thousand ha of which is sown. About 35.5% of the country consists of arable lands and 15% consists of forests. The cultivated land was around 24.4 million ha in 2011. About 18.4% of the cultivated land is irrigated. Vegetable products account for 76% of total agricultural production, then animal husbandary; meanwhile forestry and fishing contribute a minimal amount. Fruits and field crops make up the most of vegetable products, wheat being the leading crop (Figure 1.5).

According to the Farmer Record System in 2011, there were approximately 2,292,380 farmers in Turkey, most of whom are on family farms employing family labor. The average area of a Turkish farm is 6.63 ha (BUGEM, 2012).

Subsistence and semi-subsistence farming is an important characteristic of Turkish agriculture. These farms are typically characterized by the production factors being low and only a small fraction of production being marketed off farm.

With its rich soil, vast arable land, and favorable climate, Turkey offers a wide range of agricultural product groups including grains, pulses, fruits, vegetables, and livestock.

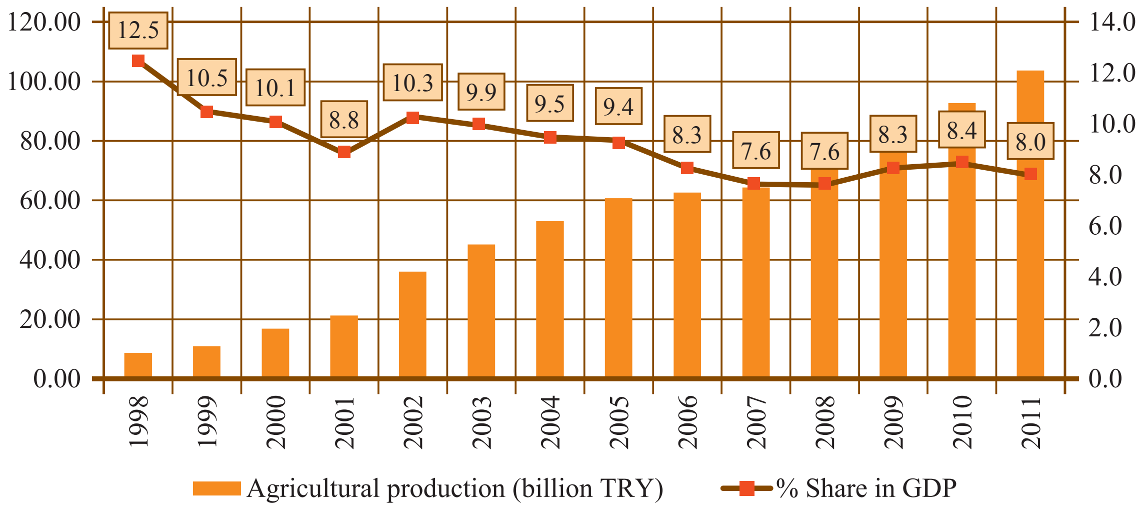

Figure 1.3 Agricultural production (billion TRY) and its share of GDP (%)

Turkey retains the top ranks in many different agricultural products. Turkey is the top producer in the world of hazelnuts, figs, apricots, and cherries by far; second in melons, leeks, and sour cherries; and third in other products such as spices, chillies and peppers, strawberries, chestnuts, chick peas, pistachios, walnuts, vetches, lentils, green beans, cucumbers, watermelons, and honey (BUGEM, 2012).

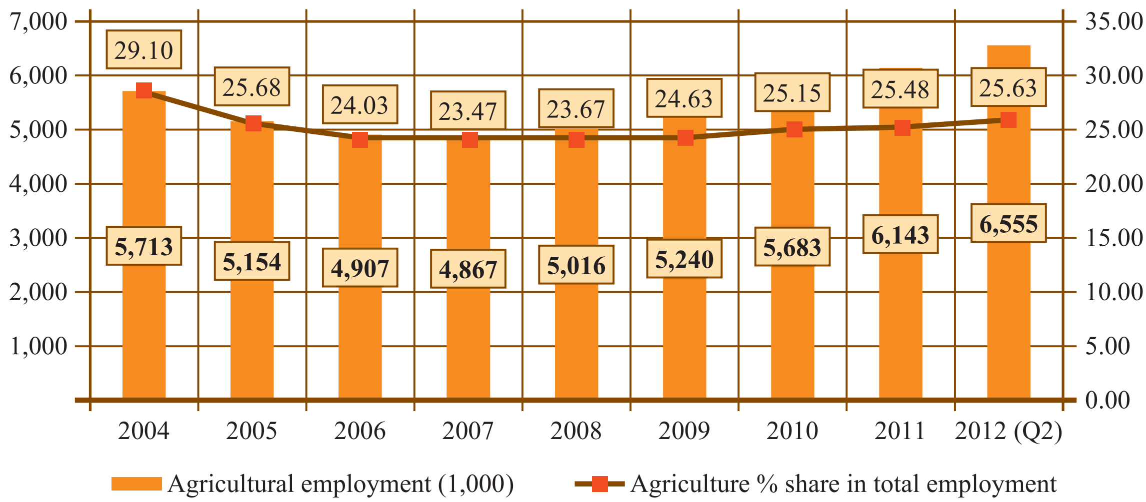

Figure 1.4 Agricultural employment (thousands) and its share of total employment (%) (**Source:** TSI, 2012a)

In the arable crops sector, Turkey is a major producer. In 2011 the production of cereals in Turkey (including rice) was 35.2 million metric tons. Grain production in Turkey is highly dependent on governmental policies. The Turkish government supports grain production through intervention prices and by direct subsidies on fertilizer, fuel, and certified seed costs. Although Turkey is an important producer of grains, with wheat

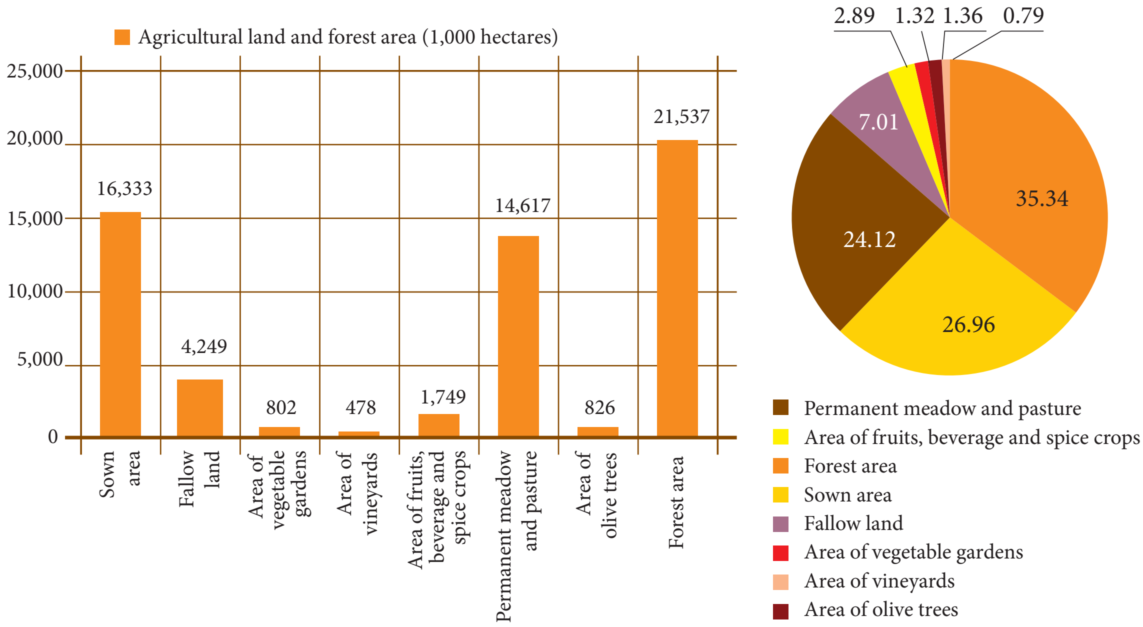

Figure 1.5 Agricultural land and forest area (1,000 ha) and its share of total area (%)
(TSI, 2012b and TSI, 2014)

yield of 2.71 metric tons per ha, it is still lagging behind the EU-27 average yield of 5.66 metric tons per ha. The main reasons behind this deficiency are the production in small-sized farms and the inefficiency in input usage as well as climatic conditions (ISPA, 2010; BUGEM, 2012; TSI, 2012b). The main products in the grain group are wheat, barley, and corn which constituted approximately 61.9%, 21.6%, and 11.9% percent of the total grain production quantity in 2011, respectively (Figure 1.6).

Wheat is the main product in the grain group and is produced in almost every province (Figure 1.7). It is also the main crop in many provinces, especially in the Central Anatolia Region. The total production of wheat is approximately 21 million metric tons. The average yield of wheat was 2.71 metric tons per ha in 2011 (TSI, 2014), despite changes in the regions.

Turkey is a major world producer and net exporter of fruits and vegetables. Despite the relative decline in agriculture's share of GDP in the last 30 years, the sector still plays an important role in foreign trade. Turkey exports many agricultural products such as cereals, pulses, industrial crops, sugar, nuts, fresh and dried fruits, vegetables, olive oil, and livestock products. The main export markets are the European Union, the United States, and the Middle East. Total exports of agricultural products were valued at $12.5 billion USD (as of 2011) (TSI, 2012c).

1.3. Biodiversity in Turkey

Turkey is fortunate as one of the countries in the world possessing vital resources for human food security and has the responsibility to protect and use this important wealth rationally for the welfare of the future generations. Turkey has a vast array of geobotanical

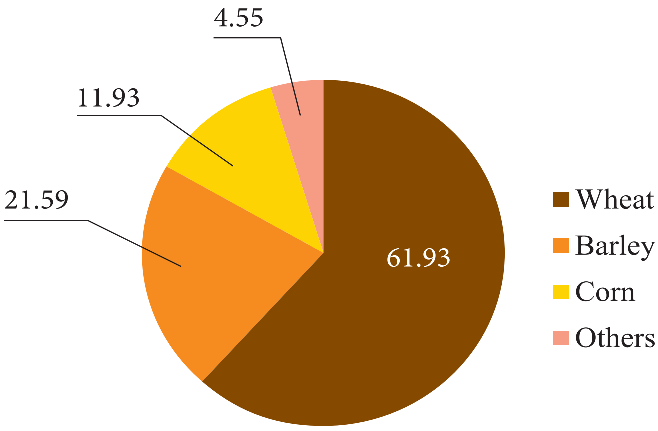

Figure 1.6 Share of some cereals in total grain production (2011) **(%)** (TSI, 2012b)

systems with cultural and botanical influences from the Euro-Siberian, Irano-Turanian, and Mediterranean regions (Inalcik and Quataert, 1994; OECD, 1994; Kaya et al., 1997; Tan, 1998, MEF, 2007). Because its climatic and geographical features change within short intervals of space due to its position as a bridge between two continents, Turkey has acquired the character of a small continent from the point of biological diversity. Turkey has forest, mountain, steppe, wetland, coastal, and marine ecosystems and different forms and combinations of these systems (MEF, 2007; MFAL, 2012). Turkey is recognized as a primary center of diversity for many globally important agricultural species, including wheat (*Triticum* spp.), barley (*Hordeum vulgare*), oats (*Avena sativa),* peas (*Pisum sativum*), and lentils (*Lens culinaris*) (World Bank, 1993; Nesbitt, 1995; Diamond, 1997). Its importance in relation to progenitor species used in Mediterranean and temperate agricultural systems is virtually unprecedented (Brush, 1992; Harlan, 1995; Bennett et al., 1998).

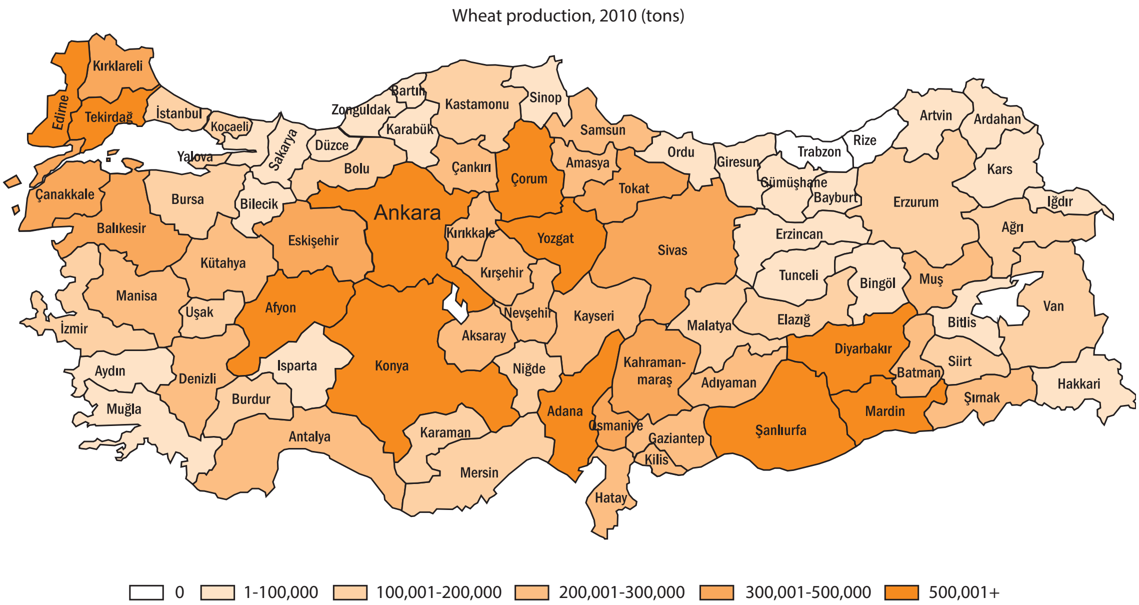

Figure 1.7 Wheat production by region (2010) (TSI, 2012b)
Source: Ministry of Food, Agriculture and Livestock, Turkey

This extraordinary ecosystem and habitat diversity has produced considerable species diversity. It is noted that fauna biological diversity is quite high in Turkey compared with the biological diversity of other countries in the temperate zone. Despite lack of data, the invertebrates constitute the largest number among identified species. The total number of invertebrate species in Turkey is about 19,000, of which about 4,000 species/subspecies are endemic. The total number of vertebrate species identified to date is near 1,500. While there are 12,500 gymnosperm and angiosperm plant species in the entire continent of Europe, it is known that there is a similar number (about 11,000) in Anatolia alone, with some one-third of them endemic to Turkey. Eastern Anatolia and Southern Anatolia, among the geographical regions, and the Irano-Turanian and Mediterranean regions, among the phytogeograhical regions, are rich in endemic plant species (MEF, 2007).

Turkey's genetic diversity becomes important (for plant genetic resources in particular) because Turkey is located at the intersection of the Mediterranean and Near Eastern gene centers. These two regions had a key role in the emergence of cereals and horticultural crops. In Turkey, there are five micro-gene centers in which more than 100 species display a wide variation and which are the origin or center of a large number of important crop plants and other economically important plant species such as medicinal plants. These centers offer very important genetic resources for the future sustainability of many plant species cultivated across the world (MEF, 2007).

Crop genetic resources and the sustaining of them are vital for future generations. Record numbers of humans, introduction of agricultural science and technology, economic integration of the world's many diverse cultures, and globalization of agriculture threaten to destroy this legacy, enhance the unification of practices, and lead to genetic erosion. These threats to crop genetic resources have led to the creation of conservation programs to preserve them. One type of crop genetic resource conservation is conducted *ex situ,* that is, maintenance of genetic resources in gene banks, botanical gardens, and agricultural research stations (Plucknett et al., 1987). Turkey has two National Gene Banks, one in Ankara at the Field Crops Central Research Institute and and one in Izmir at the Aegean Agricultural Research Institute, both of which are affiliated with the Ministry of Food, Agriculture and Livestock (MFAL), which has assumed the leading role in the *ex situ* conservation of the wild relatives of crop plants and of other herbaceous plant species. The *ex situ* conservation activities for forest trees are performed by organizations affiliated with the Ministry of the Forestry and Water Affairs, including the Forest Tree Seeds and Tree Breeding Research Directorate in particular (MEF, 2007). In terms of animal genetic resources, many domestic animal races were originally bred in Anatolia as a result of its location and spread from here to other regions of the world (MEF, 2007; WIPO, 2010).

Up to now, 12,054 species and 3,905 endemic species have been identified in Turkey. Trees and grapevine materials are protected in field conditions in sixteen Gene Gardens throughout the country. In total, 62,210 seed samples of 2,500 species are preserved in the İzmir and Ankara gene banks.

Another type of crop genetic resource conservation is conducted *in situ,* that is maintenance of genetic resources on-farm or in natural habitats (Brush, 1991; Maxted et al. 1997). In actuality, two types of *in situ* conservation can be distinguished. First, *in situ* conservation refers to the persistence of genetic resources in their natural habitats, including areas where everyday practices of farmers maintain genetic diversity on their farm. This type is a historic phenomenon, but it is now especially visible in regions where farmers maintain local, diverse crop varieties (landraces), even though modern, broadly adapted, or higher yielding varieties are available (Brush, 1999). Second, *in situ* conservation refers to specific projects and programs to support and maintain crop diversity, sponsored by national governments, international programs, and private organizations (Brush, 1999). Natural *in situ* conservation units are the first priority for dynamic conservation because their demographic and ecological conditions allow for dynamic gene conservation totally controlled by the natural disturbance of the ecosystem (de Vries, and Turok, 2001).

In Turkey, *in situ* conservation efforts were started in the 1950s, long before the concept of '*in situ* conservation' gained wide acceptance. In our country, *in situ* protected areas have been designated under various statuses including National Park, Nature Park, Nature Conservation Area, Natural Site, Wildlife Development Area, Special Environment Conservation Area, and internationally significant wetlands. The *in situ* protected areas established for different purposes to date have reached about 4.6 million ha in total, corresponding to some 6% of the country's surface area (MEF, 2007).

Tan (2002) reported that the advantages of conservation studies at on-farm levels are:

- Conservation of cultivated plants together with processes of evolution and adaptation in the surrounding area where they are grown,
- Conservation of biodiversity at different levels such as ecosystem, interspecific, and intraspecific,
- Insuring active participation of farmers in conservation activities,
- Indirectly contributing to sustainable agro-ecosystems with less pesticide and fertilizer use,
- Provision of economic benefits and means of existence for farmers using scarce resources, and
- Ability to maintain and monitor genetic resources and access to the resources at any time by farmers.

However, the existing protected areas do not adequately represent the components of biological diversity that our country has, including the steppe and marine ecosystems in particular. The conservation of biological diversity outside its natural habitat (*ex situ* conservation) is considered as a complement to *in situ* conservation. In our country, *ex situ* conservation activities were started in the 1930s with a view to protecting agricultural biological diversity and in the 1970s with a view to protecting forest biological diversity (MEF, 2007).

Biodiversity research in Turkey is mainly conducted by the MFAL, the Ministry of Environment and Urbanization (MEU), Universities and the Turkish Scientific and Technological Council (TUBITAK). MFAL coordinates and implements the agricultural R&D activities through the General Directorate of Agricultural Research and Policies (GDAR). The GDAR is the center of the national agricultural research system. Under the administration of GDAR, there are 10 Central, 10 Regional, and 26 subject-oriented Research Centers and Stations. Mandates of GDAR are plant breeding and production, plant protection, animal breeding and husbandry, animal health, fishery and aquaculture, food and feed, postharvest technologies, biodiversity/genetic resources, organic agriculture, bio-safety, and soil and water resources management (GDAR, 2012).

MFAL has adopted a strategy on agriculture for the period of 2010 to 2014 which sets also agricultural policy and priorities. Furthermore one of the main research areas established by the agricultural research master plan is biological diversity and genetic resources. The plan encourages research activities for the purpose of identification of biological diversity and resources and associated traditional knowledge having value for nutrition, food security and safety, as well as agricultural production (GDAR, 2012).

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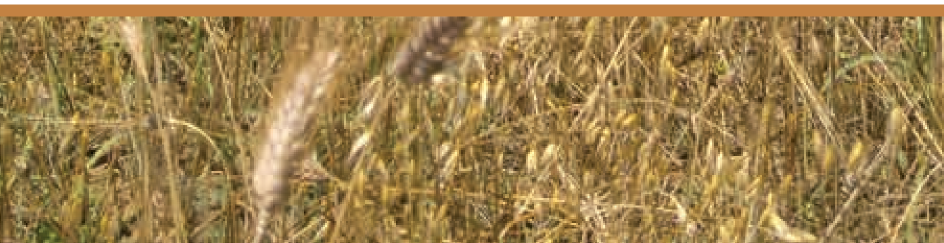
Chapter 2

THE STATE OF WHEAT DIVERSITY



CHAPTER 2

THE STATE OF WHEAT DIVERSITY

2.1. History of Wheat in Turkey

Wheat is among the oldest and most extensively grown of all grain crops. The period over which people have influenced the cultivation of wheat, however, is short in terms of human existence on earth. It is widely accepted that wheat was first grown as a food crop about 10,000 to 8,000 BCE. Presumably, wheat's unique dough-forming property was seized upon by early people, so that wheat grain was treasured above other grain species for baking. Along with other cereal grains, wheat became a major reason for the transition from hunter-gatherer nomads to the settled agriculturalists. The cultivation of storable grains meant that the family or tribe did not need to keep moving in search of whatever plant and animal food could be found. Instead, it was able to settle in one place, growing crops that could be stored safely for the long period after harvest. This major change in attitude led to a changed life style, leaving time for the development of cultural exploits beyond the day-to-day necessity of seeking food (Diamond 1997).

Wheat is a grain crop that takes many forms in the world today. The genus name for wheat, *Triticum*, comes from the Latin *tero* (I thresh). *Triticum vulgare* is the old (no longer accepted) species name for bread wheat, in which *vulgare* means "common". The current binomial name, *Triticum aestivum*, refers to hexaploid common (or bread) wheat (genomes A, B, and D). Bread wheat accounts for more than 90% of all the consumed wheat in the world today. Despite its being referred to as "bread" wheat, common wheat is used for the full range of applications, even including pasta production in some regions (Wrigley, 2009). The other main type of wheat is tetraploid macaroni or durum wheat (*T. turgidum* ssp. *durum*) (genomes A and B), which is used primarily for pasta production (Wrigley, 2009). In addition, there are minor wheats, such as *T. monococcum* (including "small spelt" wheat as a subspecies) and *T. timopheevii* (including "Georgian" wheat), which are cultivated to a limited extent, the former in the former Yugoslavia and Turkey, and the latter in the former Soviet Union (Feldman and Sears, 1981). The main cultivated form of spelt wheat is a variety of hexaploid wheat (*T. aestivum* ssp. *spelta*) (Figure 2.1) (Morrison and Wrigley, 2004).

The diploid species ancestral to wheat are *T. urartu*, *Aegilops speltoides*, an unknown *Aegilops* species that is probably closely related to the modern *Ae. speltoides*, and *Ae. tauschii*. Each of these species has seven pairs of chromosomes ($2n = 14$). Tetraploid *T. turgidum* (genomes AABB, $2n = 28$) was derived from the natural hybridization of *T. urartu* (A

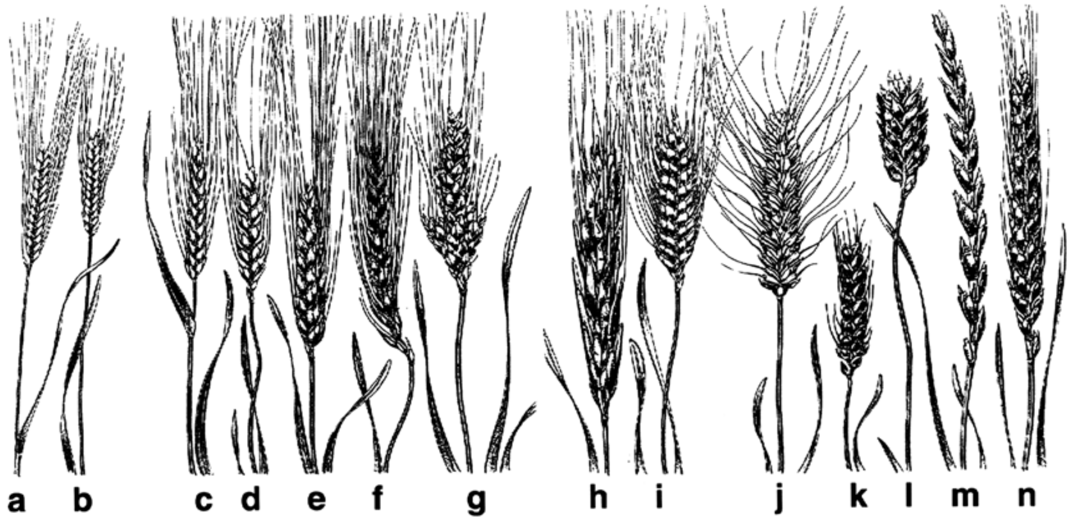


Figure 2.1 Variations in the appearance of spikes of wheat species, one of many morphological characteristics used for their taxonomic classification. The wheat species are (including their ploidy level and common names): **a,** *Triticum boeoticum (2x:* wild einkorn); **b,** *T. monococcum (2x:* einkorn); **c,** *T. turgidum* ssp. *dicoccoides (4x:* wild emmer); **d,** *T. t.* ssp. *dicoccum (4x:* emmer; **e,** *T. t.* ssp. *durum (4x:* macaroni wheat); **f,** *T. t.* ssp. *carthlicum (4x:* Persian wheat); **g,** *T. t.* ssp. *turgidum (4x:* rivet wheat); **h,** *T. t.* ssp. *polonicum (4x:* Polish wheat); **i,** *T. timopheevii (4x:* Timopheev's wheat); **j,** *T. aestivum* ssp. *aestivum (6x:* bread wheat); **k,** *T. a.* ssp. *sphaerococcum (6x:* shot wheat, Indian dwarf wheat); **l,** *T. a.* ssp. *compactum (6x:* club wheat); **m,** *T. a.* ssp. *spelta (6x:* spelt wheat); and **n,** *T. a.* ssp. *macha (6x:* macha wheat). The diploid A-genome species, *T. urartu,* is not shown here. 2*x* = diploid; 4*x* = tetraploid; 6*x* = hexaploid. (Adapted from Mangelsdorf, 1953)

genome) and the unknown *Ae. speltoides*-like species (B genome). Hexaploid common wheat (genomes AABBDD, $2n = 42$) resulted from the natural hybridization of *T. turgidum* spp. *dicoccoides* (AABB) and *Ae. tauschii* (DD) (Mangelsdorf, 1953; Feldman, 2001; Shewry et al., 2003). The diversity of spike morphology for these and other ancestral wheats is shown in Figure 2.1. Although it is not clear from the spike illustrations, these various primitive wheats differ greatly in the ease of threshing grains from the spikes, an important characteristic for successful cultivation and harvesting of any grain species (Wrigley, 2009).

Sometime around 10,000 BCE, the area around Mesopotamia and Egypt became so crowded, and the climate so hot, that there was no longer enough food available just by picking it, and people had to begin growing it. In what is now known as the Fertile Crescent, archeological findings have shown that eastern Mediterrenean regions surrounding the rivers Tigris and Euphrates (Syria, Jordan, Turkey, and Iraq) were the first places where wheat was produced. Wheat is one of the oldest plants that human beings started to cultivate. Archaelogical excavations showed that ancient people living around Şanlıurfa (Karacadağ mountains), a province in the southeastern part of Turkey, planted einkorn wheat (*T. monococcum*) between 10,000 and 12,000 years ago. Today it is still used for animal feed in some areas (Nesbitt and Samuel 1996; Tanno and Willcox, 2006; Yavuz, 2010).

Turkey is the center of origin for many crop species, possibly also of plant domestication (Davis, 1985; World Bank, 1993; Kaya et al., 1997; Tan, 1998). Diverse geological and climatic conditions of Turkey have given rise to unique plant species represented nowhere else in the world. Over 30% of the 8,800 species found in the country are endemic to Turkey (World Bank, 1993). The country is the center of origin and a source of genetic diversity for globally important plants which were first domesticated from wild species and still exist in Turkey. In fact, Turkey's importance in relation to progenitor species, such as of wheat, barley, oats, lentil, chickpea, apple, and pear, used in Mediterranean and temperate agricultural systems is virtually unprecedented (Harlan, 1995; Bennett et al., 1998).

Turkey is within the Vavilov centers of crop genetic diversity as two of these centers, namely, the Near Eastern and the Mediterranean, include parts of Turkey. For example, Zencirci and Birsin (2004) note that two wheat species, durum (*T. turgidum* ssp. *durum*) and bread wheat (*T. aestivum*) originated in the agricultural lands of the historic and productive Fertile Crescent in the Near East, located between the Euphrates and the Tigris rivers, mostly in Turkey. As they note, Turkish wheat not only contributed to production in Anatolia, but also to wheat production in other countries. For example, one Turkish wheat landrace was found to carry genes for resistance and tolerance to various rusts, smuts, and other fungal pathogens, and it was used a source of resistance genes and is a parent of many of the wheat cultivars now grown in the United States (FAO, 1998). Landraces and wild relatives of crops from Turkey continue to provide new sources of important traits needed to maintain and improve agricultural production and efficiency worldwide (Fırat and Tan, 1997).

2.2. Wheat Policy of Turkey

Thirty percent of Turkey's total surface area (24.4 million ha) is agricultural land, 67.8% of which, excluding fallow land, (16.3 million ha), is divided into arable land. Of that arable land, 74.2% (12.1 million ha) is sown as cereals. Wheat ranks first in Turkey with respect to total area of production at 66.9% (Figure 2.2).

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 staple and strategic crop and

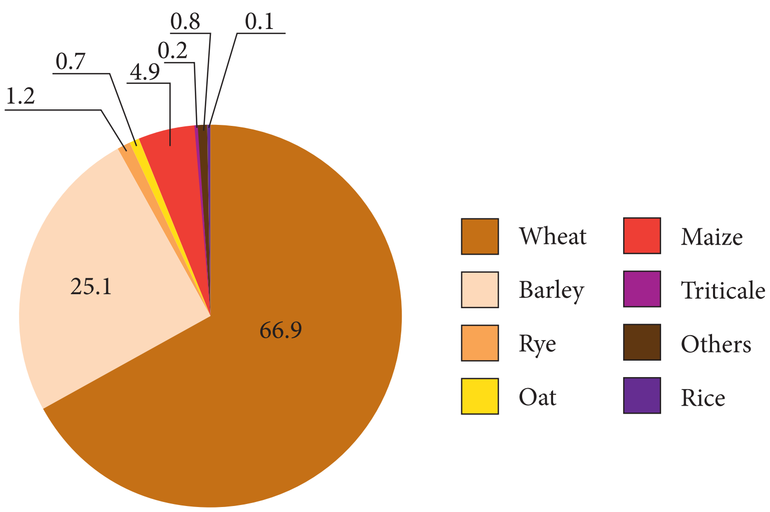


Figure 2.2 Cereal land distribution (%) (TSI, 2012)

an essential food in the Turkish diet, consumed mostly as bread, but also as bulgur, yufka (flat bread), and cookies. Total annual wheat production is about 20 million metric tons, valued at approximately $6.9 billion USD in 2010. Total production area is approximately 8 million ha (FAO, 2012). Value addition via processing makes the wheat industry one of the major sectors in the economy.

Turkey, both in terms of environmental conditions and in terms of culture, is very suitable for wheat cultivation. Wheat is generally produced in Thrace and Mediterranean, Aegean, and Marmara coastal areas as spring type and in other places it is produced as winter type. The average yield of wheat is 2,441 kg/ha in Turkey in 2010 (FAO, 2012) and this value varies by agroecological regions and wheat types (bread and durum).

The cultivation of wheat in Turkey for over 8,000 years has resulted in a large number of farmer-named wheat varieties in addition to the existing wild and semi-domesticated wheat relatives. Modern (improved) varieties have been available in Turkey since the early part of 20th century and semi-dwarf varieties were introduced from Mexico in 1966; however, the level of adoption in the country varies greatly from region to region. After the introduction of new varieties to the country there was big advance of wheat yields. At the same time, these results were an indication of the increase in the use of inputs such as fertilizers and pesticides as well as the use of modern wheat varieties. Figure 2.3 shows the development process of wheat in Turkey after 1960 on production, yield, and cultivation area by years. The wheat-yield average of the last 21 years, 2,190 kg/ha, has been realized by cultivation of new varieties, planting techniques, irrigation, fertilization, and the increase of best practices in plant protection (Altuntaş and Demirtola, 2004). Cultivation area (14%), yield (167%), and the amount of production (205%) have increased in 2011 compared to 1961 in Turkey (Figure 2.3).

Especially in yield increase, the Turkish Government plays an important role via agricultural support systems. Grain, which is the most important crop group in Turkey, corresponds to 20% of the total national production value (TSI, 2012). Grain production in Turkey is highly dependent on governmental policies. Grain, because it is a strategic

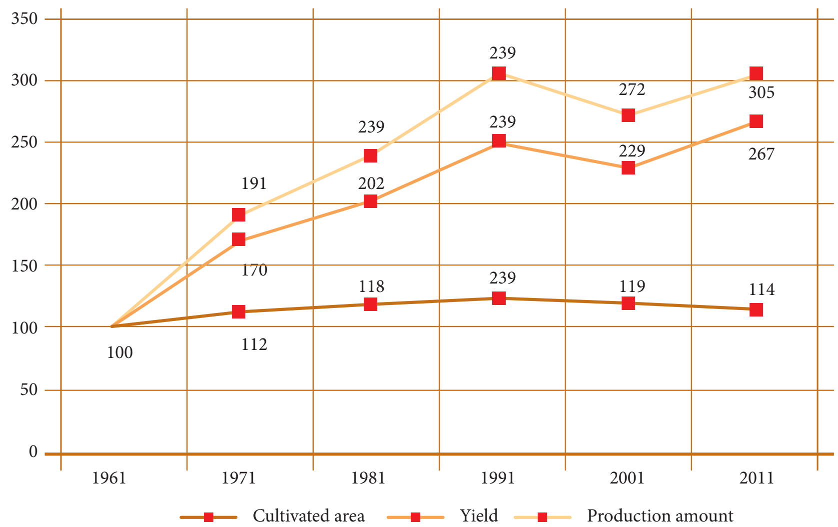


Figure 2.3 Changes in wheat cultivation area, yield, and the amount of production (index 1961=100) (TSI, 2012)

product, is within the scope of state support procurements. Four different field-based agricultural subsidies are implemented in Turkey. These are Diesel Support, Fertilizer Support, Soil Analysis, and Certified Seed Supports (BUGEM, 2015). In Turkey, 45 public institutions and 177 private sector organizations have registered varieties in all herbal crops in 2012. Particularly, seed breeding in grain and seeds bred in recent years show huge advances in terms of both quality and efficiency. In addition, subsidies to certified seed have been effective in encouraging the use of certified seed. The use of certified wheat seed in 2003 was 99 thousand metric tons and rose to 359 thousand metric tons in 2010 (Figure 2.4). In Turkey, the shares of private and public sectors in production of certified wheat seed are 46 and 54%, respectively.

The agricultural support system in Turkey is also shaped by the "Agricultural Basins" concept. With the "Basin-Based Crop Support Model", 30 agricultural basins were identified in 2009 for intensification, and supported, organized, specialized, and integrated for implementation and preparation of agricultural inventory of agricultural products in their own ecological areas. As of 2010, deficiency payment premiums were determined based on the supported crops for every basin and suitable products were supported in their own basins (MFAL, 2012). Wheat is a unique crop supported in every basin in Turkey according to the model.

Turkey has achieved self-sufficiency in many products, such as wheat, and it is also one of the wheat exporting countries. In this case, improved new varieties and production techniques have made a great contribution. While on the one hand, increasing wheat production as a result of high yield potential can be seen as a positive development, on the other hand, incorporating new wheat varieties into the production process has led to the reduction of genetic resources (local wheat varieties/landraces). Some research reports from Turkey showed that the share of modern wheat varieties in Turkish agriculture was very high and the share of local landraces was under 1% percent of the total wheat production area in the country (Mazid et al., 2009). Thus there has been a decline in national crop genetic diversity in the Turkish wheat crop.

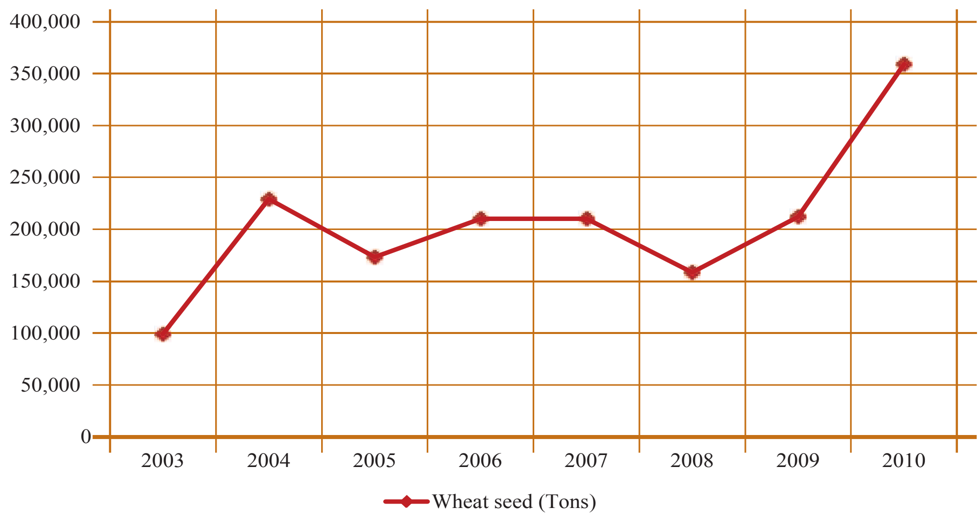


Figure 2.4 Change in certified wheat seed purchase amounts (metric tons) by year (BUGEM, 2012)

2.3. Wheat Breeding Studies in Turkey

Wheat is a staple food crop all over the world and is the most widely grown crop in the world and Turkey. Wheat is produced in almost every part of the Turkey, but the Central Anatolia Region is the one of the most important production areas. During the last 35 years wheat production in Turkey steadily increased, reaching about 21 million metric tons/year out of 9 million ha (the seventh largest area in the world). Meanwhile, genetic resources from Turkey contributed greatly to the increase of wheat production in many countries. Germplasm exploration and collection missions led to the evaluation of collected materials in different countries, and several landraces (e.g., Turkey Red) were largely utilized to breed new varieties. In Turkey, modern wheat breeding started in 1925. Its main goal was to select from local populations lines adapted to the different regions of the country. Breeding initiatives could be divided into three periods. The first was from 1960 to 1970 and cultivars such as 'Kose', 'Surak', 'Yayla-305', 'Ak–702', and 'Kunduru-1149' were released, followed by 'Gerek-79', 'Haymara-79', 'Kırkpınar-79', and 'Cakmak-79'. In 1967 the National Wheat Release and Training Project was established, with the contribution of international organizations, resulting in the Turkish Green Revolution. During the second period (1971 to 1989), 'Bezostaya-1' (a widely grown cultivar from the former Soviet Union) and 'Hawk' were introduced. With its research infrastructure and a core of well-trained scientists, Turkey has also made a significant contribution to international efforts to improve winter wheat production. In 1986, the government of Turkey and CIMMYT, joined by ICARDA in 1990, established the International Winter Wheat Improvement Program (IWWIP). Several improved wheat varieties have since been jointly developed, disseminated, and grown by producers both in Turkey and elsewhere in the world. Other varieties were also introduced into the country, particularly with the implementation of new agricultural policies in the 1980s, and both private companies and public agencies introduced new varieties at an accelerated rate. After 1990, many new cultivars were released with high yield, good quality, and resistance to yellow rust (incited by *Puccinia striiformis* Westend. f.sp. *tritici*) (Akar et al., 2007). The objective of wheat breeding programs was the selection of lines for the diverse wheat producing regions in Turkey. As part of the breeding effort, wheat germplasm from around the world was introduced into Turkey to develop wheat cultivars for specific areas. The national breeding program, meanwhile, developed over 100 wheat cultivars, many of which had a significant impact on the economy (Altıntas et al., 2008).

Commercial wheat varieties are very common in Turkey and every year new wheat varieties enter the wheat markets. There are also national and international wheat breeding programs (IWWIP) and these programs are carried out by the agricultural research institutes. The public institutes have the largest share in wheat breeding studies and now 13 public agricultural research institutes and/or stations are engaged with the wheat breeding program in Turkey, working under the Ministry of Food, Agriculture and Livestock. The mandate areas of these agricultural research institutes are shown in Figure 2.5.

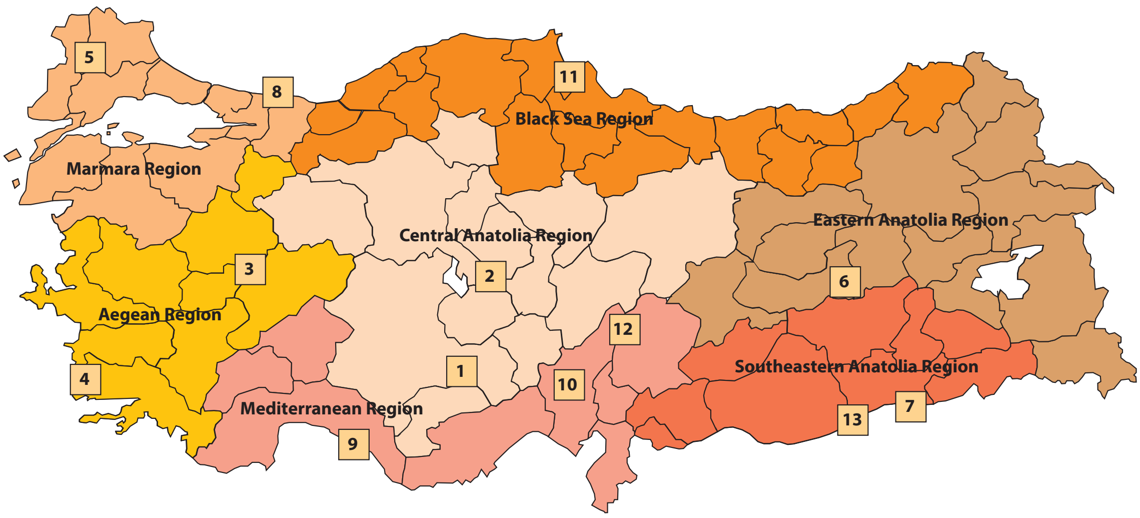
There are many commercial wheat varieties in Turkey. The initial large influx of new wheat varieties was in 1966 with varieties from Mexico. Now, there are 178 (130 bread wheat and 48 durum wheat) registered varieties and 38 (34 bread wheat and 4 durum wheat) production-allowed varieties. Of these, 75.9% is bread wheat and the rest is durum wheat (TTSM, 2012).

2.4. The State of Wheat Landraces in Turkey

Landraces, or traditional varieties, are defined as crop varieties whose morphological and genetic composition is shaped by household crop management practices and natural selection pressure over many generations of cultivation (Belay et al., 1995; Smale et al., 2001), while modern varieties refer to varieties that have been improved scientifically by hybridization, usually by professional breeders (Kruzich and Meng, 2006).

Wheat landraces are composed of traditional crop varieties developed by farmers through many years of natural and human selection and are adapted to local environmental conditions and management practices. As distinct plant populations, landraces are named and maintained by traditional farmers to meet their social, economic, cultural, and environmental needs. They are alternately called farmers' varieties or folk varieties to indicate the innovative role of farmer communities in their development and maintenance (Jaradat, 2012).

Many modern cultivars, in wheat and in other crops as well, are often genetically similar, with a rather narrow genetic base. Therefore, in breeding we need to also utilize sources of new diversity. Landraces, which have arisen through a combination of natural selection and the selection performed by farmers (Belay et al., 1995), usually have a broader genetic base and can therefore provide valuable characteristics important for breeding (Keller et al., 1991; Tesemma et al., 1998). Tolerance to local stresses (Li et al., 1997) and the resulting good yield stability are also often noted for landraces (Tesemma et al., 1998). Landraces and obsolete cultivars can be considered as a valuable portion of the gene pool (Vojdani and Meybodi, 1993; Zou and Yang, 1995) because they represent the broad intraspecific genetic diversity of crops, from which new cultivars have arisen. Due to those valuable



1. Bahri Dağda   International Agricultural Research Institute-KONYA
2. Central Agricultural Research Institute for Field Crops-ANKARA
3. Transtional Zone Agricultural Research Institute-ESKİ EHİR
4. Aegean Agricultural Research Institute-İZMİR
5. Thracian Agricultural Research Institute-EDİRNE
6. East Anatolian Agricultural Research Institute-ERZURUM
7. GAP International Agricultural Research and Training Center-DİYARBAKIR
8. Maize Research Station-SAKARYA
9. Agricultural Research Institute of the Western Mediterreneam -ANTALYA
10. Agricultural Research Institute of the Eastern Mediterrenean -ADANA
11. Black Sea Agricultural Research Institute-SAMSUN
12. Agricultural Research Station of Eastern Mediterrenean Transition Zone –KAHRAMANMARA
13. GAP Agricultural Research Institute- ANLIURFA

Figure 2.5 Distribution of Agricultural Research Institutes and stations engaged with wheat breeding (winter or spring type)
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

characteristics, the direct practical utilization of some landraces by farmers has also been discussed (Brush and Meng, 1998).

Landraces are important to conserve as genetic resources. Awareness of the need for biodiversity conservation is now universally accepted, but recent conservation activities have focused on wild species. Crop species and the diversity between and within them have significant socioeconomic as well as heritage value. The bulk of genetic diversity in domesticated species is located in traditional varieties maintained by traditional farming systems. These traditional varieties, commonly referred to as landraces, are severely threatened by genetic extinction primarily due to their replacement by modern genetically uniform varieties (Villa et al., 2005).

Extinction of genetic resources and genetic erosion are some of the main problems facing Turkey like many other countries. Modern agriculture and conventional breeding and the liberal use of high inputs have resulted in the loss of genetic diversity and the stagnation of yields in cereals in less favorable areas. Increasingly landraces are being replaced by modern cultivars which are less resilient to pests, diseases, and abiotic stresses, thereby a valuable source of germplasm for meeting the future needs of sustainable agriculture in the context of climate change is lost. Where landraces persist there is concern that their potential is not fully realized (Newton et al., 2010).

Wheat landraces are valuable sources to broaden the genetic base of cultivated wheat. The development of new varieties from landrace populations is a viable strategy to improve landrace yield and yield stability, especially under stress and future climate change conditions; also, these landraces harbor genes and gene complexes for quality traits, tolerance to biotic and abiotic stresses, and adaptation under a wide range of low-input and organic farming systems (Jaradat, 2012). The genetic diversity of wheat landraces must be investigated for use in wheat breeding. More information about the genetic diversity within and relationships among landraces would be invaluable for the conservation and utilization of existing genetic resources (Warburton and Hoisington, 2001; Zhang et al., 2006).

Turkey lies within the broad region of domestication of wheat (Zohary and Hopf, 1988). The first collection was completed in the first quarter of the 20th century by the pioneering Turkish scientist Mirza Gökgöl who collected wheat landraces from all over Turkey and evaluated them for basic characteristics. His book, "Türkiye Buğdayları", identified about 18,000 types of wheat and among them he identified 256 new varieties. His publications are still the most notable sources for breeders and scientists dealing with plant genetic resources. The analyses of these materials convinced Gökgöl that almost all wheat varieties existing in the world were present in Turkey and that Turkish landraces provide an endless treasure to breeders (Gökgöl, 1939).

In the same period as Gökgöl, the well-known Russian scientist Zhukovsky conducted three collecting missions to Turkey during the years 1925 to 1927. Zhukovsky was encouraged by Vavilov and his missions were supported by The Botany Society of the Soviet Union. During his three years in Turkey, Zhukovsky collected around 10,000 samples of cereals, forages, and vegetables. The material was an enormous contribution to plant varieties of the Soviet Union (Zhukovsky, 1951).

Another landrace collection was made by Harlan in 1948 to 1949 with the contributions of the Agronomy Department of the University of Ankara[1], the Soil Office of the Ministry of Trade, and the Plant Breeding Stations of the Office of the General Director of Agriculture.

[1] The names of the institutions are former name of Field Crop Department of Ankara University, Turkish Grain Board, and General Directorate of Agricultural Research and Policies in Turkey.

The collection included 2,121 wheat accessions (including *T. monococcum*), and 55 accessions of wild relatives of wheat. These populations were analyzed for botanical and agronomic composition, providing an unusual opportunity for studies on the behavior of botanical varieties in mixed populations under diverse climatic conditions. The wheats in Turkey were represented by remarkable diversity and great varietal wealth (Harlan, 1950).

Turkish farmers cultivated their landraces widely until the second half of the 20th century when a program was started in Turkey through an agreement with The Rockfeller Foundation. Although it was a modest start in agriculture research, mechanization, and use of fertilizers and chemicals, it resulted in unexpected consequences. Among the several plant research groups involved, the wheat program had the greatest impact. It did not take long for the new varieties to replace the landraces. This genetic heritage began to be diminished after so called high-yielding "Mexican wheats" were introduced to the country (Karagöz, 2014).

In the early years of wheat breeding in Turkey, varieties such as Köse 220/39, Sürak 1593/51, Topbaş 111/33, and Sertak 52 were improved by selection with the Köse 220/39 bread wheat variety used as a quality standard. This situation is an indication of how important the landraces are for Turkey. In recent years, landraces have not been used much in breeding and foreign-origin wheat materials have formed a basis for the crossbreeding studies in Turkey. These changes have narrowed the genetic variation in bread wheat varieties (Karagöz and Zencirci, 2005).

Damania et al. (1996) evaluated the collection of 2,420 accessions derived from single-spike population samples of durum wheat landraces collected in 1984 from 172 sites in 28 provinces in Turkey by Metzger's team. They found differentiation among these accessions for number of days to heading, maturity, days to grain filling, as well as for plant height, peduncle length, number of spikelets per spike, spike length, awn length, and kernel weight. As a result of canonical analysis, significant correlations were found among province, mean temperatures, elevation, latitude, and length of growing season. Eight distinct groups of provinces were identified by cluster analysis. They concluded that accessions could be utilized in crop improvement programs targeted at either favorable or stressed environments.

The other important collection and evaluation studies were done by Zannata's team in 1993-1994 in the western part of Turkey. They accessed farmers' seed stores in 35 villages from six districts and three provinces in western Turkey, Merkez, and Banaz in Uşak province; Altintas, Çavdarhisar, and Simav in Kütahya province; and Seyitgazi in Eskişehir province. A total of 126 populations, representing 22 landraces, were planted in Eskişehir and compared to modern varieties of wheat recommended for cultivation in Turkey: Bezostaja-1, Cakmak-79, Gerek 79, and Kunduru 1149. They found significant yield differences between wheat landraces and modern wheat varieties. The yields for the modern varieties ranged from 1,800 to 2,900 kg/ha in the first year, and from 3,500 to 4,500 kg/ha in the second year. At the same time, the landraces showed very good performance in relation to the modern germplasm in both years, with yields variying from 1,400 to 3,100 and 3,200 to 5,600 kg/ha in the first and second years, respectively (Zanatta et al., 1996, 1998).

Akçura and Topal (2006) evaluated genetic diversity of seven quantitative characters in 307 winter bread wheat landraces which were collected from 21 different provinces in Turkey and calculated the Shannon-Weaver diversity index (H'). The researchers concluded that these landraces must be considered as a reservoir of genes that plant breeders need in their winter wheat improvement programs in Turkey.

Brush and Meng (1998) studied farmer's valuations of wheat landraces in three provinces (Eskişehir, Kütahya, and Uşak). They synthesized the two approaches in order to examine farmer selection of local wheat landraces in relation to that of modern varieties. They found multiple farmer concerns (e.g., yield, risk, and quality), environmental heterogeneity, and missing markets contributed to the persistence of landraces. Household characteristics informing variety choice also affected the household's perceptions of the importance and value of landraces.

Bardsley and Thomas (2005) discussed why northeast Turkey is marginal in terms of wheat production. The de facto conservation of local wheat landraces was analyzed in light of stakeholders' opinions on agrobiodiversity conservation within the marginal agricultural community of northeast Turkey. They stated that marginal rural communities retained local wheat landraces because of their own interpretations of the value of these varieties. As results of their study, they concluded that while formal opportunities for supporting farmers' perceptions of local diversity with effective policy initiatives were available, they would require ongoing support from both international and national organizations.

Landraces are a cultural heritage and an indication of our wealth as a country. In many studies, landraces were evaluated in terms of social and private values. The social value of landraces has been described anecdotally by examples of the economic contribution of exotic crops and crop varieties and analytically by the contribution of germplasm to breeding programs (National Research Council, 1993; Evenson and Gollin, 1994). The private value of landraces is suggested by their persistence in farming systems where alternative varieties exist (Brush, 1995) and by studies on the evaluation and selection of local varieties (Sperling et al., 1993; Bellon, 1996; Zimmerer, 1996). As the results of these studies have shown, landraces should be considered an important natural resource to be conserved and used for future generations.

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Chapter 3

NATIONAL INVENTORY AND MAPPING OF WHEAT LANDRACES

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3.1. Introduction

The evaluation of landraces is important to identify and conserve them. Up to now, there are only a few studies on the landrace potential of Turkey. While some scientists collect landraces and investigate their agronomic features to determine usage opportunities in breeding studies (Gökgöl, 1939; Harlan, 1950; Metzger, 1984[2]; Damania et al., 1996; Zanatta et al., 1996; Damania et al., 1997; Zanatta et al., 1998, Akçura and Topal, 2006), there are few studies on characteristics of farmers who grow them and on *in situ* conservation of landraces (Meng,1997; Qualset et al., 1997; Brush and Meng, 1998; Tan, 2002; Kruzich, 2006; Kruzich and Meng, 2006). In almost every study done in Turkey, scientists mentioned that landraces have important potential for breeding and they should be incorporated into breeding studies (Keller et al., 1991; Zanatta et al., 1996; Tesemma et al., 1998; Zanatta et al., 1998; Dotlačil et al., 2010, Jaradat, 2012). However, while the importance of landraces has been emphasized by many scientists in Turkey (e.g;, Harlan, 1950; Çetin et al., 2007), genetic erosion and extinction of some species have not been prevented and continue.

The first evaluation and important study on landraces is that of Mirza Gökgöl's book (Gökgöl, 1939). It is a valuable reference source for wheat gene resources. This study shed light on genetic diversity studies on wheat and also gives information on which type of landraces were grown and in which region. Since this study, only small-scale research has been undertaken with limited scope and scale.

ICARDA and CIMMYT are international centers of the CGIAR carrying out agricultural research in different agricultural subjects and crops. They are also partners in many agricultural projects with Turkey. One of the important collaborative projects has been the International Winter Wheat Improvement Project (IWWIP) established in 1986 by the government of Turkey and CIMMYT, joined by ICARDA in 1990. Several improved wheat varieties have since been jointly developed, disseminated, and grown by producers both in Turkey and elsewhere in the world.

[2] This record was mentioned in two papers:

- Skovmand, B., L. Bertschinger, and J. Robinson. 1994. Quantifying heterogeneity for reactions to the Russian wheat aphid in accessions of Turkish hexaploid wheat landraces previously identified as resistant. p. 139–142. *In:* Proc. of the Russian Wheat Aphid Workshop 6, Fort Collins, CO. 23–25 Jan. 1994,
- Jaradat, A.A., S. Jana, and L.N. Pietrzak, 1987. Collection and evaluation of cereal genetic resources of Turkey and Jordan. *Rachis* 6:12-14.

A wheat landraces study was started in 2009 with CIMMY-ICARDA and Turkey partnership under the auspices of the IWWIP. The study's main objectives were to determine and present the latest situation of wheat landraces under on-farm conditions and to update Gökgöl's book on wheat landraces in Turkey. The study is based on previous visits and surveys in Kütahya, Sivas, and Erzurum provinces and on research reported over the last two decades, supported by the USA, NSF, and CIMMYT. Up to now, a survey of 65 provinces has been completed to determine the state of wheat landraces. In this chapter, we present these results organized by wheat types with geocoordinate mapping where specific wheat landrace spikes and/or seeds were collected.

3.2. General Information on Research Area

Turkey is composed of three different bio-geographic regions (Mediterranean, Euro-Siberian, and Irano-Turanian), each of which has unique species and natural ecosystems. The Euro-Siberian region is comprised of the Eastern Black Sea mountainous forest involving alpine pastures. The Irano-Turanian region includes the steppes of Central Anatolia and Eastern Anatolia. The Mediterranean region hosts the largest cypress forests available in the world. At the intersection of two major Vavilovian gene centers: the Mediterranean and the Near Eastern, Turkey plays a very significant role in the origins of cereals and horticultural plants (Tan, 2010). Some of the cultivated plant species originating in these regions are in such genera as *Linum*, *Allium*, *Hordeum*, *Triticum*, *Avena*, *Cicer*, *Lens*, *Pisum*, *Vitis*, *Amygdalus*, *Prunus*, and *Beta*, etc. The five different "micro gene centers" in Turkey (Tan, 2010) and their representative crops are:

- *Thracian and Aegean Region:* Bread wheat, durum wheat, Poulard wheat, degnek wheat, small red wheat, lentil, chickpea, melon, vetch, lupine, and alfalfa.
- *Southern and Southeastern Anatolia: Triticum turgidum* ssp. *dicoccum*, small red wheat, *Aegilops speltoides*, pumpkin, watermelon, cucumber, bean, lentil, broad bean, grape vine, and forage crops.
- *Samsun Tokat and Amasya:* A large number of fruit species, bean, lentil, broad bean, and other legumes for animal feed.
- *Kayseri and its surroundings:* Almonds, apple, peas, different fruit species, grape vine, lentil, chickpea, alfalfa, and sainfoin.
- *Ağrı and its surroundings:* Apple, apricot, cherry, sour cherry, watermelon, and legumes for animal feed.

The inventory of wheat landraces was carried out at the national level in the seven census-derived non-administrative regions, except the Thracian part of the Marmara Region. These regions have different specific features in terms of bio-geography, gene centers, and agrobiodiversity. Among the regions, the Southeastern Anatolian Region is part of what has been called the "Fertile Crescent" throughout history (Figure 3.1). This region, in the Irano-Turanian bio-geographic region, is a gene center of many grains, including wheat, barley, and their wild ancestors.

Figure 3.1 Map of the Fertile Crescent (Anonymous, 2012a)
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

3.2.1. Southeastern Anatolia Region

The Southeastern Anatolia Region contains the following provinces: Adıyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa, and Şırnak (Figure 3.2). The region comprises 75,308 km^2, 9.7 % of Turkey's total area (Anonymous, 2007a).

Figure 3.2 Map of the Southeastern Anatolia Region showing the nine included provinces (Anonymous, 2012b)

The most important feature of the region is the simplicity of land forms. The region is covered with plateaus and plains which do not have much height. However, the eastern and western halves of the region have slightly different land forms. The elevation in the region starts from 375 m and rises up to 3,358 m in the very east (Altındag). The part of the region between the cities of Gaziantep, Diyarbakır, and Mardin, which is termed the "fertile moon" and through which the "Silk Road" passes, has a softer topography compared to the lands in northeast and east (Anonymous, 2007a).

The climate of the Southeastern Anatolia Region has a feature formed under the effect of the arid tropical region to the south as well as of the Eastern Anatolia and Mediterranean Regions. The sea has no effect here and a continental climate prevails with respect to heat and precipitation. The winter season is humid, cold, and rainy. Beginning in June, desert conditions from the south begin to dominate in the region and drought is common, with much evaporation. The highest temperatures of Turkey are found around Sanlıurfa (46.5°C) and Diyarbakır (46.2°C). Most precipitation falls in winter months, decreasing toward the Syrian border.The average annual precipitation is 796 mm in the north, while it is 331 mm in the regions close to the Syrian border. It is especially cold in winter in the higher regions, snowfall and frost are frequent. At high elevations in continental climates, there is large difference in summer and winter temperatures. Here it is no different. The average temperature of the coldest month varies between 1.5°C and 6°C, while the average temperature of the hottest month is about 30°C (Anonymous, 2007a).

The agricultural sector is effective in this region, employing almost 60% of the working population, especially in the medium-scale cities with population less than 100,000. The underdeveloped traditional economical and social structure of the region as well as its rapid population growth rate reflects on the income per capita which is about half of Turkey's average. The Southeastern Anatolia Region has an employed population of 1,960,014, which is 8% of the nation's employed population. In the region, 62.6% of that employed population is male, while 37.4% is female, with the women mostly employed in the agriculture sector. In the region, 61.5% of the employed population is in the agriculture sector (1,202,525) while 13% (255,192) is in service, 6.7% (131,111) is in industry, and 3.7% (72,390) is in construction (Anonymous, 2007a).

The Southeastern Anatolia Region is the poorest of Turkey in terms of forest resources. The land area of the region is almost 7.5 million ha and 3.3 million ha of this is suitable for agricultural purposes. According to the distribution of Land Usage Capability Classes, the amount of land sufficient for processable agriculture (classes I, II, and III) in the region is almost as 33.2% of the total area. When the land sufficient for limited processing (class IV), is included, 42.3% of the region is available for agriculture (about 13% of Turkey's total amount of agricultural lands). About 50% (1,760,728 ha) of the total 3,373,188 ha of agricultural land in the region is suitable for irrigation, but only 40% of this can actually be irrigated. This rate is well below Turkey's national average. The number of enterprises in the Southeastern Anatolia Region, 8.6% of Turkey's total number of enterprises, is above the national average generally, but they are not economical. The vast majority of enterprises in the region are, in terms of the land they operate on, insufficient, scattered, unsuitable for machine agriculture, and dispersed family businesses (Anonymous, 2007a).

From the aspect of processed land, the region owns 15% of the country's cultivated area. With respect to fallowed land, the region has almost 6% of the nation's. For vegetable gardens, the region has 10% and for orchards, it has 14% of Turkey's vegetable gardens and orchards, respectively. Based on countrywide production, the region has 13% of the wheat cultivation area, 18% for barley, 4% for corn, 13% for garbanzo, 1% for beans, 9% for tobacco, 47% for cotton, 61% for red pepper, 98% for red lentil, and 38% for sesame (Anonymous, 2007). According to the 2011 TSI data in the region, wheat cultivation takes place on 1,281,520 ha and the average wheat yield is 3054 kg/ha (TSI, 2012).

3.2.2. Black Sea Region

The Black Sea Region (Figure 3.3) was investigated as two subregions, based on geography and agricultural production; the Western Black Sea Region and the Eastern Black Sea Region. The region comprises 109,076 km^2, 14% of Turkey's total area.

Figure 3.3 Map of the Black Sea Region showing the 16 included provinces (modified from Anonymous, 2012c)

3.2.2.1. Western Black Sea Region

The Western Black Sea Region includes the following provinces: Zonguldak, Karabük, Bartın, Kastamonu, Çankırıi, Sinop, Samsun, Tokat, Çorum, and Amasya. The region comprises 73,902 km^2, 9.4% of Turkey's total area. The elevation of the region ranges from sea level to 2,565 m (Catalılgaz hill in the province of Kastamonu). The region has a rugged topography, with a majority of the region at high elevations (Anonymous, 2007b).

In the coastal areas of the region, the Black Sea climate, (rainy in all seasons with little annual temperature variation) is dominant. Inland from the coastal areas, precipitation decreases and the climate becomes continental. However, in the provinces of Tokat and Amasya, a transitional climate is observed. The annual mean temperature overall in the western region is 12.5°C, with a mean high temperature of 20°C and a mean low temperature of 7°C. Average relative humidity is 70%. Average annual precipitation is 633.4 mm. Average number of sunny days is 86 while the average number of frost days is 37 (Anonymous, 2007b).

The natural vegetation of the region is forests. The slopes of the mountains facing the sea get abundant precipitation and are covered with luxuriant forests. Inland, cold-resistant tree species and steppe vegetation predominate (Anonymous, 2007b).

The region is home to 7.2% of Turkey's population with a density of 66 persons/km^2, compared to the mean in Turkey of 88 persons/km^2. The rural proportion of the region's population is 50.6%, much greater than the national average of 35.1%. While the urbanization rate in Turkey in general is 64.9%, it is 49.4% in the region (Anonymous, 2007b).

The average value of agricultural production per person in rural populations is 1,124 TRY in Turkey while it is below the national average in the region with 998 TRY per person (Anonymous, 2007b).

The area devoted to agriculture amounts to 36.7% of the region's total area; meadows-pasture lands comprise 11.2%, forests and brushlands comprise 43.1%, and areas with other uses comprise 9%. The province with the greatest agricultural area is Çorum; Bartın has the least. Altogether there are 433,473 ha in the region which are classified as first-class agriculture lands. Among these the Bafra and Çarşamba plains are the most important and most fertile of the country. The region has 1,996,956 ha of lands classified as second, third, or fourth class. Of the region's total agriculture land, (2,723,621 ha), 61% (1,651,130 ha) is suitable for irrigation, but only 30% of this can currently be irrigated. In the region, the average agricultural enterprise size is 4.1 ha. The region contains 15.3 % of the agricultural enterprises in Turkey with a size less than 5 ha, 13.6% with a size of 5.0 to 9.9 ha, and 14.4% with a size greater than 10 ha (Anonymous, 2007b).

Most herbal production enterprises in the region are small, scattered, and disjoined. Among crops, grains come first with an 82.9% share of cultivated areas and crops from the legume family come second with an 8% share. Industrial crops, tuber crops, and oleiferous crops follow with a cumulative share of 9.1%. Among field crops, wheat ranks first in area followed in order by barley, corn, sugar beet, garbanzo, and tare (Anonymous, 2007b). The Western Black Sea Region (according to the 2011 data of TSI) has 9.89% (800,613 ha) of Turkey's total wheat area; the average yield for 2011 was 2,702 kg/ha (TSI, 2012).

3.2.2.2. Eastern Black Sea Region

The Eastern Black Sea Region includes the provinces of Trabzon, Ordu, Giresun, Rize, Artvin, and Gümüşhane, with a total area of 35,174 km^2, 4.5% of Turkey's total area. Elevation ranges from sea level to 3,932 m (Mount Kaçkar in Rize province). The Eastern Black Sea Region receives the most rainfall in all of Turkey. The annual precipitation average ranges from 451 mm to 2,292 mm, changing rapidly over short distances according to the topography, but, in general, it decreases from east to west and with increased elevation. The most and heaviest rainfalls are in the coastal regions. While the coastal region has precipitation in all seasons, in interior parts, the precipitation decreases in summer (Anonymous, 2007c).

The Eastern Black Sea Region has a rich flora with many vegetation types as a result of several factors, its range of elevations, having the maritime influence of the Black Sea on its northern border, having numerous rivers and large and small lakes, and diverse soil and climate features. Each of the diverse vegetation types hosts endemic plants. Because of this biological richness, several biogenetic reserve areas have been set aside in this region, for the protection of natural sources and the maintenance of biological diversity (Anonymous, 2007c).

The portion of the total Turkish population living in this region is 4.6 %. Almost 51% of the region's population is rural, while almost 49% of it lives in cities. Population density for this region (89 persons/km^2) is almost the same as the national average (88 persons/km^2) (Anonymous, 2007c). Employment in the agricultural sector in this region is 63.3% of total employment, a rate second to that of the North Eastern Anatolia Region, which has the greatest (Anonymous, 2007c).

Cultivated areas constitute 20.9% of the total area of the region, below the country average.. When the cultivated areas of the region are classified according to their agriculture potentials, 13% are first-degree agriculture areas, while 9.5% is second degree, and 77.5% is third degree. The topography of the region is varied: 1% is plains, 0.6% of the land has a slight inclination, 2.1% has medium, 6.4% has steep, 20.6% has very steep, and 69.3% has precipitous slopes or cliffs. While Gümüşhane is the province having the greatest percentage (75%) of plains in the region, Trabzon province has the least (2.8%) (Anonymous, 2007c).

The region's agricultural enterprises are small and scattered. Those with fewer than 20 decares amount to 61.8% of the total. Field crops are not proportionally important with respect to total agricultural acreage in the region, but of the total field-crop acreage, fodder beet accounts for 30%, mixed crops (Mahlut) 20%, corn 12%, and potatoes 11% (Anonymous, 2007c). Only 37,960 ha of wheat is planted in the region (0.47% of Turkey's total wheat planting area) and the average yield is 1,217 kg/ha (TSI, 2012)

3.2.3. Eastern Anatolia Region

The Eastern Anatolia Region (Figure 3.4) was investigated as two subregions, North Eastern and Middle Eastern.

3.2.3.1. North Eastern Anatolia Region

The North Eastern Anatolia Region involves the following provinces: Erzurum, Erzincan, Bayburt, Ağrı, Kars, Iğdır, and Ardahan. The area of the region is 79,078 km^2, 10% of Turkey's total area. Elevations range from the Dilucu plain at 805 m to Mount Ağrıı (Mount Ararat) at 5,137 m (Anonymous, 2007d).

The region has a continental climate with cold and snowy winters; summers are cool at high elevations and hot and dry in lower elevations. Annual mean temperature is 7.2°C with an annual maximum of 37.3°C and minimum of -31.6°C. Average relative humidity is 66.2% and annual average precipitation is 460.9 mm (Anonymous, 2007d).

Figure 3.4 Map of the Eastern Anatolia Region showing the 14 included provinces (modified from Anonymous, 2012d)

Population density for this region (34 persons/km^2) is less than half that of the national average (88 persons/km^2). The rural population is 1,217,864 (48.6% of the region's total), while 1,289,874 (51.4%) of them live in city centers (Anonymous, 2007d).

While agricultural employment involves the largest portion of the region's rural population, agricultural production value for the rural population (960 TRY/person) is well below the country average for the rural population (1,124 TRY/person). Agricultural production in this region amounts to 4.4% of Turkey's total agricultural production. The provinces of Ardahan and Erzincan rank first in the region in terms of agricultural production value per rural population, while Bayburt ranks last (Anonymous, 2007d).

In the region, there are 241,685 ha classified as first-class agricultural land. These lands include the most important and fertile plains of Erzurum, Kars, Iğdır, Ağrı, and Erzincan. The region has 1,878,416 ha classified as second, third, or fourth class agricultural lands. As a proportion of the entire Turkish land area suitable for processing agriculture, 8% is in this region, while 8.2% of land not suitable for processing is in this same region (Anonymous, 2007d).

Total irrigable area in the region is 1,141,241 ha and 59.8% of this is already under irrigation. Ağrı province has the most land under irrigation, followed by Erzurum and Erzincan (Anonymous, 2007d).

In terms of share of field crops in the region, grains rank first with 81.4%, forage crops rank second with 12.8%, legumes, tuber plants, and oil seeds together rank next with 3.3%, and finally industrial crops follow with 2.5%. Altogether field crop production in the region accounts for 5.8% of Turkey's field crop production. Wheat has the biggest share among the grain products produced in the region. Of the important field crops grown in the region, they rank in this order: wheat, barley, sugar beet, potatoes, beans, sunflower, garbanzo, and onion. The ranking is slightly different when production is expressed as proportion of the country's total production for that crop: wheat (5.7%), barley (8.5%), sugar beet (8.3%), potatoes (6.1%), beans (6.8%), sunflower (0.8%), garbanzo (0.4%), and onion (1.1%) (Anonymous, 2007d). Average wheat yield is 1,659 kg/ha (TSI, 2012)

3.2.3.2. Middle Eastern Anatolia Region

The Middle Eastern Anatolia Region is comprised of the provinces of Malatya, Van, Elazığ, Bingöl, Bitlis, Muş, Hakkari, and Tunceli. The area of the region is 78,110 km^2, 9.9% of Turkey's total area. The elevation in the region ranges from 900 m to 4,049 m (Mount Süphan) (Anonymous, 2007e).

The region has a typical continental climate, with hot and dry summers and cold and harsh winters. The annual mean temperature is 11.3°C with a maximum of 23.1°C and minimum of -0.4°C. Average relative humidity is 58.7% and average annual precipitation is 718 mm (Anonymous, 2007e).

The average population density is 48 people per km^2 in contrast to the national density of 88 people per km^2. Of the region's population, 1,746,656 people (46.5%) are rural while 2,007,378 (53.5%) live in city centers (Anonymous, 2007e).

The average rural agricultural production value per person 1,124 TRY overall in Turkey, while in the region, it is less: 828 TRY. The region's total agricultural production accounts for 5.3% of the nation's total. The provinces of Tunceli and Elazığ rank first in terms of rural agricultural production value per person, while Hakkari ranks last (Anonymous, 2007e).

Of the region's total surface area, 22.4% is under cultivation, a rate lower than the country's average. Meadows and pasture lands constitute 52.5% of the region's area, which is above the national average. There are 223,921 ha in the region classified as first-class agricultural lands. These include the most important and fertile plains such as those of Malatya, Muş, Malazgirt, and Tohma. The region has 1,851,246 ha classified for second, third, or fourth class capacity. Of the total area suitable for agriculture in Turkey, 7.9% is in this region. In contrast, 11.5% of the nation's area not suitable for processing is also in this region (Anonymous, 2007e).

In this region, 1,762,378 ha, 61.8% is irrigable, but only 53.3% of this is actually irrigated. The province with the most irrigated area is Malatya, followed by provinces of Elazığ and Van (Anonymous, 2007e). The average wheat yield of this region is 1,606 kg/ha (TSI, 2012)

3.2.4. Marmara Region

The Marmara Region (Figure 3.5) was investigated as two subregions, Western and Eastern.

3.2.4.1. Western Marmara Region

This subregion includes the provinces of Balikesir, Çanakkale, Tekirdağ, Edirne, and Kırklareli. It is surrounded by the Aegean Sea in the west, Bulgaria in the north, the Black Sea, Bursa, and Istanbul in the east, and Manisa and Kütahya in the south.

Figure 3.5 Map of the Marmara Region showing the 14 included provinces (modifed from Anonymous, 2012e)

The surface area of the region is 43,409 km^2, 5.5% of Turkey's total area. Elevation ranges from sea level to 1,774 m (Karataş Hill in the Kazdağ). The coastlines of the region are the west coast of the Aegean Sea starting from the Gulf of Edremit in Ayvalık to the Gulf of Saros, on the northeast, the coast of the Black Sea extending from İğneada to Kıyıköy, as well as the north side of Marmara Sea starting from Marmara Ereğli to Çanakkale (Dardanelles).

Çanakkale province has a Mediterranean climate, but the average temperature in the northern part of the province in winter is very low. Because of north winds and low temperatures through the Balkans and the absence of a natural obstacle between the Balkans and this province, there are winds year round. The dominant wind direction is north, but northeast and southwest winds also occur. Precipitation is mostly in the form of rain with total annual rainfall of 636.3 mm.

Balikesir province and the surrounding areas remain under the influence of northern air masses. Cool, warm, and hot air masses which are effective in the summer around Balikesir do not bring much rainfall; which increases towards the heights and to the north. The total annual precipitation in this province is 522.3 mm.

According to 2000 population data, 4.3% of Turkey's total population (2,895,980 million people), live in this region. While 55.5% of the region's population lives in the city, 44.5% is rural. The regional population density is much less than that of Turkey overall. In the 1990 to 2000 decade, the rate of rural population growth across the country was 21.7%, and the rate of urban population growth 18.3%, while in the region, the rural and urban growth rates were 24.8% and 11.2%, respectively. According to the 2000 census, 3.6% of the country's total urban population and 5.4% of the country's total rural population were living in this region.

According to the 2001 Census of Agriculture, the region has a high proportion of cultivated land area (55.2% of total land). Only a total of 25,851 ha of land lie fallow out of the total cultivated area (1,201,244 ha). Production of field vegetables and ornamental plants takes place on 306,457 ha (5% of the region's total cultivated area) and half of that is in Balıkesir province. Fruit production takes place on about 306,457 ha (6.3% of the region's total cultivated area).

Balıkesir province ranks first with 2,024 million TRY of agricultural production and the province of Tekirdag is last with 1,472 million TRY. The total value of agricultural production in the region is greater than the national average in Turkey.

Agricultural areas of the Western Marmara region represent 44% of the region's total area, while the national average is 10% higher. While the region has only 26% of the country's forest and heath area, it is one of the wealthiest parts of the country with 38% of the population above the national wealth average. In the region, 7% of its area is non-agricultural, while in Turkey, that proportion is 13%.

In Turkey as a whole, 32% of of its area is agricultural land, while, 54% of the land in this region is irrigable. This is possible because of the flat or nearly flat topography of the region and the ready access to irrigation water. While 18% of Turkey's agricultural area is irrigable, only 16% of the region's agricultural lands can be watered. Of the existing irrigated agricultural areas in Turkey, 12% is in this region.

Of the agricultural enterprises in the region, nearly 41% are in the size range of 2.0 to 4.9 ha. Enterprises with 5.0 to 9.9 ha represent about one-third of the total agricultural enterprises. Nearly 89% of enterprises are smaller than 10.0 ha. The number of livestock enterprises are less than 2% of the total. The most prominent agricultural products in the area are wheat, sunflower, rice, bean, rape, and garlic, in that order.

3.2.4.2. Eastern Marmara Region

This subregion includes the provinces of Istanbul, Bilicek, Bursa, Eskişehir, Kocaeli, Sakarya, Düzce, Bolu, and Yalova. The surface area of the region is 54,683 km^2, 7% of Turkey's total area. The elevation of the region ranges from sea level to 2,543 m (Uludağ/ Grand Mountain). The region is bounded in the north by the coast of the Black Sea and in the south by the Uludağ, Emirdağ, Seben, and Ardıç (Juniper) Mountains. The western part of the region extends from the eastern part of the Karacabey and Kemal Paşa plains extending to the east Megri, Mengen, and Gerede plains.

In the part of the region near the Sea of Marmara, a semi-Mediterranean climate prevails, while a continental climate prevails in Bilecik and in the southern parts of Bursa and Eskişehir provinces. In the area with continental climate, the average mean temperature is 10.6°C, and in the regions with the semi-Mediterranean climate the average mean temperature is 15°C. Average rainfall decreases from the coast into the interior. Although summers are typically dry in this region, in the province of Sakarya, located between the Black Sea and Marmara Sea and separated from the rest of the region by high mountains, it is rainy in summers.

The Eastern Marmara Region holds 8.9% of Turkey's total urban population and 7.6% of Turkey's total rural population. Thirty-seven percent of the region constitutes agricultural lands, while only 3.8% of Turkey's overall land area is agricultural land. Pasture areas make up only 4% of the region, which is below the average for the nation as a whole. Forest and heath areas make up 41% of the region's lands.

The Eastern Marmara agricultural lands (about 563,934 ha) account for 6% of the total agricultural lands in Turkey. This land constitutes field crop areas (5.5%), vegetable gardens (10%), fruit production areas (9.7%), and fallow fields (5.5%). The Eskişehir province has the greatest amount of agricultural area, while Yalova province has the least. About two-thirds of region's agricultural area is cultivated and planted. The total area which could be economically irrigated is 812,104 ha., but only 50% of it is irrigated at this time. Bursa province has the greatest amount of irrigated agricultural land, while Yalova province has the least.

In the region, the majority of the agricultural enterprises (162,651 units) are on small holdings less than 5.0 ha each, amounting to a total land area of 353,669 ha. The average area of these units is 21.7 ha. Overall in the region, however, the average size of farms 5.1 ha.

3.2.5. Aegean Region

The Aegean Region includes İzmir, Aydin, Denizli, Muğla, Manisa, Afyon, Kütahya, and Uşak provinces (Figure 3.6). It is surrounded by the Aegean Sea in the west; Balikesir, Bursa, and Bilecik provinces in the north; Eskişehir, Konya, and Isparta provinces in the east; and Burdur and Antalya provinces in the south. The region's land area is 89,997 km^2, 11.5% of Turkey's total area. The elevation of the region ranges from the sea level to 2,528 m (Honaz Mountains). The region has Aegean and Mediterranean coastlines starting at the Balıkesir-İzmir border along the İzmir, Aydin, and Muğla provinces to the Antalya-Muğla border.

In the parts of the region along the Aegean Sea, a typical Mediterranean climate prevails, with an average mean temperature of 17°C, while inland the climate becomes progressively more continental, with an average mean temperature of 12.8°C. The mean temperature overall is 15.6°C, average rainfall is 672.98 mm, and average relative humidity is 62.4%.

Figure 3.6 Map of the Aegean Region showing the eight included provinces (Anonymous, 2012f)

Compared to Turkey overall, the region accounts for 12.3% of agricultural lands, 17.8% of forest areas, 8.7% of non-agricultural areas, and 4.5% of meadow pasturelands. The region's agricultural lands amount to 35.4% of its total land area, which is greater than the average for Turkey (18.6%). The region's proportion of meadow and pasture lands is 7.2%, strikingly lower than the national average (33.2%). Forest and heath land areas in the region are the richest areas of Turkey. Muğla province has the highest portion of forest and shrub land (22.4%) in the region, while Afyon province has the least (5.6%).

In the region, 11.6% of agricultural land is sown to field crops, 19.3% is in vegetable gardens, 24.6% percent is orchard, and 7.2% is fallow field. The total economically irrigable area is 1,946,444 ha but only 56.8% percent of that is actually irrigated.

The 2001 Census of Agricultural Enterprises (household) survey concluded that 67.4% of the total 3,075,516 agricultural enterprise units both produce crops and breed animals, 30.22% produce only crops, and 2.4% perform only animal husbandry. The majority of the agricultural units (318,390) have holdings of less than 5.0 ha, amounting to 2,520,996 ha in total. The average holding size of units with less than 5.0 ha is 1.96 ha. Overall in the region, the average farm size is 4.4 ha compared to the national average farm size of 6.1 ha.

3.2.6. Central Anatolia Region

The Central Anatolia Region (Figure 3.7.) was investigated as two subregions, Western and Middle Eastern.

3.2.6.1 Western Central Anatolia Region

This subregion includes Ankara, Konya, and Karaman provinces. It is bordered by Bolu and Çankırı provinces in the north, Antalya and Mersinprovinces in the south, Kırıkkale, Kırşehir, Aksaray, and Nigde provinces in the east, and Isparta, Afyon, and Eskişehir provinces in the west. Surface area of the region is 76,793 km², 9.8% of Turkey's total area.

Individually for the three provinces, Ankara has a surface area of 25,706 km², with an average elevation of 890 m; Konya has a surface area of 41,694 km², with an average elevation of 1,016 m; and Karaman has a surface area of 9,393 km², with an average elevation of 1,033 m.

A continental climate prevails throughout the region, with the exception of the northern part of Ankara province and its Black Sea climate and the southern part of Konya and Karaman provinces with a Mediterranean climate. In the area with a continental climate, the annual mean temperature is 11.6°C. Overall in the region, the annual mean temperature varies from -28.2°C to 40.8°C. Average rainfall 351.5 mm and average relative humidity is 60.3%.

This region has 15.3% of Turkey's agricultural lands, 6.8% of its grassland areas, 4.6% of forest areas, and 16.9% of non-agricultural areas. Agricultural lands account for 55.8% of the region's total surface area, which is much higher than the corresponding average for the whole of Turkey (36.0%). This distribution suggests a significant potential of agriculture for the region. Its forest and heath land areas account for 13.9% of the region,

Figure 3.7 Map of the Central Anatolia Region showing the 11 included provinces (modified from Anonymous, 2012g)

with grassland and pasture accounting for 18.9%; both proportions are lower than the corresponding rates in Turkey overall. The total area for which it would be economical to irrigate is 2,002,497 ha, but only 28.8% percent of that is actually irrigated.

The majority of agricultural enterprises operate on units of only 40.4 to 80.5 ha. The number of such units is 43,497 and the total amount of land owned by these enterprises is 611,439 ha. The average land size per farm overall in the region is 13.1 ha. Categorized by type of production, 60.6% of agricultural enterprises in the region conduct both crop and livestock production together, 36.6% are in crop production only and 2.6% are in livestock production only.

3.2.6.2. Middle Eastern Central Anatolia Region

This subregion includes Kayseri, Yozgat, Sivas, Kırşehir, Nevşehir, Kırıkkale, Aksaray, and Niğde provinces. To the west, the region is bordered by Ankara and Konya provinces; to the north Çankırı, Çorum, Tokat, Ordu, and Giresun provinces; to the east Erzincan and Malatya provinces; and to the south Kahramanmaraş, Adana, and Mersin provinces. The surface area of the region is 91,573 km^2, 11.7% of Turkey's total area. The elevation ranges from 650 to 3,917 m (Mount Erciyes).

In the typical continental climate that prevails in the region, it is hot and dry in summers and cold and harsh in winters. The annual mean temperature is 11.5°C. The annual average rainfall is 374.9 mm, with a range from 343.8 to 438 mm. The rural population (1,822,776 people) is 43.5% of the total, while 56.4% (2,363,664) live in city centers.

Of the total surface area of the region, 49.2% is agricultural land in contrast to the national average of 34.4%; 36.6% is grasslands, while the national average is 18.6%; and 9.6% is orchards, much less than the national average. Non-agricultural lands amount to

7.2% of the region's total area, while the national average is 21.7%. Wheat is cultivated on 73% of the region's agricultural land.

Of the 2,280,502 ha of the region's land which could be economically irrigated, 77.3% is not irrigated. The greatest acreage of irrigated land is in Sivas province followed, in decreasing order, by Yozgat, Niğde, and Nevşehir provinces.

According to the result of the 2001 General Agriculture Census Agricultural Enterprises (household) Survey, out of a total of 3,076,650 agricultural enterprises, 67.4% is engaged in both crop growing and livestock raising, 30.2% in crop growing only, and 2.3% in livestock raising only. Of these enterprises, 40% take place on units in the size range of 0.1 to 4.9 ha, while the average unit size is 2.6 ha. Of all agricultural enterprises in the region, the average size is 10.0 ha, which is greater than the average for Turkey in general.

3.2.7. Mediterranean Region

The Mediterranean Region includes the provinces of Antalya, Isparta, Burdur, Adana, Mersin, Kahramanmaraş, Hatay, and Osmaniye (Figure 3.8). In the west, the region is bordered by Muğla and Denizli provinces; to the north are Afyon, Konya, Karaman, Niğde, Kayseri, and Sivas provinces; in the east are Malatya, Adıyaman, Gaziantep, and Kilis provinces; in the south are the Mediterranean Sea and a portion of Syria. The surface area of the region is 89,838 km^2, 11.5% of Turkey's total area. The elevation range is from sea level to 3,756 m (Aladağ).

The region has a typical Mediterranean climate in the coastal areas (annual mean temperature of 18.5°C, with a typical continental climate in the higher elevations (average mean temperature of 13.1°C). The annual average rainfall ranges from 450 to 750 mm in the western five provinces and from 570 to 1,160 mm in the eastern three provinces.

Figure 3.8 Map of the Mediterranean Region showing the eight included provinces (modified from Anonymous, 2012h)

The Mediterranean Region has 9.9% (2,594,764 ha) of the country's total agricultural area. Of this acreage, 10.7% is farming land, 20.0% is in vegetable gardens, 12.2% is in orchards, and 3.1% is fallowed land. Adana province has the greatest acreage of cultivated land, while Osmaniye province has the least. Antalya province has the largest acreage of fallowed land, with Osmaniye having the least. Lands that could be economically irrigated amount to 1,951,477 ha, but 39.8% (777,104 ha) is not being irrigated.

Two-thirds of all agricultural enterprises are in the 2.0 to 4.9 ha size range. Overall, approximately 96% of all enterprises are units of less than 10.0 ha. Units devoted to ranching account for less than 2% of all agricultural enterprises and all of them are less than 0.5 ha.

3.3. Materials and Methods

To evaluate the landrace characteristics and production practices of the research area, data were collected by means of questionnaires distributed to 1,873 households selected from 523 villages in 172 districts selected from the 65 provinces in the years 2009 to 2014. The selection of provinces and districts was made based on the extent of the Mirza Gökgöl study (1939). Previous studies had been carried out in different regions by the "Purposive Sampling Method" (Ral, 1968). The assistance of provincial Directorates of Food, Agriculture and Livestock were utilized to select the survey areas in the chosen provinces. In the meantime, interviews were conducted by agricultural experts working in different institutes, universities, NGOs, and government agencies with the aim of clearly defining the areas where we would visit.

The first stage of the study was to collect spikes of wheat landraces from the field, so we attempted to visit farmers before wheat harvest time. Sometimes we accepted seed when we arrived after harvest time because of time limitations and geographical conditions. Before the visits, we identified wheat landrace production fields based on the earlier study of Tan et al. (2013). We followed Aegean National Gene Bank collection guidelines for spike collection. We prepared paper bags and tags showing province, district, village, and local name of wheat landraces and site geocoordinates. In 2012, 2013, and 2014, geocoordinates were obtained with a Magellan GPS device and transfered to the map of Turkey produced by the Magellan Company (Vantage Point). In 2009, 2010, and 2011, geocoordinates were obtained by reference to those of the nearest local villages and then they were plotted onto the Turkish map. The study areas targeted by year are shown in Figure 3.9.

The second stage was the use of the questionnaire to get agronomic data from the farmers. We also evaluated wheat landrace production fields with an evaluation form to understand the general condition of wheat landraces for the specific production season at which spikes were collected.

In the study, a Geographical Information System was used for mapping. Longitudes and latitudes of districts were obtained for every data point. Village and farmer-level coordinates were ignored to provide uniformity among years. To consolidate coordinate information at the district level, all coordinates within the district were arithmetically averaged to provide a single 'district' coordinate. Data were presented in four ways.

The first consists of 10 maps with the distribution by province of the 10 most commonly grown wheat landraces according to their local names (Figure 3.10).

The second presents the distribution of bread wheat, durum wheat, and feed wheat (*T. monococcum*), based at the district level (Figure 3.11). If the production area of one of these

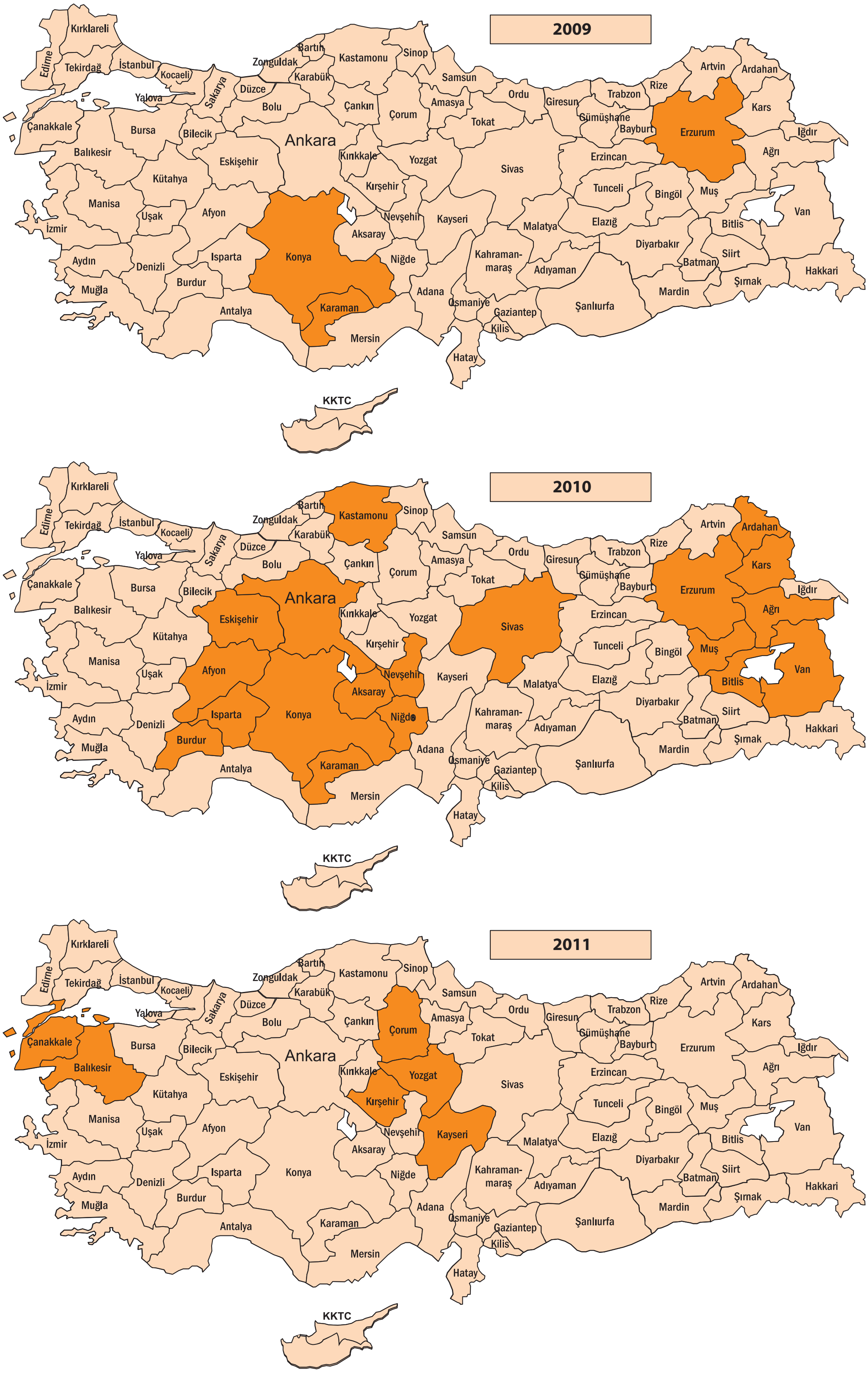

Figure 3.9 Wheat landrace survey areas by province and year
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

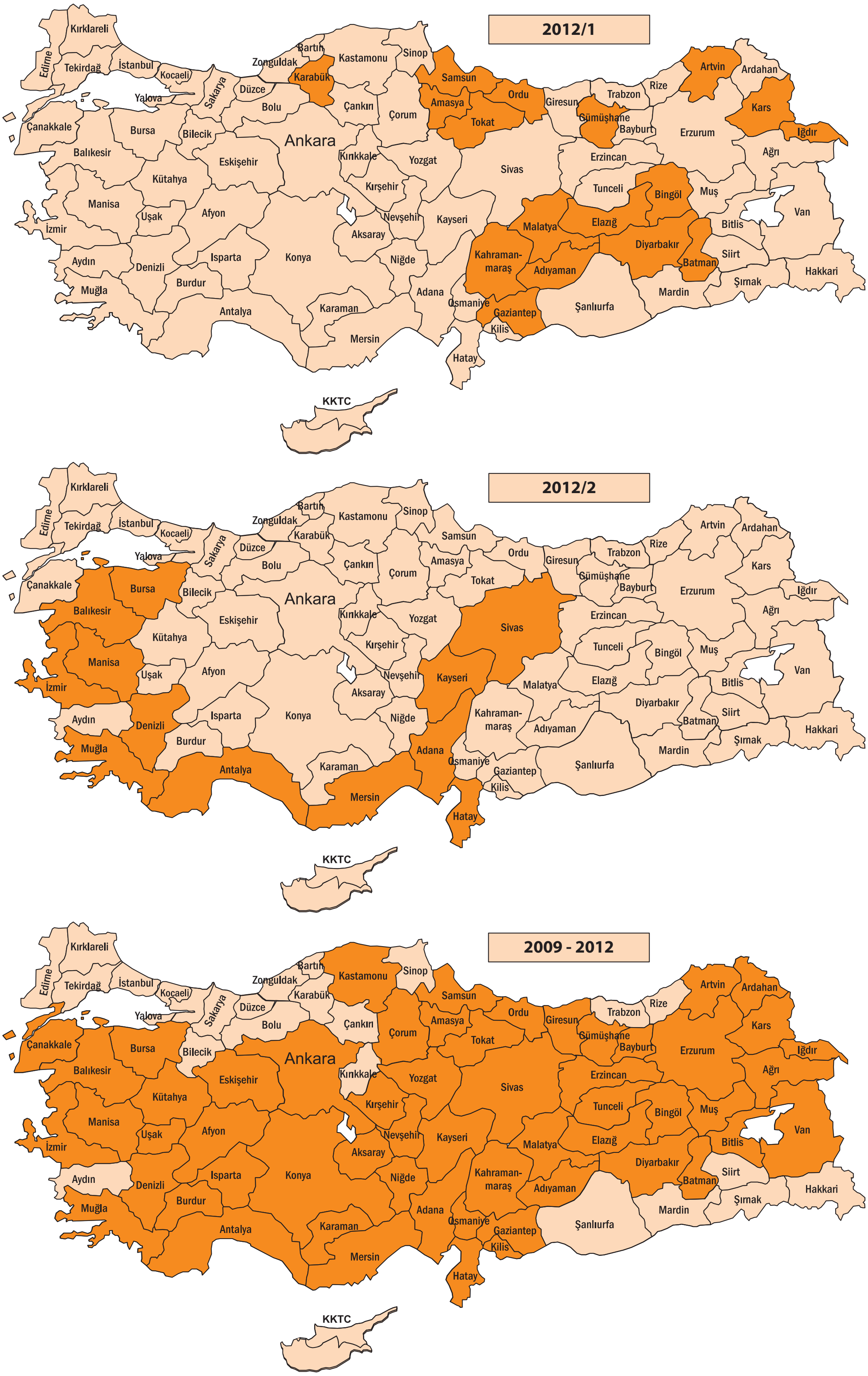

Figure 3.9 (Cont.) Wheat landrace survey areas by province and year
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

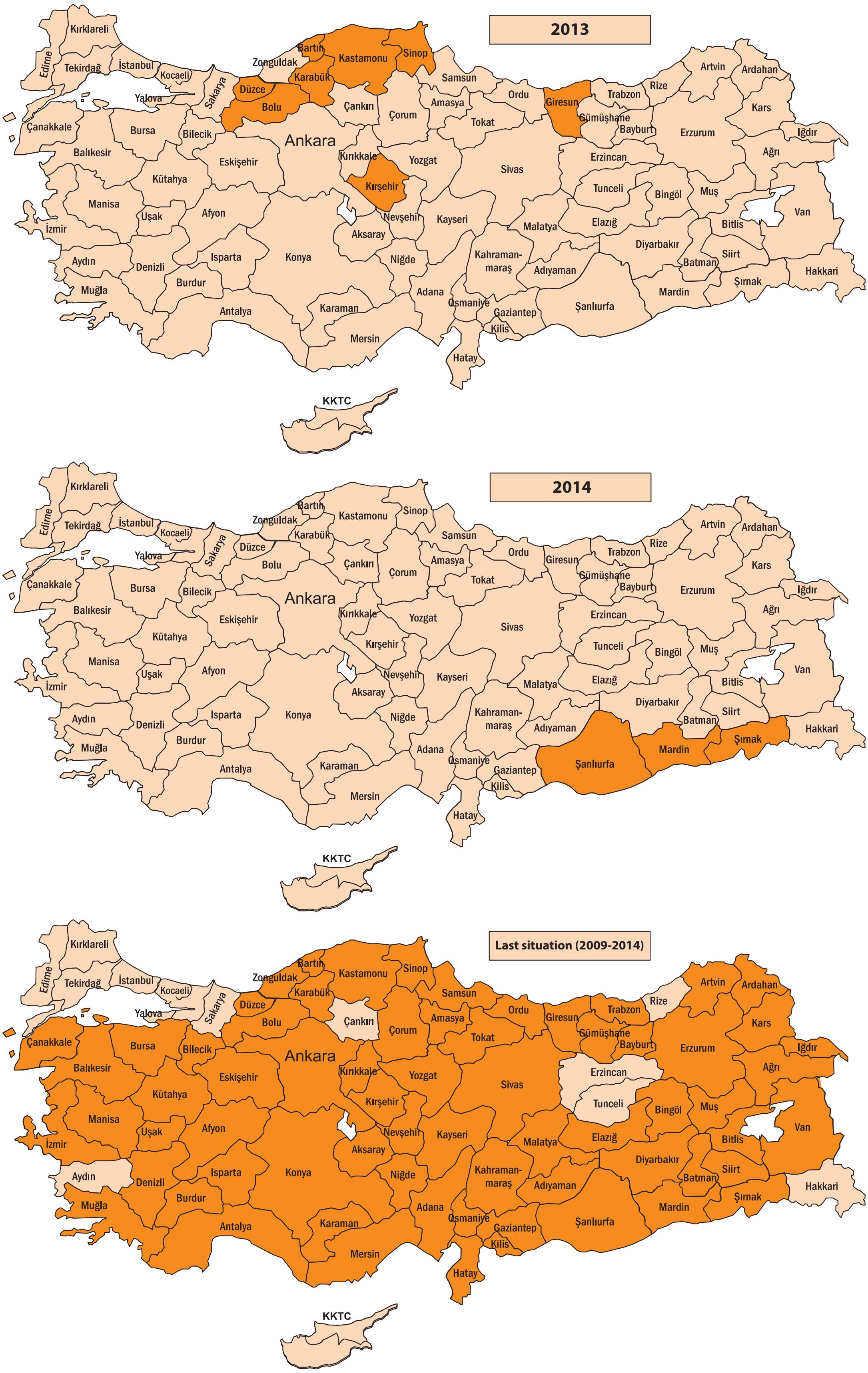

Figure 3.9 (Cont.) Wheat landrace survey areas by province and year
(Source: Ministry of Food, Agriculture and Livestock, Turkey)

wheat types in a district was higher than 75%, this district was designated accordingly as "bread wheat", "durum wheat", "both of them" (meaning both bread wheat and durum wheat), or "feed wheat".

The third (Figure 3.12) presents a map of the distribution of farmers' preferences for wheat landraces versus commercial wheat varieties. The surveys identified these preferences:

- If the farmers produced only wheat landraces in their production system, it was coded as "**Only wheat landraces**".
- If the farmers produced both wheat landraces and commercial wheat varieties together in their production system, it was coded as "**Both wheat landraces and commercial wheat varieties**"
- If neither one was dominant in the region (by the 75% rule described above for Figure 3.11), it was coded as "**Both of them**"

The fourth presents by a map the classification of wheat production systems with respect to whether irrigation or rainfall are the primary sources of water within provinces (Figure 3.13).

The data gathered from the survey of farmers were entered into spreadsheets (MS Excel™ software) and analyzed with the STATA-13 statistical program. Descriptive data about the research areas were presented as tables. Pearson's chi-squared test was used to assess the independence of the two categories ("only wheat landraces" and "both wheat landraces and commercial wheat varieties"). A test of independence assesses whether paired observations on two variables, expressed in a contingency table, are independent of each other. The test-statistic (Kesici and Kocabaş, 2007) is obtained from:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

where X^2 = Pearson's cumulative test statistic, which asymptotically approaches a χ^2 distribution. O_i = an observed frequency; E_i = an expected (theoretical) frequency, asserted by the null hypothesis; and n = the number of cells in the table.

3.4. Results and Discussion

As a result of IWWIP landrace activities in 2009, 2010, 2011, and 2014 and collaborative activities with FAO in 2012 and 2013, some landrace collections were made and geocoordinates were saved from the 65 provinces where wheat landraces were grown. The provinces and also the districts and the villages were determined by help of the local institutes, NGOs, researchers, and private and public sector organizations. Based on interviews with these partners, the survey areas at the district level were defined. Some provinces like Rize and Trabzon and also some districts were not included in this study for one of two reasons:

- The lack of data from the Turkish Statistics unit on wheat production in these areas.
- Commercial wheat varieties were predominantly produced.

In total, 65 provinces, 172 districts, and 523 villages were included in the research areas from which the survey was completed. We found that local wheat landraces are predomintly grown in areas of high elevation and remote from main production centers. It has become impossible to find these landraces in the plains areas and close to the main wheat production centers where, in general, wheat landraces have been replaced by more productive and marketable improved wheat varieties.

As a result of the survey, 162 local wheat landraces' names were identified (Table 3.1). Two problems arise when using local landrace names: a single landrace could have different local names in different production areas and a given landrace name could refer to different landraces in different areas. To assess the extent of this problem, the collected landraces were all planted in four different places (Konya, Eskişehir, Ankara, and Erzurum provinces) for every year. In Table 3.1, the named wheat landraces are ordered by frequency of production, from the highest to the lowest and the 10 most common landraces are highlighted:

The percentage of farmers growing each landrace is not enough information to show the dominance of any single landrace in an area. Therefore the percentage of farmers growing each landrace was associated with the percentage of land allocated to it. The data in Figure 3.14 show the distribution of wheat landraces among the farms within the study region. With this analysis, the Zerun landrace dominates at the country level as calculated as percentage of wheat landrace production areas. Overall, on the basis of these two criteria, there is a new order of 11 wheat landraces (eight of them are illustrated in Photos 3.1 through 3.8 at the end of this chapter):

1. ***Zerun***
2. ***Ak Buğday***
3. ***Kırmızı Buğday***
4. ***Sarı Buğday***
5. ***Karakılçık***
6. ***Kırik***
7. ***Siyez Buğdayı***
8. ***Koca Buğday***
9. ***Topbaş***
10. ***Şahman***
11. ***Üveyik Buğdayı***

Wheat landraces were categorized as 'bread wheat', 'durum wheat', and 'feed wheat or other' based on both farmers' characterizations from the survey and on our evaluation of the collected spikes (Figure 3.11). The proportion of types by region is shown in Table 3.2. The North Eastern Anatolia Region had the highest proportion of bread-wheat type landraces; the Southeastern Anatolia Region had the highest proportion of durum-wheat type landraces, the Western Black Sea Region had the highest proportion of feed-wheat type landraces, but also the most uniform production of all three wheat types of landraces.

Based on preferences identified by farmers, production was either "Only wheat landraces" or "Both wheat landraces and commercial varieties" (Figure 3.12). This distribution also provides an indication of the extent of genetic erosion of wheat landraces. As defined by Maxted and Guarino (2006): "Genetic erosion is the permanent reduction in richness (or evenness) of common local alleles, or the loss of combinations of alleles over time in a defined area." The Food and Agriculture Organization of the United Nations (FAO) described genetic erosion as "the loss of genetic diversity as a result of social, economic and agricultural changes" (FAO 1996). The International Plant Genetic Resources Institute (IPGRI) defined genetic erosion as "loss of genetic diversity between and within

Table 3.1 Local names of collected wheat landraces and their frequency ranked from highest to lowest

No	Local name	Wheat species	Frequency	Percent (%)	Cumulative percent (%)	No	Local name	Wheat species	Frequency	Percent (%)	Cumulative percent (%)
1	AK BUĞDAY	C/D	140	7.47	7.47	49	AMERİKAN BEYAZ	C	9	0.48	81.95
2	SARI BUĞDAY	D/C	116	6.19	13.67	50	KILÇIKSIZ BUĞDAY	C	9	0.48	82.43
3	KIRMIZI BUĞDAY	C/D	114	6.09	19.75	51	POLATLI	C	9	0.48	82.92
4	KARAKILÇIK	D/C	89	4.75	24.51	52	ŞERGUN	C	9	0.48	83.40
5	ZERUN	C	74	3.95	28.46	53	MENCEKİ	D	8	0.43	83.82
6	KİRİK	C	61	3.26	31.71	54	OHLEMAZ	D	8	0.43	84.25
7	KOCA BUĞDAY	D/C	59	3.15	34.86	55	ALİBAYIR	D/C	7	0.37	84.62
8	SİYEZ BUĞDAYI	O	56	2.99	37.85	56	GACER BUĞDAYI	O	7	0.37	85.00
9	TOPBAŞ	C	48	2.56	40.42	57	GÜLÜMBÜR	C	7	0.37	85.37
10	ÜVEYİK BUĞDAY	D	46	2.46	42.87	58	HAVRANİ	D/C	7	0.37	85.74
11	GÖDEREDİ	C	45	2.40	45.27	59	KAFKAS KIRMIZISI	C	7	0.37	86.12
12	YEREL POPULASYON	C/D	45	2.40	47.68	60	KILÇIKLI KIRİK	C	7	0.37	86.49
13	ŞAHMAN	D	43	2.30	49.97	61	KIRMIZI PAZARCIK	C	7	0.37	86.87
14	ÇALIBASAN	D/C	42	2.24	52.22	62	AK DİMENİT	C	6	0.32	87.19
15	AĞ BUĞDAYI	C	29	1.55	53.76	63	BEJRES	D/C	6	0.32	87.51
16	KAMÇI	C	29	1.55	55.31	64	BOZBUĞDAY	C/D	6	0.32	87.83
17	SARI BURSA	D	29	1.55	56.86	65	DIĞRAK	D/C	6	0.32	88.15
18	AŞURELİK BUĞDAY	C	25	1.33	58.20	66	GEVRO	D/C	6	0.32	88.47
19	YAZLIK BUĞDAY	C/D	23	1.23	59.42	67	HAKKI BUĞDAYI	D/C	6	0.32	88.79
20	SORGÜL	D	22	1.17	60.60	68	KATIKLI	C	6	0.32	89.11
21	KABAK BUĞDAYI	C	20	1.07	61.67	69	KÖY BUĞDAYI	C	6	0.32	89.43
22	SARI KELLE	D	20	1.07	62.73	70	SÜNTER	C	6	0.32	89.75
23	GÖĞALA	D	18	0.96	63.69	71	101	C	5	0.27	90.02
24	SERT BUĞDAY	D	18	0.96	64.66	72	GERNİK	O	5	0.27	90.28
25	ÇAM BUĞDAYI	C	17	0.91	65.56	73	RUS BUĞDAYI	C/D	5	0.27	90.55
26	KUNDURU	D	17	0.91	66.47	74	SORİK	D	5	0.27	90.82
27	ALBOSTAN	C	16	0.85	67.33	75	YUSUFİ	D/C	5	0.27	91.08
28	ERZURUM YAZLIĞI	C	16	0.85	68.18	76	AMERİKAN KIRMIZI	C	4	0.21	91.30
29	SİVEREK	D/C	16	0.85	69.03	77	KARA BUĞDAY	C	4	0.21	91.51
30	BAĞACAK	D	15	0.80	69.83	78	KAVLICA	O	4	0.21	91.72
31	BAHARİYE	C	15	0.80	70.64	79	KILCIKLI BUGDAY	D/C	4	0.21	91.94
32	ÇİRPUZ	C	15	0.80	71.44	80	KIRAÇ 66	C	4	0.21	92.15
33	SOFU BUĞDAYI	D	15	0.80	72.24	81	KOCABAŞ BUĞDAY	D	4	0.21	92.37
34	GÖLE	C	14	0.75	72.98	82	MAHSUL	O	4	0.21	92.58
35	AKBAŞAK	D/C	13	0.69	73.68	83	MEMELİ	C	4	0.21	92.79
36	CONKESME	C	13	0.69	74.37	84	ÖRMECE	C	4	0.21	93.01
37	IZA BUĞDAYI	O	13	0.69	75.07	85	SARI SEREZ	D	4	0.21	93.22
38	KÖSE BUĞDAYI	C	13	0.69	75.76	86	URUMELİ	C	4	0.21	93.43
39	KELKİT BUĞDAYI	C	12	0.64	76.40	87	ZENİT	D	4	0.21	93.65
40	MENGEN BUĞDAYI	C	12	0.64	77.04	88	ZINEBE	C	4	0.21	93.86
41	YAYLA BUĞDAYI	C	12	0.64	77.68	89	AĞ SÜNTERİ	C	3	0.16	94.02
42	HACI ALİ	D	11	0.59	78.27	90	BEYAZ KILÇIK	C	3	0.16	94.18
43	ANKARA YAZLIĞI	C/D	10	0.53	78.80	91	ÇAKMAK	D	3	0.16	94.34
44	ARI BUĞDAY	C/D	10	0.53	79.34	92	ÇOMAK	C	3	0.16	94.50
45	BİNDANE	C	10	0.53	79.87	93	ELBİSTAN KERTMENİ	C	3	0.16	94.66
46	DEVEDİŞİ	C/D	10	0.53	80.41	94	GICIK BUĞDAY	C	3	0.16	94.82
47	KELBUĞDAY	C/D	10	0.53	80.94	95	HAMZABEY	D	3	0.16	94.98
48	MEKSİKA	C/D	10	0.53	81.47	96	HAVRAN BUĞDAYI	D	3	0.16	95.14

Table 3.1 (Cont.) Local names of collected wheat landraces and their frequency ranked from highest to lowest

No	Local name	Wheat species	Frequency	Percent (%)	Cumulative percent (%)	No	Local name	Wheat species	Frequency	Percent (%)	Cumulative percent (%)
97	KARIŞIK BUĞDAY	C	3	0.16	95.30	130	ERMENİ BUĞDAYI	C	1	0.05	98.29
98	KAVAK	C	3	0.16	95.46	131	GEVRE YUMUŞAK	C	1	0.05	98.34
99	KIZIL BUĞDAY	C	3	0.16	95.62	132	GOKCEKADIR	C	1	0.05	98.40
100	SARI BAŞ BUĞDAY	D	3	0.16	95.78	133	GÜNEY	D	1	0.05	98.45
101	SARI MENEMEN	D	3	0.16	95.94	134	HARTLAK BUĞDAYI	C	1	0.05	98.51
102	YÖRÜK BUĞDAY	C	3	0.16	96.10	135	HAVRANİYE	C	1	0.05	98.56
103	AKOVA	C	2	0.11	96.21	136	HEZERE	C	1	0.05	98.61
104	AMİK BUĞDAYI	D	2	0.11	96.32	137	HINTA	D	1	0.05	98.67
105	BOZBAŞ	C	2	0.11	96.42	138	İRİ TAHIL	D	1	0.05	98.72
106	ÇILPİZ	C	2	0.11	96.53	139	İSTASYON	C	1	0.05	98.77
107	DAĞ BUĞDAYI	D	2	0.11	96.64	140	KAHYA BUĞDAYI	C	1	0.05	98.83
108	DIGE BUGDAYI	C	2	0.11	96.74	141	KAPLICA BUĞDAYI	O	1	0.05	98.88
109	DÖL BUĞDAYI	C	2	0.11	96.85	142	KARA YAZLIK	C	1	0.05	98.93
110	EĞRİ BUĞDAY	C	2	0.11	96.96	143	KARAKULAK	C	1	0.05	98.99
111	KOBAK	C	2	0.11	97.06	144	KARNIYARIK	C	1	0.05	99.04
112	ORMANYARAN	C	2	0.11	97.17	145	KIRKPINAR	D	1	0.05	99.09
113	RUS ÇAVDARI	C	2	0.11	97.28	146	KIRMIZI DİMENİT	C	1	0.05	99.15
114	TOKMAR	D	2	0.11	97.38	147	KIRMIZI EVLEK	C	1	0.05	99.20
115	YEM BUĞDAYI	O	2	0.11	97.49	148	KIRMIZI KAFKAS	C	1	0.05	99.25
116	AK KILÇIK	D	1	0.05	97.54	149	KISA BUĞDAY	D	1	0.05	99.31
117	AK PAMUCAK	C	1	0.05	97.60	150	KÜPELİ	C	1	0.05	99.36
118	ANKARA KIRİĞİ	C	1	0.05	97.65	151	LİCAS	C	1	0.05	99.41
119	BANKA BUĞDAYI	C	1	0.05	97.70	152	MAL BUĞDAYI	O	1	0.05	99.47
120	BAYIR	D	1	0.05	97.76	153	MALATYA BEYAZI	D	1	0.05	99.52
121	BOGVİ	D	1	0.05	97.81	154	MALATYA KIRMIZISI	D	1	0.05	99.57
122	BÖĞRÜALA	C	1	0.05	97.86	155	OVA BUĞDAYI	D	1	0.05	99.63
123	CİNGAN BUĞDAYI	C	1	0.05	97.92	156	RUMELİ	D	1	0.05	99.68
124	CUMAKALESİ	C	1	0.05	97.97	157	RUTO	C	1	0.05	99.73
125	CUMHURİYET -75	C	1	0.05	98.02	158	SARI MİSLİ	D	1	0.05	99.79
126	ÇAKIRLI	C	1	0.05	98.08	159	SİYORE	D	1	0.05	99.84
127	ÇAVDAR BUĞDAYI	C	1	0.05	98.13	160	TAŞHAN BUĞDAYI	C	1	0.05	99.89
128	EDİRNE BUĞDAYI	D	1	0.05	98.18	161	TİLKİKUYRUĞU	C	1	0.05	99.95
129	ELBİSTAN YAZLIĞI	C	1	0.05	98.24	162	YUNAN BUĞDAYI	C	1	0.05	100.00
							Total		**1873**	**100.00**	**100.00**

C:Common wheat, D:Durum wheat, O: Other wheat

Table 3.2 Classification of collected wheat landraces as bread wheat, durum wheat, or feed wheat types according to their spike morphology as a percentage of a region's overall wheat production

Region	Wheat type			Total
	Bread	Durum	Feed	
Aegean Region	59.69	40.31		100.00
Middle Eastern Central Anatolia Region	72.40	27.60		100.00
Eastern Black Sea Region	96.39	3.61		100.00
Eastern Marmara Region	40.19	59.81		100.00
Mediterranean Region	47.04	52.96		100.00
Middle Eastern Anatolia Region	56.88	43.13		100.00
North Eastern Anatolia Region	97.97	0.81	1.22	100.00
Southeastern Anatolia Region	31.53	68.47		100.00
Western Central Anatolia Region	50.86	49.14		100.00
Western Black Sea Region	37.30	34.84	27.87	100.00
Western Marmara Region	70.59	29.41		100.00
Total	58.28	37.93	3.79	100.00

χ^2: 790.88 S.D.: 20 p value: 0.000 φ: 0.650
Statistically significant at > 99% confidence level

populations of the same species over time, or reduction of the genetic base of a species" (Jarvis et al., 2000). Because genetic diversity exists at various levels (ecosystem, species, gene and gene-complex), genetic erosion needs to be assessed at these levels. Information on the loss of varietal diversity at landscape (field plot), household, and community levels is regarded as a good indicator of genetic erosion at the social level. This research showed that genetic erosion is a continuous process and many wheat landraces have been lost in Turkey. When we compare our findings with the collections of Mirza Gökgöl, Harlan, and Metzger, it can be seen that many wheat landraces reported by them are no longer grown. For instance, in Balıkesir province, there were 37 wheat landraces having different local names in Gökgöl's collection, but we found only seven wheat landrace populations having different local names in that province. While many factors trigger the reduction in landrace production, the comparison of our results to those of the past demonstrates that this erosion is a reality.

It is important to understand the factors affecting farmers' decisions to grow wheat landraces or modern wheat varieties to prevent genetic erosion of landraces. The results of those decisions are shown in Figure 3.12 and Table 3.3.

Farmers' land-use decisons vary by regions. In general, the overall average of farmers growing only landraces is about 73.8%. This means that a large proportion of farmers growing wheat landraces has played a role in landrace conservation. These farmers generally produce wheat landraces for their own needs, not for commercial aims. As Table 3.3 and Figure 3.12 show three eastern regions stand out for the conservation of landraces (North Eastern Anatolia (92.6%), Middle Eastern Anatolia (91.6%), and Eastern Black Sea (82.4%).

Table 3.3 Farmers' land-use decisions on wheat production (%)

Region	Production decision (% of farmers)		Total
	Only landrace	Both landrace and commercial	
Aegean Region	72.97	27.03	100.00
Middle Eastern Central Anatolia Region	73.18	26.82	100.00
Eastern Black Sea Region	82.35	17.65	100.00
Eastern Marmara Region	54.84	45.16	100.00
Mediterranean Region	78.26	21.74	100.00
Middle Eastern Anatolia Region	91.61	8.39	100.00
North Eastern Anatolia Region	92.68	7.32	100.00
Southeastern Anatolia Region	73.66	26.34	100.00
Western Central Anatolia Region	88.57	11.43	100.00
Western Black Sea Region	36.36	63.64	100.00
Western Marmara Region	54.00	46.00	100.00
Total	**73.83**	**26.17**	**100.00**

χ^2: 290.86 S.D.: 10 p value: 0.000 φ: 0.403
Statistically significant at > 99% confidence level

In contrast, in the Western Black Sea Region the proportion of farmers who grow only landraces is below 50% (36.4%), signalling the possiblity of genetic erosion in that region.

Agriculture is the largest user of fresh water globally. Irrigation is an important element for agriculture, with irrigated crops yielding up to 400% more than rainfed crops. Irrigation availability reduces the risk of weather variability in production conditions. As food insecurity continues to grow and climate instability looms, the importance of irrigated agriculture is growing: by 2030, irrigated crop production is expected to grow by 80% in order to meet global demand (World Bank, 2010). Taking into account the negative effects of global climate change in the world, it is an unavoidable fact that we should give more importance to the plant species and varieties having more tolerance to drought in the future. Landraces represent an important source of genetic variation in wheat for environmental adaptation. One of the prime examples is the use of the *Rht* dwarfing genes that became available through the Japanese wheat 'Norin 10', derived from landrace Shiro Daruma (Kihara, 1982). Two important genes, *Rht1* and *Rht2*, were observed to directly effect yield because of conferring reduced lodging. Moreover, a considerable diversity in landraces was found for resistance to pests such as stem rust (caused by *Puccinia graminis* Pers. f. sp. *tritici* Eriks. & E. Henn.), leaf rust [*P. recondita* Roberge ex Desmaz. f. sp. *tritici* (Eriks. & E. Henn.) D.M. Henderson], or Russian wheat aphid (*Diuraphis noxia* Mordv.) (Skovmand and Rajaram, 1990; Skovmand et al., 1994), and for tolerance to abiotic stresses, like heat (Hede et al., 1999; Skovmand et al., 2001). Landraces will be important for crop adaptation to climatic change. Landraces are generally more adaptive to dry conditions and could also be produced under rainfed conditions. But extending irrigation capacities to more farmers could actually lead to genetic erosion, since farmers generally prefer modern and more profitable varieties, instead of

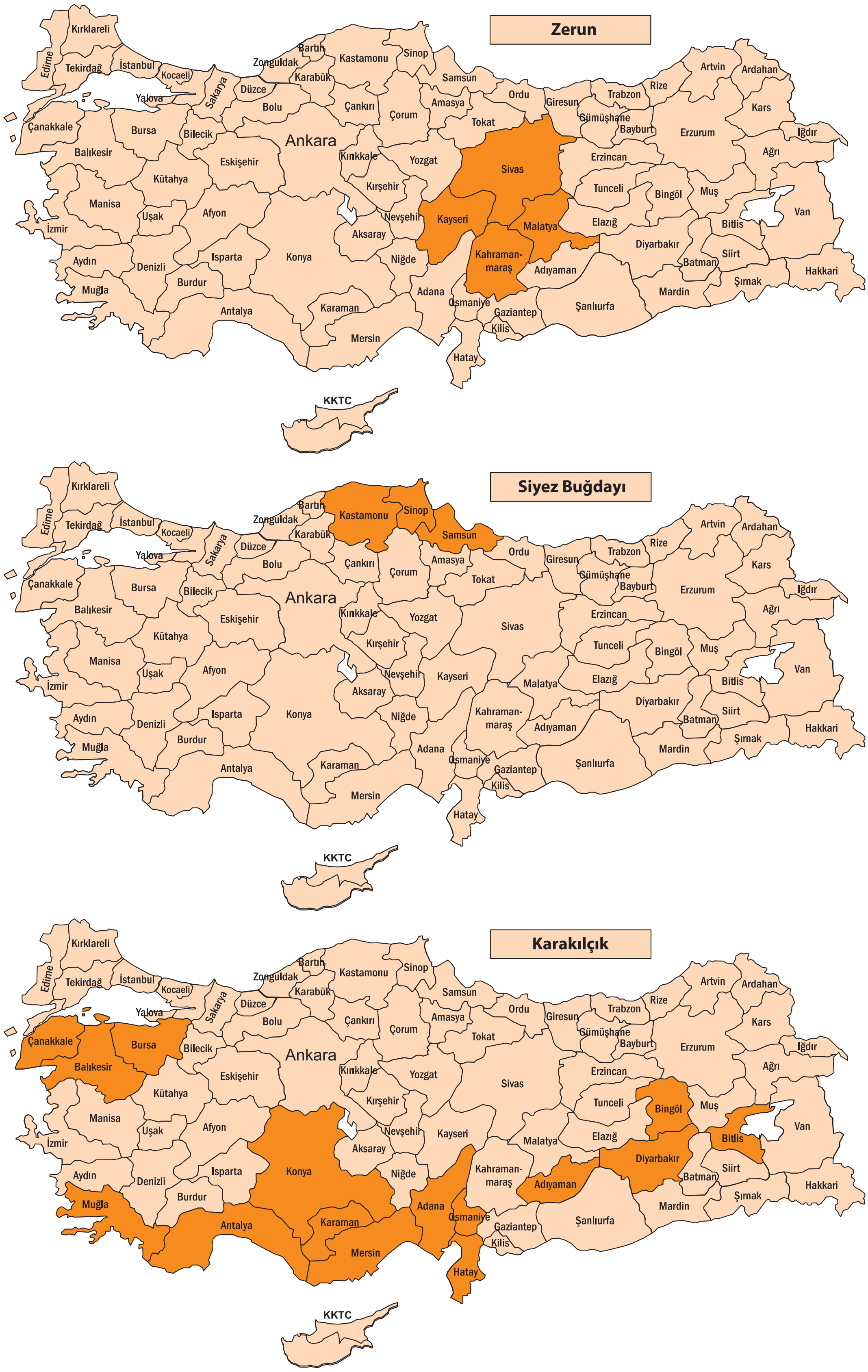

Figure 3.10 Distribution by province of the 10 most commonly grown wheat landraces (Zerun, Siyez Buğdayı, Karakılçık, Kırmızı Buğday, Sarı Buğday, Ak Buğday, Koca Buğday, Topbaş, Kırik, and Şahman) (Source: Ministry of Food, Agriculture and Livestock, Turkey)

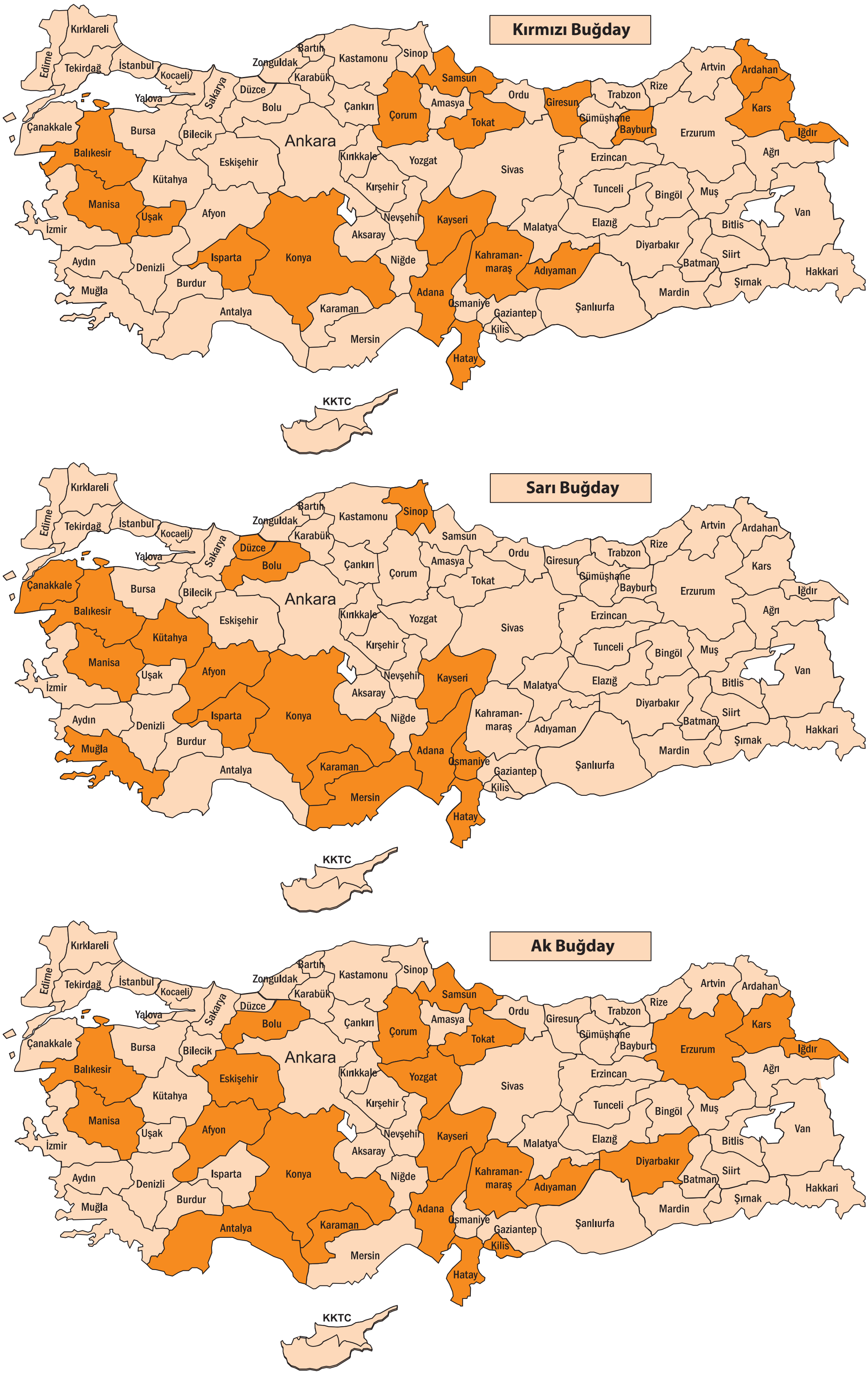

Figure 3.10 (Cont.) Distribution by province of the 10 most commonly grown wheat landraces (Zerun, Siyez Buğdayı, Karakılçık, Kırmızı Buğday, Sarı Buğday, Ak Buğday, Koca Buğday, Topbaş, Kırik, and Şahman) (Source: Ministry of Food, Agriculture and Livestock, Turkey)

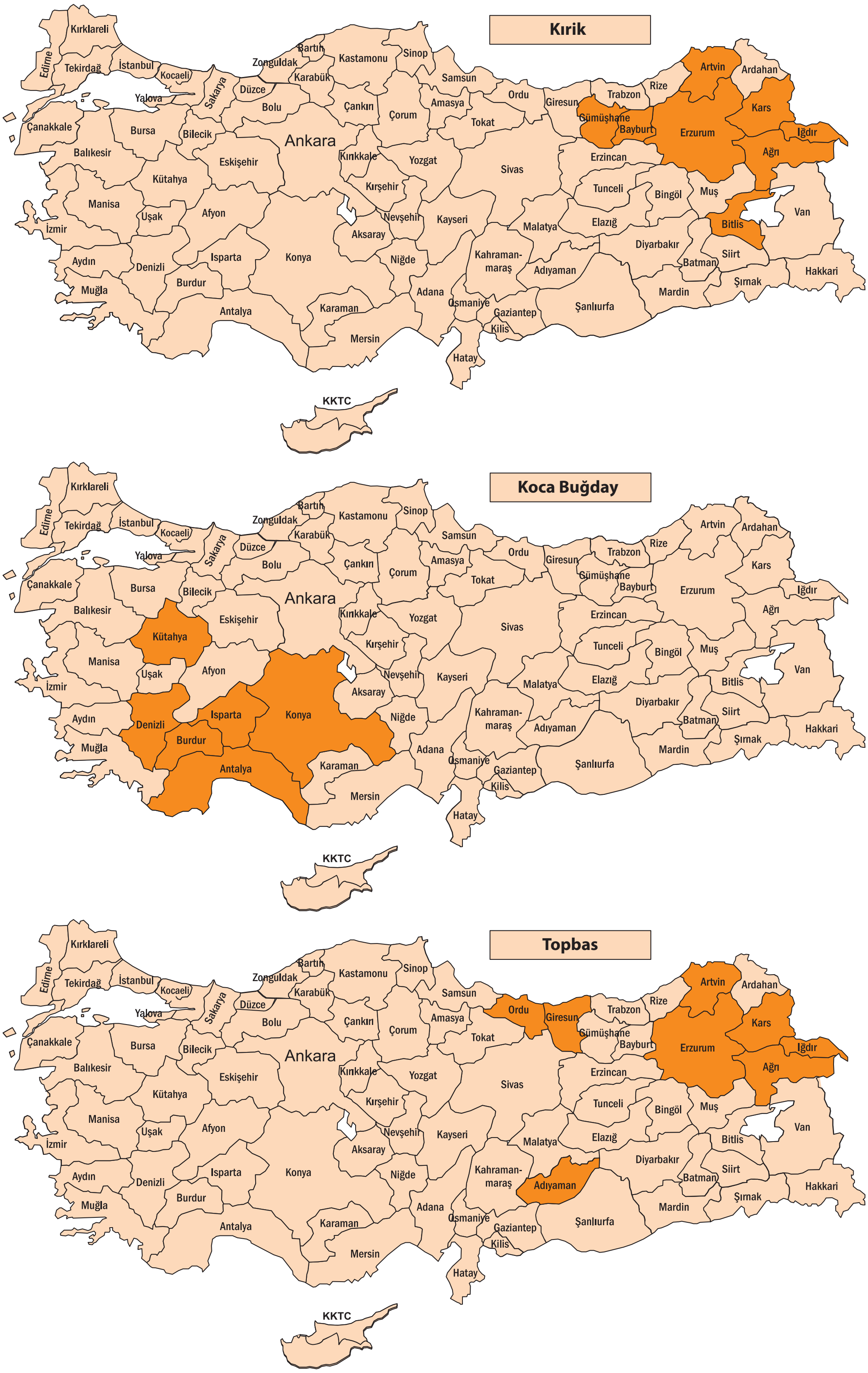

Figure 3.10 (Cont.) Distribution by province of the 10 most commonly grown wheat landraces (Zerun, Siyez Buğdayı, Karakılçık, Kırmızı Buğday, Sarı Buğday, Ak Buğday, Koca Buğday, Topbaş, Kırik, and Şahman) (Source: Ministry of Food, Agriculture and Livestock, Turkey)

Figure 3.10 (Cont.) Distribution by province of the 10 most commonly grown wheat landraces (Zerun, Siyez Buğdayı, Karakılçık, Kırmızı Buğday, Sarı Buğday, Ak Buğday, Koca Buğday, Topbaş, Kırik, and Şahman) (Source: Ministry of Food, Agriculture and Livestock, Turkey)

landraces, when they can be grown. In general, the smaller the diversity of cultivated species, the greater the expenditure required on pesticides, fertilizers, irrigation, and so on (Perrings et al., 1995). Access by farmers to irrigation facilities is an important indicator affecting farmers' decisions whether to produce landraces or not. Kruzich and Meng (2006) indicated

Table 3.4 Distribution by region of wheat landrace production according to irrigation status (%)

Region	Irrigation situation		Total
	Irrigated	Rainfed	
Aegean Region	0.91	99.09	100.00
Middle Eastern Central Anatolia Region	5.00	95.00	100.00
Eastern Black Sea Region	1.30	98.70	100.00
Eastern Marmara Region	0.00	100.00	100.00
Mediterranean Region	6.32	93.68	100.00
Middle Eastern Anatolia Region	38.06	61.94	100.00
North Eastern Anatolia Region	39.02	60.98	100.00
Southeastern Anatolia Region	8.87	91.13	100.00
Western Central Anatolia Region	13.14	86.86	100.00
Western Black Sea Region	3.32	96.68	100.00
Western Marmara Region	0.00	100.00	100.00
Total	12.78	87.22	100.00
χ^2: 328.41 S.D.: 10 p value: 0.000 φ: 0.424 Statistically significant at the 99% confidence level			

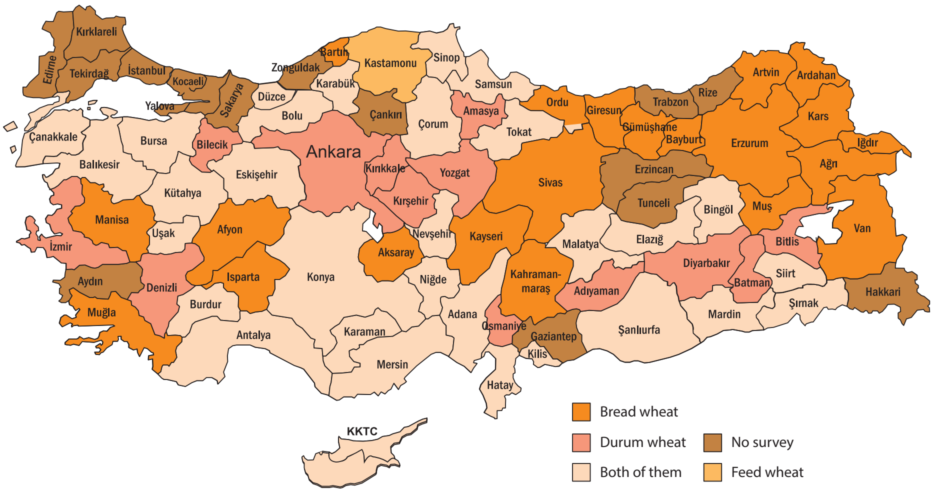

Figure 3.11 Distribution of wheat types (bread, durum, and feed) by province (Source: Ministry of Food, Agriculture and Livestock, Turkey)

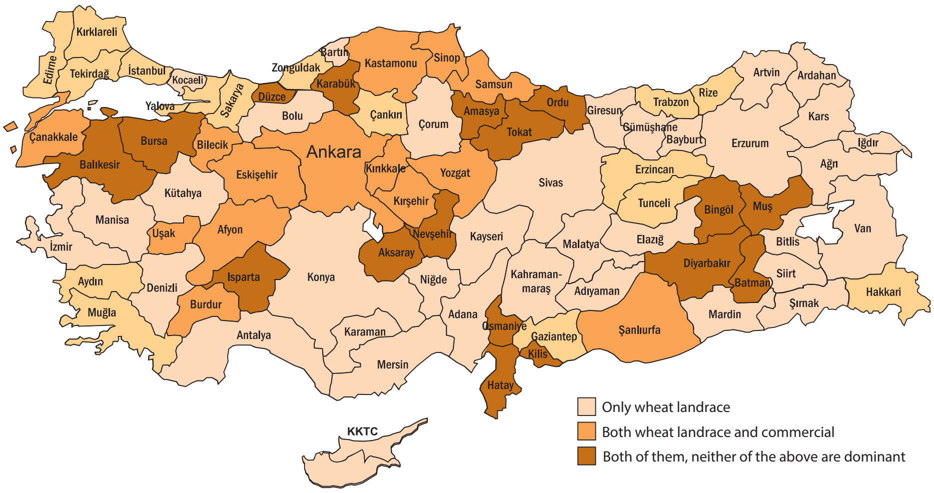

Figure 3.12 Farmers' land use decisions by province with respect to wheat landrace production (Source: Ministry of Food, Agriculture and Livestock, Turkey)

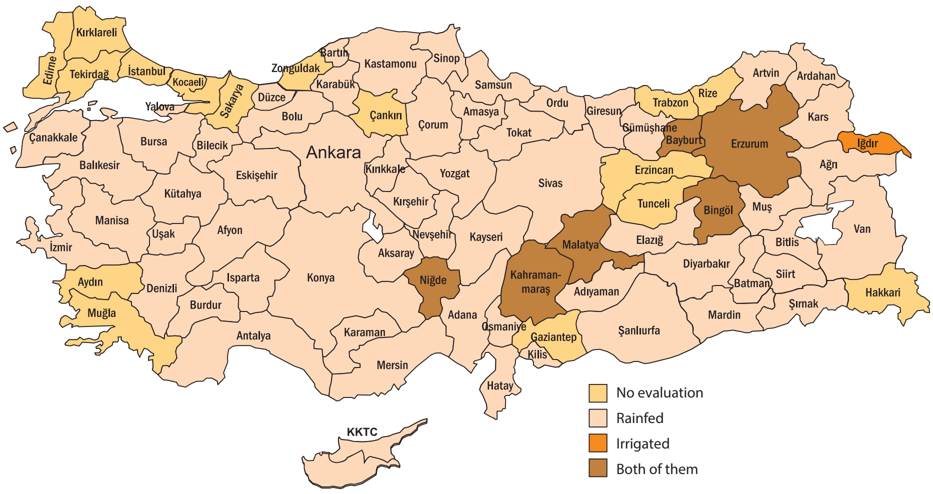

Figure 3.13 Farmers' production systems classified by province according to irrigation status (Source: Ministry of Food, Agriculture and Livestock, Turkey)

that availability of irrigation as a significant and negative effect on preference of farmers for producing wheat landraces, implying that modern varieties are preferred over landraces in the more optimal growing conditions in Turkey.

The wheat production systems of the surveyed farmers were characterized on the basis of irrigation practices (Table 3.4, Figure 3.13). The overall proportion of farmers producing wheat landraces in rainfed conditions was calculated as 87.2%, but it varies considerably by region. The regions with the highest proportion of farmers producing landraces under rainfed conditions are Eastern Marmara (100.0%), Western Marmara (100.0%), Aegean (99.1%), and the Eastern and Western Black Sea Regions (98.7% and 96.6%, respectively). Conversely the regions in which the highest proportion of farmers are producing landraces under irrigation are North and Middle Eastern Anatolia (39.0% and 38.0%, respectively).

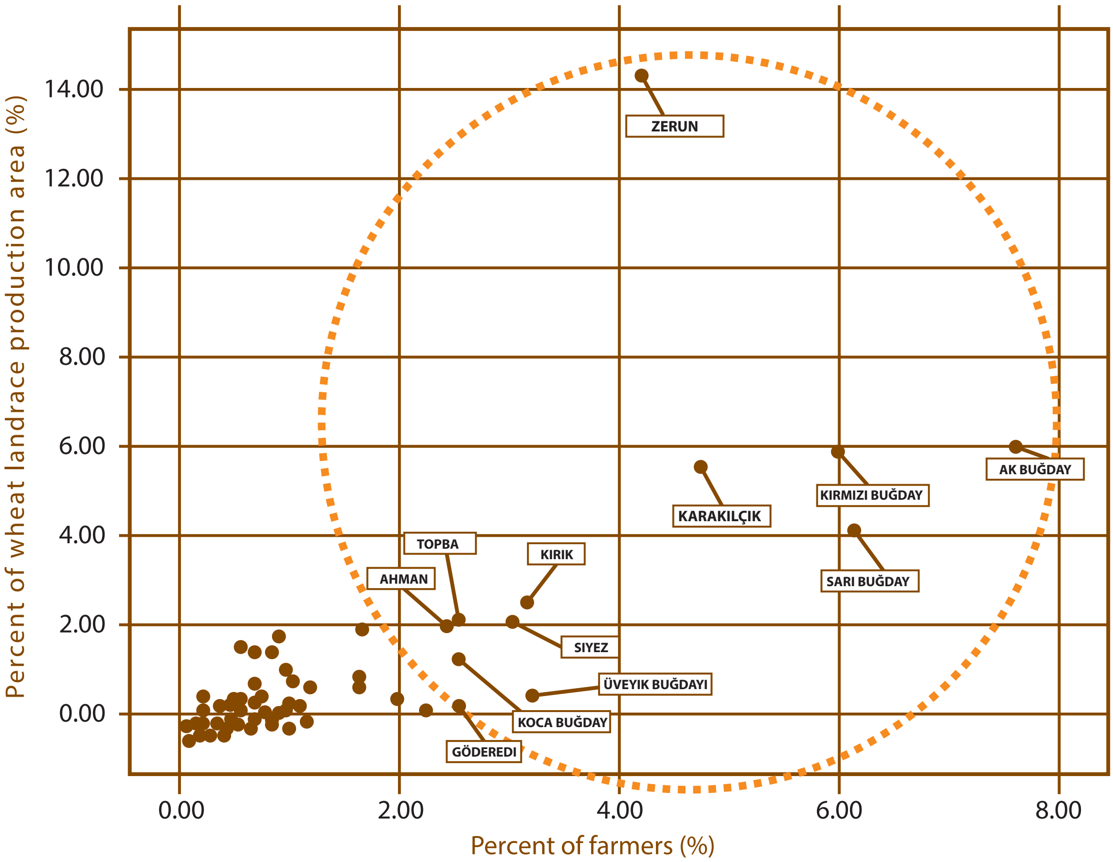

Figure 3.14 Relative importance of wheat landraces by area under production and proportion of farmers growing them; the top 12 are named and encircled for emphasis

Photo 3.1 Kırik

Photo 3.2 Üveyik Buğday

Photo 3.3 Siyez Buğdayı

Photo 3.4 Topbaş

Photo 3.5 Karakılçık

Photo 3.6 Kırmızı Buğday

Photo 3.7 Zerun

Photo 3.8 Ak Buğday

3.5. References

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Annex 3.1 Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district, based on collections and surveys in 2009-2014; the corresponding botanical variety types, when identifiable within the landrace collections, are italicized in parentheses following landrace names

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Southeastern Anatolia Region
Adıyaman: Çelikhan
T. aestivum ssp. *aestivum* – Çılpiz (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Dağ Buğdayı (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Topbaş (*hordeiforme*) *T. turgidum* ssp. *turgidum* – Dağ Buğdayı
Adıyaman: Gerger
T. turgidum ssp. *durum* – Aşurelik Buğday, Beyaz Buğday (*valenciae*); Ahlamaz (*reichenbachii*); Meksika (*leucurum*); Malatya Beyazı, Kırmızı Buğday, Yerel Buğday Makarna (*hordeiforme*); Menceki (*erythromelan*)
Adıyaman: Gölbaşı
T. aestivum ssp. *aestivum* – Elbistan Yazlığı (*ferrugineum*) *T. turgidum* ssp. *durum* – Sarı Bursa, Malatya Sarı Bursa (*hordeiforme, italicum*)
Adıyaman: Kahta
T. aestivum ssp. *aestivum* – Gevre Yumusak (*erythrospermum*); Yerli Kırmızı (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Buğday (*ferrugineum-compactoides*) *T. turgidum* ssp. *durum* – Yerli Kırmızı (*hordeiforme*)
Adıyaman: Sincik
T. aestivum ssp. *aestivum* – Licas (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Buğday (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Malatya Yerel, Ova Buğdayı, Gubey (*hordeiforme*)
Batman: Gercüş
T. turgidum ssp. *durum* – Hacı Ali (*hordeiforme*); Sorik (*hordeiforme, murciense*)
Diyarbakır: Çermik
T. aestivum ssp. *aestivum* – Memeli (*greacum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Karışık (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Sorgül (*hordeiforme*)
Diyarbakır: Çüngüş
T. aestivum ssp. *aestivum* – Devedişi (*melanopus*) *T. aestivum* ssp. *aestivum grex compactoidum* – Yusufi (*ferrugineum-compactoides*) *T. turgidum* ssp. *durum* – Kırkpınar (*leucurum*)
Diyarbakır: Dicle
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Gevro (*greacum-compactoides*) *T. turgidum* ssp. *durum* – Karakılçık, Bejres (*reichenbachii*); Gevro (*leucomelan*); Beyaz (*melanopus*)
Diyarbakır: Eğil
T. aestivum ssp. *aestivum* – Sergu, Aşurelik Buğday (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Sorgül (*barbarossa-compactoides, erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Gevro (*leucomelan, leucurum, affine*); Karakılçık (*reichenbachii, leucomelan*); Bejres (*leucomelan*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Diyarbakır: Ergani
T. aestivum ssp. *aestivum* – Memeli (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Sorgül (*erythroleucum-compactoides*) *T. aestivum* ssp. *compactum* – Sorgül *T. turgidum* ssp. *durum* – Karakılçık (*leucomelan*)
Diyarbakır: Hani
T. aestivum ssp. *aestivum* – Şergun (*ferrugineum*) *T. turgidum* ssp. *durum* – Bağacak (*hordeiforme*); Sorgül (*murciense, hordeiforme*)
Diyarbakır: Hazro
T. aestivum ssp. *aestivum grex compactoidum* – Bağacak (*erythroleucum-compactoides, erythroleucum-compactoides*)
Diyarbakır: Kulp
T. aestivum ssp. *aestivum grex compactoidum* – Bağacak (*ferrugineum-compactoides*) *T. aestivum* ssp. *compactum* – Bağacak *T. turgidum* ssp. *durum* – Sorgül (*hordeiforme, murciense*); Bağacak (*hordeiforme*); Gevro (*reichenbachii*)
Diyarbakır: Lice
T. turgidum ssp. *durum* – Bağacak (*leucurum, hordeiforme*); Devedisi, Karakılçık (*leucomelan*)
Diyarbakır: Silvan
T. aestivum ssp. *aestivum* – Sorgül (*ferrugineum , pseudo-hostianum*)
Diyarbakır: Sur
T. aestivum ssp. *aestivum* – Şergun (*erythrospermum*)
Diyarbakır: Yenişehir
T. aestivum ssp. *aestivum* – No name (*ferrugineum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Yazlık (*ferrugineum-compactoides*)
Gaziantep: Şahinbey
T. turgidum ssp. *durum* – Havran Buğdayı (*murciense*); Havran Buğdayı, Sert Buğday (*hordeiforme*)
Gaziantep: Şehitkamil
T. turgidum ssp. *durum* – Aggucuk (*affine*); Alibayır, Sarı Bursa, Makarnalik, Kırmızı Havran (*hordeiforme*); Bulgurluk Sert, Beyaz Buğday (*leucurum*); Kırmızı (*murciense*) *T. aestivum* ssp. *aestivum* – Yazlık Ak Buğday (*erythrospermum*)
Kilis: Merkez
T. aestivum ssp. *aestivum* – Havrani *T. aestivum* ssp. *aestivum grex compactoidum* – No name (*greacum-compactoides*) *T. turgidum* ssp. *durum* – Meksika Cesidi, Havrani (*leucurum*); Karakılçık (*reichenbachii*)
Kilis: Musabeyli
T. aestivum ssp. *aestivum* – Meksika Buğday (*erythroleucum*) *T. turgidum* ssp. *durum* – Karakılçık (*reichenbachii*); Zenit (*leucurum, leucomelan*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Mardin: Dargecit
T. aestivum ssp. *aestivum* – Kırmızı Uzun (*ferrugineum*)
Mardin: Mazıdağı
T. turgidum ssp. *durum* – Sorgül, Bağacak (*murciense*)
Mardin: Merkez
T. turgidum ssp. *durum* – Bağacak (*murciense*)
Mardin: Midiyat
T. aestivum ssp. *aestivum* – Zınebe, Kırmızı Buğday, Tilkikuyruğu, Sorik (*ferrugineum*) *T. turgidum* ssp. *durum* – Bağacak, Kırmızı Buğday, Sorgül, Havrani (*murciense*)
Mardin: Ömerli
T. aestivum ssp. *aestivum* – Zınebe (*ferrugineum*) *T. turgidum* ssp. *durum* – Hinta (*murciense*)
Mardin: Savur
T. aestivum ssp. *aestivum* – Sorgül, Sergun (*ferrugineum*) *T. turgidum* ssp. *durum* – Bağacak, Kırmızı Buğday, Sorgül, Hınta, Hacı Ali (*murciense*)
Şanlıurfa: Siverek
T. turgidum ssp. *durum* – Karakılçık, Akbaşak (*reichenbachii*); Akbaşak (*affine*); Bereres (*murciense*)
Siirt: Baykan
T. aestivum ssp. *aestivum* – Kırmızı Buğday (*ferrugineum*) *T. turgidum* ssp. *durum* – Havrani (*affine*)
Siirt: Eruh
T. aestivum ssp. *aestivum* – Ruto (*lutescens*); Aşurelik Buğday (*erythrospermum, ferrugineum, milturum*); Zınebe (*erythrospermum*); Bogvi, Kırmızı Buğday (*erythrospermum, ferrugineum*) *T. turgidum* ssp. *durum* – Hacı Ali, Bağacak, Kırmızı Buğday, Siyore (*murciense*); Sorgül, Akbaşak (*affine*)
Siirt: Merkez
T. aestivum ssp. *aestivum* – Zinebe, Kırmızı Buğday (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Beyaz Buğday (*ferrugineum-compactoides, erythrospermum*) *T. turgidum* ssp. *durum* – Akbaşak (*murciense*); Havrani (*reichenbachii*)
Şırnak: Güçlükonak
T. aestivum ssp. *aestivum* – Beyaz Buğday (*erythrospermum*); Beyaz Buğday, Kırmızı Buğday (*erythrospermum, ferrugineum*) *T. turgidum* ssp. *durum* – Hacı Ali, Sorgül, Bağacak (*murciense*); Kırmızı Buğday (*pseudo-alexandrinum*)
Black Sea Region
Amasya: Merkez
T. turgidum ssp. *durum* – Sarı Buğday, Üveyik Buğday (*hordeiforme*); Ağ Buğdayı (*leucurum*)
Amasya: Suluova
T. turgidum ssp. *durum* – Sarı Buğday, Üveyik Buğday (*hordeiforme*)
Artvin: Ardanuç
T. aestivum ssp. *aestivum* – Döl Buğdayı, Kotel Buğday (*ferrugineum, erythrospermum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Artvin: Yusufeli
T. aestivum ssp. *aestivum* – Kırik (*pyrotrix*); Yerli Buğday (*albidum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Topbaş (*turcicum-compactoides*)
Bartın: Merkez
T. aestivum ssp. *aestivum* – Kahya Buğday Banka Buğdayı (*ferrugineum*); Cingan Buğday (*erythrospermum*) *T. turgidum* ssp. *durum* – Sarı Baş Buğday (*murciense*); Karışık Buğday (*affine*)
Bartın: Ulus
T. aestivum ssp. *aestivum* – Hartlak, Kara Buğday (*erythrospermum*)
Giresun: Alucra
T. aestivum ssp. *aestivum* – Kırmızı Topbaş (*ferrugineum*); Erzurum Yazlığı (*greacum*)
Giresun: Çamoluk
T. aestivum ssp. *aestivum* – Erzurum Yazlığı (*greacum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Arı Buğday (*erythroleucum-compactoides*)
Giresun: Şebinkarahisar
T. aestivum ssp. *aestivum* – Erzurum Yazligi, Yazlik Buğday (*erythrospermum, greacum, milturum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Topbaş (*ferrugineum-compactoides, greacum-compactoides*) *T. turgidum* ssp. *durum* – Edirne Buğdayı (*affine, leucurum*)
Gümüşhane: Kelkit
T. aestivum ssp. *aestivum* – Hezere, Küpeli, Ankara Kıriği (*greacum*); Gonkesme (*erythroleucum*); Kırik (*delfi*); Kızıl Buğday (*erythrospermum*)
Gümüşhane: Köse
T. aestivum ssp. *aestivum* – Gonkesme (*erythroleucum*)
Gümüşhane: Torul
T. aestivum ssp. *aestivum* – Rus Buğdayı, Yazlık Buğday (*erythrospermum*); Arı Buğday (*erythrospermum, ferrugineum*)
Karabük: Eflani
T. aestivum ssp. *aestivum* – Köy Buğdayı (*erythrospermum*) *T. turgidum* ssp. *dicoccum* – Gernik *T. monococcum* – Kaplıca Buğdayı
Kastamonu: İhsangazi
T. aestivum ssp. *aestivum* – Yazlık Buğday (*erythrospermum*) *T. monococcum* – Siyez, Gernik
Kastamonu: Taşköprü
T. aestivum ssp. *aestivum* – Akbaşak (*erythrospermum*)
Ordu: Akkuş
T. aestivum ssp. *aestivum* – Çam Buğdayı (*ferrugineum, erythrospermum*); Ak Dimenit, Kırmızı Diment (*erythrospermum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Samsun: Asarcık
T. turgidum ssp. *dicoccum* – Mahsul Buğday *T. monococcum* – Mahsul Buğday
Samsun: Ladik
T. turgidum ssp. *durum* – Sarı Buğday, Üveyik Buğday (*hordeiforme*) *T. turgidum* ssp. *dicoccum* – Siyez, Mahsul Buğday
Samsun: Vezirköprü
T. turgidum ssp. *durum* – Sarı Buğday, Rumeli, Ak Buğday, Üveyik Buğday (*hordeiforme*)
Sinop: Dikmen
T. aestivum ssp. *aestivum* – Mengen Buğdayı, Yazlık Buğday (*erythrospermum*) *T. turgidum* ssp. *durum* – Sarı Buğday (*murciense*)
Sinop: Durağan
T. aestivum ssp. *aestivum* – Yazlık Buğday (*erythrospermum*) *T. turgidum* ssp. *durum* – Sarı Buğday (*murciense*) *T. monococcum* – Catal Siyez, Gernik
Tokat: Başçiftlik
T. aestivum ssp. *aestivum* – Ak Dimenit (*erythrospermum, greacum*) *T. turgidum* ssp. *durum* – Akbaşak (*leucurum*); Kırmızı Basak (*hordeiforme*)
Tokat: Merkez
T. aestivum ssp. *aestivum* – Çam Buğdayı, Çam Buğdayı (Kırmızı) Çalıbasan (*ferrugineum*); Çam Buğdayı (Kırmızı) (*erythroleucum, erythrospermum*); Çalıbasan, Örmece (*turcicum*); Çam Buğdayı (Beyaz) (*erythrospermum*); Ağ Sünteri (*greacum*); Zerun (*pseudo-erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Üveyik Buğday (*ferrugineum-compactoides, erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Üveyik Buğday, Sofu Buğdayı (Kırmızı) (*hordeiforme*); Sofu Buğdayı, Sofu Buğdayı (Beyaz) (*leucurum*) *T. aestivum* ssp. *compactum* – Ak Buğday
Tokat: Turhal
T. turgidum ssp. *durum* – Üveyik Buğday (*hordeiforme*)
Tokat: Yeşilyurt
T. aestivum ssp. *aestivum* – Örmece (*ferrugineum*) *T. turgidum* ssp. *durum* – İri Tahıl (Sofu) (*leucurum*)
Eastern Anatolia Region
Ağrı: Diyadin
T. aestivum ssp. *aestivum* – Bindane (*erythroleucum, greacum, delfii*); Amerikan Kırmızı (*erythroleucum*); Amerikan Beyaz (*erythroleucum, greacum*)
Ağrı: Eleşkirt
T. aestivum ssp. *aestivum* – Kılçıklı Kırik (*greacum*); Sarı Bursa (*delfii*)
Ağrı: Merkez
T. aestivum ssp. *aestivum* – Kılçıklı Kırik (*erythroleucum, delfii*); Beyaz Amerikan (*erythrospermum, greacum*); Kırmızı Amerikan (*erythrospermum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Ağrı: Patnos
T. aestivum ssp. *aestivum* – Kılçıklı Kırik, Kıraç 66 (*erythroleucum*); Yayla Buğdayı (*albirubrum, greacum, delfii*)
Ağrı: Tutak
T. aestivum ssp. *aestivum* – Yayla Buğdayı (*albirubrum, greacum*); Topbaş (*delfii*); Bahariye (*erythrospermum, lutescens*) *T. aestivum* ssp. *compactum* – Topbaş
Bayburt: Aydıntepe
T. aestivum ssp. *aestivum* – Gonkesme (*erythroleucum*); Kelkit Buğdayı (*greacum*)
Bayburt: Merkez
T. aestivum ssp. *aestivum* – Gonkesme (*erythroleucum*); Kelkit Buğdayı (*erythrospermum, greacum*); Kırik (*delfii*)
Bingöl: Merkez
T. aestivum ssp. *aestivum* – Karakılçık (*unknown*) *T. aestivum* ssp. *aestivum grex compactoidum* – Menceki, Yusufi (*erythroleucum-compactoides*)
Bitlis: Adilcevaz
T. aestivum ssp. *aestivum* – Karakılçık (*pseudo-greacum, pseudo-meridionale*); Kırik (*delfii*) *T. aestivum* ssp. *aestivum grex compactoidum* – Köse (*barbarossa-compactoides, Leucospermum-compactoides*)
Bitlis: Ahlat
T. aestivum ssp. *aestivum grex compactoidum* – Karakılçık (*erythroleucum-compactoides*)
Bitlis: Güroymak
T. aestivum ssp. *aestivum* – Karakılçık (*erythroleucum, pseudo-greacum, pseudo-meridionale, meridionale*)
Bitlis: Tatvan
T. aestivum ssp. *aestivum* – Karakılçık (*pseudo-greacum, pseudo-meridionale*)
Elazığ: Baskil
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*)
Elazığ: Karakoçan
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*)
Elazığ: Kovancılar
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*) *T. turgidum* ssp. *durum* – Menceki (*hordeiforme*)
Elazığ: Maden
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*)
Elazığ: Merkez
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kunduru, Yusufi (*erythroleucum-compactoides*) *T. turgidum* ssp. *turgidum* – Devedişi

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Elazığ: Palu
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*)
Erzurum: Oltu
T. aestivum ssp. *aestivum* – Beyaz Buğday, Dige Buğdayı (*erythrospermum*); Topbaş (*freacum*); Kırik (*albirubrum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Topbaş (*greacum-compactoides*) *T. aestivum* ssp. *compactum* – Ak Buğday, Beyaz Buğday, Topbaş
Erzurum: Pasinler
T. aestivum ssp. *aestivum* – Kırik (*albirubrum, milturum*)
Iğdır: Aralik
T. aestivum ssp. *aestivum* – Kırmızı Kilcik (*erythroleucum, ferrugineum*)
Iğdır: Karakoy
T. aestivum ssp. *aestivum* – Kırmızı Kilcik (*erythrospermum*) *T. turgidum* ssp. *durum* – Topbaş (*hordeiforme*)
Iğdır: Tuzluca
T. aestivum ssp. *aestivum* – Kafkaz Kırmızı, Beyaz Kilcik (*erythrospermum*); Beyaz Topbaş Beyaz Dane (*greacum*); Kırik (*albirubrum, delfii*); Kırmızı Dane (*ferrugineum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Topbaş (*turcicum-compactoides, erythroleucum-compactoides*); Topbaş Kırmızı (*erythroleucum-compactoides, barbarossa-compactoides*); Beyaz Topbaş (*pseudo-hostianum-compactoides*) *T. turgidum* ssp. *durum* – Kahverengi Topbaş Beyaz Dane (*hordeiforme*)
Kars: Arpaçay
T. aestivum ssp. *aestivum* – Kırmızı Buğday (*ferrugineum*); Kırik (*delfii*) *T. turgidum* ssp. *dicoccum* – Kavlıca
Malatya: Akçadağ
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum, ferrugineum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Kunduru (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Kırmızı Kunduru (*hordeiforme*)
Malatya: Arapgir
T. aestivum ssp. *aestivum* – Ağ Buğdayı (*erythroleucum*); Yazlık Buğday (*erythrospermum, ferrugineum*)
Malatya: Battalgazi
T. turgidum ssp. *turgidum* – Ermeni *T. turgidum* ssp. *durum* – Kunduru (*valenciae*); Sarı Bursa (*leucurum*)
Malatya: Darende
T. aestivum ssp. *aestivum* – Polatlı (*erythroleucum*) *T. turgidum* ssp. *durum* – Sarı Bursa (*hordeiforme*)
Malatya: Doğanşehir
T. aestivum ssp. *aestivum* – Kırmızı Kunduru (*erythroleucum*) *T. turgidum* ssp. *durum* – Ankara Yazlık (*hordeiforme*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Malatya: Hekimhan
T. aestivum ssp. *aestivum* – Ağ Buğdayı, Zerun (*erythroleucum*)
Malatya: Kale
T. turgidum ssp. *durum* – Siverek (*hordeiforme*)
Malatya: Merkez
T. aestivum ssp. *aestivum* – Çirpuz (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kunduru, Kırmızı Kunduru (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Siverek (*hordeiforme*); Cakmak (*hordeiforme* , *leucurum*); Kunduru (*leucurum*); Kırmızı Kunduru (*hordeiforme*)
Malatya: Pütürge
T. aestivum ssp. *aestivum* – Çirpuz (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Siverek (*erythroleucum-compactoides*) *T. turgidum* ssp. *durum* – Ohlemaz (*africanum*); Siverek (*hordeiforme, leucurum*)
Malatya: Yeşilyurt
T. aestivum ssp. *aestivum* – Aşurelik Buğday (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Kunduru (*erythroleucum-compactoides*)
Van: Erciş
T. aestivum ssp. *aestivum* – Bahariye (*ferrugineum*)
Marmara Region
Balikesir: Dursunbey
T. aestivum ssp. *aestivum* – Kabak Buğdayı (*lutescens*)
Balikesir: Sındırgı
T. aestivum ssp. *aestivum* – Köse Buğdayı (*albirubrum*)
Bilecik: Yenipazar
T. turgidum ssp. *durum* – Sarı Kelle (*hordeiforme, mursence*)
Bolu: Mudurnu
T. turgidum ssp. *durum* – Sarı Serez, Çalıbasan (*hordeiforme, mursence*) *T. monococcum* – Yazlık Iza, Kislik Iza
Bursa: Orhaneli
T. aestivum ssp. *aestivum* – Kabak Buğdayı (*albirubrum, albidum*)
Çanakkale: Yenice
T. aestivum ssp. *aestivum* – Koca Buğday (*albidum*) *T. turgidum* ssp. *durum* – Sarı Buğday (*leucurum*); Karakılçık (*melanopus*)
Düzce: Yığılca
T. aestivum ssp. *aestivum* – Sarı Buğday (*ferrugineum, erythrospermum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Eskişehir: Seyitgazi
T. aestivum ssp. *aestivum* – Gülümbür (*erythrospermum, greacum*)
Eskişehir: Sarıcakaya
T. aestivum ssp. *aestivum* – Çalıbasan (*erythrospermum*); Kırmızı Pazarcık (*ferrugineum*)
Aegean Region
Afyon: Bayat
T. aestivum ssp. *aestivum* – Ak Buğday (*ferrugineum, hostianum*)
Denizli: Tavas
T. turgidum ssp. *durum* – Koca Buğday (*hordeiforme*)
İzmir: Torbalı
T. turgidum ssp. *durum* – Sarı Menemen (*hordeiforme, africanum*)
Kütahya: Altıntaş
T. aestivum ssp. *aestivum* – Gülümbür (*hostianum, meridionale*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kobak (*erythrospermum-compactoides*) *T. turgidum* ssp. *durum* – Kobak (*leucurum*)
Kütahya: Çavdarhisar
T. turgidum ssp. *durum* – Koca Buğday (*leucurum*)
Kütahya: Domaniç
T. aestivum ssp. *aestivum* – Kasikci Buğday (*greacum*) *T. monococcum* – No name
Kütahya: Tavşanlı
T. aestivum ssp. *aestivum* – Çalıbasan (*meridionale*); Hatip Buğday (*pseudo-erythrospermum, meridionale*) *T. turgidum* ssp. *durum* – Koca Buğday (*hordeiforme*)
Muğla: Merkez
T. turgidum ssp. *durum* – Sarı Buğday (*mursence*); Ormanyaran Buğday (*hordeiforme*) *T. turgidum* ssp. *turgidum* – Karakılçık
Manisa: Akhisar
T. aestivum ssp. *aestivum* – Ak Buğday (*erythrospermum, greacum*); Kılçıksız Buğday (*albirubrum, albidum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Kırmızı Buğday (*barbarossa-compactoides*); Ak Buğday (*meridionale-compactoides*) *T. turgidum* ssp. *durum* – Ak Buğday (*leucurum*)
Manisa: Gördes
T. aestivum ssp. *aestivum grex compactoidum* – Çalıbasan (*ferrugineum-compactoides, pseudo-ferrugineum-compactoides, greacum-compactoides, meridionale-compactoides*) *T. turgidum* ssp. *turgidum* – Çalıbasan

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Manisa: Kula
T. aestivum ssp. *aestivum* – Meksika (*greacum*); Kırmızı Evlek (*albidum*); Sarı Buğday (*barbarossa*) *T. aestivum* ssp. *aestivum grex compactoidum* – Gıcık Buğday (*erythrospermum-compactoides, hostianum-compactoides*) *T. turgidum* ssp. *durum* – Sarı Buğday (*leucurum*)
Manisa: Selendi
T. turgidum ssp. *durum* – Ak Buğday (*hordeiforme*); Sarı Buğday (*leucurum*)
Uşak: Ulubey
T. aestivum ssp. *aestivum grex compactoidum* – Kırmızı Buğday (*erythroleucum-compactoides*) *T. aestivum* ssp. *compactum* – Kırmızı Buğday
Uşak: Sivaslı
T. aestivum ssp. *aestivum* – Kırmızı Buğday (*ferrugineum*) *T. aestivum* ssp. *aestivum grex compactoidum* – No name (*erythroleucum-compactoides*); Kırmızı Buğday (*turcicum-compactoides*)
Central Anatolia Region
Aksaray: Güzelyurt
T. aestivum ssp. *aestivum* – Kırmızı Kamci (*albirubrum*); Ak Buğday, Yörük Buğday, Comak (*albidum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Şahman (*erythroleucum-compactoides*) *T. aestivum* ssp. *compactum* – Ak Buğday, Comak
Aksaray: Merkez
T. aestivum ssp. *aestivum* – Ankara (*erythroleucum*); Elbistan, Albostan, Kırmızı Kamci (*albirubrum*); Ak Buğday, Comak, Kırmızı Ak Buğday (*albidum*) *T. turgidum* ssp. *durum* – Şahman (*hordeiforme*)
Karaman: Ermenek
T. aestivum ssp. *aestivum* – Ak Buğday (*albidum*) *T. aestivum* ssp. *compactum* – Sarı Buğday *T. turgidum* ssp. *durum* – Sarı Buğday (*hordeiforme*); Ak Buğday (*leucurum*)
Karaman: Sarıveliler
T. aestivum ssp. *aestivum* – Göderedi (*erythrospermum, greacum*); Godeli (*greacum*) *T. turgidum* ssp. *durum* – Ak Buğday (*hordeiforme, leucurum*)
Kayseri: Pınarbaşı
T. aestivum ssp. *aestivum* – Zerun (*delfii*)
Kırıkkale: Sulakyurt
T. turgidum ssp. *durum* – Sert Buğday (*murciense*)
Kırşehir: Akçakent
T. turgidum ssp. *durum* – Kunduru (Shahman) (*hordeiforme*); Şahman (*murciense*)
Konya: Bozkır
T. aestivum ssp. *aestivum* – Akca Buğday, Ak Buğday (*albidum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Koca Buğday (*erythroleucum-compactoides*) *T. aestivum* ssp. *compactum* – Ak Buğday *T. turgidum* ssp. *durum* – Buğday, Koca Buğday (*hordeiforme*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Konya: Hadim
T. aestivum ssp. *aestivum grex compactoidum* – Koca Buğday, Buğday, Sarı Buğday (*erythroleucum-compactoides*) *T. aestivum* ssp. *compactum* – Sarı Buğday *T. turgidum* ssp. *durum* – Sarı Buğday, Kırmızı B., Akyarnaz (*hordeiforme*)
Konya: Taşkent
T. aestivum ssp. *aestivum* – Göderedi (*erythrospermum, greacum*)
Nevşehir: Acıgöl
T. aestivum ssp. *aestivum* – Albostan (*albirubrum*) *T. turgidum* ssp. *durum* – Şahman (*hordeiforme*)
Niğde: Çamardi
T. aestivum ssp. *aestivum* – Kamçı (*albirubrum, milturum*
Niğde: Çiftlik
T. aestivum ssp. *aestivum* – Kamçı, Şahman (*albirubrum, greacum*); Şahman (*erythroleucum*)
Sivas: Gürün
T. aestivum ssp. *aestivum* – Zerun (*albirubrum*)
Sivas: Sivas
T. aestivum ssp. *aestivum* – Serun (Yazlık); Zerun (Kislik) (*delfii*) *T. turgidum* ssp. *durum* – Ulas
Yozgat: Akdağmadeni
T. aestivum ssp. *aestivum* – Ağ Sünteri (*greacum*) *T. turgidum* ssp. *durum* – Sarı Bursa (*hordeiforme*); Ak Buğday (*affine*); Çalıbasan (*leucurum*)
Yozgat: Kadışehri
T. turgidum ssp. *durum* – Çalıbasan (*hordeiforme*)
Yozgat: Merkez
T. aestivum ssp. *aestivum grex compactoidum* – Sarı Buğday, Sarı Bursa (*erythroleucum-compactoides*); Ak Buğday (*erythrospermum-compactoides*) *T. turgidum* ssp. *durum* – Sarı Buğday, Sarı Bursa (*hordeiforme*)
Mediterranean Region
Adana: Feke
T. aestivum ssp. *aestivum* – Bozbuğday (*erythrospermum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Ağ Buğdayı (*greacum-compactoides*); Kırmızı Kelle (*erythrospermum-compactoides*) *T. aestivum* ssp. *compactum* – Ağ Buğdayı *T. turgidum* ssp. *durum* – Kırmızı Kelle (*erythromelan, leucurum, valenciae, melanopus*);
Adana: Kozan
T. turgidum ssp. *durum* – Kocabaş (*valenciae, melanopus*); Karakılçık (*pseudo-alexandrinum, murciense*); Bozbaş (*affine*) *T. aestivum* ssp. *aestivum* – Bozbaş (*erythrospermum*); Karakılçık (*pseudo-erythrospermum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

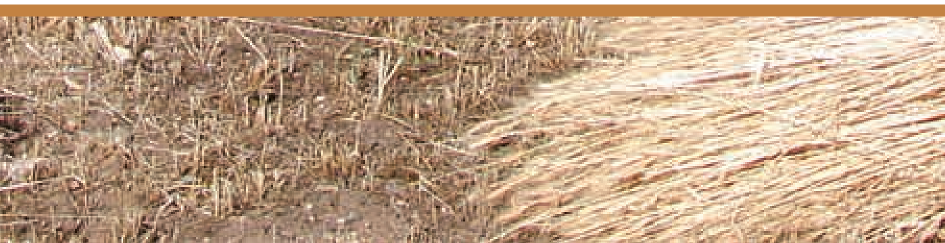
Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Adana: Saimbeyli
T. aestivum ssp. *aestivum* – Bozbuğday (*erythrospermum, greacum*); Kırmızı Buğday (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Bozbuğday (*erythrospermum-compactoides*); Beyaz Buğday (*greacum-compactoides*) *T. turgidum* ssp. *durum* – Karakılçık (*unknown*)
Adana: Pozantı
T. turgidum ssp. *durum* – Şahman, Kırmızı Şahman, Sarı Baş (*hordeiform, murciense*)
Antalya: Korkuteli
T. turgidum ssp. *durum* – Koca Buğday (*hordeiforme*)
Antalya: Akseki
T. aestivum ssp. *aestivum grex compactoidum* – Koca Buğday (*erythrospermum-compactoides*) *T. turgidum* ssp. *durum* – Karakılçık (*reichenbachii*); Kocabaş Buğday (*leucurum*)
Burdur: Yeşilova
T. turgidum ssp. *durum* – Koca Buğday (*hordeiforme*)
Burdur: Kiprit
T. aestivum ssp. *aestivum* – No name (Mixture) *T. aestivum* ssp. *aestivum grex compactoidum* – No name (*erythrospermum-compactoides*)
Hatay: Altınözü
T. aestivum ssp. *aestivum* – Kelbuğday (*lutescens*) *T. turgidum* ssp. *durum* – Kelbuğday (*unknown*); Yerli Karakilcik (*reichenbachii, melanopus*); Karakılçık (*reichenbachii, valenciae*)
Hatay: Belen
T. aestivum ssp. *aestivum grex compactoidum* – Amik Buğdayı (*pseudo-hostianum-compactoides*) *T. aestivum* ssp. *compactum* – Amik Buğdayı *T. turgidum* ssp. *durum* – Sarı Baş (*hordeiforme, murciense*); Havran Buğdayı (*africanum*); Italyan Karakılçık (*reichenbachii*)
Hatay: Hassa
T. turgidum ssp. *durum* – Beyaz Buğday (*leucomelan*); Kara Buğday (*unknown*); Havran Buğdayı (*melanopus*)
Hatay: Yayladağı
T. aestivum ssp. *aestivum* – Kelbuğday, Akova (*albidum*) *T. turgidum* ssp. *durum* – Kara Buğday, Alibayir (*africanum*); Karakılçık (*reichenbachii, leucomelan*); Yerli Karakılçık (*leucomelan, africanum*)
Isparta: Sütçüler
T. turgidum ssp. *durum* – Kırmızı Buğday (*hordeiforme*); No name (*erythromelan*); Sarı Buğday (*mursence*)
Isparta: Aksu
T. turgidum ssp. *durum* – Kırmızı Buğday (*hordeiforme*)
Kahramanmaraş: Çağlayancerit
T. aestivum ssp. *aestivum* – Beyaz Buğday, Elbistan Kertmeni (*greacum*)

Annex 3.1 (Cont.) Distribution of wheat landraces (of species *Triticum aestivum*, *T. turgidum*, and *T. monococcum*) by geographic region, province, and district,

Province: District Species, subspecies – Landrace name (*botanical variety or varieties, if known*)
Kahramanmaraş: Elbistan
T. aestivum ssp. *aestivum* – Kırmızı Ankara Yazlığı (*erythroleucum*)
Kahramanmaraş: Nurhak
T. aestivum ssp. *aestivum* – Kırmızı Ankara Yazlığı (*erythroleucum*) *T. aestivum* ssp. *aestivum grex compactoidum* – Ak Buğday, Beyaz Buğday (*greacum-compactoides, pseudo-greacum-compactoides*)
Mersin: Aydıncık
T. turgidum ssp. *durum* – Sarı Buğday (*hordeiforme*); Karakılçık (*leucomelan*)
Mersin: Gülnar
T. aestivum ssp. *aestivum* – Kunduru (*greacum*) *T. turgidum* ssp. *durum* – Sarı Buğday, Hakki Buğdayı (*hordeiforme, leucurum*)
Mersin: Silifke
T. aestivum ssp. *aestivum* – Sarı Buğday (*erythroleucum*); Dığrak (*erythrospermum*) *T. turgidum* ssp. *durum* – Sarı Buğday, Hakkı Buğdayı (*hordeiforme*); Karakılçık, Sarı Dığrak (*leucurum*)
Osmaniye: Bahçe
T. aestivum ssp. *aestivum* – Ağ Buğdayı (*erythrospermum*) *T. turgidum* ssp. *durum* – Suriye Karakiscigi (*africanum*); Suriye Karakılçıgi (*unknown*)
Osmaniye: Düziçi
T. turgidum ssp. *durum* – Karakılçık, Akkilçık (*africanum, unknown*)
Osmaniye: Hasanbeyli
T. turgidum ssp. *durum* – Yerli Karakılçık (*reichenbachii*); Sarı Baş Ak (*pseudo-alexandrinum, murciense*)

Chapter 4

FARMER PRACTICES AND DECISION MAKING CONCERNING WHEAT LANDRACES



CHAPTER 4

FARMER PRACTICES AND DECISION MAKING CONCERNING WHEAT LANDRACES

4.1. Introduction

Researchers have documented that small-scale farmers in areas of crop diversity often plant several varieties of one crop in one season (Brush et al., 1981; Richards, 1986; Dennis, 1987; Bellon and Smale, 1998). Small-scale farmers usually have multiple interests or concems and confront numerous problems in attempting to address them. Because it is unlikely that one variety has all of the traits demanded by the farm household, and because desirable traits may be associated with undesirable ones, the choice of varieties can be seen as a process by which farmers assemble various bundles of traits to suit specific production conditions, consumption preferences, or marketing requirements (Bellon 1996; Bellon and Smale, 1998). There are trade-offs in the selection of varieties, and the farmer can change the bundle of traits by changing the allocation of crop area among varieties (Bellon and Smale, 1998).

Maintenance of landraces is important for the conservation of crop genetic resources. Landraces are important for both the breeding of new varieties and as an income source for livelihoods in rural areas. Thus, landraces are both food and a means of existence. Turkey is the one of the rare countries having a rich heritage of genetic resources, especially for wheat, for which Turkey is seen as a homeland.

Turkey conducted agricultural modernization in conjunction with subsidizing industrial development from the early 1960s to the mid 1970s (Aydın, 1986; Olgun, 1989; Ergüder, 1991; Bardsley and Thomas, 2005). On the Anatolian Plateau, new wheat varieties were adopted primarily because they allowed higher yields in dryland production systems (Aresvik, 1975; Breth, 1977). New varieties responded to high inputs of agricultural fertilizers and irrigation and were resistant to some important diseases. Modern varieties were readily adopted by wealthy farmers, who had the capital, education, land, and other inputs to more fully exploit their potential (Demir, 1976; Kronstad, 1981; Tansey, 1984). Many farmers with smaller holdings also gained access to modern varieties and local wheat landraces were lost as the agricultural systems were altered or as agriculture lost viability (Brush, 1995; Kaya et al., 1997; Tan, 1998).

This chapter focuses on three questions:

1. ***What kind of farms continue to produce wheat landraces?***
2. ***What are the production inputs for wheat landraces?***

3. ***What are the characteristics of wheat landraces, both those preferred by farmers and those incidental to farmer preferences that lead to their continued production?***

To address these questions, we conducted surveys gathering data about production inputs like seed, fertilizer, and pesticide amounts, yield data, socio-economic characteristics, and farmers' reasons for maintaining wheat landraces at the household level from 65 provinces in Turkey over the years 2009 to 2014.

4.2. Materials and Methods

In this chapter, the evaluation of wheat landrace producers' farm practices is presented. For this aim, socio-economic survey instruments were designed by economists and agronomists to cover a broad range of information regarding household characteristics, production data (yield, seed amount, fertilizer amount, and other production and harvesting techniques), and landrace features (height, seed color, preferred and non-preferred characters of landraces, usage aims, wheat type). Households participating in the surveys either cultivated wheat landraces only or cultivated both wheat landraces and modern wheat varieties. Survey forms were completed by face-to-face interviews with farmers. The farmers living in selected villages were chosen with advice from the chief, "Muhtar", of the village.

The survey data gathered from the research areas were analyzed with various statistical methods using the STATA-13 statistical software. Firstly, descriptive analysis was used for the definition of the data. This method provides statistics that are used to describe the basic features of the data in a study. They provide simple summaries of the characteristics of the sample such as measures of dispersion and central tendency. The limitation with this analytical procedure is that descriptive statistics do not show the relationship among the variables and the influence that each variable may have on the response. Descriptive analysis does, however, often provide guidance for more advanced quantitative analyses. The descriptive data about the research area were presented as tables.

Categorical variables were shown with cross tabulations. Cross tabulation is useful for summarizing categorical variables. The crosstabs chi square test is used to measure whether there is some level of association among categorical variables in two-way and multi-way contingency tables. Variables for which the test statistic is significant at a set cut-off point are considered associated, while those for which the test statistic is not significant are not considered to be associated. However, the test does not indicate the direction, or even the magnitude of the association, thus it is not sufficient to use this analytical approach alone.

Pearson's chi-squared test was used to assess two types of comparison tests of independence. A test of independence assesses whether paired observations on two variables, expressed in a contingency table, are independent of each other. The value of the test-statistic (Kesici and Kocabaş, 2007) is:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

where X^2 = Pearson's cumulative test statistic, which asymptotically approaches a χ^2 distribution; O_i = an observed frequency; E_i = an expected (theoretical) frequency, asserted by the null hypothesis; and n = the number of cells in the table.

A maximum of 20% of the total cells' frequency values should be less than five in the created cross-tables and no cell frequency should fall below one to accept the chi square analysis results as reliable. If these limits are exceeded, reliability of the results obtained from chi-square analysis is questioned (Bayazıt and Oğuz, 1998). In that situation, the "likelihood ratio" value was used instead of chi-square analysis. Data were tested at 90%, 95%, and 99% confidence levels. "Variance analyses" were used in case of continuous variables and if the number of variables is more than two. If the number of variables was more than two, the F test was used, and if the number of variable was exactly two, the t test was used to compare means of two or more independent variables. "Levene's test" was used to evaluate the equality variances of two groups. If the result of Levene's test is $p<0.05$, it can be concluded that the variances are not equal in each group. In this case of absence of equal variance, the t test is used (Ergün, 1995; Büyüköztürk, 2010;). If a statistically significant difference was found among the variables with the results of an F test, these variables were grouped by means of the "Duncan test" (Düzgüneş et al., 1983).

To compare the means belonging to two independent variables, the t test was used to compare two small sets of quantitative data when samples were collected independently of one another. The criterion for this test is that the samples must be collected from two different populations or from randomly selected individuals from the same population at different times.

One of the factors taken into account when a farm enterprise determines its production strategies is the extent of available labor, because agriculture is a labor-intensive activity. The availability of labor is an important variable in the sustainability of subsistance farm enterprises. Therefore, labor availability was investigated in this study. To calculate the labor force in a household, the number of all persons living in the household was converted to "Man Labor Unit (MLU)". Not all workers have the same capacity for work. A child of twelve can do useful work, but cannot yet do the heavy work that a man can. A woman, in addition to working in the fields, fetches water and cooks the meals, so she does not work in the fields as long as the men do. It is therefore difficult to make a direct comparison of the work that can be done by different members of the households. The coefficients presented in Table 4.1 were used in this conversion.

4.3. Results and Discussion

One of the objectives of this study was to understand the production techniques of wheat landrace producers. Geographical conditions and farm characteristics were the important factors affecting the farmers' willingness to produce wheat landraces as indicated in previous studies conducted in different countries as well as Turkey (Brush, 1995; Brush and Meng, 1998; Smale et al., 2003; Kruzich, 2006). Thus, in our study, first, data collected on the wheat landrace production fields was analyzed. Next, the socio-economic information on the farmers producing wheat landraces were analyzed. Both the geographic data and socio-economic status of the farms should give an idea of the primary characteristics important for the geographic conditions and status of farms which are able to produce wheat landraces sustainably.

Table 4.1 Coefficients (α) for conversion between gender and age and Man Labor Units

Demographic group	α coefficient
Children (age < 7)	0.00
Children (7 ≤ age < 15)	0.50
Men (15 ≤ age < 50)	1.00
Women (15 ≤ age < 50)	0.75
Men (age ≥ 50)	0.75
Women (age ≥ 50)	0.50
Source: Erkuş, 1979	

Another topic covered in this chapter is the production techniques and inputs and their quantities used by wheat landrace producers. This information is important to show how the performance of wheat landraces, having different types and characters, varies in different locations.

4.3.1. Geographical Characteristics of Research Area

Since geographical structure affects both quality and yield in the production process, it is an effective factor in farmers' decisions as to what products they will produce and the what extent to which they will produce them. There are many elements that make up the geographical structure. One of them is elevation, which is an effective factor determining the maintanence of wheat landrace production. It also has a positive impact on diversity at the farm level (Kruzich, 2006). In this study, we determined that the majority of wheat landrace production took place at higher elevations as presented in Figure 4.1. The figure shows the mean elevation of landrace production areas in each province. The lowest elevation at which wheat landraces were grown was at 335 m in Çanakkale province, Western Marmara Region, and the highest elevation was 1,899 m in Ardahan province, North Eastern Anatolia Region.

We conclude that the proportion of farmers growing wheat landraces only is higher at higher elevations than the proportion of farmers growing both modern varieties and wheat landraceas together. This relationship is statistically significant as result of chi square analysis at the 99% confidence level (Table 4.2).

Another important variable impacting the decision of farmers to grow wheat landraces was distance to market from the production site. The likelihood of subsistence-level agricultural production is high in remote areas far from markets. The average distance to market of the farmers producing wheat landraces is presented by provinces in Figure 4.2. In the study, 23.7% of all farms had a distance to market greater than 25 km. As distance to market increases, the proportion of farmers growing wheat landraces only increased (Table 4.3). Similar studies showed that the market characteristics affect biodiversity outcomes. Van Dusen (2000) measured market integration with respect to distance to a regional market, use of hired labor,and international migration, and he found that the characters negatively affect diversity outcomes. Brush et al. (1992) studied the diversity of

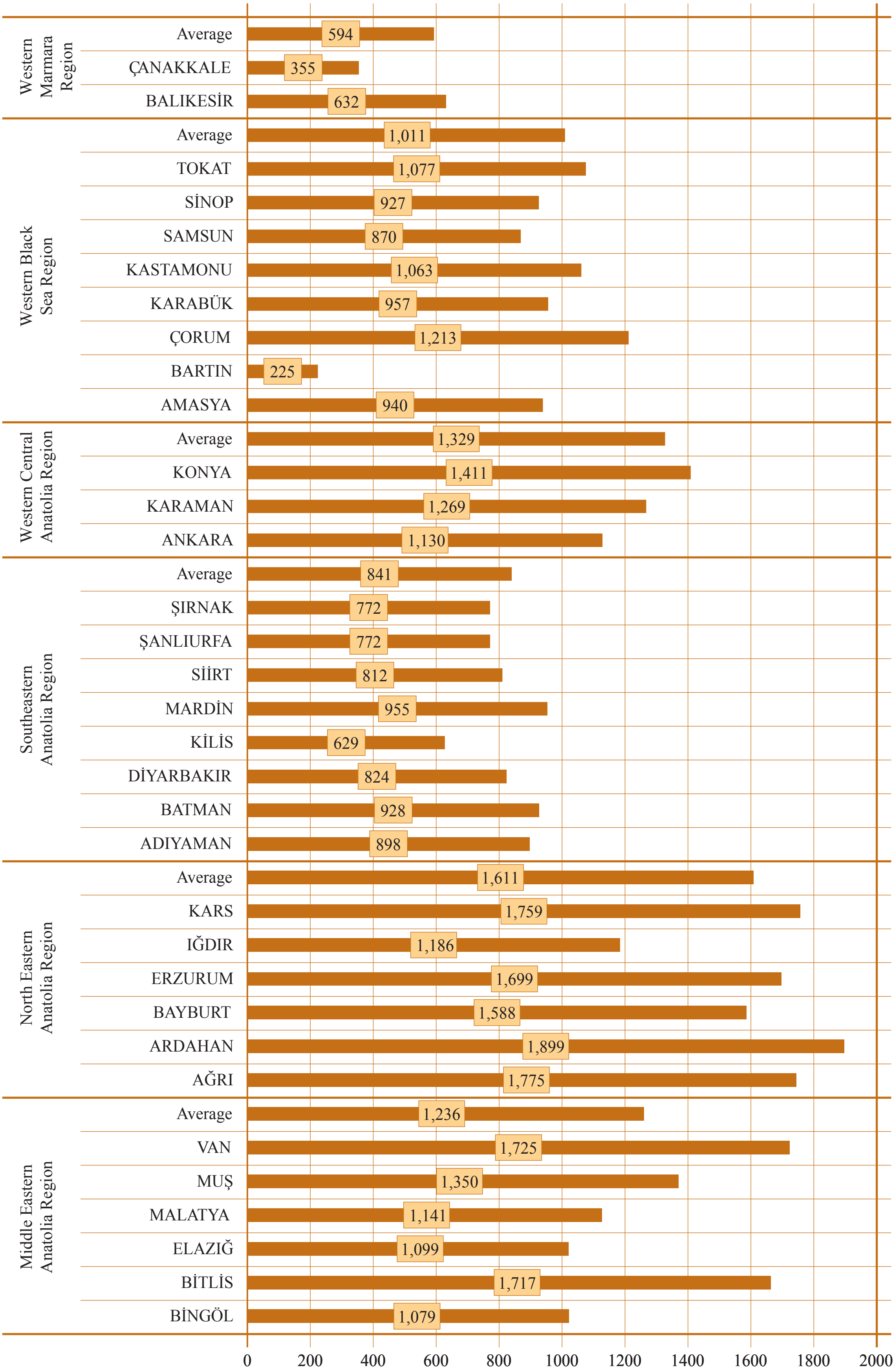


Figure 4.1 Mean elevations (masl) of wheat landrace production areas by province and region

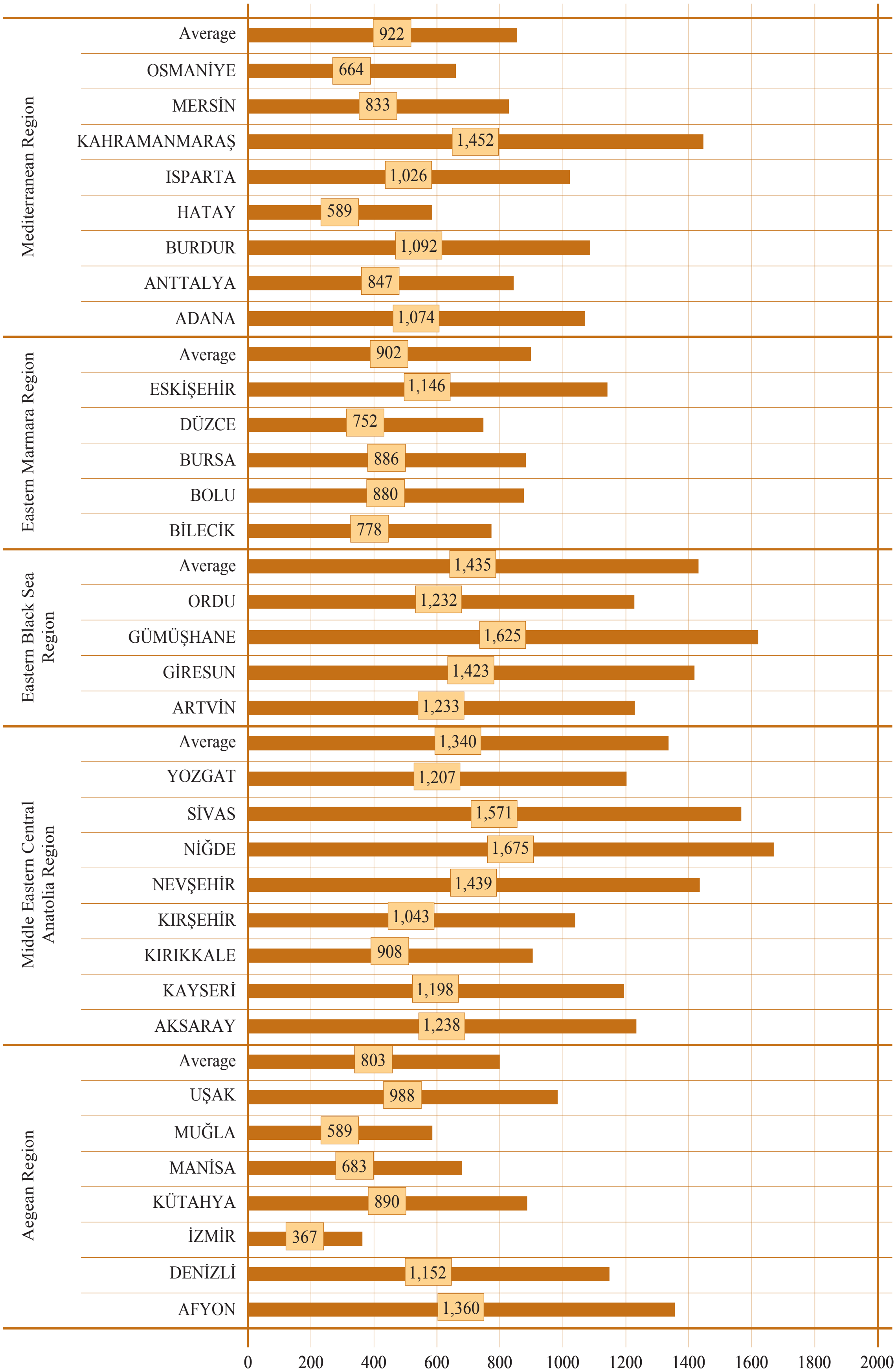


Figure 4.1 (Cont.) Mean elevations (masl) of wheat landrace production areas by province and region

Table 4.2 Number of farms by type of landrace production with respect to elevation

Type of landrace production	Elevation				Total	
	Lowland (< 1,200 m)		Highland (≥ 1,200 m)			
	Count	%	Count	%	Count	%
Only landraces	639	66.1	615	88.2	1,254	75.4
Both landraces and modern varieties	327	33.9	82	11.8	409	24.6
Total	966	100.0	697	100.0	1,663	100.0
χ^2: 106.49 S.D.: 1 p value: 0.000 φ: -0.253 Statistically significant at the 99% confidence level						

Table 4.3 Number of farms by type of landrace production with respect to distance to market

Type of landrace production	Distance to market				Total	
	< 25 km		≥ 25 km			
	Count	%	Count	%	Count	%
Only landraces	981	74.9	329	25.1	1,310	100.0
Both landraces and modern varieties	375	80.4	92	19.7	467	100.0
Total	1,356	76.3	421	23.7	1,777	100.0
χ^2: 5.58 S.D.: 1 p value: 0.018 φ: -0.056 Statistically significant at the 90% confidence level						

potato CGR in Peru and compared two valleys with different levels of market integration. They found that increased level of market integration decreased the overall level of diversity, since commercial production increased the area under simplified production systems with improved varieties. Meng's study (1997) of the diversity of wheat varieties in Turkey integrated several possible explanations into a comprehensive model. Market variables were important explanatory factors in the probability of planting landraces.

4.3.2. Socio-Economic Characteristics of Farm Households

One of the issues examined in the study was socio-economic characteristics of the farm households, including behaviors and attitudes. The variables studied were age, education levels of household heads, the distribution of existing labor forces according to gender and use, in addition to land assets and land use. The demographic structure of the farm households is a variable affecting willingness of farmers to produce wheat landraces.

Socio-economic characteristics of the agricultural enterprises can give information on access to technology, inputs, markets, and social facilities. A study of these variables was done by the Turkish Ministry of Development in 2003, producing an index that unites all the socio-economic characteristics of a district (the next smaller administrative unit of a province) in Turkey. According to this index, the districts can be divided into six development classes. Of the 189 districts in our study, 3.7% have index values in development classes 1 and 2; 38.1% of districts have index values in class 3; and 28.6%, 14.8%, and 14.8% of districts have index

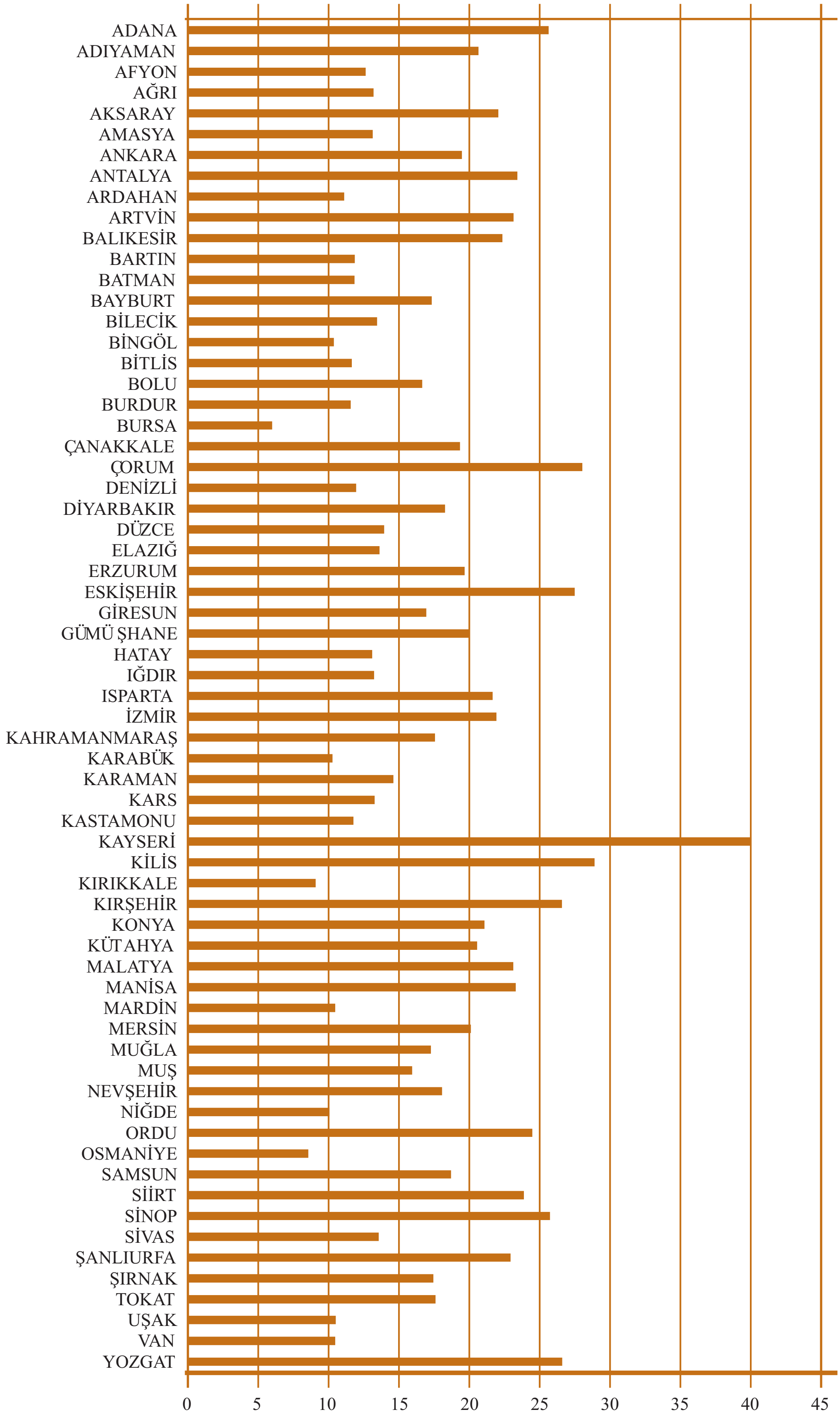


Figure 4.2 Mean distance (km) of farmers to nearest market by provinces

values in development classes 4, 5, and 6, respectively (Figure 4.3). The majority of districts in which we conducted our study fall into the middle development classes and thus can be said to be among the less-developed districts.

Development status of the areas in which wheat landrace production occurs also affects the preferences of wheat landrace producers. It was found that farmers producing only wheat landraces in their farms were living in less-developed areas when compared with the farmers producing both wheat landraces and modern varieties (Figure 4.4).

The first demographic factor studied was population. The average Turkish household size was 4.5 persons according to 2000 census statistics (TSI, 2011). The distribution of household size in our study areas ranged from 3.8 persons in Western Marmara Region to 7.3 persons in Middle Eastern Anatolia Region (Table 4.4). These differences in household size among regions are significant at the 99% confidence level.

Household size alone does not mean so much. What matters is distribution of the population according to gender and age, from that, the labor force of the farm household can be calculated. The agricultural sector is labor intensive. The labor force of the farm household was calculated using the Man Labor Unit (MLU) derived from the age and gender of the population. The average MLU was 3.7 and in all regions most of it (58.9% overall) was contributed by the male labor force (Table 4.4). The labor force potential of farm households varies significantly by region at the 99% confidence level.

Another factor examined was the age of household heads. It was expected that the families with farms growing wheat landraces have a more patriarchal structure, thus male household heads play an important role in decision-making processes. Some of the variables affecting the household-head decision-making process are age and education. On the one hand, greater age could bring experience, but on the other hand, older people could behave conservatively and may not be open to new ideas, thus continuing to maintain a place for wheat landrace production in their farming system.

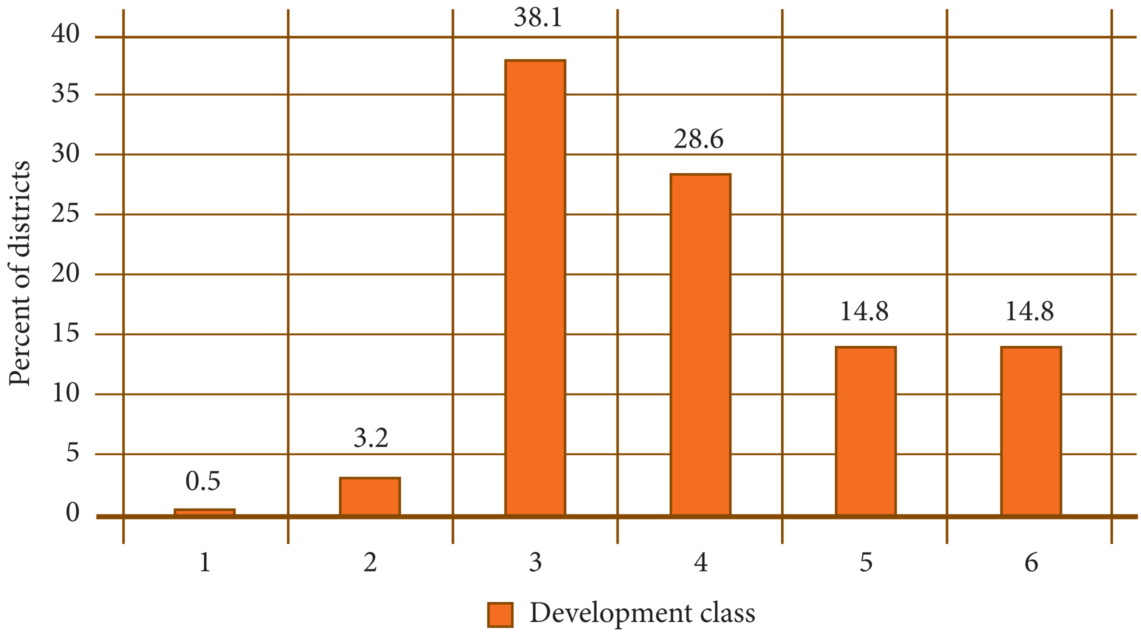


Figure 4.3 Distribution of districts according to development class

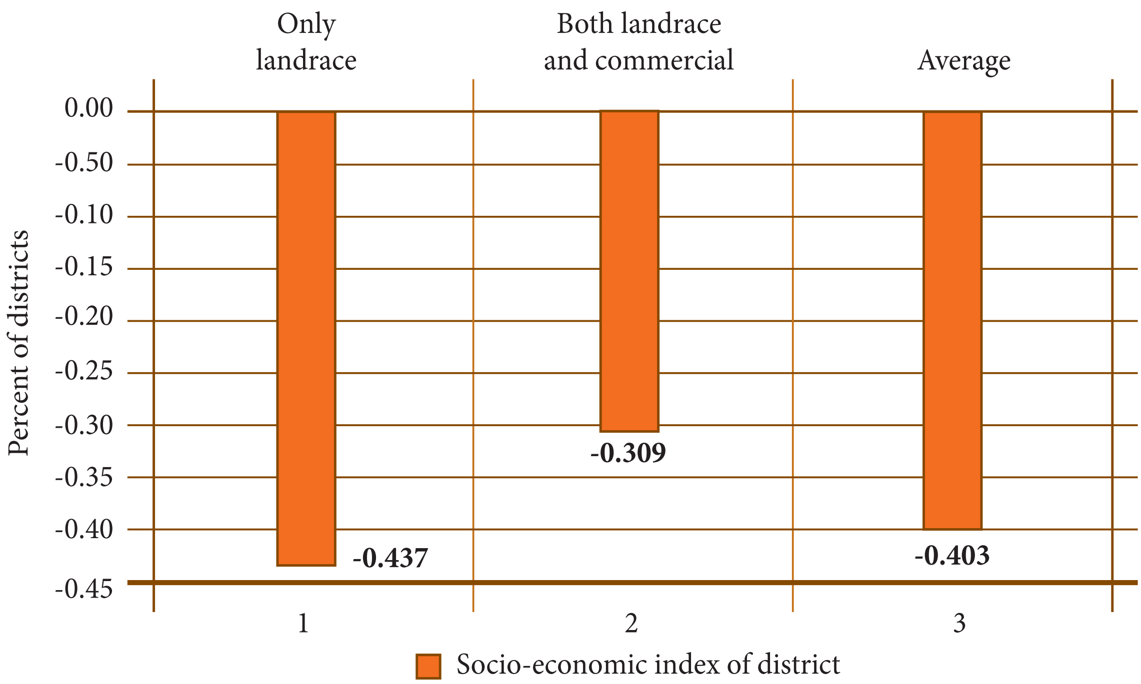


Figure 4.4 Socio-economic index values of districts according to type of landrace production

The average age of household head in the study was calculated as 53 years and while this varies by region, this age is greater than 50 years old in all regions (Table 4.4). Thus, the farmers engaged with wheat landrace production constitute the elder parts of the population. The differences in the regions are significant statistically at the 95% confidence level. Except for the age factor, none of the other studied socio-economic factors affect farmers' behaviors with respect to a preference between wheat landraces only or both wheat landraces and modern varieties together. The age of household heads (interviewed farmers) was found to bean important factor at the 90% confidence level (chi square: 2.95, p: 0.08). More farmers older than 50 years of age preferred to produce wheat landraces only, compared to the farmers younger than 50 years old (Figure 4.5)

Another demographic factor examined in the study was educational level of household heads. It is known that literacy rate is generally high in place where the agricultural activities are being done consciously (Şahin and Yılmaz, 2008). Educational level is also one of the most important factors in determining people's behavior and decisions (Kan, 2012). Increase in the level of education can have two different effects. First, as the level of education increases, people may engage in more commercialization activity and as a result of that, may adopt a production model using more modern technology and materials and more modern wheat varieties. Second, as the level of education increases, people may choose more organic, local, subsistence, or recreational agricultural activities. In such activities, despite the lower yield potential, local varieties which may have value in terms of flavor or aroma, as opposed to modern advanced varieties, are much more preferred in the production system. It was found that educational levels of household heads varied according to regions and the variation was statistically significant at the 99% confidence level. Of the total farming households surveyed, 70% of total household heads had reached a primary school educational level. The household heads in Middle Eastern

Table 4.4 Labor force characteristics of farms producing wheat landraces by region

Region	Farmer's age (Year)	Total number of males in HH[1]	Total number of females in HH	Number of people in HH	Male MLU[2]	Female MLU	Total MLU	Total MLU/ number of people in HH
Aegean Region	55.35	2.31	2.27	4.58	1.66	1.26	2.92	0.64
Middle Eastern Central Anatolia Region	53.68	2.73	2.68	5.40	2.01	1.57	3.58	0.66
Eastern Black Sea Region	55.08	2.29	2.28	4.57	1.90	1.29	3.19	0.70
Eastern Marmara Region	56.37	2.17	1.87	4.04	1.58	1.03	2.61	0.65
Mediterranean Region	54.83	2.51	2.13	4.64	1.85	1.24	3.09	0.67
Middle Eastern Anatolia Region	52.69	3.99	3.25	7.25	3.23	2.07	5.30	0.73
North Eastern Anatolia Region	51.82	3.52	3.15	6.66	2.59	1.80	4.40	0.66
Southeastern Anatolia Region	51.85	3.62	3.37	6.98	2.78	2.00	4.78	0.68
Western Central Anatolia Region	53.34	2.33	2.19	4.53	1.89	1.28	3.17	0.70
Western Black Sea Region	52.72	2.65	2.35	5.00	2.06	1.40	3.46	0.69
Western Marmara Region	55.52	1.94	1.86	3.80	1.53	1.03	2.56	0.67
National average	53.48	2.88	2.61	5.48	2.20	1.53	3.73	0.68
F value	2.39	30.70	21.97	34.40	31.47	25.80	37.33	
	*	***	***	***	***	***	***	

[1]HH: Household; [2]MLU: Man Labor Unit
*, ***Statistically significant at the 90% and 99% confidence levels, respectively

Anatolia, North Eastern Anatolia, and Mediterrenean Regions have slightly higher levels of education compared to other regions (Table 4.5).

The effects of educational levels of household heads on farmers' willingness to produce wheat landraces is shown in Table 4.6. As the educational level of household heads increased, the number of farms with wheat landrace production increased.

The relationship of wheat landrace production with respect to total area in agricultural production and to total area of wheat production, characterized by irrigation status by region ispresented in Table 4.7. Previous research demonstrated a positive relationship between farm size and the adoption of modern varieties (Perrin and Winkelmann 1976; Feder et al., 1985). Larger farmers may benefit from economies of scale, be able to dedicate some proportion of land to experimenting with modern varieties, or face lower information costs relative to small farmers (Kruzich and Meng, 2006). In Table 4.7 it is shown that the average farm size overall was 7.2 ha and 86.7% of it was a rainfed production system. Of the total cultivated area, 45.7% was allocated to wheat production, and 68.8% of that was allocated to wheat landrace production. Farm size varies by region and that variation is statistically significant at the 99% confidence. The smallest farm sizes were in the Western

Anatolia and the Mediterrenean Regions, and the largest farm sizes were in the Central Anatolia and North Eastern Anatolia Regions (Table 4.7). The region with the smallest share of wheat landrace area in the total wheat area was the Eastern Marmara Region (17.3%) and the region with the largest share was the Middle Eastern Anatolian Region (47.4%) (Figure 4.6). It was seen that as farm size increased, so did the area in which modern wheat varieties were being. If the farmer has a large production area, perhaps they are motivated to produce more marketable products (that is, modern varieties) and they allocate less space to wheat landrace production (Table 4.8).

Table 4.5 Classification of education levels of household heads of farms engaged in production of wheat landraces by region

Region	Farmer's education level (%)					
	Illiterate	Literate*	Primary school	Secondary school	Univer-sity	Total
Aegean Region	7.30	8.20	77.30	7.30		100.00
Middle Eastern Central Anatolia Region	4.50	11.80	80.00	3.20	0.50	100.00
Eastern Black Sea Region	5.50	5.50	82.20	6.80		100.00
Eastern Marmara Region		5.90	94.10			100.00
Mediterranean Region	5.90	10.70	73.10	7.10	3.20	100.00
Middle Eastern Anatolia Region	11.20	21.10	54.60	9.90	3.30	100.00
North Eastern Anatolia Region	5.30	11.00	72.80	9.30	1.60	100.00
Southeastern Anatolia Region	17.10	47.10	31.60	3.20	1.10	100.00
Western Central Anatolia Region	5.10	8.60	79.40	5.70	1.10	100.00
Western Black Sea Region	4.30	14.20	71.70	9.40	0.40	100.00
Western Marmara Region	4.00	12.00	80.00	4.00		100.00
National average	6.80	15.30	70.00	6.60	1.30	100.00
χ^2: 95.44 S.D.: 40 p value: 0.000 φ: 0.409 Statistically significant at the 99% confidence level						

*Literate' means 'can read, but has not completed primary school'

Table 4.6 Type of landrace production characterized by farmers' education level

Education level	Only landrace (%)	Both landrace and commercial (%)	Average (%)
Illiterate	6.46	8.00	6.85
Literate*	16.60	10.89	15.13
Primary school	69.72	71.33	70.13
Secondary school	5.61	9.33	6.57
University	1.61	0.44	1.31
Total	100.00	100.00	100.00
χ^2: 19.04 S.D.: 4 p value: 0.001 φ: 0.104 Statistically significant at the 95% confidence level			

*Literate' means 'can read, but has not completed primary school'

Table 4.7 Characterization of agricultural production area by region with respect to wheat landrace production and irrigation status

Region	Total cultivated area (ha)			Total wheat planted area (ha)			Total wheat landrace planted area (ha)		
	I[1]	R[1]	Total	I	R	Total	I	R	Total
Aegean Region	0.30	5.48	5.78	0.08	2.12	2.19	0.01	1.35	1.36
Middle Eastern Central Anatolia Region	0.35	10.80	11.15	0.10	5.10	5.20	0.06	4.08	4.15
Eastern Black Sea Region	0.30	5.77	6.07	0.11	2.58	2.68	0.11	2.38	2.49
Eastern Marmara Region	0.00	6.10	6.11	0.00	2.29	2.29	0.00	1.06	1.06
Mediterranean Region	0.49	4.85	5.34	0.14	2.36	2.50	0.07	1.79	1.86
Middle Eastern Anatolia Region	1.50	4.47	5.97	0.47	2.62	3.09	0.36	2.47	2.83
North Eastern Anatolia Region	2.99	6.91	9.90	0.60	3.19	3.78	0.53	2.45	2.98
Southeastern Anatolia Region	1.25	5.67	6.90	0.48	2.97	3.45	0.37	1.84	2.22
Western Central Anatolia Region	0.83	3.70	4.53	0.18	1.54	1.72	0.08	0.86	0.94
Western Black Sea Region	0.44	6.10	6.54	0.38	3.60	3.97	0.21	1.36	1.57
Western Marmara Region	0.08	8.14	8.22	0.01	3.27	3.28	0.00	2.22	2.22
National average	0.96	6.21	7.16	0.28	2.99	3.27	0.20	2.05	2.25
F value	21.17	7.87	9.17	7.53	5.73	5.82	11.62	13.76	15.12
	***	***	***	***	***	***	***	***	***

[1]I = Irrigated; R = Rainfed; ***Statistically significant at the 99% confidence level

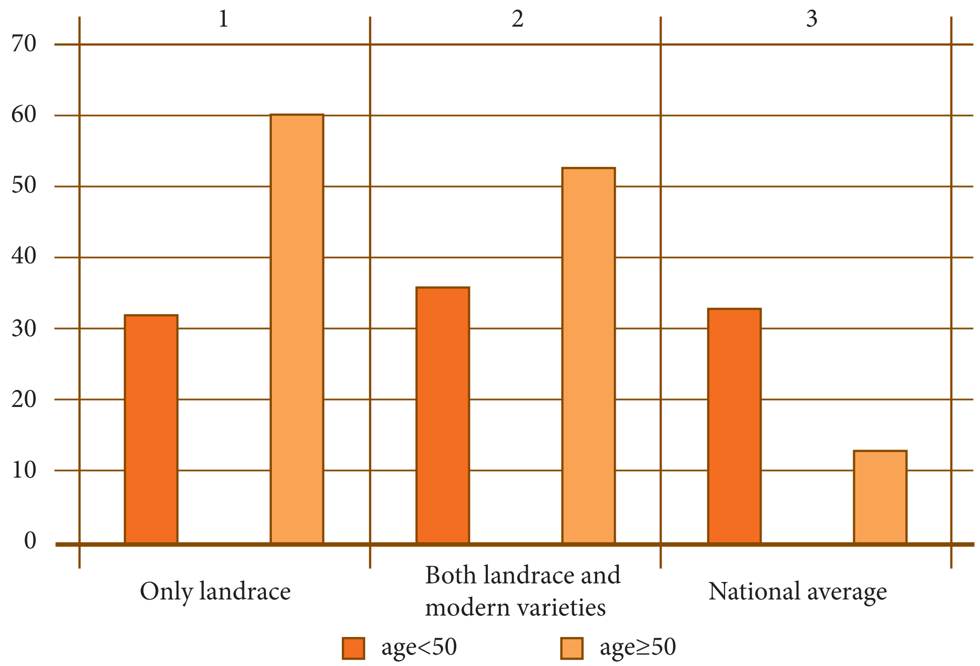


Figure 4.5 Distribution by age of farmer with respect to preferences for wheat landrace production (%)

4.3.3. Agricultural Practices of Wheat Landrace Producers

In this section, we present our analysis of all stages of wheat production, from sowing to marketing, with respect to the agronomic practices and yield values of wheat landraces at region, province, and district levels.

The intended use of local wheat production (Photo 4.1) differs according to sub-areas and this variation is statistically significant at the 99% confidence level. On average for Turkey as a whole, 55.7% of wheat landrace production is used in bread-making (village bread, phyllo, lavash), 35.8% is used in bulgur-making, and 2.6% in macaroni-making (noodle, pasta, etc.) (Table 4.9). Moreover, the straw is used as hay for animal fodder. While all the wheat landrace production in the Eastern Marmara Region is used in bread-making, in the Mediterranean Region and Southeastern Anatolia Region about half of the wheat landrace production (56.5% and 47.3%, respectively) is used in bulgur-making. The Aegean Region has the greatest usage of wheat landrace production as macaroni products (12.6%). Especially in the Eastern Black Sea region, wheat landraces of *T. monococcum* are used for feed (11.4%). (Table 4.9).

The impact of a farmer's previous experience with producing modern wheat varieties on the growing of wheat landraces was studied. There was a difference in the region with respect to the sub-areas, which is significant at the 99% confidence level (chi square: 242.39; p: 0.00; φ: 0.37). Nationally, an average of 35.5% of wheat landrace producers have planted commercial wheat varieties at one time. The regions with a high proportion of farmers planting commercial wheat types were the Western Black Sea Region, the Eastern Black Sea Region, the Eastern Marmara Region, and the Western Marmara Region (71.0%, 55.2%, 56.8%, and 52.0%, respectively) and the Western Central Anatolia Region was low (18.9%) (Figure 4.7). In Turkey overall, almost 80% of the farmers who have tried

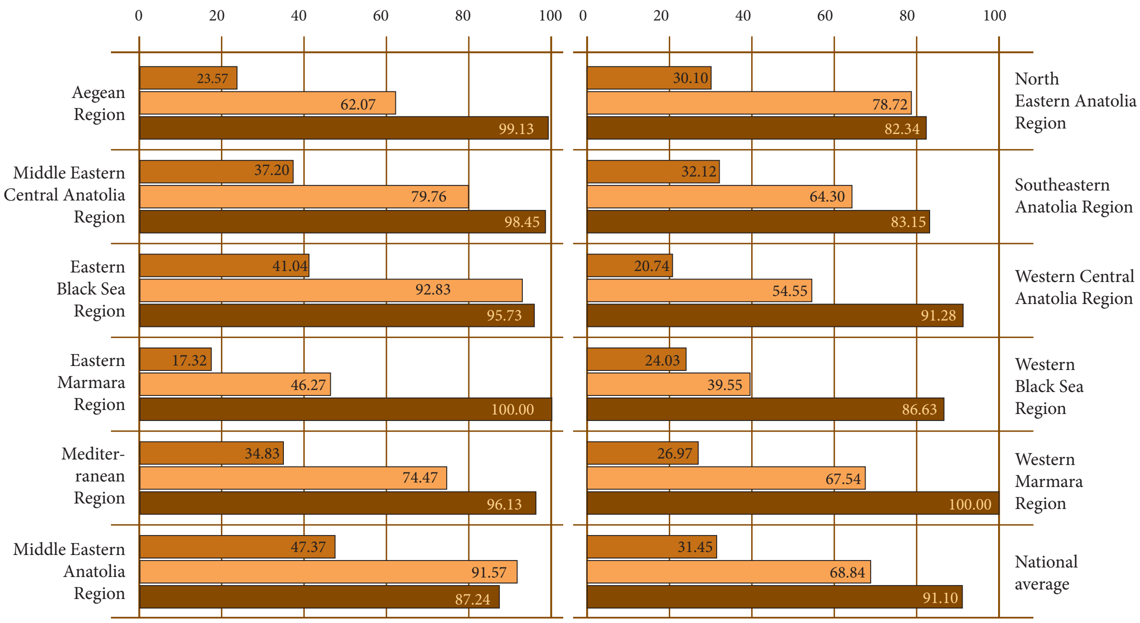


Figure 4.6 Wheat landrace production as a percentage of total agricultural production and as a percentage of total wheat production area, and rainfed wheat landrace production as a percentage of total wheat landrace production area by region

Table 4.8 Distribution of type of landrace production by acreage categories

Type of landrace production	Total cultivated area (ha)	Total wheat area (ha)	Total wheat landrace area (ha)
Landrace only	6.01	2.48	2.43
Both landrace and commercial variety	10.40	5.49	1.74
Average	7.16	3.27	2.25
t value	-5.65	-7.45	-4.00
	***	***	***
***Statistically significant at the 99% confidence level			

Table 4.9 Distribution of intended use of the wheat landrace production by region

Region	Bread (%)	Macaroni (%)	Bulgur (%)	Feed (%)	Other* (%)	Total (%)
Aegean Region	53.78	12.61	33.61	0.00	0.00	100.00
Middle Eastern Central Anatolia Region	59.87	2.34	34.11	0.00	3.68	100.00
Eastern Black Sea Region	67.14	0.00	21.43	11.43	0.00	100.00
Eastern Marmara Region	100.00	0.00	0.00	0.00	0.00	100.00
Mediterranean Region	42.14	1.00	56.52	0.00	0.33	100.00
Middle Eastern Anatolia Region	70.30	2.48	25.74	1.49	0.00	100.00
North Eastern Anatolia Region	75.71	0.00	15.46	0.95	7.89	100.00
Southeastern Anatolia Region	48.64	4.09	47.27	0.00	0.00	100.00
Western Central Anatolia Region	52.84	0.00	43.62	0.00	3.55	100.00
Western Black Sea Region	36.33	5.67	37.00	8.33	12.67	100.00
Western Marmara Region	62.71	1.69	30.51	0.00	5.08	100.00
National average	55.72	2.61	35.85	1.79	4.03	100.00
*Eriste, halvah, keşkek, Kadayif, etc.						

commercial wheat varieties have continued to produce them (Figure 4.8). The linkage between farmers' experience and socio-economic index of districts was evaluated and it was found that the wheat landrace farmers who had the most previous experience with commercial wheat varieties lived in districts having a better socio-economic index (-0.32), and vice versa (-0.45). This conclusion is statistically significant at the 99% confidence level (t value: 4.22) and it confirms our thesis on the relationship between development and farmers' adoption of wheat landrace production.

The agronomic practices of farmers suggest under which conditions wheat landraces are grown. Sowing time and sowing methods are analyzed as first agronomic practices. Wheat varieties can be of two types (winter and spring). Sowing time is governed by the climatic conditions of the region. In general, spring wheat cultivation is practiced especially in the places with high elevations and long winter periods, such as North Eastern and Middle Eastern Anatolia Regions. Overall in the study, we found that 90.9% of wheat landraces were winter sown and 9.1% of them were spring sown (Figure 4.9). The variation in sowing time with respect to regions is significant at the 99% confidence level (chi-square: 351.50; p: 0.00; φ: 0.44).

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Macaroni wheat (pasta)

©FAO/ Mustafa Kan

Bulgur

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Macaroni wheat (pasta)

©FAO/ Mustafa Kan

Cracked wheat

©FAO/ Mustafa Kan

Macaroni wheat (noodle)

©FAO/ Mustafa Kan

Village bread

©FAO/ Mustafa Kan

Village bread

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Phyllo

©FAO/ Mustafa Kan

Village bread making

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Phyllo making

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Kadayıf

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Straw making

Photo 4.1 Different uses of wheat landraces

Generally, the areas in which wheat landraces are sown are sloping lands rather than class 1 agricultural lands and the soil capability is at normal or low levels. These areas are generally not suitable for mechanization, and usually human and/or animal labor intensive agricultural practices are required. The adaptation of technological development to such areas is difficult. Most local producers grow wheat varieties for subsistence production rather than for commercial production and that adversely affects the adoption of new technologies at the farm level. The distribution of sowing methods for wheat landrace production is shown in Figure 4.10 by region. Even though sowing method varies by region, wheat landraces in the research area were sown generally by hand (59.0%). While the proportion using the slit-seeder sowing method was 18.5%, the wealthy farms having large farm size and access to technology preferred the drilling method to sow wheat landraces (22.4%).

The proportion of seed planted by hand (labor intensive) relative to the available human labor force also affects the amount of seed planted. The amount of seed planted can vary according to geography, technology used in sowing, variety features, sowing time, and irrigation facilities. Amount of seed used in wheat landrace production was shown in Figure 4.11 and Table 4.10 by regions. The amount of seed planted varies according to region, statistically significant at the 99% confidence level (F value: 30.45, p: 0.00).

Nationally, the average amount of wheat landrace seed sown was 252.4 kg/ha, the amount of seed sown in irrigated conditions was higher at 271.4 kg/ha and lower in rainfed conditions, 249.5 kg/ha (Table 4.10). With respect to means of seed sowing (Photo 4.2), the amount sown by slit-seeder (271.7 kg/ha) is greater than the amount sown by hand (245.5). More seed was sown in irrigated conditions than in rainfed condition. Overall

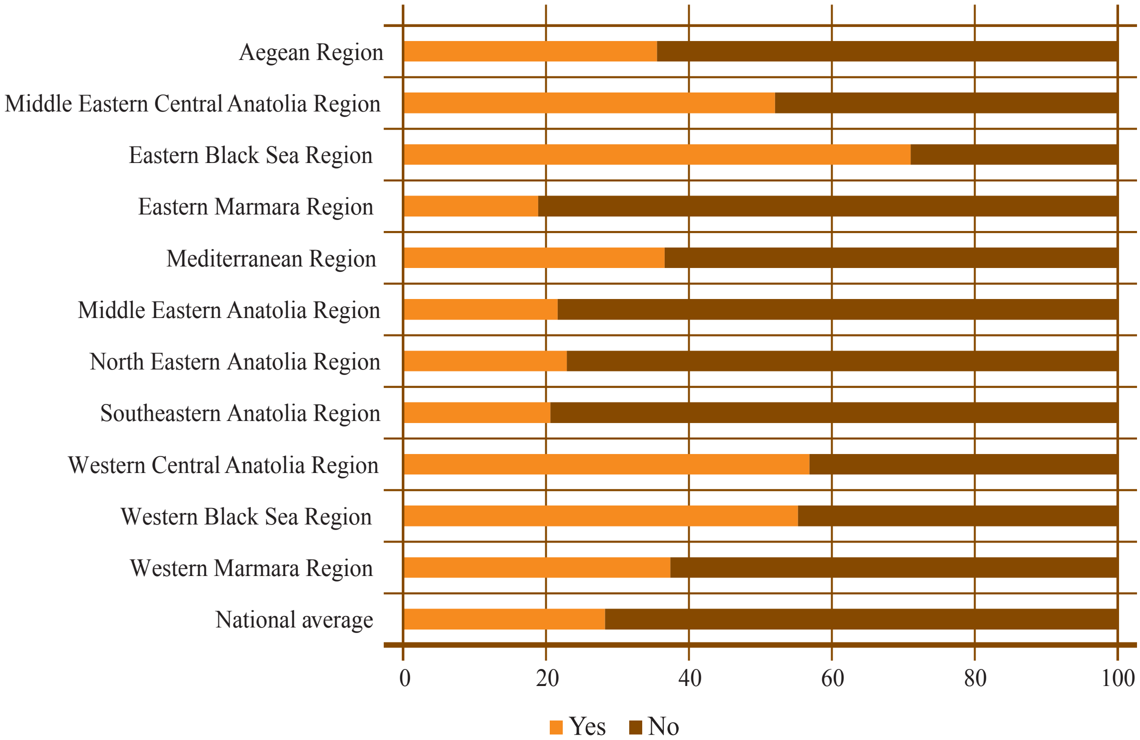

Figure 4.7 Proportion of farmers who have tried modern wheat varieties by region (%)

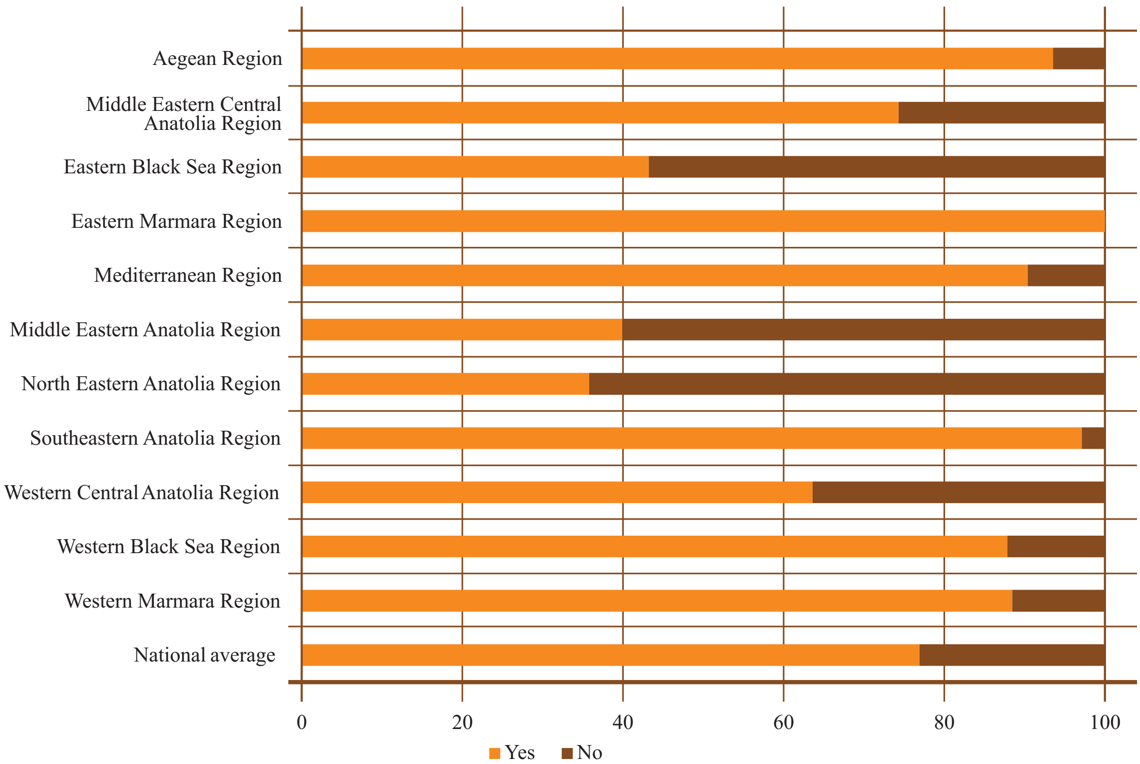

Figure 4.8 Proportion of farmers who have continued production of modern wheat varieties by region (%)

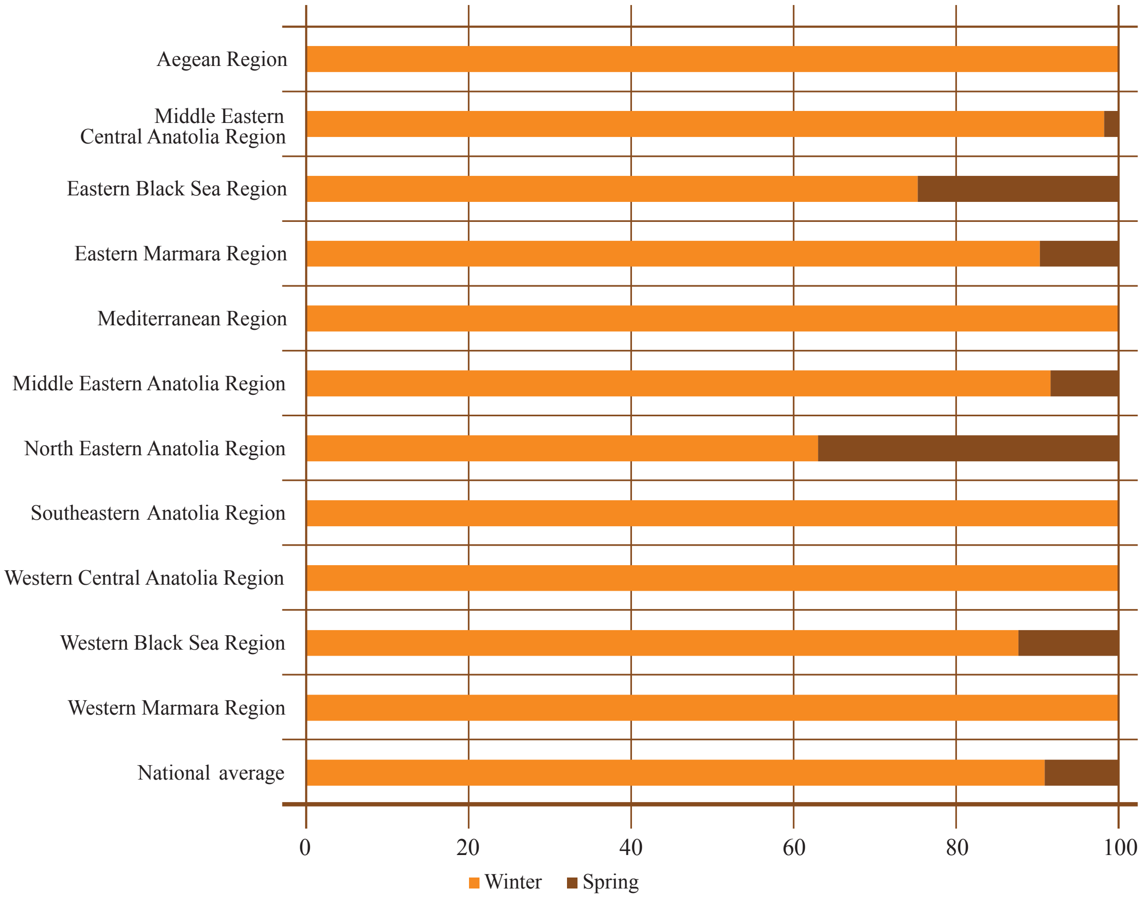

Figure 4.9 Time of sowing for wheat landrace production by region (%)

categories, the amount of seed sown varies by region, the presence of irrigation facilities, and the sowing method. This variance is statistically significant at the 99% confidence level (Table 4.10).

Another variable impacting production of wheat landraces is the source of landrace seeds. It is known that the number of wheat landraces is decreasing and landraces have been substituted by modern wheat varieties for many reasons. The decrease in the number of farmers growing wheat landraces means easy access to wheat landrace seed decreases. The distribution of the various sources of wheat landraces seed was shown in Figure 4.12 by region. Overall, 83.7% of total wheat landrace producers obtained their seed from their own wheat landrace production, 12.1% of them obtained seed from relatives and neighbors, and 3.5% of them obtained their seed from seed traders. The percentages change according to the region and this variation is statistically significant at the 99% confidence level (chi square: 166.49, p: 0.00, φ: 0.31). Thus the main source of wheat landrace seed is the farmers themselves. This shows that the seed of wheat landraces in general continue to be exposed to selection pressures of the environmental conditions in the regions where they are used, as well as subject to the selection pressures arising from the production systems in which they are grown.

Other agronomic applications that impact wheat landrace production are the seed cleaning and the seed pesticide application practices of the farmers. While seed cleaning is important for removing foreign seeds, seed pesticide application is important for pre-

Hand-scattering

Hand-scattering

Drilling

Slit-seeder

Photo 4.2. Different sowing methods:

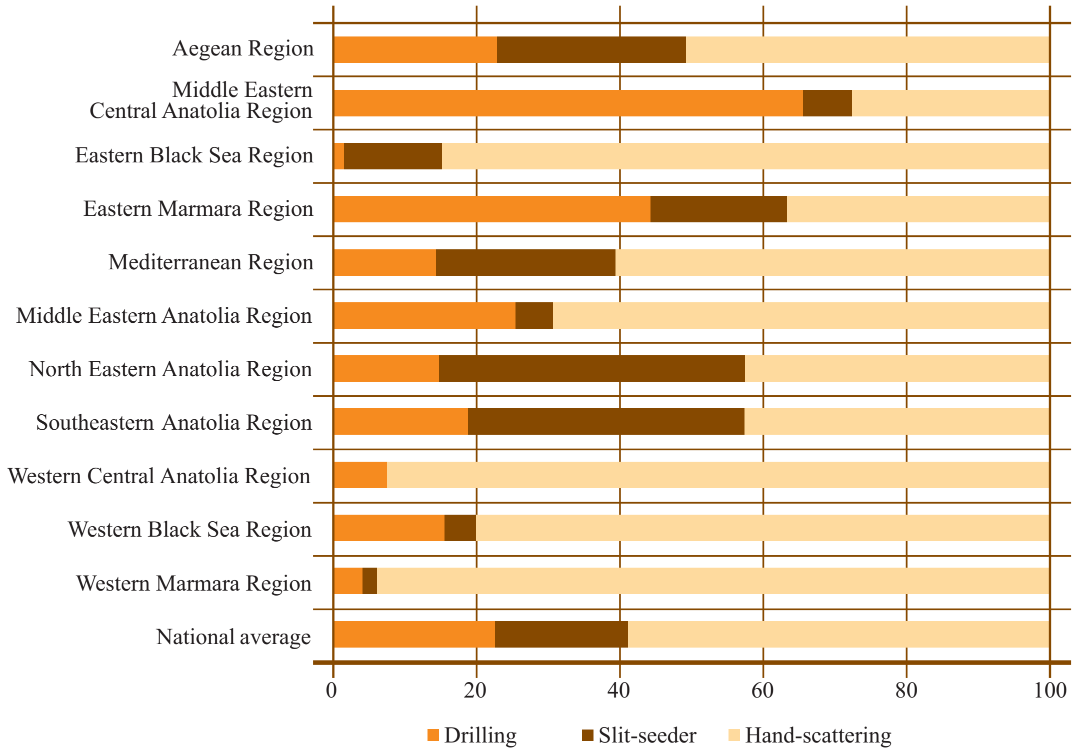

Figure 4.10 Sowing method for wheat landrace production by region (%)

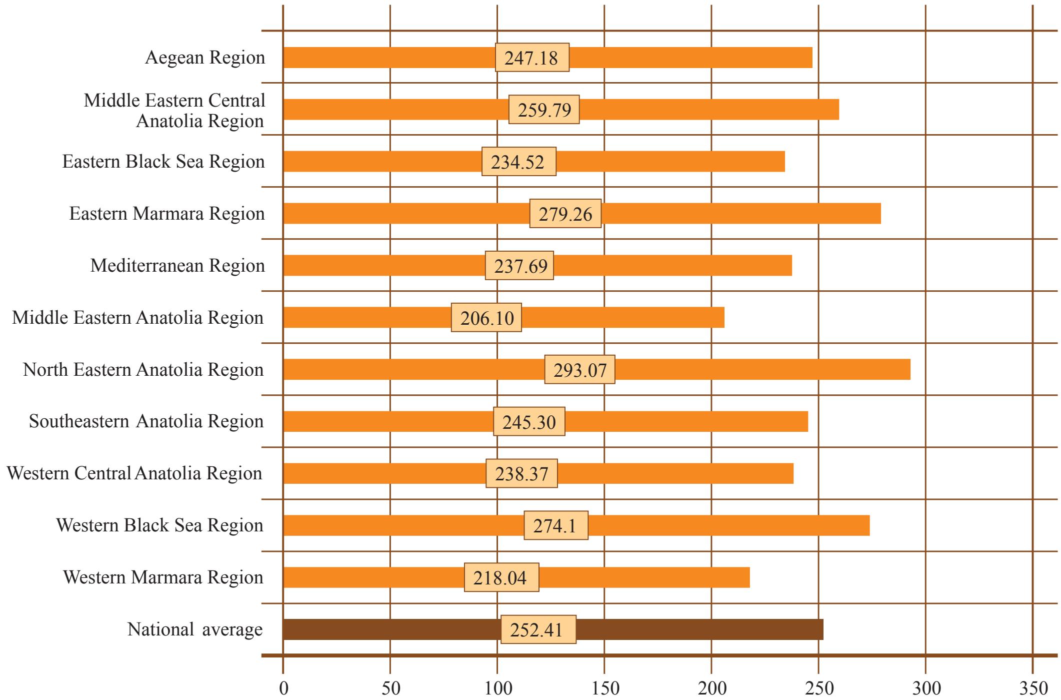

Figure 4.11 Amount of wheat landrace seed sown by region (kg/ha)

venting infection by seed-borne diseases. Especially in Turkey, the bunt disease named colloquially as "Kör", "Karadoğu", or "Karamuk" is a spike disease transmitted through seed, but able to be prevented by application of a seed pesticide. The lack of certified seed sources for local varieties or landraces (excluding Kırik) and the fact that wheat landraces are populations rather than pure lines as used in farmers' conditions, generally means they are produced in harsh conditions leading to increased exposure to biotic and abiotic challenges. The extent of farmers' practices of seed cleaning and seed pesticide use by region was shown in Figures 4.13 and 4.14, respectively. While overall in Turkey, 68.8% of wheat landrace producers practiced seed cleaning (Figure 4.13) (typically with simple hand sieves as in Photo 4.3), 68.4% of them applied seed pesticides in wheat landrace production (Figure 4.14).

Seed cleaning practice and seed pesticide use vary by region and that variance is statistically significant at the 99% confidence level (chi square: 207.18, p: 0.00, φ: 0.34; chi square: 147.09, p: 0.00, φ: 0.21; respectively). While the lowest proportion of farmers practicing seed cleaning was in the Eastern Black Sea Region, the highest was in the Middle Eastern Anatolian and Aegean Regions (Figure 4.13). While the lowest proportion of farmers applying seed pesticides was in the Eastern Black Sea and North Eastern Anatolia Regions, the highest was in the Aegean, Middle Eastern Central Anatolia, and Western Marmara Regions (Figure 4.14).

As do all plants, wheat needs fertilizers, especially nitrogen and phosphorus to achieve sufficient yield and quality. The most important soil property for wheat production is the amount of soil organic matter. It is deficient in many regions of Turkey. Animal manure constitutes an important input to address organic matter deficiency in the soil (Photo 4.4). It was found overall for Turkey that 25.2% of wheat landrace producers used animal

Table 4.10 Amount of wheat landrace seed sown by region, irrigation status, and sowing method

Region	Seed amount (kg/ha)
Aegean Region	247.18
Middle Eastern Central Anatolia Region	259.79
Eastern Black Sea Region	234.52
Eastern Marmara Region	279.26
Mediterranean Region	237.69
Middle Eastern Anatolia Region	206.10
North Eastern Anatolia Region	293.07
Southeastern Anatolia Region	245.30
Western Central Anatolia Region	238.37
Western Black Sea Region	274.11
Western Marmara Region	218.04
National average	252.41
F value	30.45***
Irrigation status	
Irrigated	271.35
Rainfed	249.49
National average	252.41
t value	4.07***
Sowing method	
Drilling	251.51
Slit-seeder	271.73
Hand-scattering	245.45
National average	252.41
F value	20.38***
***Statistically significant at the 99% confidence level	

manure (Figure 4.15), while the overall proportion of producers using chemical fertilizer was 17.6% (Figure 4.16). The regions with the highest use of fertilizers were North Eastern Anatolia (34.6%), Eastern Black Sea (34.0%), Middle Eastern Central Anatolia (32.5%), and Western Black Sea (30.2%) (Figure 4.16)

The amounts of pure nitrogen (N), phosphorus (P), and potassium (K) contributed as fertilizer applications are presented in Table 4.11 and Figure 4.17. The average overall for wheat landrace production was 59.8 kg/ha N, 35.3 kg/ha P_2O_5, and 0.50 K_2O. The values varied by region and the variance is significant statistically at the 99% confidence level (Table 4.11). The greatest amounts of nitrogen and phosphorus usage per hectare were in the Mediterranean Region with 83.3 kg/ha and 53.7 kg/ha, respectively and the least amounts of them were in the Eastern Black Sea Region with 34.1 kg/ha and 3.9 kg/ha, respectively (Figure 4.17). The amount of fertilizer used differed in irrigated and rainfed areas and that varied also by region. In irrigated areas overall, the amounts were 64.0 kg/ha N, 30.1 kg/ha P_2O_5, and 1.2 kg/ha K_2O, and in rainfed areas it was 59.0 kg/ha N, 36.2 kg/ha P_2O_5, and 0.3 kg/ha K_2O.

Another variable examined in this study was the frequency of seed change by wheat landrace producers. This also gives extra information on seed networks that are involved. Table 4.12 shows the frequency of seed change by wheat landrace producers by region.

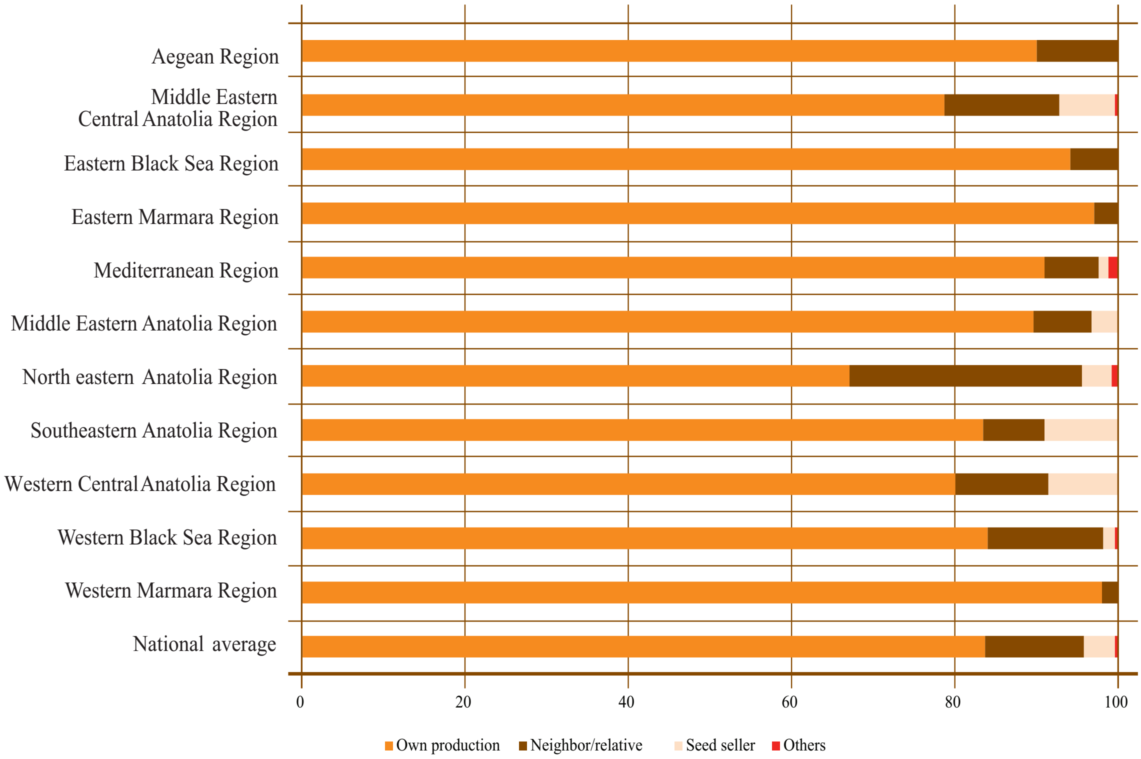

Figure 4.12 Source of seed for wheat landrace production by region (%)

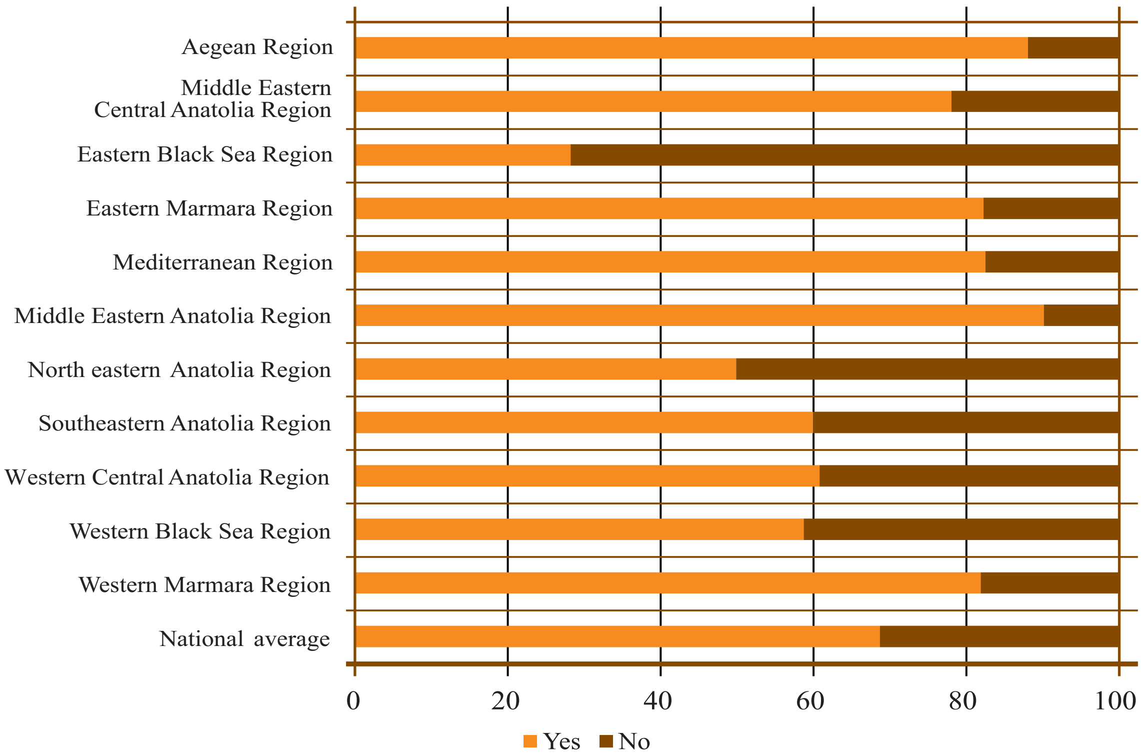

Figure 4.13 Distribution of farmers' practice of seed cleaning in wheat landrace production by region (%)

Overall for Turkey in general, 41.7% of wheat landrace producers do not change their seed. They obtain their seed for next season by taking a portion of the harvest production of the current season. There are also producers who select spikes from their wheat landrace fields and grow wheat landrace seeds in small plots inside their wheat landrace fields for increase for planting seed for the next year. The largest proportion of producers not changing their seed was in the Western Marmara Region with 92.2% and the Eastern Black Sea Region with 77.6%. Overall, 35.6% of wheat landrace producers changed their seeds at an interval of 1 to 5 years. When the most important seed source is found to be

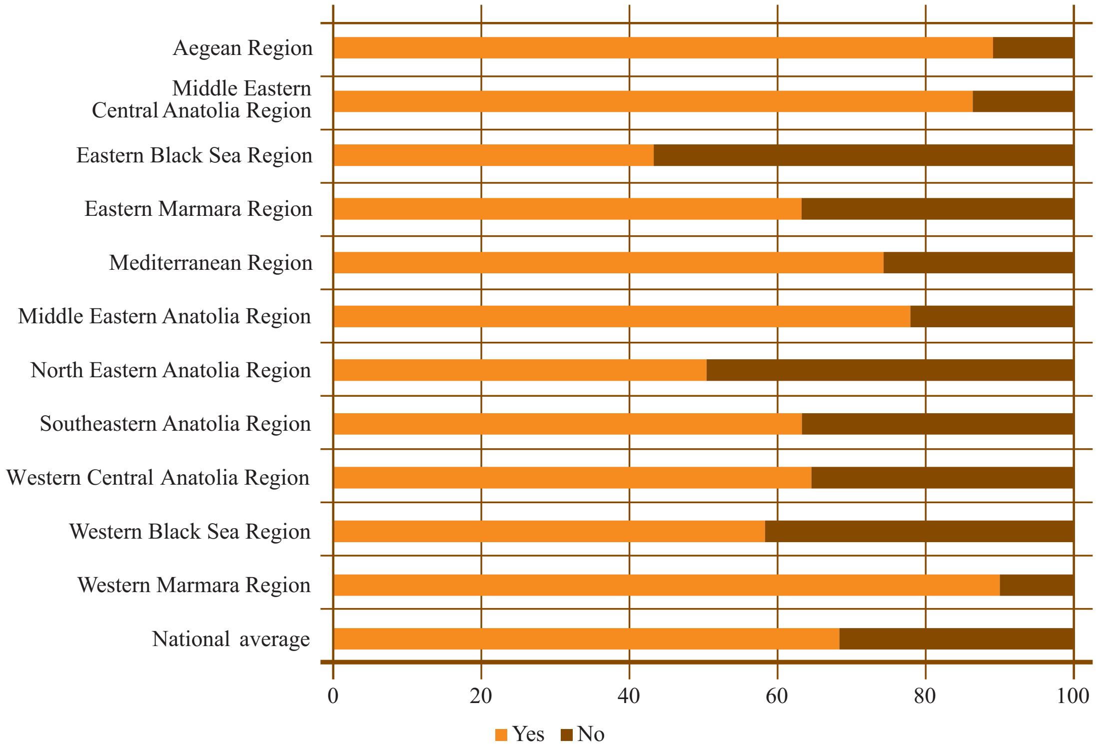

Figure 4.14 Distribution of farmers' use of seed pesticides for wheat landrace production by region (%)

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Seed-cleaning

©FAO/ Mesut Keser

Sieve

Photo 4.3. Seed cleaning technique and equipment (sieve) relatives and neighbors, it means that the wheat landrace seed network is limited at teh village or district level and especially so at the province level. Local seed material can be exchanged by the producers. According to the national seed law (Law No. 5553 of October 31, 2006), in the Seedling Trade part of the law, Article 7, "Domestically, the trade of seedlings belonging to registered varieties shall be permitted". Because landraces are not registered in the national registration system, the local seed trade is banned legally; therefore, seed barter takes place in the form of swapping.

The other production practices investigated were harvesting and threshing applications. The first harvesting variable is time of harvest. It was examined in comparison with

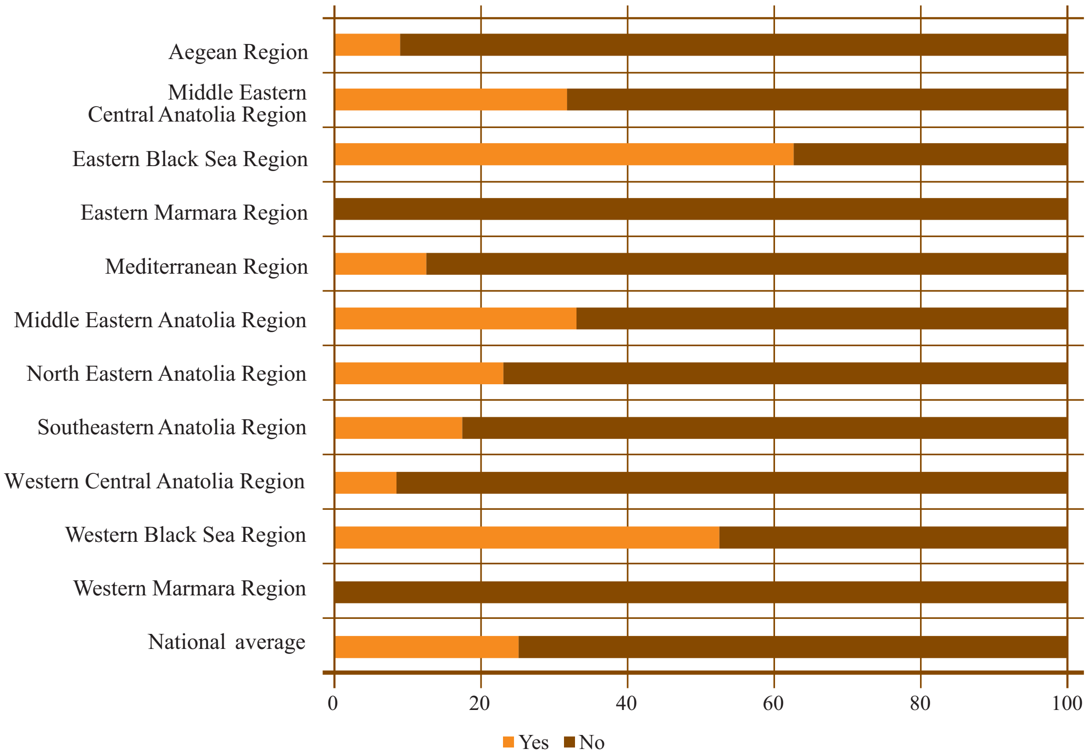

Figure 4.15 Distribution of farmers' use of animal manure for wheat landrace production by region (%)

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Photo 4.4. Techniques of using animal manure

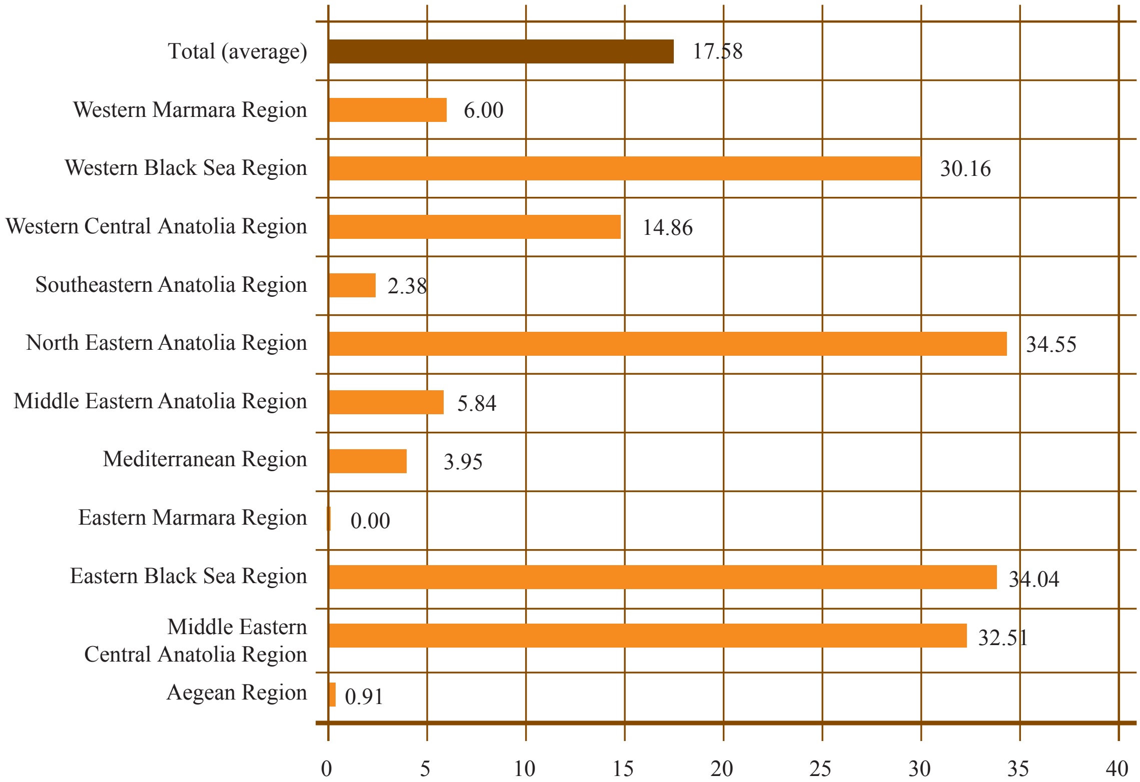


Figure 4.16 Proportion of farmers' use of fertilizer for wheat landrace production by region (%)

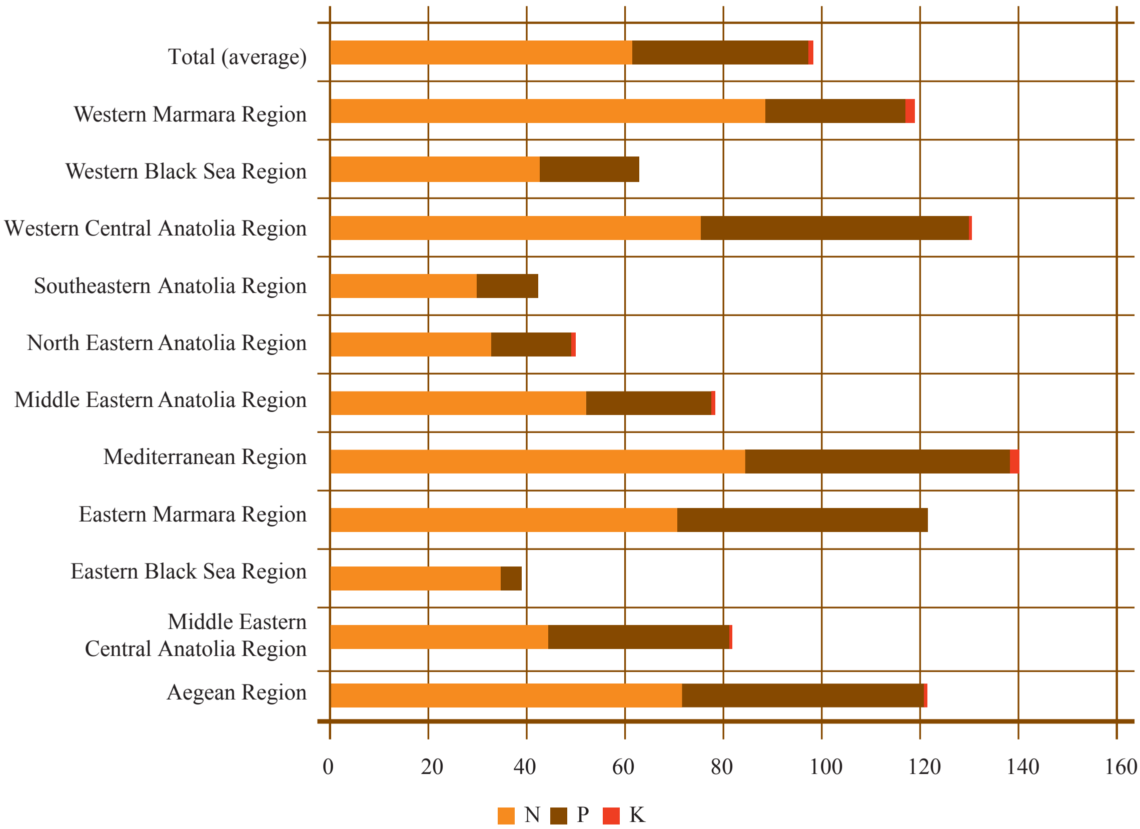


Figure 4.17 Rate and type of fertilizer used for wheat landrace production by region (kg/ha)

Table 4.11 Amount and type of fertilizer used in wheat landrace production in irrigated and rainfed conditions by region (kg/ha)

Region	Irrigation	N	P_2O_5	K_2O
Aegean Region	Irrigated	110.00	40.00	0.00
	Rainfed	70.76	48.81	0.28
	Total	71.12	48.73	0.27
Middle Eastern Central Anatolia Region	Irrigated	78.53	75.49	0.00
	Rainfed	46.07	37.40	1.37
	Total	47.83	39.46	1.29
Eastern Black Sea Region	Irrigated	0.00	0.00	0.00
	Rainfed	34.84	4.00	0.00
	Total	34.10	3.91	0.00
Eastern Marmara Region	Rainfed	71.18	51.65	0.00
	Total	71.18	51.65	0.00
Mediterranean Region	Irrigated	72.88	52.88	16.88
	Rainfed	83.98	53.80	0.32
	Total	83.28	53.74	1.36
Middle Eastern Anatolia Region	Irrigated	60.71	20.81	0.00
	Rainfed	43.30	26.30	0.26
	Total	49.86	24.24	0.16
North Eastern Anatolia Region	Irrigated	53.44	12.72	0.19
	Rainfed	21.62	19.82	0.27
	Total	34.04	17.05	0.24
Southeastern Anatolia Region	Irrigated	105.08	29.44	0.00
	Rainfed	79.76	36.50	0.00
	Total	83.37	35.49	0.00
Western Central Anatolia Region	Irrigated	78.41	89.49	0.00
	Rainfed	75.37	49.84	0.21
	Total	75.77	55.05	0.18
Western Black Sea Region	Irrigated	46.59	33.75	0.00
	Rainfed	43.32	20.29	0.00
	Total	43.46	20.86	0.00
Western Marmara Region	Rainfed	87.75	27.77	0.60
	Total	87.75	27.77	0.60
National average	Irrigated	64.05	30.18	1.24
	Rainfed	59.02	36.17	0.37
	Total	59.77	35.28	0.50
F value (Region)		40.36***	24.09***	2.69***
t value (Irrigation)		1.63*	-2.06**	1.41

*, **, ***Statistically significant at the 90%, 95%, and 99% confidence levels, respectively

harvest of commercial varieties also grown in the region. In the country in general, wheat landraces were harvested at the same time as commercial wheat varieties by 35.5% of farmers (Figure 4.18). However, 23.1% of wheat landrace producers did not know what commercial wheat varieties were grown near their farms and thus could not make a comparison for harvesting time. When comparisons could be made, wheat landraces were harvested later than were commercial varieties by 25.1% of farmers. It is more likely that local wheat landrace populations would reach harvest stage later than commercial varieties. One of the most important consequences of this lateness character of wheat landraces could be increased resistance to abiotic stress conditions.

Overall, the different harvesting practices found were use of sickle and/or swath (by hand) (used by 36.7% of farmers), combine harvesting (used by 33.1%), and towed harvester (used by 30.2%) (Figure 4.19, Photo 4.5). Harvesting is one of the most important steps of wheat production that requires use of technology. The typically harsh geographical conditions where the wheat landraces are grown means wheat cultivation areas are small and more fragmented and these situations affect negatively the technology that can be used for harvesting. Overall in Turkey, the proportions of farmers using the three different harvesting practices were similar, each about 30%. The relative proportions of harvesting practices varied by region and that variance was statistically significant at the 99% confidence level (chi-square: 417.97, p: 0.00, φ: 0.49). The combine harvester was

Table 4.12 Frequency of seed change by region

Region	How often do you change seed (%)						Total
	No change	1 to 5 years	6 to 10 years	11 to 20 years	21 to 30 years	More than 31 years	
Aegean Region	51.82	6.36	17.27	21.82	0.91	1.82	100.00
Middle Eastern Central Anatolia Region	50.96	39.90	5.29	2.40	1.44		100.00
Eastern Black Sea Region	77.61	20.90	1.49				100.00
Eastern Marmara Region	10.29	5.88	45.59	22.06	16.18		100.00
Mediterranean Region	60.87	8.70	5.93	11.46	10.67	2.37	100.00
Middle Eastern Anatolia Region	7.79	67.53	20.13	2.60	1.95		100.00
North Eastern Anatolia Region	37.80	42.28	16.67	2.03	0.41	0.81	100.00
Southeastern Anatolia Region	12.30	50.27	23.53	9.63	3.74	0.53	100.00
Western Central Anatolia Region	46.20	43.27	8.19	1.17	0.58	0.58	100.00
Western Black Sea Region	43.00	50.24	6.28	0.48			100.00
Western Marmara Region	92.16	5.88	1.96				100.00
National average	41.75	35.60	12.83	5.98	3.14	0.70	100.00

the primary harvesting practice used in the Aegean, Eastern Marmara, Middle Eastern Central Anatolia, Middle Eastern and Southeastern Anatolia Regions, sickle/swath (by hand) was the primary practice used in Western Central Anatolia, Western Marmara, Middle Eastern Anatolia, and Eastern Black Sea Regions where the topography and geography are rugged and mechanical harvesting is difficult. Towed harvester was most frequently used in the North Eastern Anatolia Region.

Valuation of the wheat landrace crop was the next practice investigated. The end result for a wheat landrace crop is either to be sold as raw material or finished product or to be stored for consumption. These results are based on the valuation of the crop by the grower and are influenced by the type of farming system: commercial or subsistence. The proportions of wheat landrace producers choosing the various end results for their crops was presented in Figure 4.20 by region. It was found that overall, 71.7% of wheat landrace producers were engaged with subsistence farming systems and did not sell their wheat landraces, 13.0% of them sold less (less than 50%), 12.6% of them sold more (more than 50%) and 2.8% of them sold all (100%) of wheat landrace production. The end results for wheat landrace crops vary by region and that variance is statistically significant at the 99% confidence level (chi-square: 259.42, p: 0.00, φ: 0.39). Tan (2002) determined that 84.4% of wheat landrace producers were producing wheat landraces for self-consumption in her study carried out in Turkey's Western Transitional Zone.

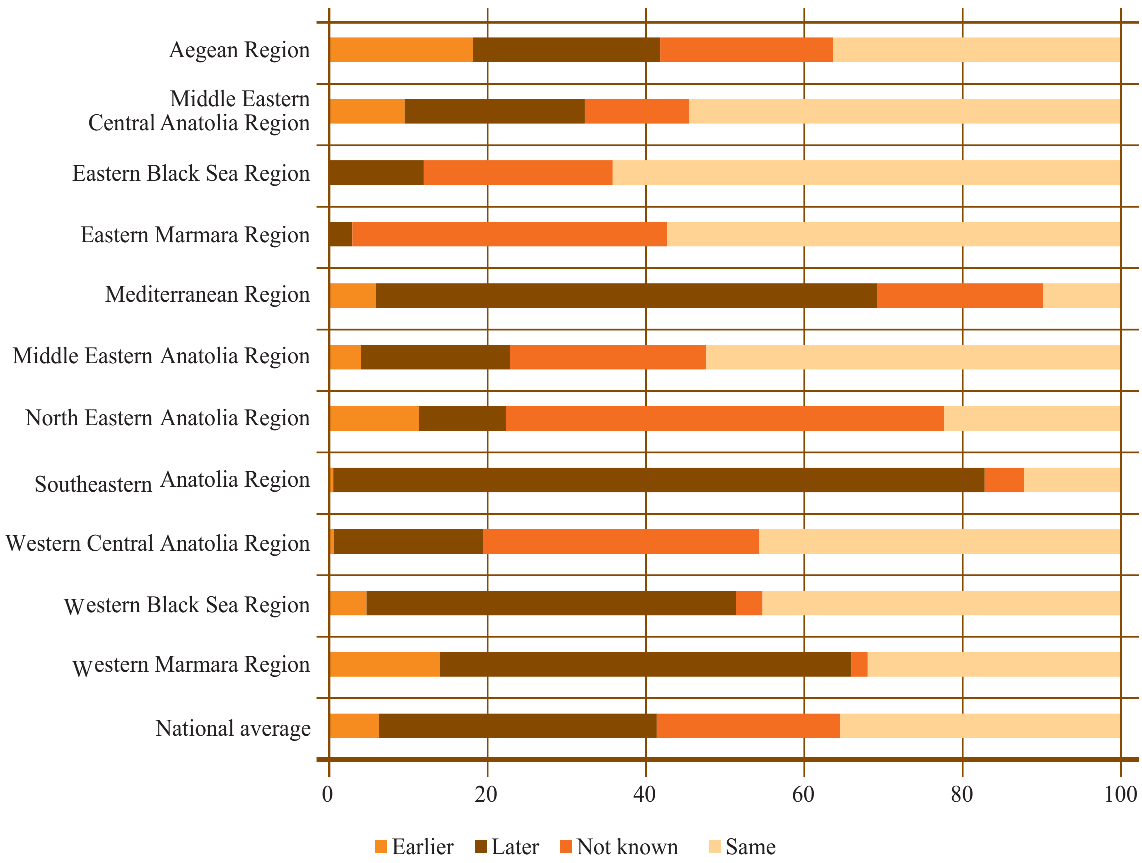


Figure 4.18 Farmers' responses to whether wheat landrace harvest will be based on harvest time of improved wheat varieties by region

Access to markets appears to play an especially important role in the farmer's decision to cultivate wheat landraces. Table 4.13 showed how the percentage of household wheat sales varied by selected household characteristics. Households with the smallest percentages of wheat market sales faced the greatest distances to markets. These households are also among the lowest with respect to receiving information transmitted through extension programs from outside villages. Finally, households with smallest percentages of wheat market sales are characterized by having the smallest amount of total land owned as well as having a relatively small percentage of available irrigated land. The farmers selling more wheat landraces have greater wheat landrace production areas. These variables affecting the wheat valuation strategies of the households vary significantly at the 99% confidence level.

The choice by farmers of place to market wheat landraces was studied and the results are presented in Figure 4.21. While overall, 21% of wheat landrace producers sold their wheat landrace production outside of the village, about 8% of them sold their wheat landrace production within the village, and the rest did not sell their production. The proportion of farmers selling their wheat landrace production inside and outside of the village varied by region and this variance was statistically significant at the 99% confidence level (chi-square: 164.20, p: 0.00, φ: 0.31). Producers in the Western Central Anatolia and Western Marmara Regions had the highest proportions (14.3% and 14.0%) of those who preferred the market places within the village (for various reasons: geographical conditions, transportation problems, distance from the main centers

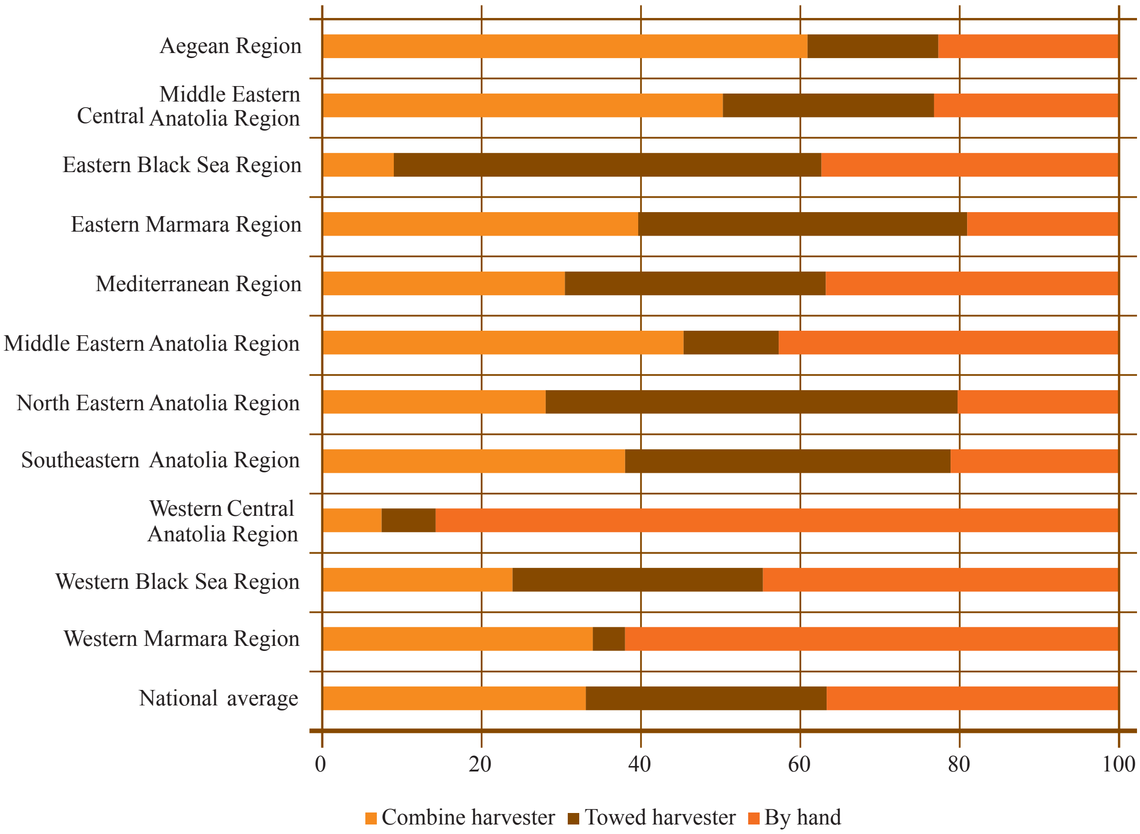


Figure 4.19 Distributions of farmers' wheat landrace harvesting methods by region (%)

Towed harvester

Combine harvester

Scythe

Harrowed harvest

Sickle

Transporting crop

Photo 4.5. Different harvesting techniques and equipment and main market places, etc.). Producers in the Middle Eastern Central Anatolia and Western Black Sea Regions had the highest proportions (33.2% and 32.7%) of those who preferred market places outside of the village.

One of the most important features of the wheat landrace populations collected in the scope of this study was plant height. While tall plants can be sometimes disadvantageous, in this study, it was shown that wheat landrace growers mostly produced them primarily for two purposes, especially if the grower was mainly engaged with subsistence farming. The first purpose is to meet human food needs and the second is to meet their animal needs, if the farmer was also engaged with animal production. For animal needs, straw is the essential product and tall plants become advantageous by yielding high straw biomass. The average height of wheat landrace populations studied was presented by region in Figure 4.22. Overall, the average height of wheat landrace populations was about 1.1 m, but in some regions it can reach heights of about 1.4 m (for example, in Western and Eastern Marmara Regions, average heights were 136.1 cm and 134.7 cm, respectively). In nearly all regions, the average height of wheat landrace populations is greater than the national average.

The decisions of wheat landrace producers on whether to market their production as processed products or as straw were presented in Figure 4.23. More than 90% of wheat landrace producers in Turkey overall did not sell their own wheat as processed products and 85.5% of them did not sell their own straw production. It means that the one of the farmers' aims in producing wheat landraces is to obtain straw for on-farm animal feed.

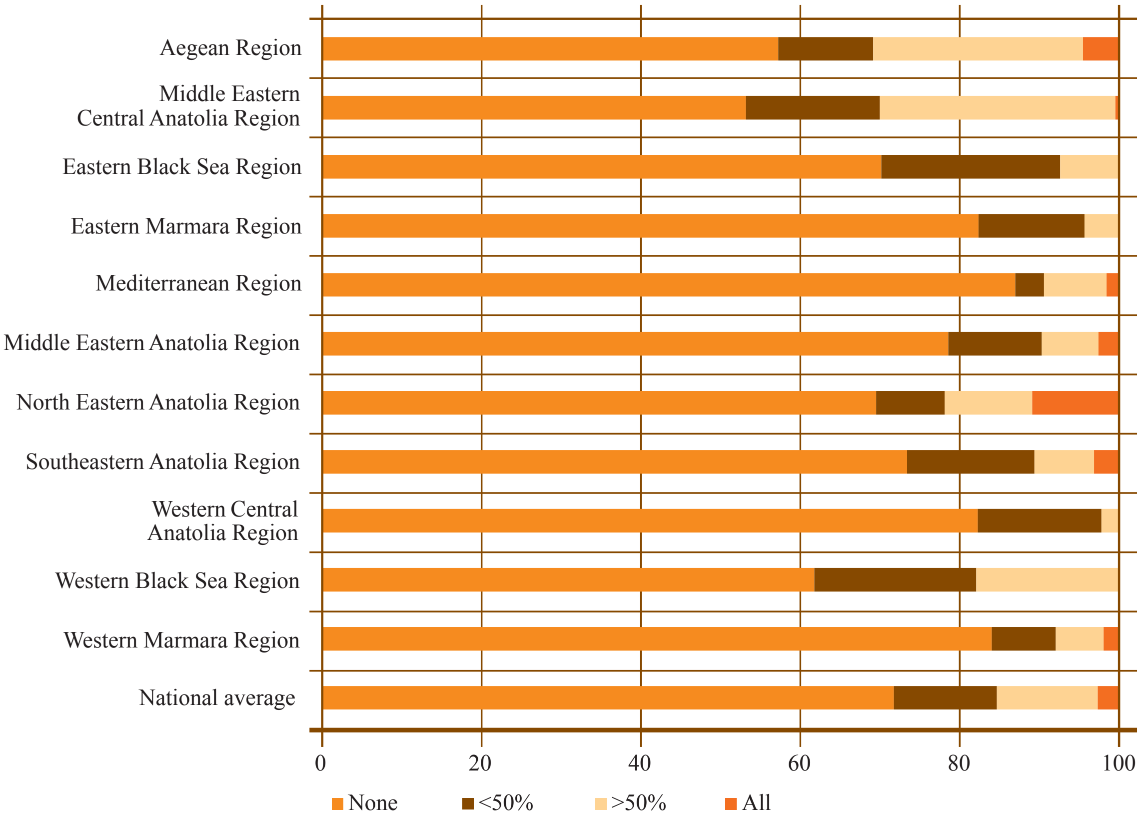


Figure 4.20 Distribution of farmers' valuation of wheat landrace crops based on extent of crop offered for sale by regions (%)

Table 4.13 Household valuation of wheat landraces as measured by amount of harvest sold as related to several production and geographic factors

Amount sold	Distance to market (km)	Elevation (m)	Total cultivated area (ha)	Total cultivated area (irrigated) (ha)	Total wheat area (ha)	Total wheat landrace area (ha)
None	19.08	1,135	5.11	0.70	2.18	1.57
< 50%	19.59	1,145	10.37	0.65	5.23	3.10
> 50%	15.85	1,210	12.50	1.58	6.18	4.67
100%	14.03	1,104	22.15	6.88	10.24	6.18
F value	8.06	2.23	75.55	64.66	73.30	68.12
	***	*	***	***	***	***
*, ***Statistically significant at the 90% and 99% confidence levels, respectively						

Another feature distinguishing wheat landrace populations from current commercial wheat varieties is the low yield potential of landraces (Ehdaie et al., 1988; Blum et al., 1989). Wheat landraces have been largely displaced by high-yielding cultivars in many developing countries and are rarely cultivated in developed countries because of their low yield potential when compared with high-yielding cultivars under high external input farming systems (Jaradat, 2012). The yield performance of the bread, durm, and feed wheat landrace populations collected in this study under bad, normal, and good growing conditions and in both irrigated and rainfed conditions, were presented in Figures 4.24 and 4.25 and in Table 4.14. The overall national average yield according to growing conditions was 1,254 kg/ha in bad conditions, 1,983 kg/ha in normal conditions, and 2,762 kg/ha in good conditions (Figure 4.24). The yield differences by region were

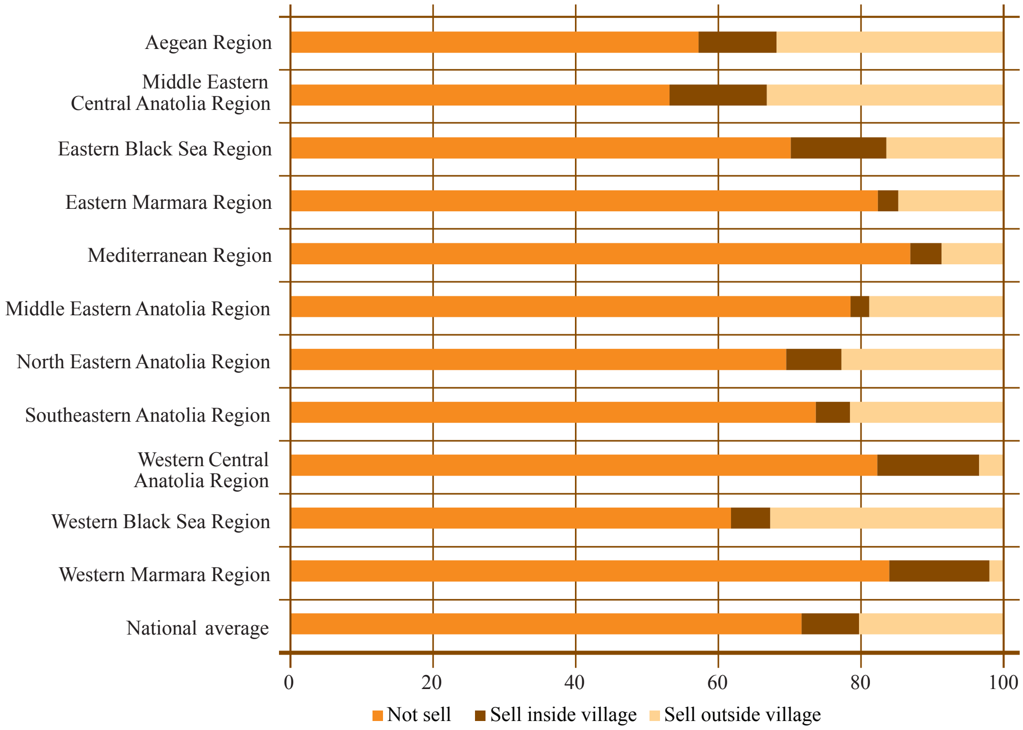


Figure 4.21 Distribution of farmers' preferences on place to market wheat landraces by region (%)

found to be statistically significant at the 99% confidence level for each growing condition (bad, normal, and good) (F value bad: 48.11, p bad: 0.00; F value normal: 24.99, p normal: 0.00: F value good: 12.28, p good: 0.00). While the highest yields in normal conditions were 2,346 kg/ha and 2,255 kg/ha in Mediterranean and Southeastern Anatolia Regions respectively, the worst yield in normal conditions was 1,684 kg/ha in Western Central Anatolia Region (Duncan test) (Figure 4.24).

The yield performances of wheat landraces with respect to wheat species (bread, durum, and feed) by growing condition was shown in Figure 4.25. The yield differences were found to be statistically significant at the 99% confidence level in bad, normal, and good conditions (F value bad: 21.94, p bad: 0.00; F value normal: 6.86, p normal: 0.00: F value good: 3.20, p good: 0.00). Overall, the yields of bread and feed wheats were similar to each other, and the yield of durum wheat was higher than either, no matter the growing conditions. In bad conditions, the worst yield potential was shown by bread wheats. In good conditions, the yield values of bread, durum, and feed wheats were similar to each other.

The yield performances of wheat landraces with respect to irrigated and rainfed conditions under three production conditions were shown by region in Table 4.14. Overall yield performances in Turkey of wheat landraces populations in irrigated conditions were uniformly better than the yield performances in rainfed conditions, 13.6% better under bad growing conditions, 20.5% better under normal growing conditions, and 22.9% better under good growing conditions.

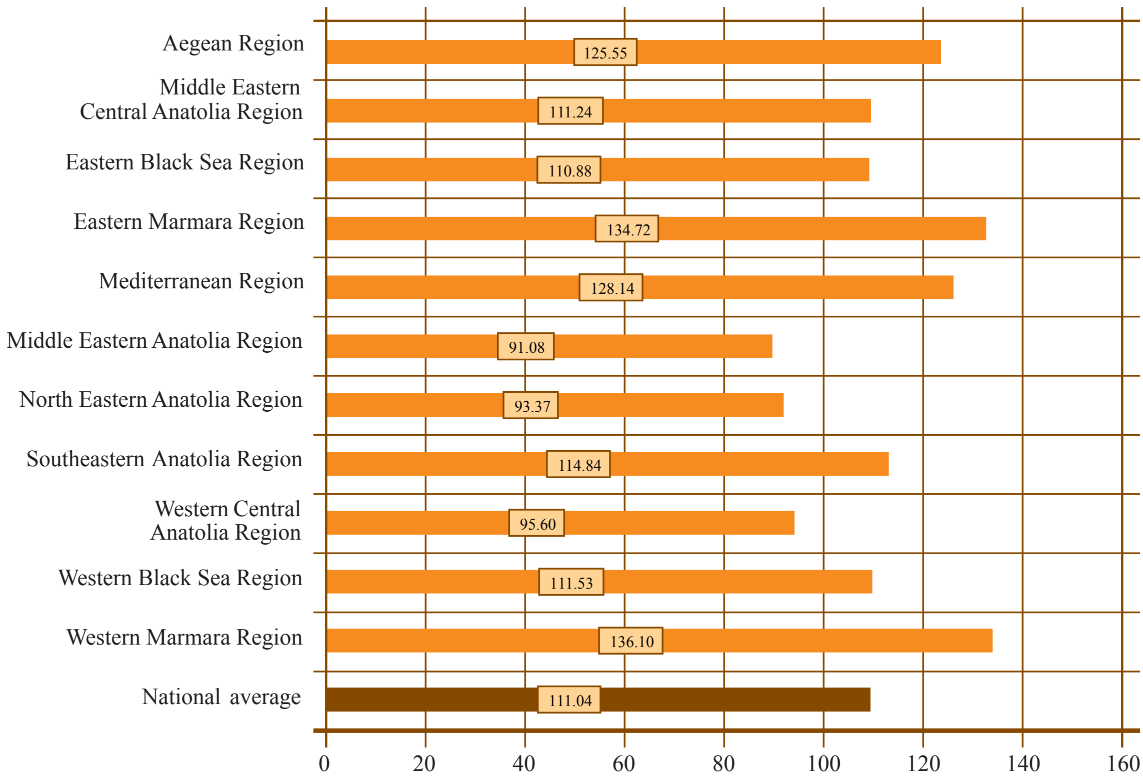
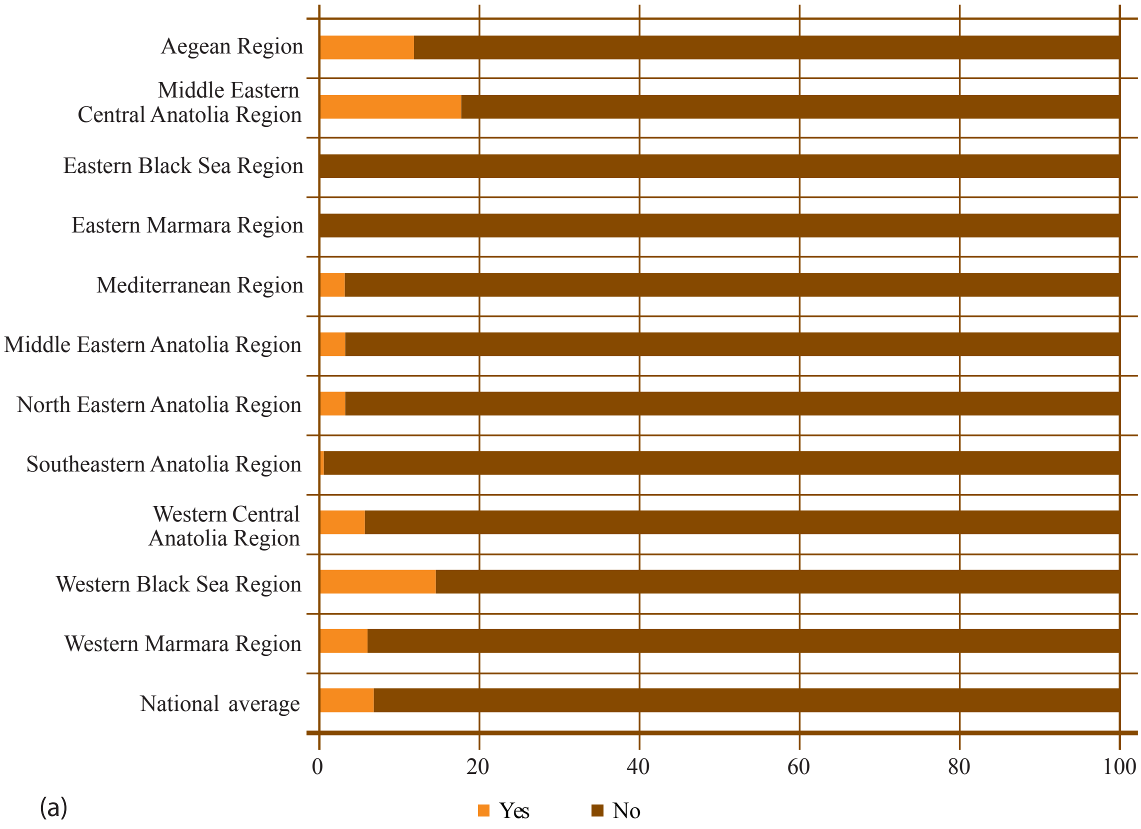


Figure 4.22 Average height of wheat landraces by region (cm)



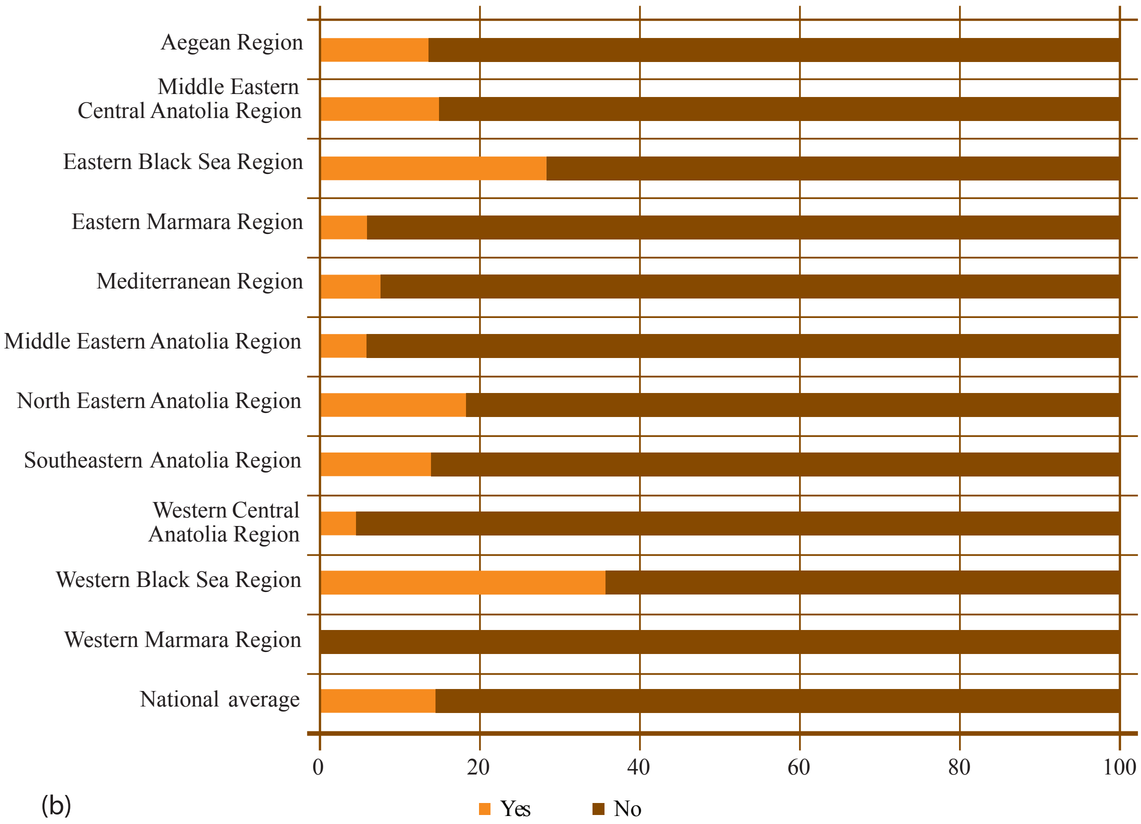


Figure 4.23 Distribution of farmers' choice of whether to sell wheat landraces as processed products (a) and as straw (b) by region (%)

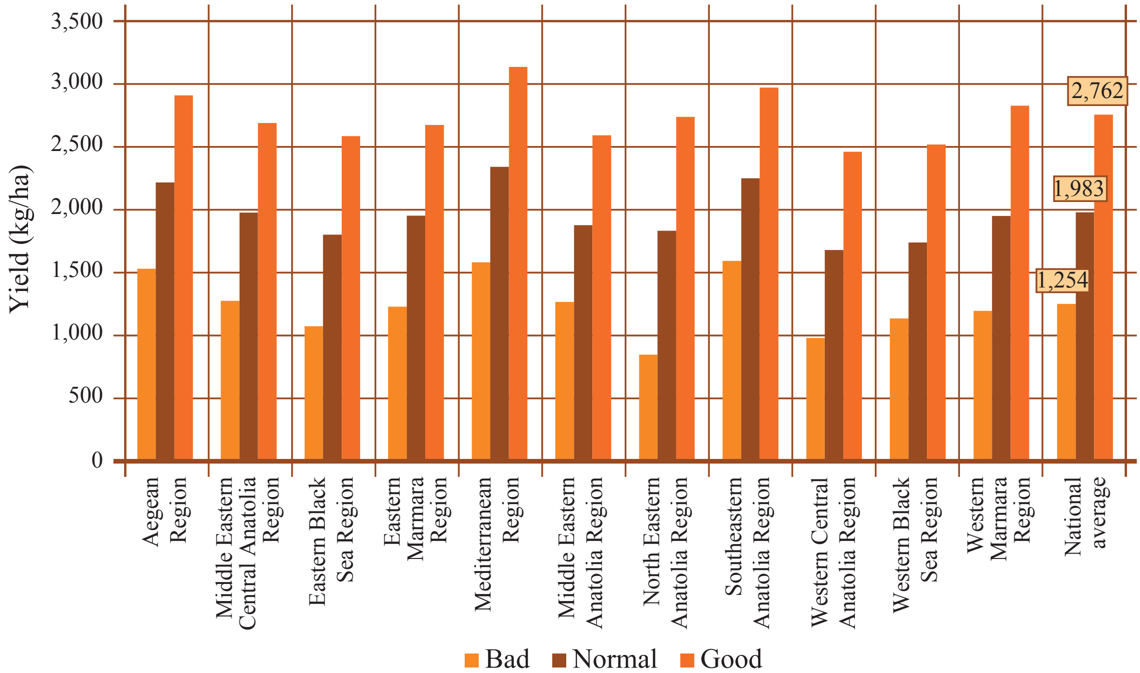


Figure 4.24 Yield potential of wheat landraces in bad, normal, and good production conditions by region (kg/ha)

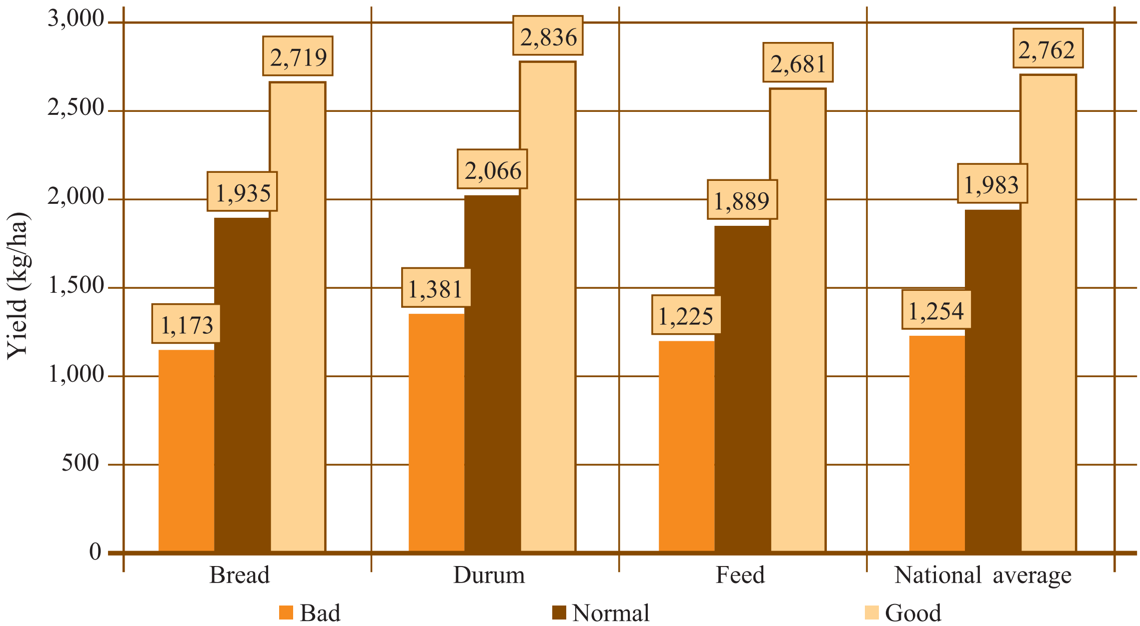


Figure 4.25 Overall yield potential of the three types of wheat landraces in bad, normal, and good production conditions (kg/ha)

Table 4.14 Yield of wheat landraces produced under bad, normal, and good production conditions classified by irrigation status (kg/ha)

Region	Irrigation statis	Production condition		
		Bad	Normal	Good
Aegean Region	Irrigated	1,400	1,800	2,000
	Rainfed	1,536	2,226	2,923
	Mean	1,5346	2,222	2,914
Middle Eastern Central Anatolia Region	Irrigated	1,5086	2,460	3,503
	Rainfed	1,2666	1,957	2,655
	Mean	1,278	1,981	2,695
Eastern Black Sea Region	Irrigated	1,440	2,240	3,200
	Rainfed	1,071	1,799	2,581
	Mean	1,077	1,806	2,591
Eastern Marmara Region	Rainfed	1,232	1,957	2,680
	Mean	1,232	1,957	2,680
Mediterranean Region	Irrigated	1,722	2,622	3,594
	Rainfed	1,575	2,328	3,112
	Mean	1,584	2,346	3,142
Middle Eastern Anatolia Region	Irrigated	1,633	2,210	3,044
	Rainfed	1,048	1,682	2,328
	Mean	1,269	1,881	2,597
North Eastern Anatolia Region	Irrigated	1,077	2,344	3,522
	Rainfed	702	1,511	2,245
	Mean	849	1,836	2,743
Southeastern Anatolia Region	Irrigated	2,278	3,447	4,464
	Rainfed	1,524	2,129	2,819
	Mean	1,596	2,255	2,977
Western Central Anatolia Region	Irrigated	1,452	2,433	3,552
	Rainfed	914	1,573	2,306
	Mean	983	1,684	2,466
Western Black Sea Region	Irrigated	1,344	1,963	2,750
	Rainfed	1,129	1,734	2,513
	Mean	1,138	1,743	2,523
Western Marmara Region	Rainfed	1,197	1,955	2,833
	Mean	1,197	1,955	2,833
National average	Irrigated	1,423	2,414	3,447
	Rainfed	1,228	1,9173	2,655
	Mean	1,254	1,983	2,762

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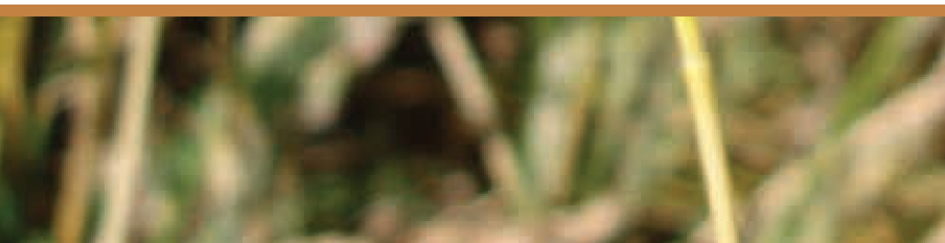
Chapter 5

VALUING LOCAL WHEAT LANDRACES



CHAPTER 5
VALUING LOCAL WHEAT LANDRACES

5.1. Introduction

Crop genetic resources are key inputs used in agricultural research to develop and produce new plant varieties with desired characteristics and to respond to unexpected environmental changes, including the onslaught of pests and disease. Maintaining an adequate pool of genetic materials with a range of traits is necessary given uncertainty over the types of problems that will arise in the future (Hawkes, 1983; Plucknett and Smith, 1983; Meng et al., 1995). Maintainance of local varieties and landraces by farmers depends on their valuation of them. Information about specific variety characteristics that farmers find important will provide insight on household preferences and behavior. If continued cultivation of landraces appears uncertain and if on-farm maintenance of some target level of diversity is a stated objective, then the accurate valuation of these genetic resources from the viewpoint of the farm household could provide crucial information for the development of policies to guarantee their future existence. One of the approaches described in the literature is economic analyses of farmer's variety choices on valuation of landraces and crop genetic resources (Brush and Meng, 1998).

Farm households allocate resources for production of favorite or preferred landraces, expecting benefits to accrue from their subsequent consumption or sale in local markets. Farmers continue to grow a wheat species or landrace and maintain it if it meets their production and consumption needs. Therefore, direct-use values, particularly the quality traits that farmers consider as valuable for consumption are indicators of private value. Socio-cultural values motivate farmers to retain some preferred landraces on the farm, and they appreciate the special organoleptic qualities and multiple uses of these landraces, despite the availability of improved wheat varieties in their locality. Landraces, especially those having multiple home uses, are more likely to be maintained for the foreseeable future. Therefore, home-use values can serve as a strong incentive to encourage continued cultivation and utilization of wheat landraces by farm households (Jaradat, 2012).

This chapter focuses specifically on the cultivation and farmers' assessments of wheat landraces in the research area in Turkey. In examining the components of the private value of landraces, we consider variables suggested by economic theory to influence farmers' choices on whether they want to produce wheat landraces only or both modern varieties and wheat landraces together in their farm.

5.2. Materials and Methods

Economists have developed several theories to explain the variety choice of farm households. The desire to diversify and shield against risk (Just and Zilberman, 1983; Finkelshtain and Chalfant, 1991; Fafchamps, 1992; Swanson, 1997), transaction costs restricting household access to markets (Strauss, 1986; de Janvry et al., 1991; Fafchamps, 1992; Goetz, 1992), and the presence of environmental constraints (Jansen et al., 1990; Bellon and Taylor, 1993) have all been advanced and tested as important influences in the land-use decisions of farm households. Risk aversion, transaction cost, and environmental constraints can each explain to some extent the occurrence of the partial adoption of improved crop varieties by farmers in developing countries (Meng et al., 1995; Brush and Meng, 1998).

Farmers continue to grow and maintain a wheat landrace if it meets their production and consumption needs. The total cost and benefit of landraces to farmer households are central to their on-farm conservation and continued utilization. Farmers maintain crop landraces if these are valued for economic, cultural, social, or even ecological reasons (Jaradat, 2012). Social and cultural contexts also shape the roles of different individuals or groups within a household or community, for example, based on gender, age, or social status. These socially determined roles affect farmers' knowledge, actions, and access to resources regarding the maintenance of crop diversity. Studying the relevance of these social roles to on-farm crop diversity will help us to understand who is involved in maintaining this diversity (Jarvis et al., 2000).

Farmer's decisions on landrace cultivation (only wheat landrace cultivation or both wheat landrace and improved wheat varieties cultivation) were analyzed. To analyze the influence of each explanatory variable on the dependent variable, which is a dichotomous variable, the binary logistic regression was used as a method (Maddala, 1983; Grene, 2000). Binary logistic regression estimates the probability that a characteristic is present (e.g., it can estimate the probability of "success") given the values of explanatory variables. In this case, there was a single categorical variable: $\pi = Pr(Y = 1|X = x)$ with the model (Agresti, 1996):

$$\pi_i = Pr(Y_i = 1|X_i = x_i)\frac{exp(\beta_0 + \beta_1 x_i)}{1 + exp(\beta_0 + \beta_1 x_i)}$$

where Y is a binary response variable such that $Y_i = 1$ if the trait is present for an observation (person, unit, etc.) i and $Y_i = 0$ if the trait is **not** present for observation i; $X = (X_1, X_2, \ldots, X_k)$ is a set of explanatory variables which can be discrete, continuous, or a combination of both; and x_i is the observed value of the explanatory variables for observation i. In this section, we focus on a single variable X.

Two different binary logistic regressions were applied for dependent variables, such as only wheat landraces cultivated ($y = 1$) or both wheat landraces and improved wheat varieties cultivated ($y = 2$). Dependent variables were assumed as socio-economic and geographical location facts, because we thought that changes in any of these factors will impact farmers' decisions.

In this study, the 4-point Likert Scale (Bad-Normal-Good-Do not know) was used to measure farmers' valuations on wheat landrace populations (Köklü, 1995). Likert scales are a noncomparative scaling technique and are unidimensional (only measure a single trait) in nature. A Likert item is simply a statement that a respondent is asked to evaluate according to any kind of subjective or objective criteria; generally the level of agreement or disagreement is measured. It is considered symmetric or "balanced" because there are equal amounts of positive and negative positions (Burns and Burns, 2008).

5.3. Results and Discussion

The definitions, descriptions, and summary statistics of independent variables included in the binary logistic regression analysis are given in Table 5.1. The independent variables considered in this analysis can be broadly classified as: household head characteristics, farm characteristics, geographical characteristics, and regional dummy variables. In similar studies carried out in Turkey by Kruzich and Meng (2006), they classified these factors, which affect farmers' variety choices, into six classes: socio-economic characteristics, plot-level characteristics, market access, variety characteristics, province, and agroecozone. Negassa et al. (2012) classified their independent variables as: household head characteristics, farm characteristics, market access and institutions, agroecotypes, and provincial dummy variables in their household decision model.

The household head was characterized based on education, age, and improved-wheat farming experience. Educational attainment of household heads was measured as a dummy variable. The variable was divided into two parts: the first represents the household heads having a literate and/or illiterate educational level, the second represents the other situation. A very similar level of household heads' educational attainment was observed across wheat variety choices. Experience of household heads on improved-wheat farming was represented with a dummy variable. If the number is 1, it means that the household heads have tried improved wheat varieties in their life; if number 2, then not.

Two variables were selected to characterize the farms for the sample households. The traits used were percentage of wheat landrace area in total area (%) and the amount of land per household. In general, the proportion of wheat landrace area in total area was calculated as 41.4%. The amount of land per household member represents also the household size and farm size in this model. The average amount of land per household member was calculated as 1.6 ha.

Geographical characteristics are covered by two variables in the model: elevation and distance to market for the farms. Both were treated as continuous variables. As shown in Table 5.1, farmers growing wheat landraces only were at a greater distance to market than farmers growing both wheat landraces and improved wheat varieties. The locations of the farms growing wheat landraces only were generally at elevations greater than 1,200 m in mountainous areas.

The results of binomial logit regression coefficients are presented in Table 5.2. The household characteristics such as education, and experience of household on growing improved wheat varieties appear to have significant effects on the household's choice of

Table 5.1 Summary statistics of factors included in the empirical model

Variable	Variable description	Summary statistics		All samples (N=1,721)
		Wheat landraces only (n=1,258)	Both landraces and modern varieties (n=463)	
Household head characteristics				
BIMPV (Dummy)	Has the household head tried improved varieties on his farm? 1: yes; 2: no	1.85 (±0.37)	1.04 (±0.20)	1.63 (±0.49)
AGE (Dummy)	1: <45 years old 2: ≥45 years old	1.84 (±0.37)	1.73 (±0.39)	1.76 (±0.38)
EDUC (Dummy)	1: Illiterate 2: Literate 3: Primary school 4: Secondary school 5: University	2.83 (±0.69)	2.84 (±0.72)	2.84 (±0.70)
Farm characteristics				
LSHARE	Percentage of wheat landrace area in total area (%)	48.49 (±31.12)	22.15 (±18.62)	41.41 (±30.62)
HHH*	The amount of land (ha) per household member	6.41	13.50	7.87
Geographic characteristics				
MDIST (Dummy)	1: 0 to 40 km 2: ≥40 km	1.73 (±0.45)	1.67 (±0.47)	1.71 (±0.45)
ELEVATION	The elevation (m) of farms growing wheat landraces	1,213.54 (±414.22)	969.40 (±312.31)	1,148.68 (±404.32)

*Median value of the HHH variable. Note: Figures in parentheses represent standard deviations.

wheat varieties (wheat landraces only or both wheat landraces and improved varieties). Similarly, the effects of farm and geographical characteristics were statistically significant. As a result of binary logistic regression, the farmers' experience in production of modern wheat varieties affects their choice of wheat varieties to grow. Farmers who have grown modern wheat varieties before tended not to continue with modern wheat variety production. They usually continue to produce both modern wheat varieties and and wheat landraces. As is known, modern wheat varieties have better yield potential and greater value in markets than wheat landraces. The probability of this variable is also high (Table 5.2).

The other household head characteristic was the age of household head. Indigenous knowledge (IK), including knowledge of crop diversity, is often held by the older members of a community. This link can be a precarious one, as knowledge can be lost if elders do not pass IK down to younger generations (Jarvis et al., 2000). In the model, the variety was represented by a dummy variable as equal to older than 45 years versus younger than 45. The result was that age was not found significant (Table 5.2). Negassa et al. (2012) found the age was insignificant on the household's choice of wheat varieties in Turkey.

Education was the other factor affecting farmers' decisions that we examined in the model. The more educated farmers preferred to produce only wheat landraces in their farming system (Table 5.2). We think that there are two main reasons for this result. One reason is that people want to take advantage of marketing wheat landraces as local products, especially Siyez wheat in Kastamonu province. The second is that the more educated people prefer to produce this landraces for their consumption for a healthy life (hobby farming). Kruzich and Meng (2006) and Meng (1997) stated that a household decision-maker with more years of farming experience was more likely to cultivate traditional varieties, while more education resulted in a significantly lower probability of landrace cultivation. Negassa et al. (2012) found that household characteristics such as education, age, and farming experiences of household heads appear to have no significant effect on the household's choice of wheat varieties. Similarly, the effects of characteristics like dependency ratio and number of cars owned on a farm household's wheat variety choice was not statistically significant. However, variables which appeared to significantly influence farm household's wheat variety choice were: household size, number of cattle owned, number of buildings on farm, farm size, farm fragmentation, percentage of irrigable farm plots, and the regional dummy variables.

As a result of the research, the average farm size was 7.2 ha over the whole sample and farm size showed great variability across wheat variety choices. For example, the average farm size for the wheat-landraces-only choice was about 6.0 ha, which is about half of the farm size of those who chose both landraces and modern wheat varieties (10.4 ha) (Table 4.8). Thus, households growing wheat landraces only tend to have small farm sized as compared to those growing modern wheat varieties only and those households simultaneously growing wheat landraces and modern wheat varieties. In the model, the variable farm size was shown by the variable representing the proportion of wheat landrace area to total area. This variable was significant at the 99% confidence level (Table 5.2). The proportion of wheat landrace area in total area was higher for farms which grew wheat landraces only than for farms growingwheat landraces and modern varieties together. When one considers that the farms, in which the proportion of wheat landrace area to total area is higher than 50%, are smaller farms. It can be said that this variable represents the farm size of the farmers. Farm size has been empirically shown to be positively related to the adoption of modern varieties (Perrin and Winkelmann 1976; Feder et al., 1985; Brush et al., 1992). Larger farmers may benefit from economies of scale, be willing to dedicate a smaller proportion of land to experimenting with modern varieties, or may have lower information costs relative to small farmers.

The variable explaining the relationship between the household size and farm size is HHH (The amount of land per household member) (Table 5.2). The value of HHH gives an idea of both the wealth status of the farms in terms of income and the amount of manageable land. With a larger value of HHH, the farm generally heads more towards commercial activities. In the model it was found that if the amount of land per household member was high, those farms tended to produce both wheat landraces and improved wheat varieties together.

The other factor examined in the model was the elevation where the wheat landraces were grown. In extremely heterogeneous and highland growing environments, traditional landrace varieties are more likely to be grown than modern varieties since the germplasm developed by centralized breeding programs may not be well adapted to these marginal areas and their microclimates (Jarvis et al., 2000). As a result of the empirical model, elevation, as expected, is an important factor affecting farmers' decisions (Table 5.2). At higher elevations, generally settlements steer away from the market centers. These locations are generally mountainous and remote areas. In this situation, farmers tend to produce only traditional varieties (wheat landraces).

The other geographical factor is distance to market. A previous study in Turkey by Meng (1997) used market access to explain land-use decisions. Distance to market and road quality both influenced the variety choices of households. Omamo (1998) empirically found that high transport costs directly influenced households and resulted in the decision

Table 5.2 Estimation of binomial logistic regression coefficients for wheat variety choice model

Explanatory variable	B	S.E.	Wald	df	Sig.	Exp(B)
BIMPV	-5.109***	0.282	328.695	1	0.000	0.006
MDIST	-0.538*	0.308	3.048	1	0.081	1.739
LSHARE	-0.037***	0.004	74.990	1	0.000	0.964
AGE	0.388	0.377	1.059	1	0.303	1.475
EDUC	-0.301**	0.151	4.001	1	0.045	0.740
ELEVATION	-0.002***	0.000	63.129	1	0.000	0.998
HHH	0.007*	0.004	3.368	1	0.066	1.007
Constant	10.803***	0.986	119.971	1	0.000	49,152.323
Number of observations	1,625					
Log-Likelihood value	680.519					
Cox & Snell R square	0.52					
Nagelkerke R square	0.76					
Percent correctly predicted						
LR only	93.77					
Both MV and LR	88.15					
Overall correct prediction	92.31					
Hosmer and Lemeshow test	16.40 p: 0.04					

*, **, ***Statistically significant at the 90%, 95%, and 99% confidence levels, respectively

to plant low-return food crops. Hintze (2002) also empirically tested road quality as an indicator of transaction costs and found it to be positive and significant for modern maize variety adoption. Distance to market, road quality, and access to input and output markets have been shown to affect households' land-use decisions and their production strategies. In our study, distance to market was a significant factor for affecting farmers' decisions of only wheat landrace production or both wheat landrace and modern wheat varieties production (Table 5.2). When we look at the elevation of the farms producing only wheat landraces they are located primarily in mountainous agroecological zones. The farmers far away from market places tend to produce only traditional varieties (wheat landraces).

In the other part of the study, yield, disease resistance, pest resistance, cold resistance, drought resistance, suitability for family consumption, market price, lodging resistance, straw yield, and straw quality characteristics of wheat landraces were evaluated by the wheat landrace producers in the research areas (Table 5.3). Except for market price and lodging resistance, these characteristics were rated at the normal or good levels. The evaluations of wheat landraces by farmers vary by region. It seems that the wheat landraces are more tolerant to abiotic (cold and drought) and biotic (disease and pest) stress conditions than are modern varieties. This is a reason why wheat landraces are grown in harsh conditions. The main disadvantages of wheat landraces are market price and the lodging problem. The lankiness (tallness) common to wheat landraces results in lodging.

The market price of wheat landraces is one of the variables showing the most variation. In some regions, the durum wheats (including emmer wheats) especially, are sold at high prices because bulgur is derived from durum wheat and it has good flavor and taste and can be rare in the market. Landraces Siyez, Kavlıca, Sarı Buğday, and Üveyik Buğday are examples. Especially in recent years with the rise in demand for local and organic products, these types of products are sold mostly in niche markets, sometimes in luxury stores with high prices. The best example is the "Siyez Bulguru" obtained from the Siyez wheat landrace.

Some other important factors affecting the preference of wheat landraces by the farmers were straw quality, straw yield, and suitability for family consumption. These three were the most important factors on which farmers focused.

5.4. Conclusion

The results are consistent with previous studies in Turkey. First, understanding and knowing the farmers who cultivate landraces is necessary for in situ conservation of the wheat landraces. The analysis was based on cross-sectional survey data collected between the years 2009 and 2014 on 1,873 sample households in 65 provinces of Turkey. The results show that not only agronomic characters affect decisions on the wheat production process. Other factors such as socio-economic, geographical, and farm characteristics also affect household decisions on maintaining wheat landrace production. Landraces are more resistant to biotic and abitotic stresses and better adapted to environmental conditions

Table 5.3 Distribution of farmers' opinion on wheat landraces by region (%)

		Region											
		Aegean Region	Middle Eastern Central Anatolia Region	Eastern Black Sea Region	Eastern Marmara Region	Mediterranean Region	Middle Eastern Anatolia Region	North Eastern Anatolia Region	Southeastern Anatolia Region	Western Central Anatolia Region	Western Black Sea Region	Western Marmara Region	Mean, all regions
Yield	Good	23.64	30.28	47.76	22.95	18.18	38.56	14.63	25.40	22.67	30.09	30.00	25.68
	Normal	60.91	38.07	46.27	42.62	63.64	54.90	55.69	53.97	51.16	46.30	30.00	51.65
	Bad	14.55	27.52	2.99	34.43	18.18	6.54	20.73	20.63	8.14	22.69	40.00	18.78
	Do not know	0.91	4.13	2.99	0.00	0.00	0.00	8.94	0.00	18.02	0.93	0.00	3.88
Disease resistance	Good	43.64	36.24	52.24	9.84	64.03	80.39	9.76	91.53	12.21	47.22	10.00	45.04
	Normal	30.00	35.32	31.34	16.39	16.21	14.38	52.44	5.29	39.53	37.50	75.00	30.26
	Bad	3.64	7.80	5.97	0.00	4.74	4.58	16.67	0.53	9.88	1.85	0.00	6.20
	Do not know	22.73	20.64	10.45	73.77	15.02	0.65	21.14	2.65	38.37	13.43	15.00	18.49
Pest resistance	Good	37.27	27.06	10.45	9.84	71.54	77.12	6.10	91.01	9.88	37.04	42.50	41.33
	Normal	30.00	31.65	10.45	14.75	10.28	14.38	53.25	4.23	40.70	33.80	45.00	27.01
	Bad	2.73	11.01	0.00	0.00	2.77	6.54	17.07	0.00	4.07	1.39	0.00	5.57
	Do not know	30.00	30.28	79.10	75.41	15.42	1.96	23.58	4.76	45.35	27.78	12.50	26.09
Cold resistance	Good	63.64	76.61	79.10	86.89	86.96	79.74	21.54	98.41	49.42	62.04	60.00	67.65
	Normal	22.73	15.60	16.42	13.11	9.88	11.76	39.02	1.59	31.98	36.57	40.00	21.45
	Bad	2.73	5.50	4.48	0.00	3.16	8.50	20.73	0.00	5.81	0.46	0.00	5.86
	Do not know	10.91	2.29	0.00	0.00	0.00	0.00	18.70	0.00	12.79	0.93	0.00	5.04
Drought resistance	Good	44.55	62.84	79.10	91.80	91.30	62.75	20.73	98.41	34.88	68.06	67.50	63.36
	Normal	18.18	26.15	14.93	8.20	6.72	33.33	43.09	1.59	35.47	30.56	32.50	23.71
	Bad	12.73	8.26	2.99	0.00	1.98	3.27	21.95	0.00	13.95	0.93	0.00	7.19
	Do not know	24.55	2.75	2.99	0.00	0.00	0.65	14.23	0.00	15.70	0.46	0.00	5.74

Table 5.3 (Cont.) Distribution of farmers' opinion on wheat landraces by region (%)

		Region											
		Aegean Region	Middle Eastern Central Anatolia Region	Eastern Black Sea Region	Eastern Marmara Region	Mediterranean Region	Middle Eastern Anatolia Region	North Eastern Anatolia Region	Southeastern Anatolia Region	Western Central Anatolia Region	Western Black Sea Region	Western Marmara Region	Mean, all regions
Suitable for family consumption	Good	67.27	78.90	91.04	81.97	89.72	89.54	84.96	96.83	89.53	62.50	92.50	83.42
	Normal	20.00	17.43	5.97	18.03	6.72	9.15	13.01	3.17	3.49	28.24	7.50	12.41
	Bad	5.45	0.92	0.00	0.00	1.58	1.31	2.03	0.00	0.00	6.94	0.00	1.97
	Don't Know	7.27	2.75	2.99	0.00	1.98	0.00	0.00	0.00	6.98	2.31	0.00	2.20
Market price	Good	20.00	31.65	17.91	9.84	65.61	45.10	15.45	69.84	11.05	12.96	2.50	32.58
	Normal	18.18	41.74	32.84	40.98	10.28	39.87	36.59	16.40	40.70	32.87	50.00	30.55
	Bad	17.27	9.63	10.45	11.48	6.72	11.76	31.30	13.76	8.14	34.72	2.50	16.35
	Don't Know	44.55	16.97	38.81	37.70	17.39	3.27	16.67	0.00	40.12	19.44	45.00	20.52
Lodging resistance	Good	31.19	24.77	2.99	4.92	38.34	43.79	17.89	24.34	12.21	11.57	0.00	22.80
	Normal	15.60	21.56	19.40	6.56	43.08	39.87	45.93	30.69	39.53	44.91	17.50	34.45
	Bad	51.38	48.62	76.12	88.52	18.58	15.69	30.89	44.44	32.56	43.06	82.50	39.44
	Don't Know	1.83	5.05	1.49	0.00	0.00	0.65	5.28	0.53	15.70	0.46	0.00	3.31
Straw quality	Good	75.45	64.22	73.13	44.26	88.14	87.58	42.68	94.18	43.60	48.15	47.50	65.91
	Normal	18.18	29.82	22.39	47.54	10.28	10.46	35.77	5.29	34.88	43.06	52.50	25.68
	Bad	0.91	2.29	4.48	8.20	1.58	1.96	8.13	0.00	5.81	8.33	0.00	4.00
	Don't Know	5.45	3.67	0.00	0.00	0.00	0.00	13.41	0.53	15.70	0.46	0.00	4.41
Straw yield	Good	78.18	67.89	80.60	75.41	92.09	79.74	32.93	93.65	37.21	64.81	60.00	68.12
	Normal	14.55	24.31	17.91	16.39	6.72	17.65	39.84	6.35	34.88	33.80	37.50	22.78
	Bad	6.36	2.29	1.49	8.20	1.19	2.61	8.94	0.00	5.23	0.93	2.50	3.42
	Don't Know	0.91	5.50	0.00	0.00	0.00	0.00	18.29	0.00	22.67	0.46	0.00	5.68

than modern varieties. Sustainability of landraces is not possible with only ex situ conservation of landraces, in situ conservation is necessary and landraces should be assessed for use in breeding programs.

The inhabitants of Turkish villages are industrious and willing to produce crops which are suitable for the agro-climatic conditions of the region in order to meet family needs and to sell surplus produce at the local markets. This practice has maintained great diversity in the landraces of many crops. The fact that these varieties, with excellent taste qualities, were created many decades ago in the respective micro-areas with characteristic agro-climatic peculiarities, are grown by an aging population makes our activity in collection and preservation of this wealth priceless, because the desire to cultivate landrace diversity is not being sustained by younger generations. Our study showed also that the age of farmers growing wheat landrace greater than 50 years old (Figure 5.1).

The farmers producing wheat landraces are maintaining this farming system under difficult conditions. Therefore, when policy-makers are establishing policy in rural areas, they should establish different policies for specific areas, as well as general policies. One example is the EU Agriculture Development Policy for people living in mountainous areas. Mountainous rural areas face particular challenges and have specific needs with respect to other rural areas. In the current EU agricultural policy context, rural mountainous areas are included in the designation of "Less Favored Areas (LFAs)" because they are generally characterized by a short growing season (because of high elevation), or by steep slopes at a lower altitude, or by a combination of the two. Such conditions pose challenges for agriculture and the rural economy in these areas. Specific support instruments

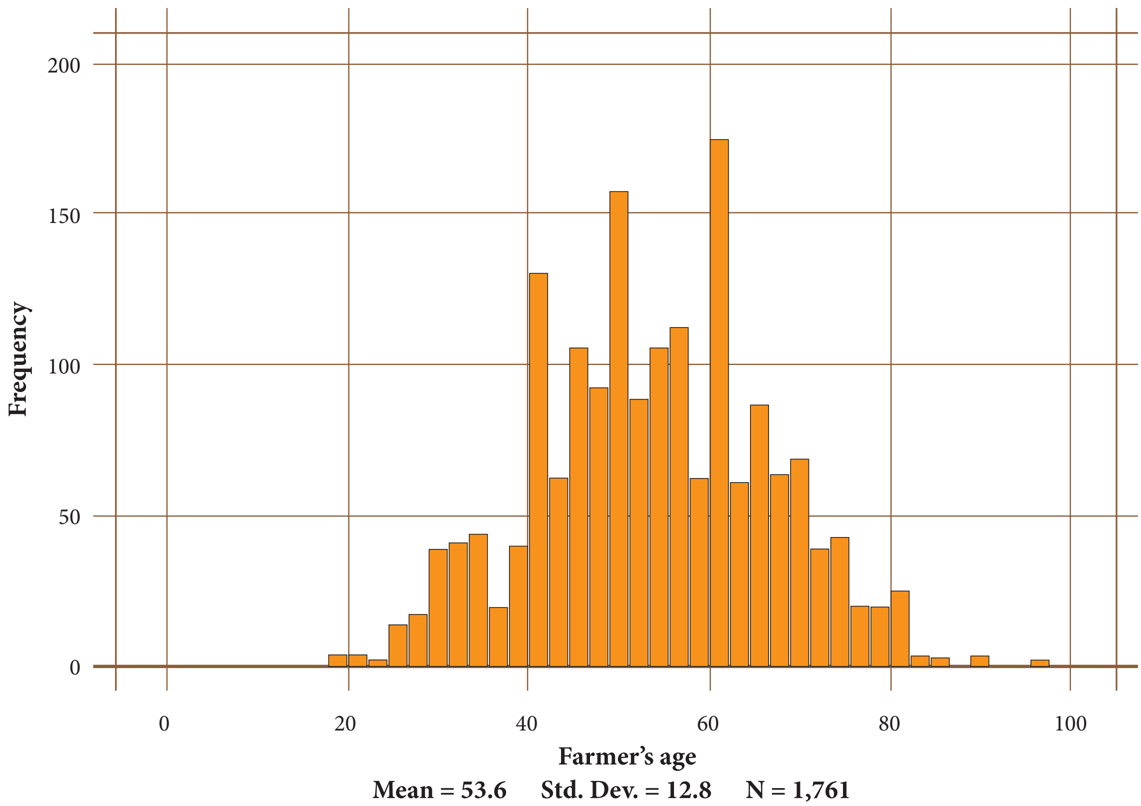


Figure 5.1 Histogram of age of wheat-landrace-producing farmers

have been developed by the EU which are targeted at mountainous rural areas and these include rural development policy measures (Anonymous, 2012). Because wheat landraces are grown in such areas, having such a policy in Turkey would aid in conservation of crop genetic resources and biodiversity.

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Chapter 6

NGOs AND THE SUSTAINABILITY OF WHEAT LANDRACES

CHAPTER 6

NGOs AND THE SUSTAINABILITY OF WHEAT LANDRACES

6.1. Introduction

Turkey is the country of Europe and Middle East which has the richest biological diversity and it is ranked ninth in the continent of Europe in terms of biological diversity. Each one of the seven regions of the country has different climate, flora, and fauna and Turkey has the three most important ecological regions of the world. Within biological and cultural diversity is agricultural biodiversity – the diversity of the plants used in agriculture. Agricultural biodiversity involves all the components of biological diversity concerning food and agriculture. Types of crops and farm animals, genetic resources of types of fish and all resources not tamed within field, forest, meadow, and water ecosystems are included in the scope of agricultural biological diversity. The importance of biological diversity in terms of agriculture will be understood better when its features enabling the ecological services like nutrient cycling, pest control, protection of local wildlife, protection of water basins, control of erosion, and impact on climate.

Agricultural biodiversity of all food types is an indispensable part of general biodiversity and it is the first link in the food chain developed and protected by farmers, breeders, and fishermen all over the world. In our day, it is known that agricultural biodiversity is threatened by many dangers caused by globalization of food markets, intellectual property systems, and unsustainable industrial food production. Our agricultural genetic resources either disappear or are seriously diminished because of changing market conditions, agricultural monoculture, decreasing rural populations and their departure from traditions, as well as change in nature (e.g., climate changes). Difficulties encountered for the maintenance of small-scale farmers whose production styles take natural cycles into consideration, user preferences, and market demands encouraging excessive consumption and causing irreversible destruction of natural areas are all factors which affect small farmers and their livelihoods and the security of wild gene resources to a large, negative extent.

Protection of biodiversity is possible with the coordinated and integrated work of various shareholders and cannot be dependent only on legislations, laws, and government policies. Conserving biodiversity is a complex phenomenon requiring the participation of many different units from public institutions to private companies and from nongovernmental organizations (NGOs) to volunteer workers. NGOs are one of the important shareholders in this phenomenon. NGOs working on the protection of biological diversity in Turkey have specializations that are well accepted in the international arena. For this reason, partnerships of governmental agencies with NGOs in the research and practices to protect biological diversity will increase the useful results. In Turkey, examples of such collaboration with issues like introduction of local products, marketing attempts based on local products, and protection of local multiplication materials, such as seed, have positive effects on sustaining biological diversity. These activities have succeeded with the active support of local communities and with both financial and organizational support of various institutions, in the public and private sectors. They are important examples for the country in terms of protecting biological diversity locally and enabling sustainability. Thus, in this section, some examples of various attempts related to the protection of biological diversity in Turkey are presented and advice is given about what kinds of work can increase the effectiveness of these examples and should be carried out in terms of enabling sustainability and protection of biological diversity nationwide.

6.2. The Role of Local Initiatives and NGOs

In Turkey, both the government and nongovernmental organizations have long-standing programs to protect biological diversity. These activities include *in situ* protection programs such as national parks, protected wildlife reserves, nature parks, wildlife protection areas, specially protected environment areas, natural sites, natural assets, gene protection and management areas, and *ex situ* protection programs such as orchards, arboreta, botanical gardens, and gene banks (Anonymous, 2007).

Until today, education about environmental protection has been carried out indirectly with protection of forest fires as the initial purpose. In recent years, the private sector, with the support of NGOs, has started to carry out supportive activities for raising public awareness about the environment. In Turkey, the concepts of "environment" and "biological diversity" were presented by the government, but it has gained higher popularity as a result of the activities of NGOs. For example, the Society for the Protection of Nature—a national NGO—is a member of World Wildlife Fund (WWF) and is the Turkish partner of Bird Life International. The Society for the Protection of Nature has taken on tasks such as the evaluation of the effects of fish farms, projects for breeding sites of marine turtles, projects for important bird and plant areas, carrying out biological diversity protection projects for some deltas and lakes, and integration of a wetland management plan in Delta Göksu (SADAG, 2015). The Society of Volunteers from Bodrum, which has connections with Greenpeace,and A SEED, has also contributed to a project to benefit the Mediterranean seal near Bodrum. The Environment Society of Turkey has published widely on the protection of environment. International NGOs have contributed to the activities for protection of biological diversity in Turkey at different scales.

The examples dealt with above relate directly or indirectly to wheat landraces which constitute the main theme of this study. These works especially relate to the protection of agricultural biodiversity, the main foundation of which is to stimulate *in situ* protection and utilization of the available biological resources and to enable the financial and economical sustainability of these resources by emphasizing the potential of rural tourism.

One of the NGOs working to protect and use biological diversity in Turkey is the Buğday Association for Supporting Ecological Living (buğday means wheat in Turkish). It was incorporated in August 2002 and had grown out of the Buğday movement which had been based at the Buğday Vegetative Products Restaurant and Natural Living Center in Bodrum, in Muğla province. At incorporation, the Association gave its reasons for establishment as follows:

- Protection and maintenance of traditional production processes,
- Redefining human requirements in harmony with the ecosystem cycles,
- Supporting sustainable agricultural methods not harming the environment and human health, and
- Informing the public to let them live in harmony with nature and environment and creating fields of activity in order to let them develop their abilities.

The Association is an important example of how *in situ* protection of genetic resources in Turkey can be carried out along with creating a market based on local Turkish products, protection of local materials, and facilitation of local manufacturing. One of the Association's most important works is the project "Seed Network for the Protection of Turkey's Agricultural Biodiversity" begun with the objectives of protecting agricultural biological diversity and maintaining rural life. The Network emerged in 2007 by generating a road map intended to protect the local seed types with the collaborative participation of individuals, other NGOs, related Ministry units, and universities. All these entities had been involved in various efforts at protecting seed types from the local to national level. The "Seed Exchange Network" emerged and, under its auspices, festivals of seed exchange are organized through which maintenance and sustainability of local materials is enabled, preventing the loss of diversity. With the donations raised up to now, the Seed Exchange Network has planted 155 local varieties from 42 different stocks being grown on 471.5 ha on 27 farms in total from different regions of Turkey (Anonymous, 2012a).

Another project that arose from the Buğday Association is TaTuTa, a project on "Eco-Agro Tourism and Voluntary Knowledge and Skills Exchange on Organic Farms" which stimulates the production of ecological products and which is supported by UNDP, GEF, and SGP. Other Buğday Association projects are the "100% Ecological Market", "Nature-friendly Agriculture Policies", and "Camtepe Education, Application and Research Center of Ecological Life", all which are made possible by the association with its equity capital. These examples and the Association's information exchange service are important examples of NGO work for protection of Turkish agrobiodiversity (Anonymous, 2012a).

Another relevant NGO is the Boğatepe Environmental Life Association in Kars province, which created a model local economy in which women are featured for the purpose of supporting village life and assuring that local varieties survive and increase. The cooperation of 27 villages was secured in this project. Among its achievements: seeds belonging to eight local varieties at risk of extinction (including wheat varieties "Kavlıca" and "Caucasian Red") were grown out for increase and their usage was popularized. By creating living gardens in the villages for subsistence vegetable growing for self consumption is emphasized. Moreover, training is conducted for the presentation, multiplication, collection, and drying of ethnobotanical and medical plants. In the host villages, visits of persons from abroad interested in sharing cultures are enabled via rural tourism. Foreign language education and communication training are offered for the village participants to facilitate their communication with incoming foreign visitors. As a result, the importance and status of women have increased in the villages. In one village, a grocery store administered by women was founded, village incomes have increased, and the local economies have grown stronger (Koculu, 2012).

In the village of Karoat, in the Torbalı district of Izmir, a seed association founded in 2004 by the village farmers has worked at finding, protecting, and popularizing local seeds. Results include an increase in the use of local seeds, enabling the production and sale of products to various cities of Turkey. The association began as an informal organization of women in the village. A greenhouse was built to produce seedlings that are offered for sale. Cooperation and and self-sufficiency were developed among the women in the village (Çelik, 2012).

In 2005, the Association of Ecology and Life was founded in the village of Kirazlı, in the Kusadası district of Aydin province. It began with the purposes of protecting peasantry and local values and enabling rural improvement. A UN/GEF-funded project was to develop ecological production of local fruit and vegetable varieties, to build an ecological vegetable seedbed, and to present high quality, branded, processed, and packaged local fruit types to the market. At the end of the two-year project, the brand name of "Kupluce", the old name of the village, was formed, the production of local fruit and vegetable types began to be more ecological, sales of the products were made in Kusadası markets, and a market was formed to sell the products in the village. By the Association's work, traditional information and diverse varieties are gathered and preserved, incomes have risen, and the efficiency and creativeness of women have been enhanced (Çelik, 2012).

The Çanakkale Bayramiç Yenikoy Kaz Mountains Ecological Life and Seed Association started its activities in Çanakkale province eight years ago and was formally incorporated in 2010.. It has been producing local seeds with traditional methods, involving farmers, especially women, from the surrounding villages, and selling and adding value to its products. One result is that a local variety called "Saz Çavdarı" was multiplied thereby saving it from extinction. They have also spurred the proliferation of the types of wheat landraces that are being sown, including "Yellow wheat, Kavlıca, Kızılca, Akkunduz, and Karakılcık". Products, such as flour, cracked wheat, bread, noodle, vegetables, and the foods obtained from them, were sold via community supported agriculture methods. These products were all based on local seeds, which, along with traditional information about them, were distributed (Çelik, 2012).

The Slow Food Organization, operates in Turkey. It is a global, grassroots organization with supporters in 150 countries around the world who are linking the pleasure of good food with a commitment to their community and the environment. A nonprofit member-supported association, Slow Food was founded in 1989 to counter the rise of fast food and fast life, the disappearance of local food traditions, and the dwindling interest by the public in the origin of the foods they eat. Today, the organization has over 100,000 members joined in 1,300 Convivia worldwide, as well as a network of 2,000 food communities which practice small-scale and sustainable production of quality foods.

One of the projects of the organization is "Slow Food Presidia". The Presidia project is one of the most effective tools for putting into practice and exemplifying Slow Food's policy on agriculture and biodiversity. The Presidia sustain quality production at risk of extinction, protect unique regions and ecosystems, recover traditional processing methods, and safeguard native breeds and local plant varieties. The general objectives of the presidia are numerous, complex, and multifaceted, but can be boiled down to four areas. The economic aspect is obviously vital (presidium products were disappearing because they were no longer profitable and in order to continue their activity, producers have to have economic assurance about the future), but another three factors are also crucial: environmental, social, and cultural aspects (Anonymous, 2012b). The Presidia support traditional small-scale products at risk of disappearing, promote local areas, recover ancient crafts and production techniques, and save native breeds and fruit and vegetable varieties from extinction. Currently there are almost 400 Presidia in over 50 countries (Anonymous 2012c). There is one presidium in Turkey and its name is Siyez Wheat Bulgur. Many farms in the forested northern Turkish province of Kastamonu continue to cultivate the oldest type of wheat still in existence, *Triticum monococcum*, known as Siyez in Turkey. Compared to common wheat, it is low in gluten and has a high protein content, around 20 percent. It has spikes of single-grain spikelets, a very long growing cycle, and low yields. But it also flourishes in poor soil where modern wheat varieties would struggle, often surviving harsh climates with at least three months of snow cover. Slow Food Organization promotes these types of products as indicated in the Slow Food Presida Guidelines (Anonymous, 2012b).

Another project carried out by the Slow Food Organization is "The Earth Market" project. Earth Markets are farmers' markets that have been established according to guidelines that follow the Slow Food philosophy. These community-run markets are important social meeting points, where local producers offer healthy, quality food directly to consumers at fair prices and guarantee environmentally sustainable methods. In addition, they preserve the food culture of the local community and contribute to defending biodiversity. In the world, there are 22 earth markets and one of them is in Turkey (Foça). Launched by Slow Food Convivium Foça Zeytindali in April 2011, the market takes place every Sunday from 8:30 to 18:30, in the market square or Yerel Pazar. All producers attending the market come from an area within a 40 km radius. The convivium has carried out considerable mapping of local products and producers of bread, fresh fruits and vegetables, preserves, fresh herbs, mushrooms, cheese, milk, yogurt, and flower-related products to promote local producers and preserve local culture and biodiversity (Anonymous, 2012d).

As well as NGOs, producer unions also play an important role in the protection of local products. The Presidency of the Chamber of Agriculture in Meram, in Konya province, is one of these unions. It has championed the production of dinkel wheat, a hexaploid wheat variety (*Triticum aestivum* subsp. *spelta*) in the province of Konya to prevent its extinction. Dinkel can be marketed among 'diet products', but it is said that products made from this wheat have a distinct aroma and taste.

6.3. Conclusion

Protection of biodiversity and sustainable production is not only a public service but also a social responsibility. Social responsibilities are not tasks to be administered or achieved by only a single institution. They require the coordinated and integrated work of all related stakeholders. The use and protection of biodiversity, environment, and local heritage are topics impacting the future of humankind directly and everyone is responsible for their protection. NGOs play an important role. Especially in recent years, it can be seen that NGOs have intensively struggled to create awareness on these topics in Turkey. The work carried out by NGOs, based on the principal of willingness, have contributed greatly to the protection of local culture, notably local products, in Turkey, especially by creating awareness. *In situ* conservation programs can be successful only if all stakeholders work together. From our in-depth interviews with NGOs, their roles in the protection of biodiversity can be summarized as follows;

- ***Introduction.*** NGOs share the importance of local varieties along the axes of ecology, nutrition, sustainable agriculture, and rural development in a wide communication network. In this way, NGOs stimulate the use of these varieties and products produced from these varieties and create awareness in the general society.
- ***Information transfer and communication network.*** NGOs enable the free circulation of information about local varieties in local, national, and international platforms. They adopt the facilitating task of sharing technical and scientific information among the parties and use of it in a focused way.
- ***Defense and policy making.*** NGOs develop advice for overcoming the political, legal, and legislative obstacles for the production, multiplication, sharing, inventory, and protection of local varieties. They defend and unite defenders of the ideals of biodiversity protection with decision-making and executive institutions.
- ***Research and development.*** NGOs enable and conduct research and development about the products that can be produced from local varieties.
- ***Formation of marketing channels.*** NGOs bring relevant parties together to form marketing channels for increasing the use/consumption of local varieties and act as facilitators of the processes. The projects of the Buğday Association such as the 100% Ecologic Markets, TaTuTa, and Wheat Points are important examples.
- ***Multiplication of seeds.*** NGOs contact small producers who multiply local varieties and stimulate their production by creating social networks. For example, the project of Seed Exchange Network of the Buğday Association serves this purpose.
- ***Technical education.*** NGOs contribute to educating, informing, and guiding of existing and potential producers of local varieties and provide technical support.

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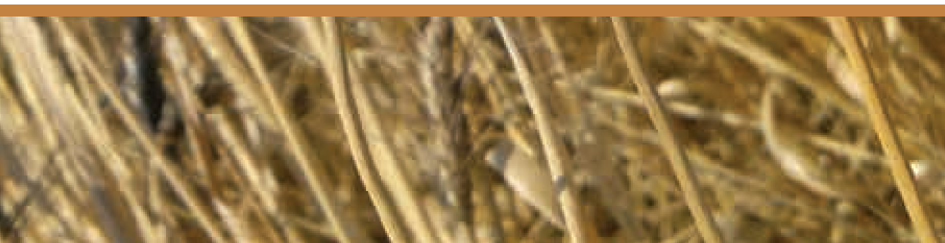
Chapter 7

CONCLUSIONS AND RECOMMENDATIONS



CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

All societies depend on biodiversity and genetic resources, and policy-makers are increasingly aware that development pressures are today generating unprecedented rates of biodiversity loss. For this reason, strategies, and courses of action are being developed to protect both the genetic resources and biological diversity at national and international levels. In Turkey, the public institutions responsible for the application of laws and legislations towards the protection and sustainable use of natural resources are the Ministry of Forestry and Water Affairs and the Ministry of Food, Agriculture and Livestock. The protection of plant genetic resources (both ex situ and in situ) is a function of the Ministry of Food, Agriculture and Livestock. This Ministry's national program for the Protection of Genetic Resources of Plants involves many research areas related to the protection of available plant diversity and habitats and agricultural ecosystems of these plants. Within the framework of this program, research institutes of the Ministry build national cooperation with universities, NGOs, and others. Through this program, Turkey has become a member of various regional and international networks.

Turkey has also international responsibilities for the protection of biological diversity and genetic resources. Turkey has signed many agreements, contracts, and protocols related to the protection, alteration, and commerce of natural and biological resources. Plant genetic resources, which are the most important elements of biological diversity, are protected with *ex situ* and *in situ* strategies. The seed samples collected in gene banks are protected as main (long-term) and active (short- and middle-term) collections while vegetative material is protected in field gene banks maintained on various institute lands. In recent years, infrastructure for Turkey is being created to start protection of seed and possibly some vegetative materials under ultra-cold conditions (cryoprotection). In total, some form of *in situ* conservation of biodiversity takes place on 3,749,673 ha of land (Karagöz et al., 2010).

Research programs are being implemented to enhance *in situ* and *ex situ* protection methods of gene resources. Work on *in situ* conservation is more recent in Turkey, which has had a longer history and adequate infrastructure for *ex situ* conservation. For example, the project "In Situ Protection of Genetic Diversity" started in 1993 and lasted for five years. At the end of the project, six areas for five wild relatives of wheat were selected as "Areas of Gene Protection and Management" in the fields of Ceylanpınar Agricultural Enterprise (Karagöz, 1998).

Wheat is a staple food crop all over the world and is the most widely grown crop in the world and in Turkey. Wheat is produced in almost every part of Turkey. During the last 35 years wheat production in Turkey steadily increased, reaching about 21 million tons/year on 9 million ha (the seventh largest wheat production area in the world). Unfortunately, the production area of wheat landraces is decreasing day by day. Wheat landraces have been largely displaced by high-yielding cultivars in Turkey as in many developing countries. Jaradat (2012) stated that wheat landraces are rarely cultivated in developed countries because of their low yield potential and susceptibility to diseases when compared with high-yielding cultivars under high external input farming systems. However, landraces and old cultivars out-yield, and have better quality attributes than, high-yielding cultivars under organic and low-input farming systems. Agronomic and socio-economic studies indicated that farmers' selection for desirable agronomic and quality traits is a major force shaping the dynamics of wheat landrace populations; therefore, sustained on-farm conservation and sustainable utilization of these landraces will ensure their continued evolution and contribution to sustainable local food systems (Jaradat, 2012).

The numbers and working areas of NGOs related to the protection of living natural resources in Turkey have been increasing. But, in spite of their achievements, progress is still less than desired, especially because of insufficient fiscal resources. The following associations and foundations help bring about the participation of the public in the protection of nature, arrange educational activities, and even create income-generating activities by transforming their operations into rural tourism activities:

- Association for Protection of Turkey's Nature,
- Association for Protecting Natural Life,
- The Turkish Foundation for Combating Erosion and Reforestation,
- Research Association for Rural Environment and Forestation Problems,
- Buğday (Wheat) Association,
- World Wildlife Fund,
- Slow Food, and
- Other NGOs.

At the moment, the NGOs play a large role in increasing public awareness about the importance of genetic resources and they are encouraging farmers to provide mainteinace of landraces (traditional varieties) in their own farms (*in situ* conservation).

Work related to *in situ* protection of local varieties is new in Turkey and not much progress has been achieved. A major effort on this topic was conducted to determine the status of important local varieties in the northern regions of Turkey and providing protection of these varieties. As a result, it was determined that the following steps should be taken when establishing *in situ* protection of local varieties under farmer conditions (Tan, 2002):

a. Determine the local varieties grown by farmers and understanding their ecologicaland socio-economic situations;
b. Determine the main factors affecting farmer decisions to continue to plant local varieties and therefore thestorage needs for those varieties;
c. Detect the direction and dimension of effectiveness of farmer decisions affecting the variation in local variety populations in time; and

d. Look for ways to help the use of local varieties or village varieties to increase market opportunities for farmers and to create new varieties according to the wishes of farmers by use of local varieties, thus, the opportunity to market these varieties.

The importance of interdisciplinary research on biodiversity in both traditional and modern agroecosystems should be recognized as a prerequisite for the development of more effective agrobiodiversity conservation regimes (Bawa et al., 2004; Jackson et al,, 2005). It is not sufficient that protection be achieved only through legislation, the value and goal of protection must be integrated with all national policies and sectoral approaches. It is essential to understand that the protection of biological diversity is synonymous with the protection of vital resources of the country.

The farmers, who play an important role in the protection of traditional varieties even though they cannot trade for local varieties, can share these varieties via informal seed exchange. Legal arrangements related to "The Record of Plant Genetic Resources" are being made based on Law Number 5553 and the "Regulation of Record of Plant Varieties". These arrangements will even entitle the farmers to record their local varieties (Tan, 2010). Under this new law, farmers will be able to continue to save seeds for their own use and to exchange them with other farmers without having to register them. But the trade of unregistered varieties as seed has been forbidden. NGOs have led the reaction against this regulation. The new regulation must be introduced and explained to public, informing the public why this is needed in Turkey. It must be explained that this regulation does not hinder or limit the production and trade of traditional varieties. Moreover, the new law prevents the uncontrolled movement of plant seeds. Uncontrolled, undefined, and unrecorded seeds (landraces are not uniform varieties, each may consist of more than one type) cannot be merchandised as seed. But if the landraces are defined and recorded especially by MFAL and if new regulations are created for traditional varieties and farmers' rights, the concerns of the NGOs and farmers will have been addressed.

Prior to making policy for the protection of traditional varieties and enabling sustainability, descriptive research is important to define which enterprises are involved and where the local varieties are produced. The socio-economic structure of the farming operations is an important factor in the protection and production of local varieties involved in *in situ* conservation under farmer conditions. If it is found that these varieties are grown under subsistence agriculture practices, rather far from the main centers, and in rugged land areas, it is apparent that the policies to be made should be directed towards specific areas rather than general policies.

Some of the most genetically diverse plant populations of potentially great value to global society are grown by some of the poorest human populations in the world. As long as farmers themselves find it in their own best interests to grow these populations, both farmers and society will benefit at no extra cost to anyone. But to what extent do farmers need to have an incentive to keep growing them? When we refer to farmers' incentives to grow crop populations, we mean the extent to which these populations provide the traits that satisfy farmers' objectives, as they define them. Since most small farmers produce food crops for their own consumption, these traits often include not only agronomic characteristics such as tolerance of biotic and abiotic stress, but also some consumption characteristics, such as suitability for the preparation of special dishes that are valued in local communities. When markets are not well developed, the value of varieties is directly related to the extent to which they meet the needs of farm households. Even when markets develop, there may still be a number of attributes over which farmers define their needs that cannot be obtained through the market. In many areas of the world, markets are imperfect (Jarvis et al., 2000). In such situations, to conserve genetic resources and provide the maintainance of them, we first must create "markets" (niche markets can be an example) for them and after that facilitate access of landrace farmers to those markets. If the financial potential of local varieties is not realized, their production will only remain as subsistence production.

According to the Millennium Ecosystem Assesment (2005), encouraging market-based mechanisms is necessary to conserve biodiversity. The idea is that market creation can help increase the opportunity cost to local land users of agricultural practices that negatively affect agrobiodiversity. Markets can take different forms. Firms and NGOs can already purchase land-use rights, such as logging in forested regions, and then decide not to extract wood but to conserve the land for its biodiversity. (Pascual and Perrings, 2005). Besides creating local product markets (examples of which can be found in some regions of Turkey), it will be further necessary to support these markets and support the related activities based on local products – organic production, gastronomy tourism, and rural tourism. Moreover, value can be conferred on local products having specific features arising from a specific region in Turkey, or in some situations from the country as a whole, and that geographical indication (GI) can be given a special protection status. This system can be used as an important media tool in the protection of both biological diversity and genetic resources. Regarding sustainability, having GI status may promote biodiversity conservation directly through the use of a specific genetic resource, or indirectly through production and management practices that include landscape and ecosystem considerations.

Globalization of food trade impacts the everyday decisions of farmers worldwide because agroindustrial generic products have increasing access to local and regional markets. Attempts by farmers, usually supported by public policies, to compete with generic products may change local agricultural practices and genetic resource use. If market success is a key component of the sustainability of small farmer livelihoods and the conservation of the diverse genetic resources they use, then GIs and informative labeling offer the possibility of commercializing production with a differentiated identity, avoiding the type of competition that is based on volume, low prices, and marketing (Guerra, 2010; Kan, 2012).

To conserve local wheat types in the natural environment and to leave them as heritage for future generations, the Ministry of Food, Agriculture and Livestock should support the planting of local wheat by farmers for the protection of genetic resources as well as for use by livestock farmers. In the study by Küçükçongar et al. (2006), in the province of Aksaray, it was determined that farmers planting a local wheat (Ak Buğday) were earning 659.20 TRY ($467.50 USD) less revenue per hectare compared to commercial wheat-growing farmers. Given this situation, farmers growing the local wheat variety need to be subsidized at the rate of $500 USD/ha.

The studies on wheat landraces carried out in Turkey between the years 2009 and 2014, tried to establish why producers continue the production of wheat landraces, what factors may be effective to continue the production of landraces in the future, and what kind of precautions should be taken to achieve *in situ* protection of landraces. As a result of the work, a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis related to the types of wheat landraces was made and is presented in Table 7.1.

Table 7.1 SWOT analysis of wheat landraces

Strengths	Weaknesses
▪ High adaption ability to extreme conditions (drought, cold, etc.) (Meng et al., 1998; Williams, 1989; Jarvis et al., 2000; Bardsley and Thomas, 2005, Jaradat, 2012) ▪ Greater adaptability to a range of soil types (Bellon and Taylor, 1993) ▪ High bulgur quality for durum wheat landraces (Aktan and Zencirci, 1995), high flour yield for bread wheat landraces (USDA-ARS, 2013) ▪ Distinctive flavor (Bardsley and Thomas, 2005 ▪ High straw yield (Bardsley and Thomas, 2005; USDA-ARS, 2013) ▪ High straw quality (Bardsley and Thomas, 2005; USDA-ARS, 2013) ▪ Almost all documentation is available for wheat landraces. ▪ They have intrinsic characters and special genes (Williams,1989, Masood et al., 2005)	▪ Low yield feature (Ehdaie et al., 1988; Blum et al., 1989) ▪ Wheat landraces are generally prone to lodging because of their height ▪ Wheat landraces are generally sold in market at low price ▪ Local products do not have a regular market (Jarvis et al., 2000) ▪ Production of wheat landraces not as a farmer's choice, but instead as a traditional habit or because of a lack of other alternatives ▪ Lack of information on wheat landraces and their products ▪ Lack of coordination between NGOs and public and private sectors
Opportunities	**Threats**
▪ The growing interest at national and international levels to local varieties ▪ Increase in the number of local markets ▪ Response to the growing of GMO products ▪ The presence of consumers linking local products with organic and healthy products ▪ The Government's promotions and support to conserve genetic resources ▪ Increase in the number of NGOs involved in promotion and conservation of local products ▪ They have intrinsic characters and special genes which may be employed in breeding studies (Cecceralli, 1994; Harlan, 1995) ▪ The existence of the necessary legal basis ▪ Local products can be a tool for alleviating poverty in underdeveloped areas, if it can be made to contribute to income generation	▪ Improved varieties getting increasingly adopted by farming systems with every passing day. These leads to genetic erosion and extinction of the local varieties which were replaced ▪ Farmers are forced to comply with capitalist market systems to continue their existence and make a living by agriculture ▪ It is hard for governments to support financially all farmers who choose to conserve genetic resources within in situ concepts within *in situ* concept

Wheat landraces are better adapted than modern cultivars to changing climate conditions and to stress environments due to their population genetic structure, buffering capacity, and a combination of morpho-physiological traits conferring adaptability to stress environments (Jaradat, 2012). Their specific features should be evaluated in every area, especially as breeding material to produce better varieties. But it does not mean that we should replace them with modern varieties. The opportunities (Table 7.1) can be used as valuation tools and as leverage in terms of achieving economic development for rural remote areas.

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