



## Organic Tea Production and Tea Breeding in Turkey: Challenges and Possibilities

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### ABSTRACT

Tea production can be seen at the zone beginning at the Georgia border of the Black Sea region up to the Fatsa district of Ordu in Turkey. Tea production areas are present foremostly in Rize, followed by Trabzon, Artvin, Giresun and Ordu. These regions are representing the top zone tea production areas in the World. The region beginning from the Georgian border up the district Araklı represents the most suitable and primary high yielding tea plantation areas in Turkey. Tea is the most important income resource of people settled in this region. With the switch of the Hemsin district to organic tea production and with future plans to switch also in Rize gradually to organic tea, in public organic tea production have become important. In this present work the changeover to organic tea production in Rize, the use of organic fertilizers, possible changes in production and marketing and also general challenges and possibilities are discussed.

**Keywords:** tea, organic agriculture, breeding, quality

### Introduction

*Camellia sinensis* belonging to family Theaceae, commonly known as tea is a plant species whose leaves and leaf buds are used for tea production. There are 3 types of tea: green, oolong and black. Green and Oolong tea are the most widely consumed beverages in Asian countries and has been familiar in China and Japan for centuries. Oolong tea is semi-fermented during processing, whereas green tea is not fermented and black tea is fully fermented (Rahman *et al.*, 2013). Black tea accounts for approximately 72 % of the world's total tea production (Sharangi 2009). In Turkey, generally black tea production is common and a little green tea production is present at the Eastern Black Sea Region.

Agriculture changed direction due to the effect of industrial revolution and green revolution arised in the second half of the 20th century. The aim in the Green Revolution was to increase yield obtained from a unit area to compensate the food need of the human

population. The requested yield increase was obtained by intensive application of pesticides and fertilizers, but it was observed that with time applied pesticides and fertilizers showed a lot of negative effects especially for human health. Besides this environmental problems like the degeneration of the physical structure and nutritive balance of the soil, salinisation and desertification encountered. As a result of all this and other negative developments "Organic Agriculture" arised as an alternative production system (Aksoy 2001).

The purpose of organic agriculture is to rehabilitate the degenerated ecological balance due to the still used conventional agriculture applications, to minimize the agricultural inputs and applications which are responsible for the degeneration of this balance and to use natural products instead of fertilizers, pesticides and hormones harmful for human health (Kayahan 2001; Kirazlar 2001).

In Turkey organic farming is developing rapidly due to the increase of demand from foreign countries,

the support of the Ministry of Agriculture, Food and Livestock, the increasing interest of universities, research companies and non governmental institutions, the interest of local farmers and public opinion, the formation of a domestic market etc. (Aksoy and Altındışlı 1999; Kenanoğlu and Karahan 2002; Demiryürek *et al.*, 2008).

The main cultural application in increasing yield per unit area is fertilization. Materials used as fertilizers can be very different. These are grouped as organic fertilizers and chemical fertilizers. Organic fertilizers are like farm manure of natural, organic character. In case chemical fertilizers are containing one or more nutrients. Negative effects of the extreme use of chemical fertilizers on human health are determined by conducted experiments (Demiryürek 2011).

Tea production are practised in the Eastern Black Sea Region, in a zone beginning from the Georgian border up to the Fatsa district in Ordu. In this region tea production is mainly located in Rize, Ordu, Giresun, Trabzon and (Anonymous2015). If we are considering the tea production areas in the World these regions are located in the top zone. In Asian countries like China, India and Sri Lanka temperature does not falls up to minus degree in tea production areas and tea production is covering the whole year. But in our country where we can have four climates tea plantations are in fallow four six months. The fact that snow falls on Turkish tea plantations bring them an extra important characteristic. Because of this character pesticides are not applied in our tea production areas. This gives Turkish tea compared with teas in the world “the most natural tea” characteristic.

The biggest advantage of Turkish tea sector is that pesticides are not used for its cultivation. The winter conditions decrease pests in natural means as it snow in Rize province situated in the north east of Turkey. As a result of that, there is no need to use any pesticides. A small amount of pests have been seen in Rize province actually, but they does not reach the population require to use pesticides. Two important parameters prevent the production of organic tea in general. One of them is the pesticides and the other one is chemical fertilizers. All of the tea, produced in Turkey, will be organic product if organic fertilizers are used instead of chemical ones, as the Turkish tea industry is already not using pesticides. That feature is a great advantage of Turkish tea sector (Saklı 2011).

### ***History of Tea in Turkey***

At the start of tea cultivation in Turkey, the primary goal was to meet the domestic demand only. It looked very difficult to introduce a new crop in the area and it

was popularly understood that the effort was going to end up in fiasco. However, in a relatively brief space of time, the tea trade and industry have undergone sweeping changes due to the consistence efforts. Today, Turkey holds a significant place among the world’s largest tea producers and ranks sixth in world production of tea such that the farmers have no reservations about tea cultivation (Klasra *et al.*, 2007).

Tea cultivation was first introduced in Batum (Republic of Georgia), neighboring Eastern Black sea region of Turkey by Russians in the last quarter of 19th century after importing seedlings from China. They had successfully established commercial tea planting here and tea industry had slowly expanded with opening of large acreage of lands for the purpose. Since Russians had successfully introduced tea in Batum, it was felt that tea cultivation must also be introduced in Turkey. Therefore, under the directions of the state, the Department of Agriculture selected Bursa (an important historical city of Ottoman empire surrounded with hills and large number of natural springs and forests), to evaluate the feasibility of tea cultivation by importing seedlings from Japan and China in 1888 (Tekeli 1976). Soon it was discovered that the tea plants needed very specific environmental conditions to produce an economic crop, which led to the identification that tea cultivation was not feasible in Bursa.

Mr. Ali Riza Erten, was assigned the duty to discover feasibility of some other suitable locations with in Turkey for tea cultivation. He made extensive visits to Rize, Artvin, Ardahan (Turkey) and Batum (Georgia) in the Eastern Black Sea region (Kakuzu 1944; Kacar 1986a,b). He made a detailed analysis of the soil and climatic conditions of these areas, to know the feasibility for economic and successful cultivation of crop and found that the ecology of Rize, Artvin and Ardahan was very similar to Batum. He observed tea, orange and bamboo gardens in Batum. He reported economic feasibility of tea cultivation at Rize and (Hatipoğlu 1934 a,b; Arar 1969).

In Turkey, tea cultivation was determined in 1917 around Rize province and cultivation was first started by law in 1924 and the Tea Research Institute was established. Afterwards, research studies began to be conducted and tea cultivation began on a commercial basis. In 1947, the first plant for processing green tea leaves was opened in Rize. From then on, tea production has been carried out in a microclimate along the Eastern Coast of the Black Sea Region and thus, Turkey takes its place on the upper limit of tea ecologies. Along this region Rize, Ordu, Giresun, Trabzon and Artvin are the provinces in which tea is produced.

In order to supply better service, parallel to the growth in this sector, an economic enterprise, ÇAYKUR (General Directorate of Tea Enterprises) was established in 1971 and was fully authorized as a state monopoly in the tea business. In 1984, with the abolishment of the monopoly in the tea sector, private enterprises were also given the rights of procurement, processing and marketing (Anonymous 2017).

### **Tea Production in Turkey**

Although the tea business in Turkey is a relatively new activity compared with the other producer countries, tea cultivation and the industry have shown very important improvement in a short time. While the production of dried tea was below 25, 000 tons in the 1950's, this figure reached significant quantities in recent years. Today, Turkey holds a significant place among the world's largest producer countries with a share of 3%. According to the Food and Agriculture Organization (FAO) statistics, Turkey ranks 8th place in the world production area of tea after China, India, Sri Lanka, Kenya, Indonesia, Vietnam and Myanmar (Table 1).

Regarding world tea production Turkey ranks at the 6th place in the world after China, India, Kenya, Sri Lanka and Vietnam (Table 2).

In Turkey tea production is located in the North-East Black Sea Region. The tea plantations are distributed in the cities Artvin, Rize, Trabzon, Ordu and Giresun (Picture 1).

Table 3 shows the distribution of tea production areas according to related cities. The main tea production area is Rize with 65.96%, followed by Trabzon, Artvin, Giresun and Ordu. Parallely, the number of tea farmers are following the same ranking.

### **Why organic tea?**

There are various factors influencing the consumer preference to buy Organic Tea. Supplements due to their perception like its health properties and consume safety of organic tea, environment friendly character of organic tea, their high nutritional value, price of products, trust in product certification and availability of products..

Objective of organic tea cultivation is to have an ecologically sustainable plantation, aimed at the conservation of ecology and natural habit without polluting soil, air and water and yet maintaining sustainable tea production. Tea is produced in the absence of synthesized chemicals like pesticides, fungicides, herbicides, growth regulators and concentrated fertilizers. Naturally occurring, mined products and bulky and concentrated organic manures are used for resistant cultivars, regulation

of microclimate or by the introduction of biological control agents/the use of biological products, naturally extracted without the use of inorganic solvents.

### **History of Organic Tea Production**

Organic agriculture is practised in almost all countries of the world, and its share of agricultural land and farms is growing everywhere. The market with organic products is growing at a fast rate, not only in Europe, Japan and North America (which are the major markets) but also in many other countries, including many so called developing countries. Lack of state regulations for organic agriculture makes it difficult in many countries to distinguish organic from low-chemical or even non-organic products. Official interest in organic agriculture is emerging in many countries. On an international level FAO is giving in creasing support to organic farming (Williges 2004).

Modern scientific technology encourages the use of chemical pesticides, herbicides, fungicides and chemical fertilizers for the high crops production. It creates the whole agriculture production chemicalization environment and soil become unhealthy, all biodiversity and ecosystem have been sick and whole ecology becomes chemicalized. The modern agriculture technology creates the farming system an organic. Organic cultivation system deals as whole elements of farming i.e. fertilizer, soil management, plant or seeds selection, irrigation, pest and diseases management, biological control method. In that case direct control measures with natural pesticides may be appropriate in organic tea cultivation (Khanal 2012).

Organic agriculture is a production system that sustains the health of soils ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local condition rather than the use of inputs with adverse effects. Organic tea farming is based on four principles that are principle of health, principle of ecology, principle of fairness and principle of care. Organic tea farming promotes and enhances biodiversity, biological cycles, soil biological activity through management practices that resort, maintain and enhance ecological harmony. The organic tea production system is different from non-organic tea production (Acharya 2009).

The organic movement in Sri Lanka started in the 1980s through contact and inspiration of local NGOs with the Philippine organic agriculture move ment. In 1982 a group of local NGO representatives, planters, scientists and environmental officers had drafted a Memorandum of Association to create a movement named Lanka Organic Agriculture Movement (LOAM). This can be seen as the official starting point for the dissemination of organic agriculture in Sri Lanka (Williges 2004).

### ***The past, presence and future Organic Tea Production***

Organic products which could not or not enough produced in countries where Organic market is expanding or where demand for organic products is increasing are imported mostly from developed countries. One of this products is tea, a product of high economic value in our region.

In India organic tea farming begun in 1986 with 'Darjeling' and spread to Assam and South India. In India the organic tea farming areas corresponds to 4.000 ha. Tanzania, Japan, Kenya and China started with organic tea in the same period. 1989 organic teas were saled in England.

The tea production area in the world is 2.9 million ha, 4.8 million tonnes tea are produced. But organic tea farming is produced in 5.000 ha and approximately 4-5 tonnes organic tea production exists (Anonymous 2016).

Why Organic Tea Production in the world did not expand enough can be explained as follows:

1. Tea production is located most in the equatorial or near the equatorial region, no winter, battle against diseases and pests are obligatory
2. Besides bacterial and fungicidal diseases more than 100 different insects were detected in this regions
3. Losses in yield and quality due to diseases and pests specific for tea
4. High residue levels (above the permitted limit)
5. Soil pollution due to intensive chemical inputs
6. Switch to organic farming is a long process
7. High input costs

### ***Organic Tea Production in Turkey***

Parallel to the developments in the world ÇAYKUR initiated in 2003 studies to increase organic tea farming in our country. Within the context of organic tea farming Borçka/Artvin and Çamlıhemşin and Hemşin/Rize was choosen as organic tea production areas. In 2006 ÇAYKUR founded the "Organic Tea Farming Commission" to organize studies regarding organic tea farming and production and to determine a road map for organic tea.

In 2006 "Farmer Briefing Meetings" were organized to inform them about the benefits and contributions of organic tea farming. In 2007 organic tea farming contract was signed with 135 farmers covering 37,8 ha to initiate the organic tea production project.

As mentioned before Borçka Muratlı, Çamlıhemşin and Hemşin was choosen as organic tea production areas. Between this areas Hemşin was selected for following reasons:

- a old center for population containing historical and natural beauties
- it represents an closed basin
- surrounded totally by mountains and forests,
- suitability of ecological conditions
- high education level, possible easier acceptance of organic tea farming by local farmers
- higher willing of local farmers
- presence of organic honey and egg production in the region; a proportion of local farmers are familiar with organic farming
- support local administratives and non governmental institutions
- sufficient technical personal in related managements etc.

After involving the whole Hemşin district in the organic tea farming project; Muratlı/Artvin, the districts of Rize Çamlıhemşin and İkizdere, the Tunca district, Senoz basin in Çayeli district, higher altitudes of the districts Pazar and Ardeşen, a part of the Çağlayan basin in Fındıklı, two settelements in Of/Trabzon, two settlements in Rize center and 1 settlement in Kalkandere was included in organic tea farming.

The selected regions display similar characteristics. These are: are rich in water resources, relatively young tea plantations, upper tea plantation areas, mean yield is low, tea plantations are surrounded by forests, absence of other agricultural practices, rich resources regarding running waters, low settlement and industrialisation, no air, water and soil pollution due to industrialisation, suitability for ecotourism, preservation of their historical tissue and presnece of hot spring and baths.

The agricultural land of the Hemşin district is surrounded by forests. This leads to a closed basin and its ecological conditions are suitable for organic tea farming. Because of this reasons ÇAYKUR declared this region as 'Organic Tea Farming Basin' and all farmers were supported to tend towards organic tea farming.

During Tea Purchase Campaign in 2008 processed in the Taşlıdere Tea Factory and 5.900 kg green tea was produced and saled as 'Zümrüt Yeşil Çay'. After this developments a tea factory was built in the Hemşin district. It was opened in 2009 as "Hemşin Organic Tea Factory".

The tea plant needs higher nitrogen amounts for plant development. With the switch from an inorganic fertilizer containing 25% nitrogen to organic fertilizers with low nitrogen contents increases in yield arised.

ÇAY-KUR has supported from the beginning of the organic tea farming project that all produced organic tea by farmers has to be purchased, no quota or limitations are given, Projenin the price has to be earlier payed compared with conventional tea,

50% support for organic fertilizer will be given, that farmer commodities has to contact fertilizer companies and that seminaries concerning fertilizer and fertilisation should be given (Anonymous 2016).

### ***Advantages of Turkey regarding Organic Tea Production***

Turkey has compared with tea producing countries some advantages. These can be explained as follows:

- 1- Ecological conditions in this region are suitable for organic tea production
- 2- The presence of winter prevents damage caused from fungi and insects while tea plants are under the snow cover
- 3- No yield or quality losses caused by tea specific diseases and pests,
- 4- No demand for crop protection chemicals
- 5- No need for chemicals except fertilizers
- 6- Absence of air, soil and water pollution caused by heavy industry
- 7- Sufficient technical information and equipment by side of ÇAYKUR
- 8- The switch to organic production come true in a short time of 3 years
- 9- Support from local administratives and non governmental institutions because of possible contibution to tourism and regional development
- 10- Increase in income level of farmers by supports and different price applications
- 11- Demand for organic tea in the organic market is high
- 12- The shelf price of organic products are higher compared with conventional products
- 13- Tea waste obtained from tea factories can be used as organic fertilizers,
- 14- The organic tea factory will help to improve the economy of the region.

Organic tea production increased from 378 da in 2007 up to 38.034 da in 2016. Also number of organic tea farmers increased from 135 in 2007 up to 11.786 in 2016 (Table 4).

In Table 5 processed organic black and green tea amounts are given. The amount of bought wet tea, processed black and green tea and in total increased from 2009 up to 2016. There is a remarkable increase in organic tea production in Turkey during the last decade. Organic black tea production increased more compared with organic tea production.

### ***Scientific Work Regarding Tea at the Black Sea Region***

In Turkey, most of the tea plantations were

established by using seeds; continuous seed ropagation has produced populations with different yield and quality properties, reflecting wide genetic variation. Clonal selection studies were conducted in the Black Sea region and several promising tea clones such as ‘Tuglali-10’, ‘Derepazari-7’, and ‘Pazar-20’ have been identified (Öksüz, 1987). Clones named Muradiye, Gündoğdu, Fener3, Enstitü1, Enstitü2, Hamzabey, Hayrat, Çayeli, Ardeşen, Fındıklı, Pazar and İyidere followed later. Basicly clonal selection work was done by ÇAYKUR in this region.

Molecular characterisation work (Kafkas *et al.*, 2009; Beriş *et al.*, 2001, 2005, 2016) and the use of plant growth promoting bacteria in organic tea production was conducted by Çakmakçı *et al.*, (2012, 2013, 2016).

### ***Organic Fertilizer Studies***

Due to the plan of ÇAYKUR expanding the organic tea production area collobaration of ÇAYKUR, Ministry of Agriculture, Food and Livestock begun. The primary aim was to find out the potential of organic fertilizers to be used in tea plantation areas.

A research study was conducted in 2017 using 21 different organic fertilizers and chemical fertilizer. These were compared in a randomized block design with three replications in 8 locations, Çamlı and Pınarlı/Hopa, Fındıklı, Ardeşen, Pazar, Çayeli, Ortapazar and Of/Trabzon. 4 solid, 16 liquid and 1 solid + liquid mix fertilizer were used in this study. Each trial plot was depending on field structure 25-30 m<sup>2</sup> and three replications were used.

In this ongoing Project leaves were collected at possible harvesting times and investigated regarding all components important for tea. Chosen samples will be processed for black tea. Also soil samples were taken before fertilizer application and after every harvest time to determine the changes in soil due to fertilizer application.

Basing on experimental statistics, only after 3 year results it can be possible to recommend any fertilizer for organic tea production in this region.

Further the use of organic fertilizer in an high altitude, in Tunca/Rize was conducted by Prof. Seyis and colleagues (unpublished data) to prove the possible yield increase in high altitudes.

### ***Improvement of Tea Quality***

In 2016 the Project “Improvement of Black Tea Quality” supported by DOKAP (Doğu Karadeniz Projesi-East Black Sea Project) belonging to the Ministry of Development started. The aim of this study is to characterize the present tea plantations on chemical and molecular level, determination of

tea clones with edible oil quality and multiplication of promising tea clones. Further a mini tea factory will be built for developing a tea trademark for the Recep Tayyip Erdoğan University after research and development focussing on black and green tea quality.

### ***Possible Challenges and Opportunities***

The switch to organic tea farming will also start some challenges in the production behaviour of local tea producers. Specially, the switch to use of organic fertilizers will allow to restore soil fertility and also water resources in tea production areas. But the switch to organic farming should not be considered only in case of tea, it should be considered as a whole. There are some advantages and disadvantages regarding this issue.

Advantages are:

#### **1- The Hemşin example**

The experience in the Hemşin district will help in the switch of other regions to organic tea farming

#### **2- Intensive interest of farmers**

The interest of farmers sensitive to the protection of the environment is also an advantage, because they want to live an healthy environment

#### **3- ÇAYKUR**

The support of this governmental institution is the biggest advantage.

#### **4- Interest of Ministry of Agriculture, Food and Livestock**

This Ministry supports organic agriculture facilities overall in Turkey.

#### **5- Presence of Faculty of Agriculture and Natural Sciences (Recep Tayyip Erdoğan University)**

The Faculty of Agriculture and Natural Science is the only Agricultural Faculty in the tea production area. Finished or ongoing research projects in the mentioned faculty and university are highlighting present problems and are giving advices for solutions

#### **6- Farmers experience in tea cultivation**

Because tea has a history of nearly 8 years in this region, this experience will help in the switch to organic tea farming

#### **7- Increasing number of educational training courses related with organic tea**

The members of Faculty of Agriculture and Natural Sciences are involved in educational training of local farmers regarding organic tea production since 2013. Cooperations with ÇAYKUR and the National Tea Council (Ulusal Çay Konseyi) are ongoing.

### **Disadvantages:**

#### **1- Recommendation for suitable organic fertilizers**

Organic tea production is ongoing in Turkey, but there is a lack in recommendation of organic fertilizers. Ongoing studies will hopefully solve this problem

#### **2- Misunderstanding that switch to use of organic fertilizers will decrease obtained yield**

Due to wrong applications, there is a misunderstanding that the use of organic fertilizers will led to yield decrease. But in the example Hemşin organic fertilizers are not used and because of corresponding yield losses the gossip arised that yield losses will company organic tea production.

#### **3- Intensive nitrogen fertilization and corresponding problems**

During the last 20 years the intensive use of chemical fertilizers has led to soil and environment pollution. In such regions the switch to organic tea production will take time and needs another approach.

### **Conclusion**

Turkish tea, to have the advantage of producing organic tea, is an important opportunity. The increasing importance of healthy consumption today can be treated as a chance for consumers in Europe and in the World as well as Turkish consumers. For this reason, all necessary efforts should be initiated to produce organic tea in tea gardens of Turkey as soon as possible.

The industry must tackle the problem of quality for use advantage of organic tea as needed. The high quality of fresh tea harvested and good quality black tea processed will be given high price in the tea exchange and this will play an important role in the system. Organic tea meeting the high price in the market will eliminate the problem of competition about Turkish tea due to high costs. If organic tea production realized, the factories could pay a higher price to tea farmers and ask them to harvest higher quality fresh tea leaves (Saklı, 2011).

ÇAYKUR is planning to switch to Organic tea production in all tea plantations in Rize in 2018. But the lack of information about the use and kind of organic fertilizers is still present. In near future the farmers has to be educated intensively about the structure of organic tea production, the use of organic fertilizers and they have to be highlighted about future plans of ÇAYKUR and the Ministry of Agriculture, Food and Livestock).

Table 1. Tea production areas in the world

Countries	Tea Area (thousand ha)
China	1984
India	604
Sri Lanka	222
Kenya	203
Indonesia	119
Vietnam	115
Myanmar	83
Turkey	76
Other countries total	382

FAO (2014)

Table 2. Tea production in the world

Country	Yield (tonnes)
China	2.111
India	1.207
Kenia	445
Sri Lanka	338
Vietnam	228
Turkey	227
Iran	119
Indonesia	154
Other countries total	731

FAO (2014)

Pic. 1. Tea production areas at the Black Sea region

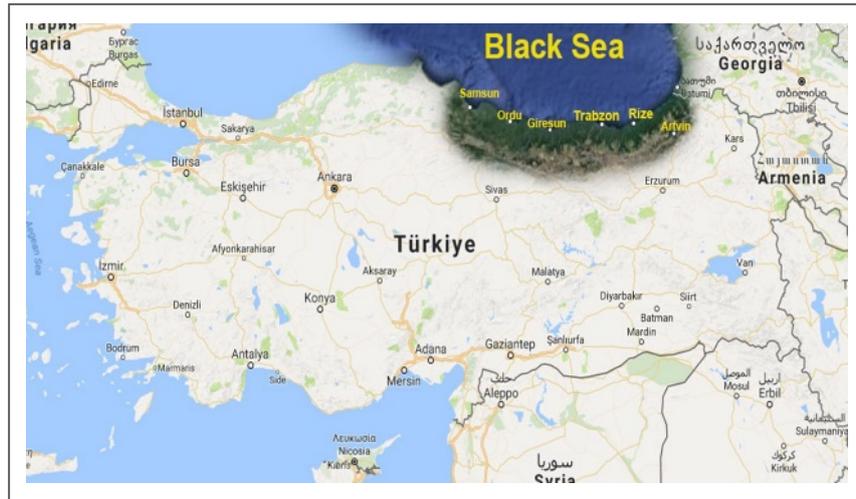


Table 3. Tea plantation area and number of farmers

City	Tea Area (da)	%	Number of farmers	%
Rize	574.135	65.96	131.443	61.81
Trabzon	165.982	20.01	51.222	24.08
Artvin	98.433	11.51	20.169	9.48
Giresun	20.844	2.51	9.814	4.61
Ordu	111	0.01	44	0.02
Total	829.505	200	212.692	100

Anonymous (2016)

Fig. 1. Consumer preference buying organic tea (Snehagha and Ramawat, 2016)

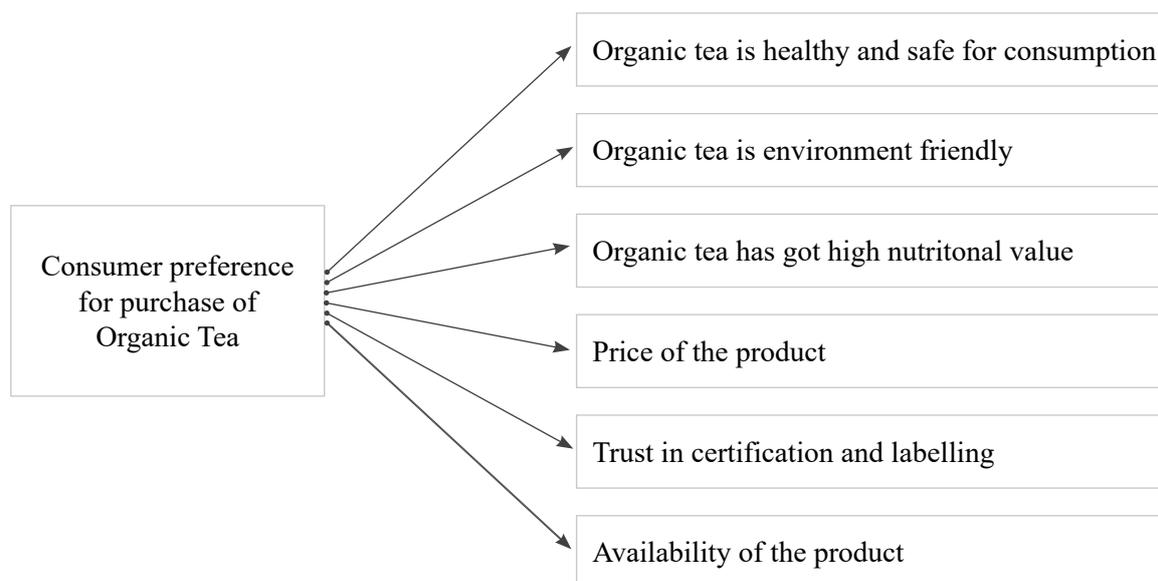


Table 4. Organic tea production areas in Turkey

Years	Numbers of Farmers	Tea area (da)
2007	135	378
2008	400	1.080
2009	1.434	3.558
2010	1.438	3.555
2011	1.448	3.557
2012	3.843	11.298
2013	9.758	28.768
2014	11.155	32.505
2015	11.224	34.665
2016	11.786	38.034

Anonymous (2016)

Table 5. Organic tea leaf production and produced tea amounts (tonnes)

Years	Processed Tea (tonnes)			Total
	Bought Wet Tea (tonnes)	Black Tea	Green Tea	
2009	361	58	3	61
2010	384	152	5	157
2011	1.743	313	13	326
2012	1.724	339	10	349
2013	1.732	353	9	362
2014	1.927	341	26	367
2015	7.381	1.328	21	1.349
2016	22.330	4.449	39	4.488

Anonymous (2016)

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