REPUBLIC OF TURKEY
ONDOKUZ MAYIS UNIVERSITY
INSTITUTE OF SCIENCES

FACTORS INFLUENCING SHAREHOLDER FARMING SYSTEM IN TEA PRODUCTION AND ITS EFFECTS ON SUSTAINABILITY IN RIZE PROVINCE

SHAMSHEER UL HAQ

DOCTORAL DISSERTATION

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SHAMSHEER UL HAQ

DEPARTMENT OF AGRICULTURAL ECONOMICS

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ETHICAL STATMENT

I have prepared this research work in accordance with the rules of Graduate School of Sciences, Ondokuz Mayis University for Ph. D. Degree Thesis. It contains correct and complete information which was gathered at different stages of the thesis. I also adhered to scientific ethics and all information sources from which I benefited are indicated in reference section.

31/05/2019

Shamsheer ul Haq

ÖZET

Doktora Tezi

ÇAY TARIMINDA YARICILIK SİSTEMİNİ ETKİLEYEN FAKTÖRLER VE BU SİSTEMİN SÜRDÜRÜLEBİLİR TARIM ÜZERİNE ETKİLERİ

Shamsheer ul Haq

Ondokuz Mayıs Üniversitesi
Fen Bilimleri Enstitüsü
Tarım Ekonomisi Anabilim Dalı

Danışman: Prof. Dr. İsmet BOZ

Gittikçe artan gıda talebi, girdilerin yaygın kullanımı, iklim ve piyasa ile ilgili belirsizlikler, tarımın sürdürülebilirliğini tehdit etmektedir. Çay tarımında sürdürülebilirliği etkilemesi olası diğer bir faktör de işletmenin mal sahibi veya yarıcı tarafından işletilmesidir. Bu nedenle, bu çalışma, çay işletmeciliğinde mal sahibi ve yarıcılar tarafından yönetilen işletmelerin sürdürülebilirliğini ele almaktadır. Araştırma verileri Rize İlinden tabakalı örnekleme yöntemiyle belirlenen toplam 138 çay çiftçisi ile yapılan anketlerle 2017'de toplanmıştır. Çalışma t-testi, ki-kare testi, faktör analizi, kümeleme analizi, verimlilik analizi, lojistik regresyon ve Tobit modeli gibi birçok istatistiksel analizin ve ekonometrik modellerin yürütülmesi ile tamamlanmıştır. Ayrıca, çay işletmelerinin sürdürülebilirliğini ölçmek için; ekonomik, sosyal ve çevresel olmak üzere üç sürdürülebilirlik boyutunda çeşitli göstergeler geliştirilmiştir. Bu çalışmanın sonuçları, sahibi tarafından işletilen işletmelerin teras uygulamaları, toprak testi ve gübre uygulama yöntemi vb. gibi çiftlik yönetim uygulamalarında yarıcı işletmelere göre daha iyi olduklarını ortaya koymaktadır. Yarıcılığın sosyal maliyeti 879,32 TL/hektardır. Yarıcı çay çiftliklerinin sürdürülebilirlik seviyesinin mal sahibi tarafından işletilen çiftliklere göre daha düşüktür. Bölgede çay işletmeciliğinin sürdürülebilirliği ekonomik sürdürülebilirliği 0,23, çevresel sürdürülebilirliği 0,43 ve sosyal 0,52 sürdürülebilirliği olarak bulunmuştur. Sürdürülebilirliği artırmak için çiftçiler, gübrelerin kullanımını kontrol etmeli ve aile emeği mevcut olduğunda gereksiz yabancı iş gücü kullanımına izin vermemelidir. Aynı zamanda, çay bahçelerinin verim seviyesini sürdürmek için zamanında yeniden dikim yapmalıdır. Ayrıca hükümet, çay çiftçilerinin ilgisini çekmek için çalışma alanındaki çiftçilerin küçük çaplı hayvancılıkla gelir kaynaklarını artırmaya çalışmalıdır. Yayım elemanları ve çay firmalarının personeli, çiftçilerin iyi yönetim uygulamalarını benimsemesi ve hem çay kalitesi hem de insan sağlığına olumsuz etkileri olan kimyasal gübrelerin kullanımının azaltılması için çiftçileri (özellikle yaricilari) özendirmelidir.

Mayıs 2019; 160 Sayfa

Anahtar kelimeler: Çay tarımı, Sürdürülebilirlik, Yarıcı, Mal sahibi, Rize

ABSTRACT

Doctoral Dissertation

FACTORS INFLUENCING SHAREHOLDER FARMING SYSTEM IN TEA PRODUCTION AND ITS EFFECTS ON SUSTAINABILITY IN RIZE PROVINCE

Shamsheer ul Haq

Ondokuz Mayis University
Institute of Sciences
Department of Agricultural Economics

Supervisor: Prof. Dr. Ismet Boz

With the growing demand for food, the extensive use of the inputs, and the uncertainty associated with the agriculture regarding climate, and market threats its sustainability. One of the key factors influencing sustainability in tea farming is whether the farms are operated by owners or shareholders. Therefore, this study focused on shareholder and owner-operated tea farming systems as well as their effect on farm sustainability. The data was collected in July 2017 from a total of 138 tea farmers selected by stratified sampling method in Rize province. The study was completed with the execution of much statistical analysis and econometric models such as t-test, chi-square, factor analysis, cluster analysis, efficiency analysis, logistic regression, and Tobit model. Moreover, a set of indicators for measuring tea farms sustainability was also developed under three sustainability dimensions as economic, social, and environment. The results of this study describe that owners were good in farm management practices, like terrace practice, soil testing, and fertilizer application method etc. Furthermore, for shareholders social cost equaled to 879.32 TL/hectare. Similarly, they had also low tea farms sustainability levels than owners. The low tea sustainability in the region was highly depend on low economic sustainability (0.23) followed by environmental (0.52) and social (0.43) sustainability. To increase the sustainability farmers should control their use of fertilizers, and unnecessarily hired labor whenever the family labor is available at the time of need. They should also replant their orchards on time to sustain good yield level. Moreover, the government should start to focus on providing the side source of income like dairy farming in the study area to attract the tea farmers. The extension agents and tea firms' staff should encourage the farmers (especially shareholders) in adopting good management practices, and applying low chemical fertilizers which have adverse effects on tea quality as well as human health.

May 2019; 160 Pages

Keywords: Tea farming, sustainability, shareholders, owners, Rize

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First of all, it is necessary to gratitude to my almighty Allah for his blessings on me to complete all steps regarding this Ph.D. program. Similarly, it is also impossible to close this research without showing my respect and love for our Hazrat Muhammad (PBUH). Furthermore, I am thankfull to beloved person Hafiz Muhammad Irfan Sadique for his encouragement and prayers during my whole study period. Moreover, I am dedicating this achievement to my beloved late mother who saw me off to Turkey, and started her journey to the world hereafter.

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Shamsheer ul Haq

TABLE OF CONTENTS

ACRONYMS

GDP	:Gross Domestic Product
NGO	:Non-Governmental Organization
OOF	:Owned-Operater Farms
SOF	:Shareholder-Operated Farms
WCED	:World Commission On Environment And Development
LSI	:Livelihood Security Index
SAFE	:Sustainability Assessment Index
ASI	:Agricultural Sustainability Index
CSI	:Composite Sustainability Index
CTFSI	:Composite Tea Farms Sutainability Index
TE	:Technical Efficiency
EE	:Economic Efficiency
CRS	:Constant Return To Scale
DEA	:Data Envelopment Analysis
LP	:Linear Progrming
GM	:Gross Margin
BCR	:Benefit Cost Ratio
PCA	:Principle Component Analysis
FA	:Factor Analysis
KMO	:Kaiser-Meyer-Olkin
LSTF	:Low Sustainability Tea Farm
HSTF	:High Sustainability Tea Farm
SC	:Social Cost

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Agriculture is one of the most important sectors of Turkey, which has 6.1% contribution to the country's GDP in 2018. It also absorbs the 19.2% labor force of the country. The proportion of women labor in agriculture of the country is higher than the men's. The women agricultural labor is about 28% while only 15.2% of men are engaged in agriculture. Moreover, the total agricultural land is 38002 thousand hectares, the cereal and field crops are cultivated on 40.88% of total agricultural land. Similarly, 2.10% land is under vegetable gardening, 0.01% is under cultivation of ornamental plants, 8.81% is covered by fruit, beverages and spice crops, and 38.46% is permanently used under meadows and pastures. The fallow land is 9.73% of the total agricultural area of the country (Turkstat, 2018[a]).

In the last fiscal year, the total marketable value of crops produced was equal to $18281.68 million. The highest share was of cereals, and field crops which were equal to 38.37% ($ 7015.16 Million), followed by fruits, beverages and spices crops with the share of 35.22% ($ 6439.43 Million), and vegetables with 26.40% share in the total marketable value of crops (Turkstat, 2018[c]). It describes that the climate diversity allows the cultivation of various crops all over the country. Turkey has been distributed geographically into seven different regions known as i) Aegean, ii) Black Sea, iii) Central Anatolia, iv) Eastern Anatolia, v) Marmara, vi) Mediterranean, and vii) Southeastern Anatolia regions. Figure *1.1* shows the geographical distribution of seven regions of the country.

Figure 1.1. Geographical distribution of country

Among these, the Black Sea regions of Turkey receives the highest precipitation annually. Generally, the rainfall is evenly distributed whole year, and summer remains humid and warm while winter experiences heavy snow and cold. Geographically, it can be separated into three different sub-regions such as; i) Eastern Black Sea region, ii) Central Black Sea Region, and iii) Western Black Sea Region. Among these three regions, the Eastern Black Sea region's climate also remains mild, rainy, and normally humid in mild temperature (Sesli and Tüzen, 1999).

The climatic conditions and geographical characteristics in the Eastern Black Sea region favor the cultivation of various crops, especially tea (Camellia sinensis) (Gülser and Pekşen, 2003). As tea has secured an important position in the daily diet of human, it is the second most consumed drink after water. Culture differences discriminate tea consumption all over the world. Some countries produce black tea, and some white (Adagioteas, 2016). Turkey is famous for its production of black tea. Generally, it assumes the fifth rank among top ten tea producing countries after China, India, Kenya, and Sri Lanka, respectively (Worldatlas, 2016).

Tea is not a native plant of the Eastern Black Sea region of Turkey. In 1917, Prof. Dr. Ali Riza Erten had found the possibility of tea cultivation in the Eastern Black Sea region since the tea growing required high lands with no water stagnation, and fertile acidic soil in humid and hot weather. Then, serious attempts regarding tea cultivation have started in Turkey. Therefore, the Rize province in the Eastern Black Sea region was considered suitable for tea cultivation.After the report prepared by Prof. Dr. Ali Riza Ertan, the cultivation of tea had been legalized by the Turkish National Assembly in 1924. Consequently, to promote tea cultivation, the first agriculturist Zihni Derin was officially appointed to implement and consolidate the tea cultivation. In order to execute the tea cultivation, a team of agriculture officers was sent to Georgia (Batumi). The responsibilities of this team were to analyze the tea cultivation and get information about production technologies while buying tea seeds. In 1933, tea cultivation had experienced a break, due to lack of necessary technical information leading unsuccessful trials. Continuously after four years, Zihni Derin was appointed again in 1937, and at this time 20 tons' tea seeds were imported. Moreover, the serious steps have been taken to cultivate tea successfully in Rize province. By 1965, tea production was too much that the domestic market had been satisfied, and Turkey started tea export (Aylangan, 2011; GDTE, 2016).

The state-owned enterprise, Çay-Kur, was founded in 1971 to boost up the tea farming. Generally, it was responsible for coordinating tea farming and tea processing in the country. It started functioning legally in 1973 with limited capital in Rize province. It was controlling import and export of tea, and also responsible for promoting tea cultivation, as well as introducing new tea cultivation related technologies. It has a 60% share in the domestic tea market and buying almost 55 to 60 percent green tea. After passing the law number 309 in December 1984, the private sector was enabled to enter the tea sector production, processing, and marketing (ÇayKur, 2016).

Figure *1.2* presents the tea produced area, and Figure *1.3* describes the tea production over the last 17 years, respectively. The maximum area tea plants sown was observed between the years of 1990-95. Afterward, the fluctuation was not severe in the area of tea cultivation; it remains almost the same from 2001 to 2007 with a slow decline. Again, a sharp rise of 6790 hectares the in tea area happened after 2015 was observed, and remained same afterward. The fluctuation in production describes an increasing trend with uneven fluctuations over the last 17 years.

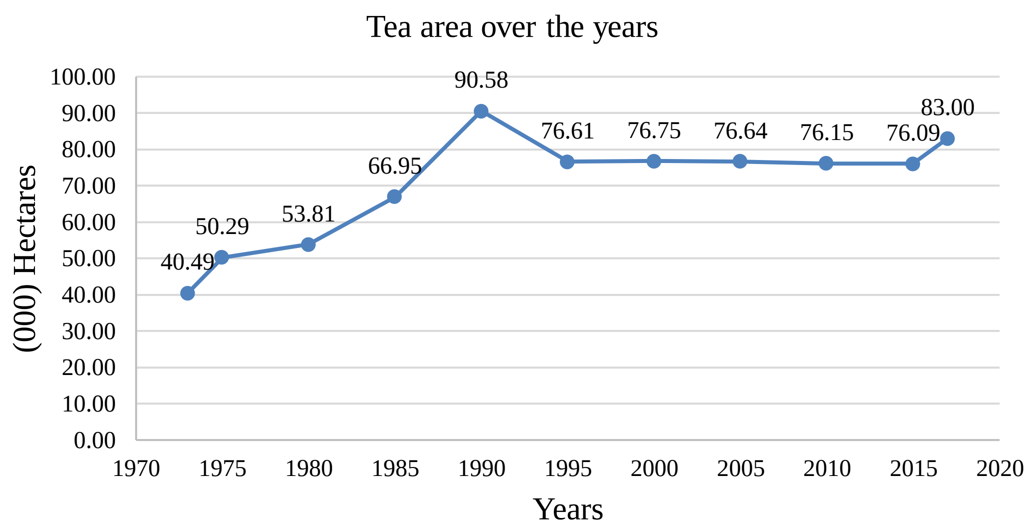

Figure 1.2. Tea area over the years

(Source, RTMAF, 2018; Klasra et al, 2007)

The maximum production was observed in 2016 which may be due to the highest tea cultivated area in the year. In 2017, the area was same as it was in 2016, but the 50 thousand tones reduction was observed. Although Turkey has good tea production capability, the tea farms are hindered by many productions, management, processing and marketing problems. Delaying in replanting tea, land downsizing, fluctuation in the tea processing sector, illegal tea entry, high cost of production due to heavy fertilizer application, and inadequate organic production are the problems faced by tea farms (Özcan and Yazıcıoğlu, 2013).

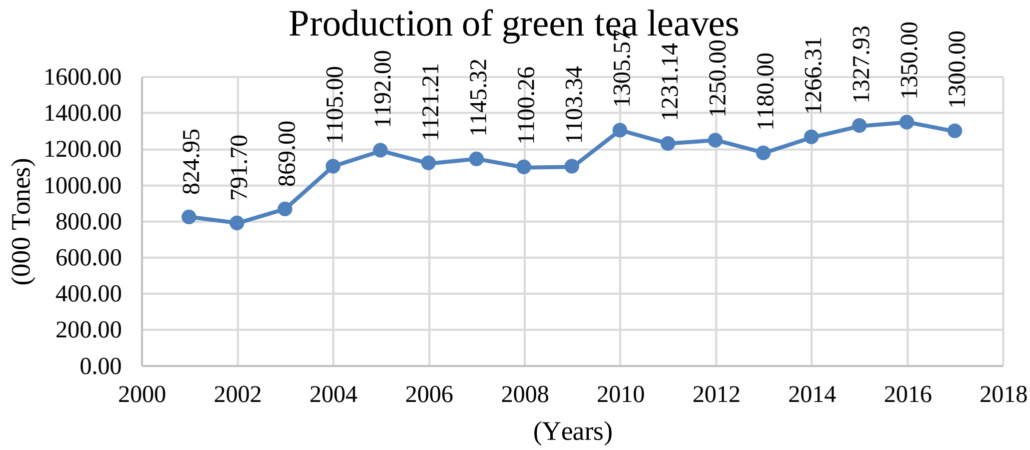

Figure 1.3. Tea production over last 17 years

(Source, RTMAF, 2018)

The land fragmentation, low tea prices, late payment and lack of solidarity between the organizations are the problems affecting the small tea growers. Moreover, the public enterprises are confronting problems regarding the inefficiency, lack of exporting opportunities, and low capacity utilization. Similarly, low product quality, capital shortage, insufficiency, ineffective marketing, and poor, unprofessional management are the issues faced by private tea firms (Sakli. 2011). In this point of view, problems prevailed in tea farming economically affect the tea farmers resulting in low tea sustainability. Moreover, mechanization, dependency on chemical fertilizers, resilience on the chemical (pesticides, herbicides), increasing soil-erosion problem, and risk related to human health threatens the sustainability of farming systems. Use of chemical fertilizers and agro-medicines has reduced the yield loss. However, its negative impact on the environment and human health can be ignored. Similarly, the heavy use of chemical fertilizers, land, irrigation water, farm machinery, and pesticides have been driving the farm productivity for the last some decades. Chemical inputs being used in different management practices at farm enhance the production, in turn, these chemical inputs' hidden losses also are too much. Their adverse effects on degradation of land, fauna, flora and fisheries, as well as the expositions of the farmers to serious health risks cannot be ignored (Terano et al, 2015). This situation shows the need for developing new approaches that will integrate the ecological and biological process into food system with minimum use of those non-renewable inputs that cause the health and environmental problems. Furthermore, making productive use of skills and knowledge of the farmers, and making productive use of farmers' collective capacities to solve the agricultural and environmental problems. These principles improve the capital assets of agricultural systems such as natural (environmental), social (Social), and financial (economical) capitals. It is possible with the best use of genotype of crops and animals at farms as well as ecological conditions under which farming is practiced. Therefore, agricultural sustainability implies attention on both genotype developments through fullfledged application of biological approaches through a better understanding of benefits associated with ecological and agronomic manipulation, management and redesign (Pretty, 2007). These farm activities directly affect the economic, social and environment sustainability communally known as agricultural sustainability.

Sustainable agriculture does not call for going back to farming practices that push the farmers to subsistence farming practices. Additionally, it does not describe ruling out the adoption of new technologies at farms. If a technology tends toward improving the productivity without undoing harm to the environment, it possess some sustainable benefits (Dobbs and Pretty, 2004; MEA, 2005). It is directing the farmers toward the right way of farming, and adopting the new farming technologies for higher economic benefits while the environment is not affected. This sustainability concept has become the prime agenda of discussion of development agencies, institutes, NGOs, and of many researchers. Parallel to conceptual debate, now there is a need for a methodological framework for transforming conceptual sustainability into the operational level (Lopez-Ridaura et al, 2005).

Developments related to mechanization, reliance on fertilizer and agro-chemicals, destruction of wildlife habitats, increasing soil erosion, environmental pollution and risk related to human health have led the current production farming systems to a low chance of long term viability. These negative impacts of modern agriculture development divert the attention toward consideration of a sustainable farming system. The use of chemical fertilizers and plant protection medicines has reduced the yield loss. However, its negative impact on environment and human health cannot be ignored. Similarly, tea sustainability in the country is also one of the most concerned topics that affected by human (farmers) activities that directly influence the socio-economic and environment sustainability regarding tea farming in the region. Furthermore, agricultural land is operated by different tenure forms. In Turkey, two general types of land tenure have been found; 1) people operating on their own lands a as well on others , 2) people do not have their own land but operating on others. Further, each of the two groups of land operating styles has two types of holdings. Table *1.1* shows the holdings and their tenure forms in Turkey. First, people having their own land are also operating on the other's. Second, people having no land but renting, and some operating on land sharing basis. The holding and operating only on shared basis is also prevails in the country in a small proportion. However, this farming system also bears the cost and also contributes to the economy of the country. The 36.41% agricultural land is operated by owner-cum-tenant, 3.16% agricultural land operated by only renters who do not have their own land. At last, 0.39% of the agricultural land is operated by landless tenures on shared basis. Similarly, in tea farming two different tenure farming systems were observed. Due to various tea farming related problems, the two farming systems such as owner-operated farms (OOF) and shareholder-operated farms (SOF) might also differ in farm practices, and farm sustainability. Both OOF and SOF are expected different in tea cultivation practices, tea profitability as well as tea sustainability.

Table 1.1. Land holdings and types of tenure in Turkey

Holding size (Decares)	Holdings having their own land				Holdings operating land by sole type of tenure					
	Holdings operating only their own land (possession land included)		Holdings operating both their own land and other's land		Holdings operating only rented land		Holdings operating land only on share basis		Holdings operating land in other tenure forms	
	A	B	A	B	A	B	A	B	A	B
Total	79.51	59.86	17.06	36.41	2.97	3.16	0.34	0.39	0.11	0.17
-5	96.49	95.46	1.35	2.09	1.86	2.12	0.23	0.28	0.07	0.05
5 - 9	91.53	91.29	4.22	4.33	3.54	3.71	0.21	0.22	0.51	0.44
10 - 19	88.93	88.17	8.07	8.92	2.63	2.52	0.34	0.37	0.03	0.02
20 - 49	81.87	80.28	13.59	15.02	4.17	4.31	0.36	0.38	0.01	0.01
50 - 99	73.48	72.23	23.73	24.99	2.36	2.35	0.43	0.42	0.00	0.00
100 - 199	63.41	61.82	33.69	35.38	2.40	2.28	0.45	0.46	0.05	0.06
200 - 499	53.50	52.05	43.50	44.93	2.43	2.55	0.15	0.13	0.41	0.34
500 - 999	42.70	41.60	54.08	55.22	2.50	2.51	0.61	0.58	0.10	0.10
1000+	45.67	51.86	49.59	41.51	3.73	5.69	0.88	0.58	0.13	0.37

Figures are in percentage (%). A = Holdings; B = Agricultural Land (Source; Turkstat, 2018[b])

Before estimating the sustainability of any farming systems, there is a need of deciding measurement level of sustainability. Two different spatial levels have been discussed in the literature, namely horizontal and vertical spatial levels. The first horizontal spatial level describes the sustainability measurement at parcel, farm, and landscape level. The vertical spatial level considers the biosphere level which is thin layer at the earth's surface that is affected by the living organisms and atmosphere above the plant canopy (Cauwenbergh et al, 2007). The first horizontal level, known as the parcel, is the smallest level which is internally uniform regarding management practices. Farm level is a bigger level than the parcel in addition with some capital stock including humans, man-made social capital and some natural resources (buildings, livestock, machinery). The land scale is the biggest one considering broad issues like landscape, ecosystem, surface water, soil, air, biodiversity and administrative units such as state and region. In respect toprevious discussion, the farm level sustainability assessment was decided to analyze.

1.1 Research Questions

The basic research questions for this study are described as;

1. What are the differences between shareholders and owners in terms of socio-economic characteristics and farming practices?
2. Which factors influencing the decisions of shareholders to act in this position?

These research questions area broad which try to entail all thesocio-economic characteristics of the owners and shareholders as well as their farming practices. Furthermore, the factors influencing the decisiond of shareholderd to act in a speific position were also explored in detail to answer the questions in detail. These broad research questions resulted in some sub-questions as below.

a) What are the socio-economic characteristics of the shareholders and owners?
b) What are the factors affecting the decision of the real landlords to give their land to landless people?
c) What are the factors influencing the shareholders to act in that position?
d) What is the social cost of shareholders' tea farming?

This sub-research questions describe the owners' and shareholders' socio-economic characteristics such as their age, education, off-farm occupation, family and hired labor, farm and off-farm income, and farm activities, tea management activities, farmers' communication behaviors, farmers abiding level of rules related to tea harvesting, etc. These aditonal sub-research questions further describe the situation of why a landlord give their land to landless. Thus the factors affecting the landlord decision to give their land to landless people are explored. These factors might be able to explain the landlords'decision to supply their land to land market. Moreover, why shareholders have decided to become tea farmers while they do not have their own land were also analyzed. In this way, we would be able to enlighten the factors regarding the demand for renting in the land market. At last, the social costs of shareholding were also calculated.

3. Is it possible to explore the tea farms sustainability level in Rize province?

The basic purpose of this question was to analyze the possibility of developing the sustainability index. The index development is very challenging which requires attentive and comprehensive information of farms, farmers, crops, market, and stakeholders. Furthermore, the possibility of indicators' selection for measuring the tea farm sustainability as well as method for measuring the sustainability index is also challenging. Consequently, this major research question was described by the following sub-questions .

a) What are the basic indicators to include in the measurement of farm level sustainability index for tea producers in the region?
b) What are the appropriate methods for measuring dimensionally and overall sustainability levels of tea farming in the study area?
c) What factors influences farm level sustainability?
d) Does sustainability level of owner and shareholder farmers differ?

First sub-question needs an answer about the selection methods of indicators for measuring the tea farm sustainability. Second sub-question desires the answer about the calculation process of tea farms sustainability in order to measure the final tea farms sustainability index to describe it in the region. The third sub-question requests answers for exploring those factors that need to be considered to increase tea sustainability in the region. Final sub-question requires the comparison of two farming systems (owning and shareholding) in order to find out any differences in terms of their sustainability level.

1.2 Research Hypothesis

This study is also planned to analyze the some research hypothesis defined below.

1. Both tea farming (shareholder and owner operated) systems are not different in terms of their personal and farm characteristics.
2. There is no social cost associated with the shareholding farming system in the research area.
3. There are some influential factors on the decision of the shareholder to act in this position.
4. It is possible to define broadly adoptable set of indicators for measuring tea farms sustainability.
5. The sustainability level of shareholders and owners are the same.
6. There are some managerial and demographic factors affecting the farm level sustainability.

1.3 Objectives

The estimation of farm level sustainability, determining the factors affecting the shareholding system, and its effects on sustainability are the major objective of this study. This study will be completed by considering the following specific objectives.

1. To compare the socio economic characteristics of owned and shareholding farming systems.
2. To assess the factors influencing the land owners to give their land to shareholders.
3. To assess the factors influencing shareholders to act in this position.
4. To calculate the social cost of shareholding in tea farming.
5. To measure the farm level sustainable agriculture index in Rize province.
6. To compare the sustainability level of owners and shareholders.
7. To assess the factors or variables affecting the sustainability.
8. To develop the recommendations for tea farming and family farming based on sustainability.

2 LITERATURE REVIEW

2.1 Theoratical Background

The first definition of sustainability has been proposed by the World Commission on Environment and Development (WCED), which is also known as the Brundtland Commission. Afterward, the sustainability concept has been familiarized, and greatly focused by the scientists and policy makers in each field, all over the world (Bosshard, 2000). In the Brundtland Commission's report, the sustainable development describes "the ability of present generation to fulfill their needs without compromising the ability of future generation to meet their own needs" (WCED, 1987).

Agriculture uses intensive human, financial, and environmental capitals. This use also expresses the need of sustainable use of non-renewable resources such as land, water etc. for future generations to fulfill their own needs. Therefore, the sustainable agricultural concept also has been adopted by the agricultural scientific community. As time passes, many different concepts of agricultural sustainability have come to being implied in agricultural systems. Similarly, agricultural systems that use the environment and services without damaging the nonrenewable resources is known as sustainable (Altieri, 1995; Conway, 1997; Hinchcliffe et al, 1999; NRC, 2000; Li-Wenhua, 2001; Tilman et al, 2002; Uphoff, 2002; McNeely and Scherr, 2003; Gliessman, 2005; Tomich et al, 2004; Swift et al, 2004; MEA, 2005; Kesavan and Swaminathan, 2008; Pretty, 2007; Scherr and McNeely, 2008). Edwards et al (1990) called the agricultural system sustainable which develop the indefinitely high human utility through efficient use of inputs with healthy environment that is favorable for both human and other species. Hansen (1996) said that agricultural sustainability is an ability that satisfies the long term divers set of social, economic, and environmental goals. Boone et al (2007) described the agricultural sustainability as a production and distribution system that protect the soil form degradation and maintain its fertility, able to renew the base of natural resources, maintain the best integration level between natural biological cycle and control, use farm resources efficiently with low dependency on purchased inputs and make suitable return which promotes the agriculture as occupation for families. Singh (2013) has defined the sustainable agriculture as a practice that requires low inputs, and preserving the soil quality without compromising the economic yield. The key principle for sustainable agriculture can be described as; 1) minimizing the use of the non-renewable resources those pollute the environment, and also harmful for human health, 2) improving the self-reliance of farmers, and substituting the inexpensive inputs for expensive ones by making the knowledge and skills of the farmers more productive, 3) solving the management and production problems regarding agriculture and natural resources by making the farmers' capacities of working together. These principles of sustainable agriculture explain the intensive activities in landscapes and economies. As agriculture produces food and other farm products for both farmers and market, and also contribute to valued public goods, carbon sequestration, landscape amenity value, and truism.

With well-familiarized and increasingly adapted concept of agricultural sustainability, tended to measure the conceptual sustainability into an operational level. Afterward, the assessment of agricultural sustainability has been started and progressively classified, and assessed at different spatial levels (horizontal and vertical) (Cauwenbergh et al, 2007). Most of the earlier studies present the application of the sustainability concept in agriculture on horizontal spatial level. Gowda and Jayaramaiah (1998), Reganold et al (2001), and Terano et al (2015) assessed the sustainability at field parcel level related to rice and apple, respectively. Pretty et al (2008), Binder et al (2008), Dillon et al (2009), and Olde et al (2016), concentrated on the farm level measurement of sustainability. Similarly, researches related to region level were also conducted by Zhen, et al (2005), Sydorovych and Wossink, (2008) and Dantsis et al (2010). These studies have been completed in different developing and developed countries at various spatial levels. Thus, there were some studies which focused on Agricultural sustainability in Turkey, such as Gunduz et al (2011) and Akcaoz and Kizilay (2009). The former described the sustainability of apricot farms in Malatya province, and the latter analyzed the sustainability of dairy production. Moreover, the study of the farmers' perception regarding agricultural sustainability was also conducted in Turkey by Tatlıdil et al (2009). There was another study focusing on assessment of agricultural sustainability of conventional farming systems in Samsun province by Ceyhan (2010). It concerned four different dimensions in sustainability measurement named as economic, social, bio-physical and environmental.

The assessment of agricultural sustainability extensively conducted with consideration of the three basic aspects such as economic, social and environment. All three aspects together explain the concept of agricultural sustainability (Binder et al, 2010) which is measured by adopting different indicators under each aspect, and by application of different theoretical and mathematical procedures.

Throughout the world, many different indicators had been proposed. Taylor et al (1993) measured "Farmer Sustainability Index (FSI)" with 33 farm practices used by the cabbage farmers. They considered the inherent sustainability effect (negative/positive) of each practice on farm sustainability. They assigned the number based on the extensive effect of a farm practice toward the sustainability. In such a way, the farmers whose farm practices have been contributing to farm sustainability positively obtains higher FSI than others.

Rigby et al (2001) have considered horticultural producers, and developed indicators based on possible adaptable sustainable farming practices. Their basic concern was higher yield, and low loss as one of the basic facts of farming. Lopez-Ridaura et al (2002) compared sustainability level of two different farming systems such as traditional and innovative systems. They considered 12 indicators for assessing the sustainability at farms, additionally they described an evaluating systems to emphasize methodological issues regarding selection, transformation and aggregation of the indicators. Pacini et al (2003) measured the economic, and environment sustainability level of organic, integrated and conventional farms. Rasul and Thapa (2004) compared the sustainability of ecological and conventional farming system through selection of sustainability indicators based on socio-economic and biophysical characteristics of the study area. Hani et al (2006) proposed the RISE (Response-Inducing Sustainability Evaluation) model with the application of 12 indicators which consists of more than 60 parameters those covered under economic, social and environment dimensions of agricultural sustainability. Pretty et al (2008) extensively focused on five different crops and measured the sustainability with indicators to evaluate the progress of Unilever toward the sustainable agriculture. Gomez-limon and Riesgo (2009) measured the agricultural sustainability with 12 indicators: six under environmental dimension, two under social and four under economic dimension of sustainability. Moreover, they compared some aggregation methods for developing the composite indicators based sustainability index. Dillon et al (2009) measured farm sustainability by using time series based indicators. Gomez-limon and Sanchez-Fermandez (2010) compared the rain-fed and irrigated farms sustainability level by indicators selected through SAFE (Sustainability Assessment of Farming and Environment) framework proposed by Cauwenbergh et al (2007). Gomez- Limon and Riesgo (2010) also assessed the indicator based sustainability of olive grove farms in Andalusia. Roy and Chan (2012) focused the site specific conditions for the selection of indicators to measure the farm level sustainability. Sajjad and Nasreen (2016) assessed the farm level sustainability by using "Livelihood Security Index (LSI)" on some selected indicators based on site-specific characteristics. Van der Werf and Petit (2002) compared 12 different indicator-based approaches assessing farm-level environmental impact. They concluded that assessing the environmental impact the evaluation method should consider the various objectives through the selection of indicators that express the impact of farming practices on the environment. The indicator's output in the form of values or scores, and defining the threshold values based on scientific knowledge are better to evaluate the environmental impact of any farm practices. Hayati et al (2010) discussed the method for measuring farm level sustainability with indicators. The interaction between farm and its surroundings reveals the importance of sustainable farm. They stated that the selection of indicators in measurement of farm level sustainability should be site specific, and the sustainability measurement should be according to the context of specisific farm's ecological and socio-economic conditions. Vecchione (2010) selected 18 different indicators under the social, economic, and environment dimension of sustainability. Moreover, they used Fuzzy Logic for transforming the indicators, and estimated the weight of indicators by adopting analytical hierarchy approach. The purpose of measuring the sustainability was to evaluate the effect of European legislation in rural sector. Their estimated agricultural sustainability index (ASI) was varying in range from 1 to 0. A number toward 1 shows the higher farm sustainability, and significant effect on rural sector improvements which was considered as the effect of the European Union's legislation and vice versa. Abdel-Maksoud and Abdel-Salam (2012) used 26 different indicators selected with the discussion of agricultural officers and extension workers to explore the agricultural sustainability. They assessed the 200 farmers' perception and knowledge toward sustainability dimension.

Gowda and Jayarmaiah (1998) had measured the farm level sustainability of four different rice production systems. They also considered the economic, social and environmental indicators after the experts' appraisal. Gaviglio et al (2016) assessed the social sustainability at farm level by selecting 15 different literature based indicators through evaluation of the five components of social sustainability; 1) society, culture and ecology, (2) work, (3) ethical and human development, (4) short supply chain and related activities, and (5) quality of the products and the region.

Terano et al (2015) measure the sustainability of paddy growers (field level). They measured the paddy farmer's sustainability index (PFSI) based on 30 different sustainable farming practices regarding paddy cultivation. The direct effect of farming practice on sustainability was considered for giving weight to each farming practices. Singh et al (2016) also assessed the sustainability of 108 cattle farms. They estimated the composite sustainability index (CSI) with 12 indicators under economic, social and environment dimensions. They found the farmers were belonging to medium economic, social and environment sustainability. Castellini et al (2012) compared the sustainability of three different poultry farming systems namely conventional, organic and organic-plus. They used six indicators under four dimensions economic, social, environmental and quality. They found organic-plus most sustainable poultry farming systems after integrating social, economic and environmental dimensions. They assessed good performance of organic-plus poultry farming system.

2.2 Research Gap to be Filled

It was realized after the review of the literature that; i) the selection of indicators can be different in numbers in the sustainability assessment of farms, ii) the economic, social and environmental dimensions are widely accepted, and used worldwide in agricultural sustainability assessment, iii) selection of indicators should be in accord with the site-specific, social-economic and ecological conditions, iv) three different spatial level namely field, farm and regional level were addressed by different studies. Moreover, these studies enlightened the different farming systems based on farming practices in order to compare their agricultural sustainability. There was a lack of evaluating the sustainability of the farming systems based on the land tenure forms. Second, sustainability of the tea (a perennial crop) was not measured anywhere. Third, indicators for measuring sustainability for farmers growing perennial crops such as tea was also not observed anywhere.

Therefore, these research gaps were tried to be filled. This study proposed the widely usable indicators for measuring tea crop sustainability as well as compared the two types of farm known as owner and shareholder-operated tea farms. Consequently, study fulfills these research gaps of measuring tea farms sustainability by selecting site-specific indicators. In such a way, this study is also expected to give the general framework for the tea growing countries. Furthermore, the proposed indicators can act as a guideline for the beginners in selecting the locality-based indicators.

3 MATERIALS AND METHODS

The most important part of the study that describes the precise application of procedures and techniques to identify, to select and to analyze the collected data and information to understand the research problems. We can conclude that methodology in a study is crucial to get the reliable results leading to sound and coherent interpretation of results (USC, 2016)**.** Therefore, the explanation of each method should be clear that can facilitate the reader to evaluate the validity and reliability of the study. In this part, the objective oriented methodology which will clearly articulate that why this method has been adopted. This section will describe step by step procedure of conducting the current study. The description of the study area and sampling procedure were presented at first. Then, the selection procedure of applicable and widely acceptable indicators under each dimension of sustainability was enlightened. Afterward, statistical methods for combining selected indicators to calculate a composite tea farm sustainability index (CTFSI) were elucidated. Additionally, the statistical method for analyzing the factors affecting the tea farms sustainability was also clarified. Moreover, the method for exploring the factors influencing the decision of landlord to give their land to landless for farming as well as the decision of shareholder to become a farmer were also described in detail.

3.1 Material

3.1.1 Study area

The research problem and objectives of the study plays a significant role in the selection of the study area. Current study concerns tea growers as a target population to measure the tea farming sustainability at the farm level. This leads to area in which tea is cultivated as major crop (vague sentence??). The review of the literature provided the information about the area with extensive tea cultivation (GDTE, 2016; ÇayKur, 2016; RTB, 2014; Aylangan, 2011). In results of the review of literature, Rize province was found most suitable as study area of the current study. More than 90% area of the province is under tea cultivation, and it shares 78% in total country production of tea. Additionally, more than 200 thousand families were involved in the tea industry as farmers (owner or sharecroppers), and employees of tea processing factories, and extension agents.

Figure 3.1 presents the map of the study area. The Rize province with 3920 km^2 total surface area is located on Eastern Black Sea coast. It characterized with rough and mountainous land. The neighbouring provinces of the Rize are Trabzone (in the west), Erzurum and Bayburt (in the South), and Artvin (in the East). The Black sea is located on the North side of Rize.

Figure 3.1. Map of Rize province

3.1.2 Sample selection

The target population was tea growers, and the list of tea farmers from the agricultural department of Rize province was obtained. The stratified sampling formula proposed by Yamane (2001) was applied to obtain the optimum sample size for executing the questionnaire. The formula used in defining sample size is described below in Eq. 3.1.

$$n = \frac{N \sum N_h S_h^2}{N^2 D^2 + \sum N_h S_h^2}, \quad D^2 = \frac{e^2}{t^2} \qquad \text{Eq. 3.1}$$

n = Sample Size.

N = Population of tea growers in main strata

N_h = Number of tea growers in each stratum

S_h= Standard deviation within each stratum

D^2= Expected variance

e = Accepted error from mean

t = value of corresponding the accepted confidence interval

The main objective of using this stratified sampling method was to increase the accuracy of the estimates of the mainframe and to ensure that the different groups in the mainframe are represented adequately and properly in the study. Moreover, the principle of this method is to reduce the variance by separating the homogenous strata from the mainframe. In this way, with fewer examples, a healthy and detailed study is possible.

The accessible population was 1647 tea growers, and ascendingly ordered based on their land under tea. Hereafter, the farmers were divided into three strata. First stratum consisted of those farmers having land less than 0.50 hectare of tea. Farmers having land equal and greater than 0.50 hectare but less than 1 hectare of tea were included into the second stratum. Finally, the third stratum contained tea-farmers having land greater than 1 hectare. Table *3.1* presents the accessible population and sample size regarding each stratum. The total number in each stratum was 649, 475 and 523, respectively. We supposed 3% accepted error from the mean, and the t-value was equal to 1.645. After executing the stratified sampling formula, the ultimate 138 tea growers were defined as the sample size of this study.

Table 3.1. Accessible population and sample size of each stratum

Strata	Criteria	Population	Sample Size
Stratum 1	< 0.50	649	54
Stratum 2	0.50 ≤ Hectare ≤ 1	475	40
Stratum 3	1<	523	44

3.2 Method

3.2.1 Questionnaire description

A well-structured questionnaire was constructed and pre-tested. During pilot study, the questionnaire was consulted with the tea stakeholders like tea factory staff, heads of the tea firms, and tea growers etc. In this way, questionnaire was upgraded, and finally, it was arranged into section based on the different type of questions. The first section was about the socio-economic characteristics of the tea farmers. This section collected the information about the age, education, farming experience, off-farm occupation, off-farm income, family size, education status of family members, and migration of any family members. After that, the tea related farm management activities, and the input used as well as the tea output obtained were asked. Moreover, the type of data requirement for measuring or estimating the true value of selected indicators was analyzed and collected in detail. The questionnaire was in Turkish language to collect healthy data without any inconvenience.

The information about the persons who gave their land to the shareholder was also collected. For this, if the interviewee was a shareholder, the landlord was contacted , and directly interviewed. In case of absence of the landlord, the information was collected from the shareholder. This had happened when only landlord migrated from the town. The questionnaire was administered by a research team in a face-to-face interview with the tea farmers. The collected data were entered into the excel table according to the questionnaire types. During the data analysis, SPSS, SAS, STATA, as well as Excel and MS Word were used. These statistical programs were convenient to use for the respective model, and facilitate to complete this study.

3.2.2 Selection procedure for indicators to measure sustainability of tea at farm level

This section explains the three sustainability dimensions, meaning of an indicator, geographic and climate conditions of Rize province for evaluating its suitability for tea cultivation, and farming community. Additionally, based on all discussions in regards to site-specific characteristics, the development of basic factors for the indicator's selection was also elucidated.

3.2.3 Dimensions of sustainability

Figure *3.2* describes the three basic dimensions of sustainability. These are economic, social and environmental dimension. Whenever anyone is measuring the sustainability, they should consider these three dimensions (ECADG, 2001; Harris, 2003). Therefore, the selection of indicators under each dimension should be acceptable, and able to cover all aspects of the tea farming.

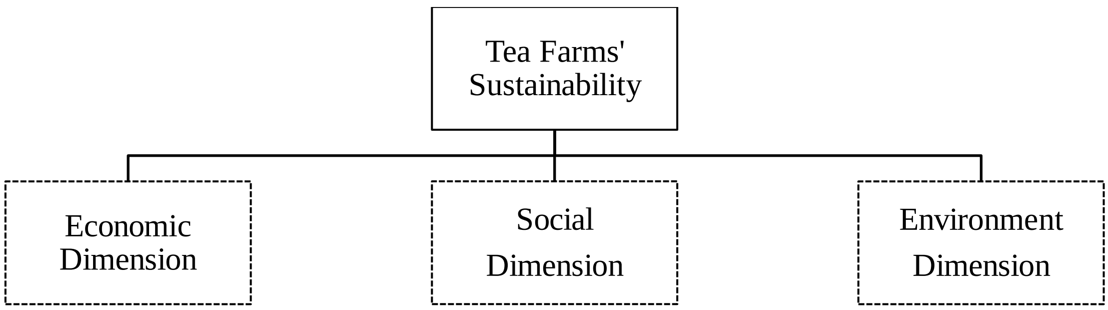

Figure 3.2. Three dimensions of sustainability

Therefore, in current study economic, social and environmental dimensions to measure sustainable tea farming at the farm level in Rize province were also considered.

3.2.4 What is an indicator?

Briefly, indicator acts as measurement of effect of certain activity under each dimension of sustainability. Misra (1997) specifically defined that the indicator is a variable that helps to estimate the changes in certain situation or it is a tool to monitor and evaluate the effect of any activity. Another definition of indicator proposed by Walker (2002) which entails that indicator is a subset of many possible attributes that can be utilized to quantify the condition of specific ecosystem, catchment or landscape. These attributes could be derived from economics, biophysical, social institutional features, and management from a range of measurement forms. Generally, it can be stated that an observed variable can be turned into an indicator when it has significant part in the evaluation or measuring a phenomenon (Tanguay et al, 2010).

Designing framework of indicators for gauging the agricultural sustainability is a very challenging task. The different climatic and biographical conditions limit the applicability of an indicator across the regions in the country, even more across the different countries. It describes that if one indicator applied in the measurement of agricultural sustainability in one region or country may not be applicable in other region or country (Tellarini and Caporali, 2000; Hatai and Sen, 2008; Sharma and Shardendu, 2011). Similarly, suitable and enough number of indicators in each dimension to measure agricultural sustainability is also very crucial. For example, when only specific indicators are considered then, trade-off between systems escapes the attention; and when the too few indicators are supposed than critical aspects tend to be ignored. For many years, search for defining adequate indicators of sustainability measurement has been continued at different levels of society including small communities, cities, regions, countries and world as a whole. It depicts that the site-specific and certain number of indicators are indispensable to measure the sustainable agriculture in a region to capture all the significant features of sustainability in their particular application (Bossel, 2001). It has been realized that the constructing an adequate set of indicators is a very complex and crucial problem. Therefore, indicators should provide a representative picture of sustainability.

Literature provides two basic approaches to define the indicators namely, deductive and inductive approaches. In deductive approach, researcher defines the area of interest then develops the indispensable indicators. While in inductive approach, the system of economic, social and demographic statistics is developed, and wide range of indicators are defined based on the developed statistics (Misra, 1997). In this study the deductive approach was followed. In this approach, the economic, social and environmental indicators were developed on the basis of regional characteristics, climate conditions and farming community.

3.2.5 Procedure for developing the set of indicators

The method used for the selection of indicators includes the procedure which is presented in

Figure *3.3*. Many indicators have been proposed by different scholars in developing and developed countries to measure the sustainability. In the selection of indicators, earlier farm level sustainability measurement studies were reviewed. This review of the relevant literature confirms the possibility of analyzing the existence of such an indicator (Cloquell-Ballester et al, 2006). The purpose of this analysis was to get idea about the indicators those can be applicable at the farm level. This confirmed that the indicator selection for measuring the sustainability should be based on site specific characteristics. For this, earlier researches had been reviewed for compiling a list of proposed indicators for the farm level sustainability assessment such as Sajjad and Nasreen (2016); Roy and Chan (2012); Gunduz et al (2011); Gomez- Limon and Sanchez-Fernandez (2010); Gafsi and Favreau (2010); Ceyhan (2010); Gomez-Limon and Riesgo (2010); Dillon et al (2009); Tatlıdil et al (2009); Gomez- Limon and Riesgo (2009); Akcaoz and Kizilay (2009); Zahm et al (2008); Pretty et al (2008); Binder et al (2008); Hani et al (2006); Rasul and Thapa (2004); Pacini et al (2003); López-Ridaura et al (2002); Rigby et al (2001). The second step was to review the reports related to the climate conditions and soil characteristics of the Rize province, tea cultivation and farming community to outline the site-specific and community-based farming features to define the basic factors for the indicators' selection under each dimension of tea sustainability (Economic, Social and Environmental). Third step was to define the criteria selection that an indicator should obey to be incorporated in the final set of indicators for current study. If one of the indicators from the developed list in first step fulfills the criteria, the next step was to ensure whether indicator qualifies for direct use in the indicator based on the basic factors defined. An indicator goes through the criteria and accords the basic factors then its validation was checked. Validation process confirms the credibility and correct performance of an indicator to fulfill the sustainability measurement objective (Cloquell-Ballester et al, 2006).

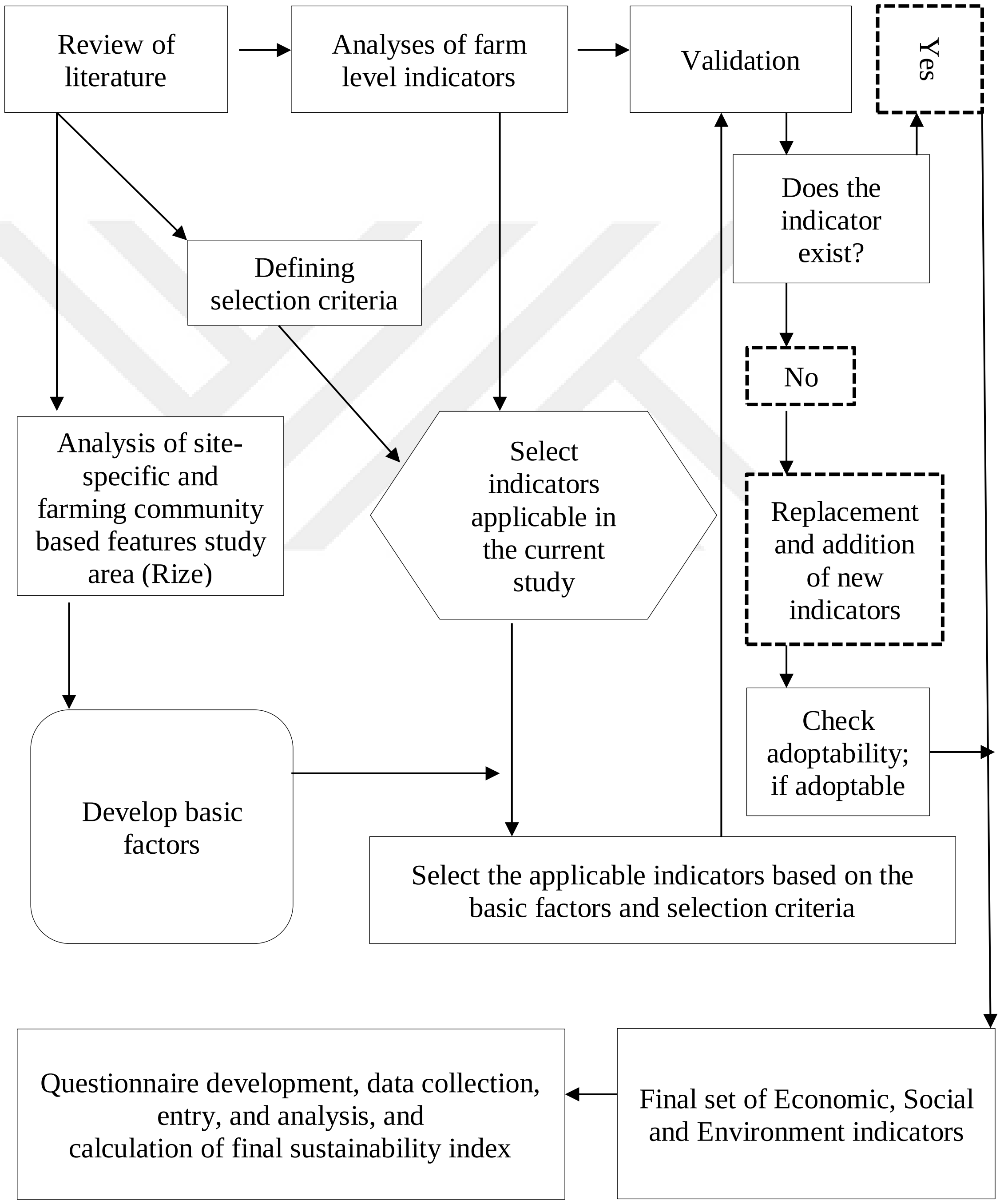

Figure 3.3. General procedure for selection of indicator for measuring tea farms sustainability

As every indicator used in earlier studies is not applicable as such it is used in all countries even in a region within a country due to geographical and climate diversity, to select certain number of indicators, some new indicators were also chosen. The new selected indicators also evaluated based on the defined criteria and basic factors, and also their validation was checked. With the replication of these steps, final set of indicators for measuring tea farms sustainability was constructed.

3.2.6 Climate and geographic characteristics of rize, and requisites of tea plant

This section explains the characteristics of the Rize province, and requisites of the tea plant. Tea is a very climate sensitive plant. It needs moderately hot and humid weather. Well drained and fertile acid soils are characterized as more suitable land for tea cultivation. Additionally, high lands with heavy rain and no stagnation of water also provides suitable and favorable climate for the tea. Table *3.2* shows the monthly and yearly temperature and rainfall of Rize province. The great fluctuation was observed in monthly temperature and rainfall. The average yearly temperature of Rize province is 14.30 °C and average rainfall counted as 2298.80 mm per year. With a look over the temperature and rainfall requirement, the favorable temperature for the tea plant is between 10 to 32 °C. Similarly, the average minimum rainfall of 1200 mm is required for tea cultivation, and average maximum rainfall should not be more than 3000 mm per year.

Table 3.2. Temperature and rainfall in Rize province

Months	Average temperature (°c)	Average maximum temperature (°c)	Average minimum temperature (°c)	Average sunshine duration (hours)	Average number of rainy days	Average monthly total rainfall (mm)
January	6.70	10.50	3.70	2.20	14.60	233.30
February	6.60	10.60	3.50	3.10	14.30	186.60
March	8.00	11.80	4.80	3.60	15.60	161.00
April	11.60	15.30	8.30	4.50	14.80	96.50
May	16.00	19.30	12.50	5.60	14.20	95.70
June	20.20	23.40	16.50	6.60	13.80	133.80
July	22.70	25.80	19.50	5.40	13.70	152.40
August	23.00	26.40	19.90	5.20	14.20	195.40
September	20.00	23.80	16.80	5.00	14.50	253.90
October	16.10	20.30	13.00	4.20	14.80	295.30
November	12.00	16.40	9.00	3.00	13.50	257.30
December	8.70	12.70	5.60	2.10	14.20	237.60
Yearly	14.30	18.00	11.10	50.50	172.20	2298.80

For tea plants, the average humidity per year in cultivation area should not be lower than 70% (GKTM, 2018). Table *3.3* describes the humidity level of the Rize province. Over the months, the average relative humidity level in province is not less than 70%, and average yearly relative humidity level is 75%. The other land requisites of a tea farm is an organic matter and pH level of soil. In view of this requirements, tea plants demands soil with acidic pH in average of 4.5-5.5, and 2% organic matter. If pH of soil is less than 4 and greater than 6, it can cause adverse conditions for tea growth as suggested by the tea cultivation research center. Özyazıcı et al (2010) calculated a range of pH of 2.80-5.97, and 5.06% average organic matter in the soils of the province. Moreover, they also determined pH level greater than 4.5 in 90% of the soil samples collected from different places of the province.

Table 3.3. Humidity level in Rize province

Months	Average relative humidity
January	72
February	72
March	74
April	74
May	76
June	75
July	77
August	78
September	78
October	79
November	76
December	73
Yearly	75

According to the Table *3.2* and Table *3.3*, the favorable climate conditions and soil characteristics can be observed for the tea cultivation. The Rize province has temperate weather in summer, and mild and snowy in winter. But, the average monthly temperature or minimum and maximum level of temperature is fluctuating over the years. The average yearly temperature 14°C is not less than the required temperature for the tea. Similarly, the average rainfall 2298.80 per year is in range of the required rainfall for the tea. Based on the pH (2.80-5.97) and organic matters (5.06%), the soil of the province is also suitable for the tea cultivation.

3.2.7 Developing site-specific features of tea farming in rize province

In this part of the study, based on the previous discussion about the geographical and climate of Rize province, and land and climate requirements for tea cultivation, the following features for the cultivation of tea in the province was described below.

3.2.8 Climate features

The province is characterized as the rainiest region of Turkey. In autumn, it experiences the highest rainfall while it is low in springs. Due to rainfall throughout the year, the dry season cannot be observed in the province. Sometimes, heavy rainfall causes floods and landslides leading to death (Savsatli and Seyis, 2014). Moreover, it might lead to a substantial loss of nitrogen from the soil and contaminate the water streams. As ammonium sulfate fertilizers are replaced by the NPK fertilizers, the later has major use in the tea cultivation in the province nowadays. This increase in using NPK fertilizers lead to the high volumes of wastes and soil pollution that lower the fertility rate, and the pH value of the soil (Özyazıcı et al, 2010). Such as, agricultural activities are considered as major contributor to N_2O through soil activities of nitrification and De-nitrification (Wrage et al, 2001; Mosier et al, 1998). Therefore, the emission of such gases in the air create greenhouse effects, and the potential influence of N_2O to global warming is 300 times of that of CO_2. It destructs the ozone layer (Galloway et al, 2008; Ravishankara et al, 2009; Li et al, 2013; Xu et al, 2014; Hirono and Nonaka, 2014). The second major problem of using chemical fertilizers in such a rainy region for the crop is water pollution. This pollution is sourced by nitrogen which reaches the water streams through drainages, leaching and flowing (Savci, 2012). It leads to the eutrophication problem, an oxygen free environment which lowers the survival rate of theliving, and promotes the propagation of unwanted species. These unwanted species make the recreation unsuitable due to the bad smell (Sönmez et al, 2008). It was also observed that heavy use of chemical fertilizers has no significant effect on crop productivity, and also adversely affects the quality of the tea. Additionally, it creates the problem of high NO_3^- and N levels in water streams, and acidification of soil and emission of N_2O (Hirono et al, 2009; Tokuda and Hayatsu, 2004; Hirono and Nonaka, 2014).

3.2.9 Land distribution among crops in Rize province

There is 15.2% of the land area of the province is agricultural area. Major land area (44%) is covered by forests and shrubs, and 28.21% is uncultivated and residential area. The remaining area comprises of pastures and meadows (Savsatli and Seyis, 2014). The ratio of land used for the cultivation of crops in province is only 1.7% which is very lower as comparing to the land used for crop cultivation in the country (70%). Tea cultivation covers 90% agricultural area of the province, and remaining agricultural land is used for fruits, citruses, vegetables and ornamental plants (MFAL, 2017). The high humidity and low level of sunshine limits the cultivation of field crops in this highly slopped area. That's why perennial crop like tea is the major crop of the province followed by kiwi and hazelnut.

3.2.10 Farming community and their source of income

As limited sources are available for earning income in the province, the farmers continue to look for additional income sources. Since many years, tea is the major crop as a source of income for the farmers in the province. Consequently, the tea sector is the dominant sector which provides the occupation facilities to 10457 permanent and temporal workers, and 200 thousand families are involved in the cultivation of tea (GDTE, 2016). As increasing family sizes required additional income to survive, tea farmers have been facing pressure to search for other sources income. While searching for the new sources of income, the farming community has started to migrate to other provinces. Figure *3.4* explains the local situation of people's migration. It was observed that the moving out-migration remains always above the moving in-migration, which describes the fact that the people of Rize started migrating to other provinces are socially unsustainable.

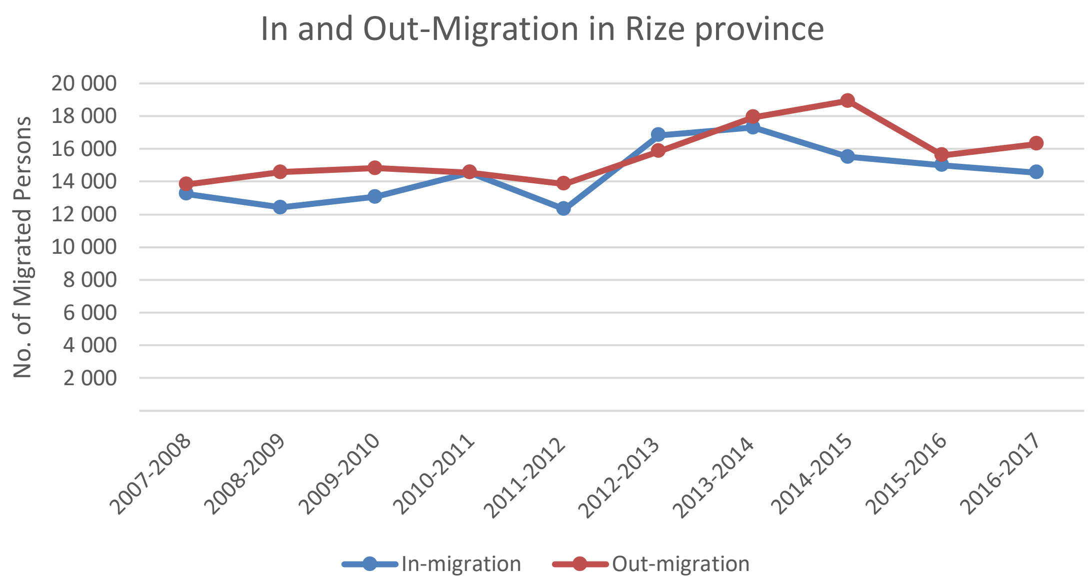

Figure 3.4 In and out-migration of Rize province

(Source; General Directorate of State Meteorology Affairs, Research and Information Processing Department observation)

Taking into consideration the discussion about climate and geographical conditions of the province, requisites of tea, and life style of the farming community, following site-specific features were laid down for delineating the basic factors for indicators' selection for measuring sustainability of tea farms.

1) The risk of landslide and soil erosion is high due to humid weather and heavy rainfall.
2) The extensive use of NPK fertilizers can increase contamination of natural resources like eutrophication in water streams, and emission of greenhouse gasses in air.
3) The land structure (such as mountainous land) of province is more suitable for perennial crops like tea.
4) The residents directly and indirectly involve in the tea farming which is their major source of income.
5) The out-migration of residents is an evolving problem for searching other types of work due to limited income source availability in the province.

3.3 Defining Basic Factors Based on Site-Specific Features

In development of basic factors which is the more important step toward the selection of the indicators. These basic factors were developed based on the previously defined site-specific features. Two things were taken into account for developing basic factors 1) basic factors should be aligned with the tea farm, and 2) basic factors should be able to explain all the aspects regarding tea farming. Therefore, due to different interpretation of dimensions of the sustainability, basic factors were developed for each dimension.

3.3.1 Basic factors and indicators for economic dimension

3.3.1.1 Basic factors for economic dimension

As site-specific features explained the heavy use of fertilizersand out-migration, the economic sustainability of tea farms required good production of tea crop, high efficiency of farmers, and high inputs. Following basic factors were considered for the economic indicators to measure the economic sustainability of tea farms.

1. High value added
2. Inputs' productive use
3. Vision of the farmers
4. High interest of farmer in tea farming

As the tea crops demands fertilizers and labor, it leads toward the situation of expenditures. Therefore, tea crop should be able to give sufficient return to farmer to compensate their expenditures. Secondly, the farmers should be efficient in consumption of inputs used in tea farming. Moreover, the high inputs like land and labor productivity leads toward the sustainable tea farming economically. As the time passes, the farmers' interest in yielding of the tea and income form crop is fluctuating that some farmers view this fluctuation positively and some perceives negatively. The positive vision encourages the farmers to continue tea farming. Similarly, the farmers having interest to continue tea farming show that the tea farming has potential to attract the farmers. These basic factors made the selection of the indicators easy under economic dimension of the tea farms sustainability.

3.3.1.2 Indicators for economic dimension

Table *3.4* describes the indicators for measuring the economic tea farms sustainability. First column explains the basic factors, and on the inside column, the indicators are presented. These indicators are gross margin, benefit cost ratio, and value addition per unit of land under the basic factor "High Value Added". Gross margin is the difference between the revenue and the variable cost. The benefit-cost ratio is equal to the ratio between the total benefits to cost of tea cultivation. Value addition per unit of land explains the difference between value of output and value of intermediate goods. The basic factor "Inputs' Productive Use" covers the land and labor productivity. The Productivity of land and labor will be measured by the total output, the total land and the labor used for a relevant crop.

$$Land\ productivity = \sum_{i=1}^{n} \frac{TP_t}{TL} \qquad \text{Eq. 3.2}$$

Here TP_i is total production of i^{th} crop and TL is total land under i^{th} crop. If farmers just cultivating tea crop, then in this case the crop is 1 and i equal to 1. Similarly, Labor Productivity is equal to

$$Labour\ productivity = \sum_{i=1}^{n} \frac{TP_i}{NHW} \qquad \text{Eq. 3.3}$$

Here in equation, TP_i is total production of i^{th} crop and NHW is total number of worker in a day. If farmers just cultivating tea crop, then in this case the crop is 1 and i equal to 1. It is supposed that higher labor productivity explains the good management of herbs in tea orchards which enabled a person to collect more tea leaves.

The technical and economic efficiencies were estimated by the Data Envelopment Analysis (DEA). The description of the efficiency estimation was emphasized below. Suggestion of Charnes et al (1978) and Banker et al (1984) were followed in constructing the theoretical framework of DEA for the tea growers. It has been assumed that the tea yield per hectare (kg/hectare) (y_i) was the outputs, while Chemical Fertilizer (kg), and Labor (Days) were the inputs (x_i). In DEA model, each Tea cultivator (i) was allowed to set its own set of weights for both inputs and output. The data for all tea growers were characterized by the K×N and M x N into input (X) and output matrix (Y), respectively. TE was calculated for i-the tea farmer via linear programming (LP):

$$\begin{aligned} &\text{Minimize}_{\theta,\lambda}\ \theta \\ &\text{Subject to} \quad -y_i + Y\lambda \geq 0 \\ &\qquad \theta x_i - X\lambda \geq 0 \\ &\qquad \lambda \geq 0, \end{aligned} \qquad \text{Eq. 3.4}$$

Where θ was the TE score and the vector λ is an N×1 vector of weights which defined the linear combination of the peers of the i^{th} tea grower. The economic efficiency for i^{th} tea cultivator can be generated by solving the following LP problem:

$$\begin{aligned} &Minimize_{\lambda,xi^*}\ w_i^T x_i^* \\ &\text{Subject to} \quad -y_i + Y\lambda \geq 0 \\ &\qquad x_i^* - X\lambda \geq 0 \\ &\qquad \lambda \geq 0, \end{aligned} \qquad \text{Eq. 3.5}$$

Where w_i is a input prices vector for the i^{th} tea grower; superscript T is the transpose function; x_i* is the cost-minimizing vector of input quantities for the i^{th} tea grower calculated by the LP, given the input prices w_i and output level y_i and λ is a Nx1 vector of constant. Equation Eq. 3.4 and Eq. *3.5* represent the cost minimization under constant returns-to-scale (CRS) technology. CRS means that output increases in proportion to changes in all inputs. The economic efficiency ($EE_{i,CRS}$) of the i^{th} tea grower was calculated as:

$$EE_{i,CRS} = w_i^T x_i^* / w_i^T x_i \qquad \text{Eq. 3.6}$$

That is, $EE_{i,CRS}$ is the ratio of the minimum cost to the observed cost, given input prices and CRS technology (Coelli et al, 2005).

Second last basic factor “Vision of the Farmers” contains one indicator namely income fluctuation which were assessed by two sub-indicators. First sub-indicator is the vision of the farmer about yielding of tea crops, that it is either stable, constant or fluctuating over the years. Second sub-indicator is the perception of the farmer that tea farming is a sufficient source of income. The last basic factor of economic dimension has one indicator which gauged by 6 sub indicators. Different sub-indicators were various statements which were answered by the farmers according to their farm activities and their perception.

3.3.2 Basic factors and indicators for social dimensions

3.3.2.1 Basic factors for social dimension

The four basic factors for the social dimension were developed, those were explained below.

1. Good human capital
2. High social inclusion
3. Stable social capital
4. Good family security

The first basic factor “good human capital” describes that the farmers are able to understand new technologies, able to work actively, and able to employ more people. High social inclusion emphasized the ability of the farmer to access the basic social facilities like health-care, water, school etc. The “stable social capital” means that the farmer continuously and easily can make contact with the extension staff, good relationships with other farmers, and the farm labor. The last basic factor, “Good social security”, focuses on ability of farmers to fulfill living expenditures, and enjoy other social services like insurance etc.

3.3.2.2 Indicators for social dimension

The first basic factor “human capital” contains 4 indicators in Table *3.5*. First one is equity that explains the ability of the farmers to generate more employment opportunities. In more detail, tea farming is able to hire off-farm labor, and also allow the housewives to work on farms. Education and age also among the most important social variables that are considered as very important indicators for assessing social sustainability. Fourth indicator, the old age index shows that the numbers of the active members of a family at a farm are mostly young. Second basic factor, the “High social inclusion” consists of and calculated by 6 sub-indicators. These sub-indicators were mostly answered by the farmers who they either have or do not have easy access of concerned facilities and services like child education, clean drinking water, primary health services, migration of some family members, and having other sources of income. Third basic factor "stable social capital" was assessed by the social involvement of the farmers which were measured by 4 further sub-indicators. These sub-indicators explain the farmer's situation of having good relationships with the temporary workers hired at the farm, cohesion status between the factory staff/other involved persons/ leader farmers, and highly socialized persons with farmers. Last basic factors "good family security" consists of one indicator and 6 sub-indicators. These sub-indicators explained the ability of farmer to fulfill the daily life expenditures of his family. Further, if the farmer has a house in good condition, and also have social security plans like a retirement plan, health insurance of the family members, and a perception of the health status of his family members. Further, if the farmer has a house in good condition, and also have social security plans like a retirement plan, health insurance of the family members, and a good perception of the health status of his family members.

3.3.3 Basic factors and indicators for the environment dimension

3.3.3.1 Basic factors for environment dimension

Total 5 basic factors were defined below for the last third dimension of tea sustainability named as environment. The farming activities regarding tea cultivation are more crucial for environmental sustainability. The extensive use of chemical fertilizer such as NPK, ignorance of precautionary measures during performing tea management activities. The following basic factors were developed to select indicators for measuring the environmental sustainability of tea farming.

1. Low dependency on chemical fertilizers
2. Producing more with less
3. Efficient practices for soil conversation and health
4. Adverse effects of fertilizers on health
5. Proper land management

Tea is a directly drinkable product which needs low usage of chemical fertilizers due to its adverse effects on human health. Therefore, the first basic factors explain that the chemical fertilizers should be used by less quantity. Second basic factor "produce more with less" describes producing at a maximum level with the minimal use of farm inputs, and minimal impact on environment. As the province is a mountainous area, the farmers need to perform farming practices in order to conserve the health of the soil. In fourth basic factor, tea farmers are required to take the precautionary measures during performing the farm activities, for example,during the application of a chemical fertilizer. Proper land management enlightens the practice which reduces the risk of land slide and soil erosion.

3.3.3.2 Indicators for environment dimension

The indicators for the environment sustainability dimension was presented in Table *3.6*. The first basic factor of environmental dimension "low dependency on chemical fertilizer" was assessed by the actual quantity of the chemical fertilizer applied per unit of land (Decare = 0.1 hectare). Second basic factor "Produce more with less" was estimated by the eco-efficiency which was also estimated by the Data Envelopment Analysis (DEA). Third basic factor "Efficient Practices for soil conservation and practices" has one indicator with three sub-indicators. These sub-indicators extensively focused on the application of barnyard manure, organic manure, performance of soil test and methods of fertilizers application. There should not be any adverse effect of chemical fertilizer on health of farmers. Proper land management are explained by the one indicator and 3 sub-indicators. These 3 sub-indicators are regarding the existence of soil erosion, and farmer's practices to lower this risk like they performing terracinand also planting trees at land slide and erosion prone land.

Table 3.4. Economic indicators

Basic factors	Indicators	Sub indicators	Definition
High value added	Gross margin (gm)		Revenue minus variable cost
	Benefit cost ratio		Benefit to cost ratio
	Value addition per unit of land		Value of output minus value of intermediate inputs used
Input's productive use	Labor productivity per day		Quantity harvested per unit of labor per day
	Land productivity		Quantity per unit of land
	Technical and economic efficiency		Ratio of total productivity to maximum attainable productivity
Vision of the farmers	Income fluctuation	Stability of crop yield	Fluctuation of yield over the years
		Tea farming is sufficient as the source of income	Tea provides enough income to farmers to survive
Higher interest of farmer in tea farming	Farmer's interest	Practice of crop cultivation and rearing animals	To measure how many farmers want to busy in farming
		Farmer's thinking to be a successful farmer	
		Desire to grow your business by buying new land	Measuring farmers want to extend tea farming in any way or they have fed up with it.
		Desire to grow business by planting new tea orchards	
		Inter-generation continuity of farming	Farmers' wish to divide land equally among their children or not.
		Purpose of selling tea land or farmland for construction purpose	Determining farmers' mindset in future to give up farming

Table 3.5. Social indicators

Basic factors	Indicators	Sub indicators	Definition
Good human capital	Equity		Measuring the ability to generate the employment at farm
	Education level		Schooling years attended by farmer
	Farmer's age		Years
	Old age index		Age ratio of family worker at farm
High social inclusion	Social inclusion	Access to education facility for children Access to clean drinking water Access to primary health services Membership of organization Migration of family member Having another source of income	Encompassing a sufficient level of access of farmers to basic facilities such as health, education, clean drinking water, income, and services etc. (cousins, 1999)
Stable social capital	Social involvement	Good relationships with temporal workers Good cohesion status with tea factory staff Good cohesion status with leader farmer of village Socialization level of farmers	Referring to the diverse networks and relations of trust between people involved in agriculture. Social capital strengthens social cohesion and stability within groups of people, organizations or society at large. Hence, it eventually creates a broad social support base for agriculture (meul et al, 2008)
Good family security	Social security	Ability to purchase essential food items Ability to fulfill educational needs of children Living at good house condition Social security status of family members Health insurance status of family members Health status of family members	Referring to the good social status of the family regarding the house conditions, social security, etc.

Table 3.6. Environmental indicators

Basic factors	Indicators	Sub indicators	Definition
Fertilizer application	Quantity of chemical fertilizer		Quantity of chemical fertilizer per unit of land
Produce from less	Eco. Efficiency		This means that maximum value with minimum use of resources and/or with minimum environmental impact (jollands et al, 2004)
Soil conservation	Soil health management practices	Application of barnyard manure Application of organic manure	Application of barnyard manure and organic manure is better than chemical fertilizers. The application of these manures indicates the farmers' interest in the environmental sustainability in the area
		Testing the soil	Farmers response as yes or no
		Method of fertilizer application	Three ways are for fertilizer application having different impacts on soil health and crop quality
Adverse effect of chemical inputs		Health problems related to chemical fertilizer application	Farmers' exposure to health problems while applying fertilizer shows weak control measurements
Proper land management	Land management practices	Erosion risk Stable terracing Tree planting at landslide and erosion prone land	Referring to improve the management of land and tea farming by building contacts with an extension agent and farmers attention toward the encounter measurement of erosion and landslide risk.

3.3.3.3 Eco. efficiency

The true values of the on Eco. Efficiency was also estimated by the DEA program. It is a very important environmental concept to consider in this study which entails how efficient an economic activity is with regard to natural good and service (Zhang et al, 2008). Similarly, Jollands et al (2004) describes the Eco. Efficiency as a situation of producing maximum with minimum use of resources as well as with minimum environmental impact. The extensive use of the chemical fertilizers in tea production also have a great threat to the environment through associated greenhouse gas emission risk. Therefore, Figure *3.5* describes that there are two inputs that has been used similarly in previous technical efficiency model, and it results in two outputs as well. The one output which is highly desirable (tea) and second one is highly undesirable (greenhouse gasses emission due to chemical fertilizers such as CO_2, N_2O).

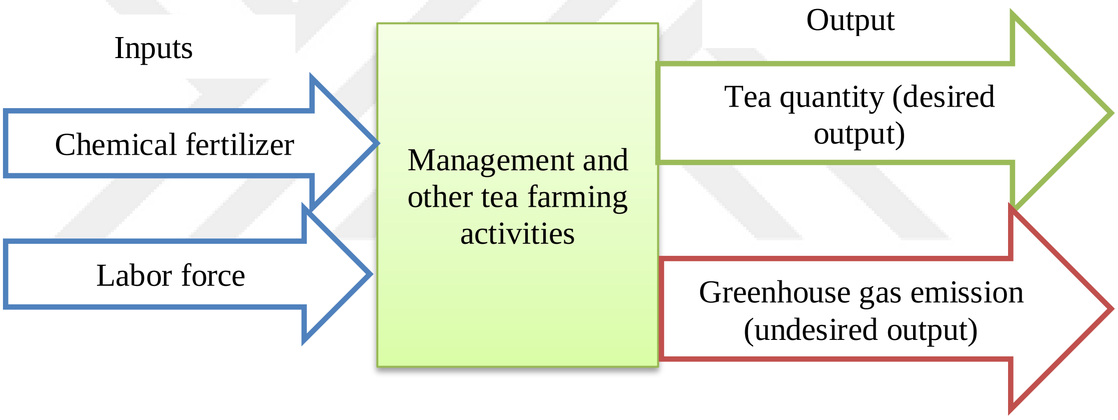

Figure 3.5. Input and output for estimating eco. efficiency

The chemical fertilizer was in kg and labor force was in days. The desired output was taken into the model as kg and greenhouse gasses was the sum of all possible gasses emit-able from the chemical fertilizers in kg. Before entering the data into the DEA model, it was necessary to get data into the desired form. Here the desired form was to arrange the data which ensure the characteristic that lower values for inputs and higher values for outputs were preferred. The positive values of the inputs had "lower value is better" characteristics. the desired output (harvested tea quantity) had no problem because this also had "higher value is better" characteristic. The undesired output (greenhouse gasses emission) had no this "higher value is better" characteristic. Due to this, undesired output was rescaled by taking the inverse of its actual value, in this way the higher value of undesired output was more desirable which in fact lower the number /quantity of greenhouse gasses. The output oriented was considered more suitable in the estimation of eco. efficiency. This methodology also in line with the study conducted by the Damanik (2017).

3.4 Specifying Indicator's Selection Criteria

The indicator should be coherent that one may achieve convenient measurement of tea farms sustainability. Nambiar et al (2001) specified that initially selected indicators should be featured as analytically sound, measurable, economically feasible/viable, socially structured, sensitive to changes in management and climate and easily understandable by the researchers. Pannell and Glenn (2000) also proposed almost the same indicators' selection criteria. Additionally, they proposed that there should exist a method of measurement for the indicators with the low error factor. Similarly, Reed et al (2006) explained that the indicators should be able to measure the sustainable development goals accurately and objectively. Moreover, that the indicator should be convenient for the local user to apply them. Meul et al (2008) explain the criteria; an indicator should be selected based on its characteristics like sensitivity to changes, compensability, solidness and causality. Pinter et al (2008) described that there are no specific criteria for the selection of indicators but they used some common ones across the various sets. They focused greatly on the following criteria during indicators selection. The indicators should be scientifically valid, correctly measurable, data is available for measuring the parameters of an indicator, and no extra cost should be for data access. The indicators' selection criteria for the current study was also developed similarly like explained before. Due to the existence of some commonality among the different researcher's defined selection criteria, the following criteria were enlisted for the selection of indicators.

1) Scientifically valid
2) Data availability
3) Measurability
4) Easily interpretable
5) understandable
6) Sensitive to changes in management and climate

The indicators for measuring the tea farms sustainability were selected based on these above mentioned criteria. According to these criteria, all chosen indicator for the current study are able to clarify the phenomenon accurately (Scientific valid), data is available for measuring, calculating or estimating the true values of an indicator (Data Availability), the method of measuring, calculating or estimating is available (Measurability), the interpretation of indicator is easy (Easily Interpretable), indicator is easily understandable by the non-specialists and easily adaptable by the new researcher (understandable or user-friendly). At last, indicators are able to reflect the changes in the management in tea farming and climate conditions of the province.

The selected indicators were cross-checked either they fulfill the criteria of indicators selection or not. Generally, it was confirmed that each and every indicator of all dimensions fulfill the selection criteria. The data availability, measurability, understandability and also they were sensitive to changes in management and climate. For example, gross margin needs price a quantity data of inputs and output of tea, and it is also easily understandable what gross margin is. Moreover, it is sensitive to changes in management and climate. In social dimensions, farmers age, equity, his cohesion level with other stakeholders, and his ability to fulfill his family daily expenditures, and easy approach to basic life facilities also coincide the selection criteria. In environment dimension, the quantity of chemical fertilizer is tended to be changed, soil conservation practices can be adopted carefully, erosion risk can be reduced with the passage of time by growing awareness level among tea farmers. As all the indicators were confirmed and adaptable in this study, they might be reused by other researchers in future studies.

3.5 Validation of the Selected Indicators

When indicators were according the developed basic factors, and also passed the selection criteria, then their validity was confirmed. Bockstaller and Girardin (2003) proposed that an indicator is validated if it is objective oriented and generates the expected effects. Therefore, they proposed three types of validation procedures. The first is “design Validation” which regards to design of indicators. Design validation explains that indicator is scientifically sound. Second validation type is “Output Validation” which describes that an indicator supplies the information for which it is designed. Third validation type is “End-user Validation” it stats that an indicator is useful for the potential user to make decisions. Based on these three validations, “3S

Methodology" was developed by Cloquell-Ballester et al (2006). This "3S Methodology" known as self, scientific, and social validation.

3.5.1 Self-validation

The self-validation ensures the performance of the newly defined indicator with a low chance of operational errors and theoretical discrepancies. Additionally, it also ensures that an indicator is correctly documented for later interpretation, and also ensure the repeatedly and easily use by potential users. Therefore, this validation of indicators was conducted by the researcher team. They examined the accuracy, and satisfactory conditions of selected indicators. The team evaluated the indicators based on the developed basic factors to ensure that indicators are site-specific, and also assessed that indicator fulfill the selection criteria.

3.5.2 Social validation

The second type of validation such as Social validation explains the participation of different stakeholders in order to confirm that the base and application of an indicator is socially sound. The public participation is observed very limitedly in the social and environmental studies. However, the people who are potentially affected by an action or activity in a region should have a chance to give their opinion (Cloquell-Ballester et al, 2006). In this way, the useful information can be obtained from the different stakeholders such as farmers, tea firms personals, and farmer organizations. This validation is confirmed with the pilot study through the comprehensive meeting with leader farmers, heads and staff of the tea firms, and with the interaction of the tea farmers.

3.5.3 Scientific validation

Similarly, the Scientific validation describes the accuracy, rationality, and objectivity of an indicator by consolidating the experts' opinion. This validation accomplished by the short presentation about the indicators and experts' opinion and recommendations were incorporated. After the full consensus of the experts the indicators were selected as scientifically validated. In such a way the validation of indicators was completed, and the final set of indicators were developed for measuring tea farms sustainability.

3.6 Data Requirements of Indicators

As developed indicators are different in nature, they need various types of data before calculating and estimating final values. Some requires quantitative data and some requests qualitative data. Therefore, during developing the well-shaped questionnaire, these aspects of data requirements were also considered. Consequently, the following types of data were explained below.

3.6.1 Quantitative data

This type of data denotes the measures of counts, values, which are depicted as numbers. It defines the situation that has happened in the form of numerical. Subsequently, quantitative data regarding the quantity of inputs like chemical fertilizers, labor employed, as well as the actual prices farmer paid for were collected. Moreover, products produced at farm especially collected a quantity of tea leaves and its received price per Kg were also asked.

3.6.2 Qualitative data

This form of data just describes the situation, response of the respondents, and some time known as categorical variables. Many developed indicators need the farmer's actions to conduct the farm activities were asked in categorical variables. Additionally, the vision of the farmer was also inquired in the form of categorical variables. Consequently, two types of categorical variables were adopted; for one the farmers questioned to response in form of "Yes/No" response, and for the second they were enquired to mark their response on five Likert scale.

3.7 Scoring Methods of Indicators

Farmer's organizational affiliation, self-identification, use and non-use of the particular farm practices or inputs usually chemical fertilizers etc. classifies him as sustainable or unsustainable. The oversimplified practice of assigning the score to the practices of a farmer by comparing to those used by all other farmers under several dimensions of the sustainability (Taylor et al, 1993). Therefore, the scoring of some response indicators was also based on the inherent sustainability effect of a practice at the farm. First of all, the quantitative and qualitative data collected with questionnaire through face to face interviews were unable to use directly in measuring the sustainability of tea farms in July 2017. Therefore, to measure composite tea farms sustainability index, there is a need of giving the score to indicators for defining benchmark values. The objective of defining benchmark activity was to make the indicators dimension less. This calibration allows the mutual comparison of three different dimensions of tea farms sustainability. The following different methods of scoring the indicators were emphasized below.

3.7.1 Scientific knowledge

This type of scorning methods is related to the scientifically proposed information about the inputs used for a crop. More clearly, some recommendations exist for each crop in each country by the scientists to cultivate the crop for optimal results. Similarly, the recommended quantity of input like chemical fertilizer for tea crop is 80 Kg per decare (10 decare is equal to 1 Hectare). Consequently, this recommended quantity for tea cultivation was decided to use as a benchmark to make the indicator dimension less in case of no one applying less than 80 Kg per decare. It means that if any farmer applied the chemical fertilizer lower than 80 Kg the minimum benchmark value was actual applied minimum quantity.

3.7.2 Production possibility curve

This scoring method describes the situation of econometric estimation of some indicators. There are some indicators like efficiencies demands such type of estimations. Therefore, the production possibility curve was used as a scoring method for technical, economic, and eco. efficiencies. This curve explains the ability of the farmer to obtain maximum productivity by using the same level of inputs (Van Passel et al, 2006). For example, the technical efficiency is "the ratio between the actual productivity achieved by a farmer to his maximum achievable productivity" (Meul et al, 2008).

3.7.3 Questionnaire results

This method was used when data about the subjective assessment for some indicators were required (Meul et al, 2008). For example, socialization and cohesion level of farmers with other farmers or with tea firm staff were answered on five Likert Scale (1 for Very bad, 2 for bad, 3 for normal, 4 for good and 5 for very Good). Moreover, some indicators were calculated by using the collected information via questionnaire about the price and quantity of input and outputs. For example, gross margin, benefit cost ratio, old age index etc. were some types of indicators that were calculated by using questionnaire information.

3.7.4 Expert judgment

When there was not any other suitable method found, this scoring method was considered for application. This time some indicators assess in response form of the farmers like YES and No. The scoring of these response variables was completed based on the expert judgment. For example, if a “Yes” response was supposed for the higher tea farm sustainability then it was scored as “1” otherwise “0”. Similarly, if a “No” Response was considered as higher for the tea farm sustainability then it was scored as “1” otherwise “0”. Among the response indicators, if a farmer responds to the statement “Farmer’s thinking to be a successful farmer” yes, then it was assigned “1” otherwise “0”. Similarly, if any family member migrated to another city then “yes” response was scored “0” and if no one migrated from locality then it was scored “1”. Subsequently, all response indicators were assigned high value such as “1 or greater” if it has a positive effect on tea farm sustainability.

Afterward, based on the measurements of indicators, there were two sub-sections explained to measure the tea farms sustainability. The first section explains the indicators that obliged farm level estimations and information. Table *3.7* describes those indicators and their unit’s definitions.

The data requirements and units or range of indicators for the estimation or calculating the true value of indicators were emphasized. The gross margin (Lira per Hectare), benefit cost ratio, value addition per unit of land, labor/land productivities, and old age index were calculated by using the questionnaire results. The education (schooling years), equity (No. of person), and farmer’s age (years), were as the actual responses given by the farmers. The quantity of chemical fertilizer applied per Hectare was asked. The technical, economic and eco. efficiencies were estimated with input output quantities used at the farm. The final value of these efficiencies was in range of 0 and 1. Where “0” (benchmark value) means low efficiency and 1 means higher efficiency.

Table 3.7. Indicators oblige farm level measurements and estimations

Indicators	Type of data required for calculating indicators	Units/range
Economic indicators		
Gross margin (gm)	Price and quantity of inputs and outputs	Lira/hectare
Benefit cost ratio (bcr)	Price and quantity of inputs and outputs	Raito
Value addition per unit of land	Price and quantity of inputs and outputs	Lira/hectare
Labor productivity per day	Quantity of tea harvested by one person in a day	Kg/p/d
Technical efficiency Economic efficiency	Measured by data envelopment analysis	0 to 1
Social indicators		
Equity	The number of total persons hired at farm	No.
Education level	Schooling years completed	Years
Farmer's age	Years after birth	Years
Old age index	Raito between no. Of persons above sixty working at farm to total family member	Ratio
Environmental indicators		
Quantity of chemical fertilizer per unit of land	Actual amount of fertilizer applied	Kg/hectare
Eco. Efficiency	Measured by data envelopment analysis	0 to 1

The second sub-section described the indicators that require the information of farmer's response. Table *3.8* shows the scores given to the response of farmers based on their contribution to tea farms sustainability. If a farmer answered that crop yield has been increasing, it is scored as 2; remaining constant then scored as 1, and if it is decreasing, scored as 0. If farmers were cultivating only crops, then the score was equal to 1; and if the farmers are also rearing animals then the score was given 2. The method used for applying chemical fertilizer were of three types. These three methods were possessed its own potential effects on the crop productivity. Therefore, this indicator was scored based on significant impact on soil fertility as well as on adverse effects on the crop. For example, if the spreading method has a low impact on soil fertility, it can also damage the leaves of the tea plants. If fertilizer grains remained on the surface of the leaves, then this method was assigned as 1. If the fertilizer applied in root zone, then it was scored as 2. Similarly, if a farmer is applying by mixing the fertilizer with soil, which has significant higher impact on soil fertility, with no chance of adverse effects on tea leaves, then it was scored as 3.

The indicators those were responded by the farmers in the form of Yes/No response were scored based on the theme behind the indicator for its possible impact on tea farms sustainability. Most of these indicators are sub-indicators of relevant dimensions of sustainability.

Table 3.8. Indicators responded by farmer

Indicators	Response
Economic indicators	
Stability of crop yield	Increasing(2), constant(1), decreasing(0)
Tea farming is enough source of income	Yes (1), no (0)
Practice of crop cultivation and rearing animals	Both (2)or only one (1)
Desire to grow your business by buying new land	Yes (1), no (0)
Farmer’s thinking to be a successful farmer	Yes (1), no (0)
Desire to grow your business by planting new tea orchards	Yes (1), no (0)
Inter generation continuity of farming by dividing land among children	Yes (0), no (1)
Purpose of selling tea land or farm land for construction purpose	Yes (0), no (1)
Social indicators	
Access to education facility for children	Yes (1), no (0)
Access to clean drinking water	Yes (1), no (0)
Access to primary health services	Yes (1), no (0)
Membership of organization	Yes (1), no (0)
Migration of family member	Yes (0), no (1)
Having other source of income	Yes (1), no (0)
Environmental indicators	
Application of barnyard manure	Yes (1), no (0)
Application of organic manure	Yes (1), no (0)
Testing the soil	Yes (1), no (0)
Method of fertilizer application	Spreading (1), in root scattering (2), or soil mixing (3)
Health problem due to chemical fertilizer application	Yes (0), no (1)
Erosion risk	Yes (0), no (1)
Stable terracing	Yes (1), no (0)

Furthermore, Table *3.9* also explains some social indicators and only one environmental indicator was answered by five Likert Scale. Farmers marked the one point among five Likert Scale according how good or bad situation they considered. Such both sub-section described were intended to measure the tea farms sustainability in three dimensions economic, social, and environmental. However, data requirements were different for each level as shown in tables 3.7 and 3.8. The real data and observation were used to calculate the first one, and farmers' responses and viewpoints were used to determine the second one.

Table 3.9. Indicators responded by farmers in Likert scale

Indicators	Response				
Social indicators					
Communication level with temporary workers	1	2	3	4	5
Cohesion status with tea factory staff	1	2	3	4	5
Cohesion status with leader farmer of village	1	2	3	4	5
Socialization level of farmers	1	2	3	4	5
Ability to purchase essential food items	1	2	3	4	5
Ability to fulfill education needs of children	1	2	3	4	5
House condition	1	2	3	4	5
Social security status of family members	1	2	3	4	5
Health insurance status of family members	1	2	3	4	5
Health status of family members	1	2	3	4	5
Environmental indicators					
Tree planting at landslide and erosion land	1	2	3	4	5

1 = Very Bad, 2 = Bad, 3 = Normal, 4 = Good, 5 = Very Good

3.8 Measuring Composite Tea Farms Sustainability Index (CTFSI)

Finally, the indicators selected were used to measure the composite tea farms sustainability index (CTFSI). Figure *3.6* shows the procedure for measuring CTFSI. The indicators selection framework was explained in details before. Now, this section is going to explain how the indicators were made dimensionless, and how they combined in the composite index. The composite index has been widely recognized for analyzing and communicating the multidimensional issues like the agricultural sustainability scenario (Sands and Podmore, 2000; Andreoli and Tellarini, 2000). In order to develop the process of measuring the indices of sustainability, the reasonable and comprehensible sequence has been developed. The basic idea was picked from the studies conducted by OECD-JCR (2008) and Nardo et al (2005a, b). After reviewing these studies, the methodology for measuring the composite tea farming sustainability index was developed which is presented below.

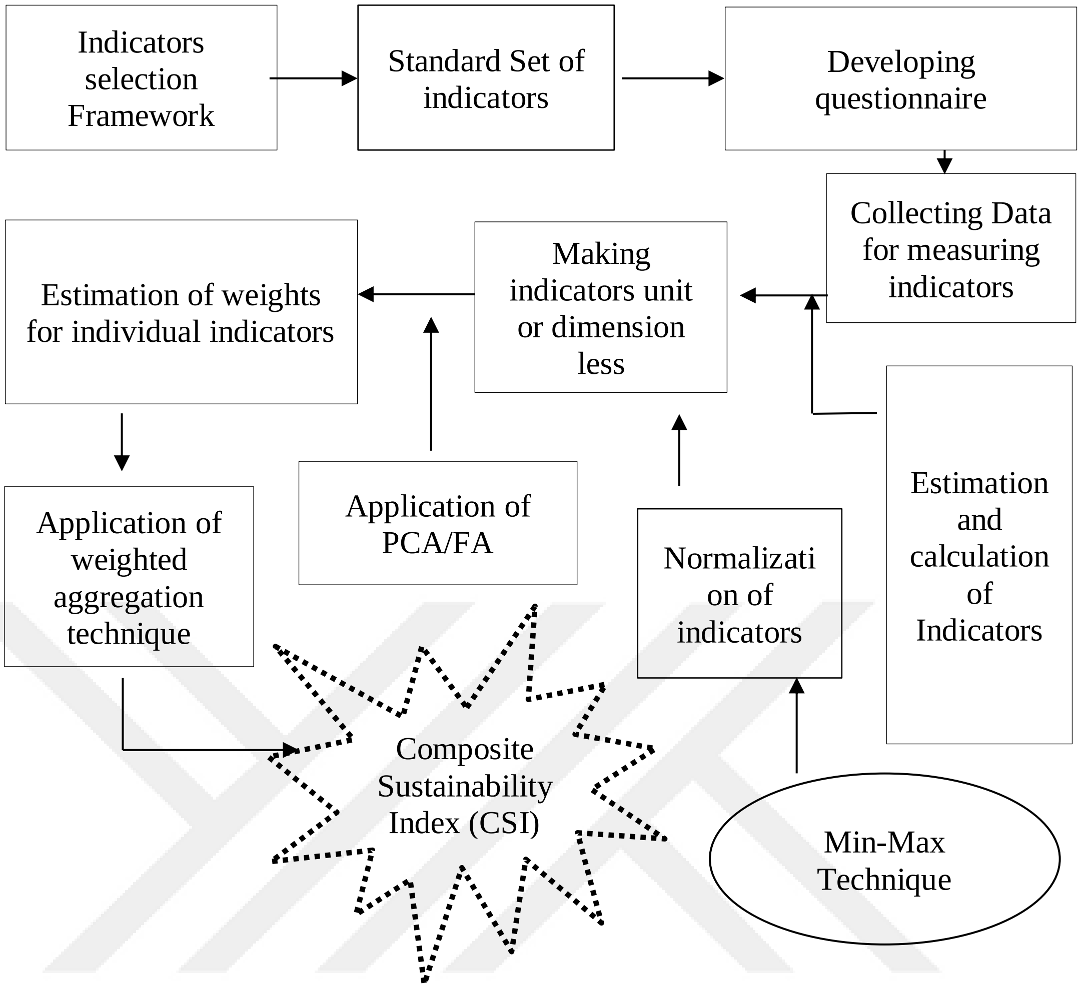

Figure 3.6. Measurement procedure of sustainability index

3.8.1 Assessing the dimension less indicators

3.8.1.1 Normalization of data

At this stage, the selected indicators were conveying a different kind of information. Some Indicators was having a different unit of scale. Therefore, before aggregating the indicators, there is a need to bring all the indicators to same standard. This is possible only when all indicators will be dimensionless. This process of bringing indicators into dimensionless variables called normalization. A number of research methods are available to encounter this problem like the standard deviation from the mean, distance from the group leader, distance from the mean and the minimum-maximum normalization method (Min-Max method). The commonly adopted method by the researcher is the minimum- maximum normalization method. The general formula of minimum- maximum normalization method made available below when maximum score of indicators was classified as being more sustainability.

$$\left(\frac{X - minimum\,Value}{Maximum\,Value - Minimum\,Value}\right)$$ *Here; X= Actual Value of indicator* Eq. 3.7

Similarly, the following equation was used for those indicator whose minimum score was classified as being more sustainability,

$$\left(\frac{X - maximum\,Value}{Minimum\,Value - Maximum\,Value}\right)$$ *Here; X= Actual Value of indicator* Eq. 3.8

This method is adopted after reviewing the study of Freudenberg (2003). The only difference is we did not multiply the final value with 100. So, normalization method yields the value of indices in range of 0-1.

3.8.2 Estimation of weights for individual indicators through factor analysis

Gomez- Limon and Fernandez (2010) explained two types of techniques for assessing the individual indicator's weights named as positive and normative technique. According to him there are three methods in positive technique for weight estimation including principal component analysis or factor Analysis, data envelopment analysis, and regression analysis. According to theses method, the researcher can calculate the weights via statistical procedure without including the value judgments of their relative importance. On the other hand, the normative techniques allow the opinion of external decision makers and experts. In these techniques the methods are estimating the weights as the function of experts' opinions. This technique is considered similar to introducing the social preference respective to the individual dimension of sustainability. This normative technique includes direct assignment of points, the SMART method, swing weighting, analytical hierarchical process and trade off weighting etc. On the basis positive and normative techniques having self-regarding benefits, the one of the positive technique was selected to be applied in this study. From the positive techniques, the FA was supposed better.

3.8.3 Description of factor analysis

This technique is one of the multivariate techniques which is used for reducing the number of independent variables by considering the interrelations. Specifically, the FA groups-sub-indicators those having interdependency. The basic idea of FA is to derive the least possible number of component those explain the highest variation in the set of an indicator/or the sets of indicators. The general framework of FA was explained below.

The purpose of FA/PCA is mainly to investigate the origin of the interdependencies between variables. The main assumptions of factor analysis are that the data matrix is not divided into sub-matrices of criterion and prediction variables before analysis, and that the relationship between variables is linear. Briefly, factor analysis also referred to data reduction technique for determining the number of factors involving, defining, and interpreting each factor. Centroid element was considered to test the applicability of factor analysis in this study. Centroid element is one of the most important factors that are effective in determining the variables, and indicates the ability to represent variables. How much this value is close to 1 means the selection of variables are good. To analyze the relevancy of explanatory variables subject to factor analysis was tested using the Kaiser-Meyer-Olkin (KMO) test. KMO is sampling adequacy criterion, which is being used to compare the magnitude of the observed correlation coefficient and magnitude of the partial correlation coefficient. As the value of KMO decreases the feasibility of FA also decreases. According to this, the value of KMO is evaluated as very good, 0.80 is good, 0.70 is moderate, 0.60 is low, 0.50 is very bad and less than 0.50 is not acceptable. The main criteria taken into account when determining the number of factors are eigenvalue, scree test and cumulative variance criteria. In practice, the factors above eigenvalue value 1 are selected. The factor analysis data matrix at the start point is given below. Columns include variables subject to factor analysis, and rows contain observational values

Table 3.10. General framework of factor analysis

	Variables					
Case	X_1	X_2	X_3	.	.	X_p
1	X_{11}	X_{12}	X_{13}	.	.	X_{1p}
2	X_{21}	X_{22}	X_{23}	.	.	X_{2p}
3	X_{31}	X_{32}	X_{33}	.	.	X_{3p}
.	.	.	.	.	.	.
.	.	.	.	.	.	.
n	X_{n1}	X_{n2}	X_{n3}	.	.	X_{np}

The mathematical model of factor analysis was explained in following form (Ness, 2002).

$$X_1 = b_{11} f_1 + b_{12} f_2 + \ldots + b_{1k} f_k + u_1$$
$$X_2 = b_{21} f_1 + b_{22} f_2 + \ldots + b_{2k} f_k + u_2$$
$$\vdots \qquad \text{Eq. 3.9}$$
$$X_p = b_{p1} f_1 + b_{p2} f_2 + \ldots + b_{pk} f_k + u_p$$

Here; f_k is General Factors (importance or factor weight in measurement of p^{th} variable of K^{th} factor). b_{pk} are factor loading related to the factors (Correlation between the p^{th} variable and K^{th} factor). u_p is Unique factor (unexplained variation by Factor)

For this the dimension less variables are required. So in step 3 estimated dimensionless and normalized indicators were used in this step to calculate the weights for each indicator. Therefore, the composite index no longer depends upon the dimensionality of the data set somewhat is grounded on the statistical dimension of the data. For weight estimation following steps is taken into account.

3.8.3.1 Checking correlation among indicators

At the first step, the correlation between the indicators was estimated. If this correlation between the indicators is not strong, then it means that indicators are unlikely sharing common factors.

3.8.3.2 Finding out the number of latent Factors

The second step is to identify the number of least factors. Here each factor is depending on the set of loading coefficient (Loadings). The PCA is usually used to extract the factors (Manly, 2014). For FA, a subset of PC is taken into account, the once that represent the principal volume of variance. The factor having eigenvalue greater than one or individual contribution to overall variance more than ten percent was used to choose the number of factors.

3.8.3.3 Rotation of factors

This step includes the rotation of factors to minimize the number of individual indicators that have a high loading on the same factor.

3.8.4 Estimation of weights and intermediate indicators

The last step is to calculate the weights from the loading matrix. After rotation, the square of loading explains the unit variance of the indicators emphasized by the factors. The Nicoletti et al (2000) used the highest loading value of a factor in order to gather the several indicators to estimate the intermediate indicators. Therefore, for each dimension (economic, social, environment) having various individual indicators, the intermediate composite indicators corresponding to each principal component (II_i) was developed by using the following formula given in

Eq. *3.10*.

$$II_{ijk} = \sum_{L=1}^{L=n} w_{Lj} I_{Lk} \qquad \text{Eq. 3.10}$$

Where II_{ijk} is the intermediate indicators regarding to each dimension of sustainability, i is sustainability dimension as economic, social and environment for component j, and farm k. w_{Lj} demonstrates weight of indicator L in j component, and I_{Lk} signifies the normalized indicators L for farm k. Weights for each indicator (w_{Lj}) was estimated by using

Eq. *3.11*.

$$w_{Lj} = \frac{\left(factor\ loading_{Lj}\right)^2}{eignvalue_j} \qquad \text{Eq. 3.11}$$

3.8.5 Estimation of composite intermediate index for each dimension

Finally, the composite index for each dimension of sustainability (economic, social and environment) was estimated by using the following formula. This was estimated by aggregating the intermediate indicators (II_{ijk}) through general equation given below. The aggregation of intermediate indices to get each dimension, the following formula was applied. The composite index for i^{th} dimension (economic, social, and environment) of farm k (CI_k) was estimated by using Eq. *3.12*.

$$CII_{ik} = \sum_{j=1}^{n} \alpha_j II_{ijk} \quad \text{Eq. 3.12}$$

Where the weights $\alpha_j$was applied to intermediate indicator, which is estimated by Eq. *3.13*.

$$\alpha_j = \frac{eignvalue_j}{\sum_{j=1}^{n} eignvalue_j} \quad \text{Eq. 3.13}$$

3.8.6 Estimation of composite tea farms sustainability index (CTFSI)

Finally, the estimation of composite tea farm sustainability index (CTFSI) was measured by applying the simple average formula as presented in Eq. *3.14*.

$$CTFSI_k = \sum_{i=1}^{3} CII_{ik}/3 \quad \text{Eq. 3.14}$$

Here $CTFSI_k$ is Composite Tea Farm's Sustainability Index for K^{th} farm, CII_{ik} is Composite intermediate index value for each sustainability dimension at farm k.

3.9 Comparing Sustainability Level of Owned and Shareholders

Indicators selection and their usage in measuring CTFSI enabled the comparison of the two prevailed farming systems in the study area. These two farming systems were owned in farming and shareholder farming. Some tea farmers were growing tea on their own, and have their own land. It implies that they hold the possession, and rights for using their land for farming. On the other side, the second system was shareholding. Inthis system, the tea farmers only hold the right for using a land without its possession. In this situation, the real owner remains unable to perform tea farming due to various social factors like the old age, migration to other district or province, and having other occupation. Consequently, the real owner finds a willing person, and they verbally decide how the land can be used for tea farming. In this way, they decide to share the income or returns from the tea crop by fifty percent. This type of farmers was named as shareholders. Therefore, the owners and shareholders ware compared based on the measured CTFSI. For this t-test were applied for these two independent groups of farmers. The clear picture of the farmer's CTFSI scores was presented as radar graphical form.

3.10 Factors Affecting the Tea Farms Sustainability

The next step was to determine the factors influencing the sustainable tea farming. The measured CTFSI had a range of 0 and 1, the double censored Tobit model was considered with this upper and lower boundary of the index. The choice of Tobit model is justified by below and above bounded characteristics of sustainability indices, because the application of ordinary least square and regression is not problem free for this type of data (Simar and Wilson, 2007). Both structural and decision variables were included as the independent variable. These all considered independent variables were presented in Table *3.11*.

In Tobit model, among the incorporated independent variables, the operational land in a hectare, parcel age in years, and slop of land in percentage were considered as structural variables. Additionally, personal characteristics such as age, and education were also included in the model. Moreover, number of family members working at farm, cost of chemical fertilizer in TL, farmer's decision of hiring the labor, participating the training and symposium etc., accepting and using the opinion of other farmers regarding tea cultivation, and working in status of owner and shareholder were counted as decisional variables in the model.

Table 3.11. The description of variables used in Tobit model

Dependent variable	
Composite Tea Farms Sustainability Index (CTFSI)	
Independent variables	
Age of farmer	Years
Education	1 = primary school 2 = secondary school 3 = high school 4 = university graduate
Family labor	No. Of family member working at farm
Operational land	Hectares
Age of parcels	Years
Slope	%
Cost of chemical fertilizer	Tl
Tea sale value	Tl
Labor hiring	1 if labor hired; otherwise 0
Participation in agri. Training, symposium etc.	1 if participated; otherwise 0
Use of other opinion in tea farming	1 if using; otherwise 0
Land ownership status (owned/shareholder)	1 for owned; otherwise 0

3.11 Comparing the Socio Economic Characteristics of Tea Farmers

Socio economic characteristics of farmers have been securing a robust position in almost every social study for many years. There were two types of the farmers (owned and shareholders) were compared based on their socio-economic characteristics. Likewise, the farmers were also categorized into two groups based on their CTFSI with the aaplication of K-mean cluster analysis, and they were named as lower sustainability tea farm (LSTF) group and higher sustainability tea farm (HSTF) groups. The primary purpose of cluster analysis was only to make interpretation easy. This analysis clustered the tea farmers based on the similarities of CTFSI scores. Additionally, the socio-economic characteristics of these two groups were also analyzed. Among socio-economic characteristics, demographic characteristics of farmers, farming practices, profitability analysis of tea cultivation, an adoption of some recommended techniques regarding tea cultivation were discussed.

Demographic characteristics of the farmers like age, education, land holdings etc. were under the concern of each researcher. Except that in this study many different characteristics regarding tea farmers were discussed. Both general groups based on their farming types (owned and shareholder); and sustainability groups were compared by considering their management practices related to the farming like fertilizer application, weeds management and extension sources. Many statistical analyses were available to compare farmers over their characteristics. The interval variables were tested for their normality before applying any statistical test by using the Kolmogorov Smirnov test. Sometime, this formal normality test presents incompatible results when sample size is larger or smaller. At that time Kurtosis and Skewness distribution test is considered more suitable this is irrelevant to the sample size (Kim, 2013). The z-test was used to check the normality of variables. Kim, (2013) proposed that for sample size ($50 < n < 300$), reject the null hypothesis at absolute z-value over 3.29, which corresponds with an alpha level 0.05, and conclude the distribution of the sample is non-normal.

The average values for interval variables were determined. To make comparison between the average values of interval normally distributed variables over the two independent groups (owned and shareholders), the independent sample t-test were performed. The categorical variables were compared between the groups by using the Chi-square test, and Fisher’s Exact test were also applied when it is required.

Moreover, considering the different farm size large, medium and small tea farms, the sustainability levels of owners and shareholders were also compared. The interaction effect was first checked by applying two-way ANOVA (because one categorical variable was describing the owner and shareholder status of tea framer, and second categorical variable was describing large, medium and small tea farms). If the interaction effect was found non-significant, the small, medium and large tea farm owners and small, medium and large shareholder tea farms were separately compared by using one-way ANOVA.

Similarly, the owner and shareholder were also compared by considering the low and high sustainability tea farms those resulted out by cluster analysis. Again, two-way ANOVA was applied because of having two independent categorical variables (i. variable describes the owners and shareholders status of farmers, ii. Low and high sustainability tea farm groups), and one interval variable (index scores). Likewise, the interaction effect among categorical variables was non-significant, the separate comparison of low and high sustainability owner tea farms, and low and high sustainability shareholder tea farms was presented.

3.12 Assessing the Factors Influencing the Farmer's Decision of Continuing and Entering Tea Farming

This section explains the two objectives of the current study. The first objective was to describe those factors that influence the farmers (named as a *real owner or landlord*) to supply his land to a person who is willing to perform tea farming on a share basis. In this objective, the dependent variable has one new category of the real owner or landlord farmers as well as those farmers who still working as the owner (doing farming on their own land). This real farmers' category describes the farmers who have land, but were unable to do tea farming, and he gave his land to another person known. For this the dependent variable is a categorical variable, and coded first as 0 and 1. Subsequently, the real farmers assigned 1, and those who still performing tea farming currently named as the owner were scored as 0. The independent variables incorporated in the model were explained in Table *3.12*. This may imply the supply of land to the land market for who want to rent in or shared in the land. It makes their land available in land market for use of anyone who wants to hire land for tea farming.

Table 3.12. Description of variables influencing the supply of land to shareholder

Dependent variable	
Categorical variable	1 for real owner and 0 for owner (real owner who gave his land to shareholder, and owner who not gave his land to anyone and still doing tea farming).
Independent variable	
Age of farmer	Years
Education	Schooling years
Family size	The number of family members
Off-farm occupation	1 if having; otherwise 0
Family member having other occupation	No. of working family members
University graduated family members	No.
Cooperative membership	1 if have membership; otherwise 0

The second objective was to assess the factors influencing the decision of a local person to work as shareholders. This also may imply the condition of demanding land by the person who does not have his own land but wants to do the tea farming, and started tea farming on share-basis by sharing the land. In this way, the independent variables for this model were explained in Table *3.13*. In this case, the dependent variables were categorical variables, and shareholders (farmers have no land and sharingthe land) were assigned as 1, and 0 assigned to owners (doing tea farming on their own land).

Table 3.13. Description of variables influencing the demand of land by shareholder

Dependent variable	
Categorical variable	1 for shareholder, and o for owner (shareholder who demand the land, and owner who did not demands land)
Independent variables	
Age of farmer	Years
Education	Schooling years
Family size	No. of family members
University graduated family member	No. of graduated members
Family member having other occupation	No. of working family member
Membership of cooperative	1 for having membership; otherwise 0
Off-farm occupation	1 for off-farm occupation; otherwise 0
Farmers' wish	1 for if farmer has wish of becoming successful farmer; otherwise 0

The logistic regression was applied for these two models separately. The model specification was explained below.

$$\text{Prob}(y = 1) = \frac{e^{x\beta}}{1 + e^{x\beta}} = f(x\beta) \qquad \text{Eq. 3.15}$$

Here

Prob (y = 1) is probability equal to 1.

“e” denotes the natural logarithms

f (xβ) shows the standard logistic distribution function

x is the vector of explanatory variables

For estimation of odd ratios for explanatory variables, the following formula was used.

$$\text{Exp (B) or odds} = \frac{P}{1-P} \qquad \text{Eq. 3.16}$$

Odds ratios shows that how much probability of a farmer to be a shareholder or a farmer (those gave their land on share) will increase when one unit change in independent variable occur, while all other variables are held constant.

3.13 Calculating Social Cost of Shareholding in Tea Farming

The social cost (SC) explains the situation of shareholding farming which creates somehow externality on the society. As shareholding describes the condition of short term tea farming which influences the behavior of shareholders toward farm management. They may tend to earn more by compromising the sustainable use of the inputs. The shareholders were expected to apply high quantities of fertilizers to get high yields from the old tea orchards.(Repetitive sentence) The general framework to estimate the social cost of shareholding in tea farming was explained below.

To calculate the social cost of shareholding, technical efficiency (TE) of shareholders and owners were estimated by applying the approach of input-oriented in DEAP. The difference was calculated between TE of owners and TE of shareholders which explains their possibility of lowering the input levels without compromising the current yield level.

$SC_{shareholding} = \{(TE_O - TE_S)*I_{(CF,L)}\}*IP_{(CF,I)} + (TY_O - TY_S) * P_{TY}$ Eq. 3.17

Here in equation,

TE_O = Technical efficiency of owners

TE_S = Technical efficiency of shareholders

$I_{(CF,L)}$ = Chemical and labor inputs

$IP_{(CF,I)}$ = Price of chemical and labor per unit

TY_O = Tea yield by owners

TY_S = Tea yield by shareholders

P_{TY} = Price per unit of tea

In this way, the difference of their TE score gave us the possible extra use of inputs to save that shareholder could not take care. The second difference between their actual yield was also taken. If the yield of the shareholders was also low this was also considered in calculating the SC of shareholding. The possible quantity of inputs to save and yield difference was multiplied by the per unit price of inputs and yield to get SC value of shareholding in tea farming. Yıldırım (2018) also measured the social cost of full and part-time hazelnut farmers by using the efficiency scores.

Moreover, the social cost for Turkey, and for Rize province was also calculated. This was calculated by considering the proportion of land held by shareholders in the total average land held by both, the owners and the shareholders in the province. Afterward, this proportion of land was multiplied by the total tea land in Turkey, and in Rize province. To calculate the monetary value of the social cost, the measured per unit land social cost (Eq. *3.17*) was multiplied with the total land held by the shareholders.

4 RESULTS AND DISCUSSION

The application of methodology explained in the previous chapter resulted in many possible comparisons of the tea farmers based on their demographic characteristics and sustainability level. This chapter describes the results of the study subsequently because the various comparisons between the tea growers based on several variables. Section firstly explains the socio-economic characteristics of the farmers with a comparison of the owner and shareholder-operated farms. This also explains the management practices of these two tea farming systems. Afterward, the tea farms sustainability has been explained, and also compared the owner and shareholder-operated tea farms based on their sustainability level. Moreover, the management practices and socio-economic characteristics of the high and low sustainable tea farms were also compared. Furthermore, the results of the Tobit model in order to explore the affective factors on tea farms' sustainability were described. At last, why the landlord gave up tea farming and gave their land to others, and why the landless wanted to become shareholders were also enlightened.

4.1 Socio-Economic Characteristics of the Owner and Shareholder

4.1.1 Framer's characteristics

Table *4.1* explains the personal characteristics of the tea farmers such as age, family members, family income, education, and university graduated family members, etc. The first variable is the age of the farmer. Age is a very important social variable because as they get older humans learn different things and try to survive in their birth place. Smith and Zopf (1970) stated that the behavior, thinking and expression of needs closely related to the age of a person. The average age of the shareholder and owner was 50.37 and 47.37 years respectively. Although there was no significant difference between the age of the owner and shareholder, the latter was 3 years younger than the former. The owner had 32.60 years' experience of tea cultivation, and shareholder had experience of 29.96 years of tea cultivation ($p>0.10$).

The education level of the owners was better than the shareholders. It can be described as the high proportion of the owners were having higher education than shareholders. More than 55% of the shareholders were primary school graduated. Similarly, more than 21% of the owners were university graduates, regardless of their degree level, and only 7.40% shareholders were graduated from a university. Similarly, Savaş and Yenice (2016) explained the education level of dairy farmers in Rize province. They also found most of the farmers were primary school graduates and only 5% were university graduates.

Table 4.1. Farmers' characteristics

Characteristics	Owners		Shareholders		p-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Age (Years)	50.37	12.52	47.37	9.83	0.25
Experience (Years)	32.60	13.10	29.96	10.58	0.33
Household size (No.)	4.64	1.85	4.63	1.62	0.94
University graduated family members (No.)	1.14	1.10	0.66	0.83	0.04**
Family members having other occupation (No.)	1.35	1.33	0.93	1.11	0.13
Family labor at farm (No.)	2.14	0.95	2.30	0.87	0.42
Family income(TL/Year)	32144.14	21145.45	30977.78	36244.02	0.83
Farm income share in family income (%)	42.48	24.40	50.04	26.39	0.16
	Percent		Percent		
Education					
Primary school	38.70		59.30		0.20
Secondary school	19.80		14.80		
High school	19.80		18.50		
University graduated	21.60		7.40		

,**, shows significant difference at 1%, 5%, and 10%**

Both types of farmers had almost the same family sizes with an average of 4.63 family members. However, most of the owner's family members were university graduates as compared to the shareholder's family members. The average 1.14 member of the owner's family and 0.66 members of the shareholder's family were university graduates. Moreover, most of the owner's family members had off-farm occupation than shareholder's family members. More than one family member (1.35 members) of an owner was working out of farm, and almost one person from shareholder's family was busy in off-farm occupation. The family income of owners was greater than shareholders per year. The owner's annual earnings were 32144.14 TL, and the shareholders were earning 30977.78 TL. No significant difference was found between their family income levels. Shareholders' 50% of the family income was coming from tea farming and owners' were receiving 42.48%. However, the differences existed in the share of the farm income between both types of farmers but it was statistically insignificant. It may imply that the farmers had almost the same level of farm income share in total as a family income regardless of any family members having off-farm occupations.

4.1.2 Social involvement of tea farmers

Social involvement describes the situation of the farmers for / as having a cooperative or farmers' organization membership, their participation in village administration, their level of credit use, and their access to social security. Social involvements of sampled farmers were presented in Table *4.2*. Globally, having membership of any cooperative, which is working locally should not be ignored in agriculture It has positive effects on adoption of innovations and newly evolving technologies. Moreover, it empowers the weak farmers economically by reducing market risk, by increasing their bargaining power which provide the pathway to farmers to get rid of poverty and powerlessness (Bibby and Shaw, 2005; Birchall and Simmons, 2009; Kolade and Harpham, 2014; Woldu et al, 2013 and Ahmed and Mesfin, 2017). Both types of farmers had cooperative membership, but generally the proportion of owners (65.77%) having membership was high that of shareholders (55.56%) (p>0.10).

Table 4.2. Membership, participation in village administration, credit use and social security type

Characteristics	Owners	Shareholders	p-value
Cooperative membership			
Yes	65.77	55.56	0.32
No	34.23	44.44	
Participation of family in village administration			
Yes	29.73	23.08	0.49
No	70.27	76.92	
Type of social security			
No	2.70	7.41	0.48
Bağ Kur	11.71	18.52	
SSK	76.58	66.67	
Other	9.01	7.41	
Using credit for inputs			
Yes	12.61	11.11	0.83
No	87.39	88.89	

The participation level of the tea farmers in their village's administration was very low. Almost less than one-third of the farmers, irrespective of farmer's type (owner or shareholder), were participating in the activities related to the village administration. The prevalence of social security from the SSK was common in the study area. Some farmers had no social security. Most farmers were having social security such as retirement etc., the credit use also was very low among them. Only 12% of the owners, and 11% of the shareholders had used credit (loans) in the tea farming, regardless of the credit source.

4.1.3 Tea farming profitability

Tea is a perennial crop, and it requires just a few inputs. The labor requirement of tea farming is higher than the other crops. Table *4.3* shows the owner and shareholder based on their earnings from tea farming in last year. No statistically significant difference was found between their variable cost, return and gross margin even that return on management was also non-significant ($p>0.10$). Generally, the owner was spending 5659.40 TL per hectare for the inputs, and receiving 28570.80 TL per hectare after satisfying the input cost. Their gross margin per hectare was 22911.40 TL. The shareholder spent 6198.70 TL and got 31482.80 TL in return per hectare. Their gross margin was equal to 25284.10 TL per hectare.

After satisfying all the inputs, even the partial labor force came from the land owner's family, the income of the land owner was equal to 14990.80 YTL per hectare. Similarly, the income of the shareholder's family was equal to 18510.70 YTL per hectare. The non-significant difference between the income of the owners and shareholders may be due to the low numbers (amounts) of the inputs required by the crops. It means only chemical fertilizer and labor at the time of harvesting they are spending their money and earning after selling the quantity of leaves harvest. Moreover, the quota system in tea leaves purchasing may also hinder earning more.

Table 4.3. Profitability of sampled tea farms (TL/he)

	Owners		Shareholders		p-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Variable cost	5659.40	4823.50	6198.70	5206.80	0.61
Return	28570.80	9580.60	31482.80	8798.20	0.15
Gross margin	22911.40	9915.90	25284.10	10395.10	0.27
Return on management	14990.80	10612.70	18510.70	9817.20	0.12

4.1.4 Farmers' perception for their income level

Although the tea farmers were earning income from both farm and off-farm occupation, their perception regarding their income level also matters in their economic conditions. The farmers categorized themselves into three groups such as low, medium and high-income groups by considering the general income level of peoples around them in the village. The significant difference was found among their perception regarding their income level. Most of the owners were perceived themselves as they belong to the medium income group, while shareholders perceived themselves as they belong to low income group according to the results presented in Table 4.4. This can be described by the situation of the shareholders; they share their earnings with their landlord, whereas the owners had no need of sharing their earnings. Furthermore, the most of the family members of shareholders were attached to tea farming as compare to owners.

Table 4.4. Farmers' income group

Farmers' level of income[1]	Owners	Shareholders	p-value
Income group			
Low income group	26.13	44.44	
Medium income group	64.86	37.04	0.02**
High income group	9.01	18.52	

,**, shows significant difference at 1%, 5%, and 10%**

[1] Since asking the farmers directly their income would create problems in the locality. Therefore, different strategy was adoptred to determine their income level. in order to determine the income level of farmers, they were asked the following question;

"if farmer of your village were divided in to three income categories as low, medium and high income, which one you would likely to fall".

4.2 Farm Characteristics and Farmer's Management Practices

4.2.1 Farm structure and tea yield

Table *4.5* explains the general structure of the tea farms. The land under tea was equal to the actual land holdings. The tea cultivated area by a shareholder was significantly greater than the owners. The average tea cultivated area by a shareholder was 1.18 hectares, and cultivated area by owners was 0.76 hectares. Moreover, both types of farmers were not statistically different in the number of parcels. The shareholders had slight more parcels (5.44) than the owners (4.99). This may be due to the excess land held by the shareholders. Yüksek et al (2013) also stated that most of the tea farmers were having hectares less than 1.5, and they divided their land into the 4-7 parcels.

The economic age of a tea orchard is 50-60 years which also depends on the ecological condition of the area (Özcan and Yazicioğlu, 2013). The owner and shareholder farmers had tea orchards of 38.20 and 39.57 years respectively. The shareholders' tea orchards had 42.30% slope and owners' tea orchards had 39.97% slope. Similarly, the altitude of shareholders' tea orchards was high than owners' tea orchards. The variables regarding the structure of the tea farms were not significantly different between the owners and shareholder with the exception of the variables "parcel age" and " labor productivity" (p>0.10). This may explain the same structure of the tea orchards due to the mountainous area of the province. Similarly, the productivity of a person to harvest the tea leaves was greater at shareholders' farm than the owners' farm. It describes that one person can collect 281.48 kg per day of tea leaves at shareholder's farm, and 250.11 kg per day at the owners' farm (p<0.05). The labor productivity difference may be due to the easy collection of tea leaves which explains the well-managed orchard by shareholders. If a person collects more leaves in a day, this leads to a high yield of tea.

Table 4.5. Farm structure and tea yield

	Owners		Shareholders		
Variables	Mean	Std. Dev.	Mean	Std. Dev.	p-value
Land under tea	0.77	0.62	1.18	0.88	0.01*
No. of Parcels	4.99	3.56	5.44	2.15	0.53
Age of Parcels	38.20	13.92	43.46	14.19	0.07***
Slope (%)	39.97	16.83	42.30	16.10	0.52
Altitude (m)	316.32	265.61	392.11	370.00	0.22
Distance from reception point (m)	1081.53	882.40	1224.26	1025.19	0.47
Labor productivity (Kg/Man/Day)	250.11	64.60	281.48	60.09	0.02**
Yield (Tons/Ha)	14.82	4.60	16.53	3.95	0.07***

,**, shows significant difference at 1%, 5%, and 10%**

4.2.2 Soil problems and its management

The study results in Table *4.6* revealed the existence of the erosion and landslide risk problem at the tea farms. Generally, the soil erosion and landslide problem were highly reported by shareholders than owners. Although shareholders had soil erosion and landslide problem at their farms, their attention toward the management techniques such as terracing was significantly low. This may be describable as the owners were practicing attentively terracing at their farm which reduced the soil erosion and landslide problem at their farms. More than 65% of owners were practicing the terracing at their farms, and only 44.44% of shareholders were practicing terracing. About 24.32% owners and 40.74% shareholders were not practicing terracing even soil erosion and landslide problem existed at their farm. Remaining farmers had no need of practicing terracing because they had not soil erosion problem. This significant difference was expected due to the natural behavior of the owners to manage their farmland in order to maintain long term soil fertility. The shareholders' low attention to practice terracing at their farm may be due to short time verbal contract. Stocking and Murnaghan (2001) and Sklenicka et al (2015) describes that the owners are more likely to tackle the soil erosion problem, and adopt the good management practices.

Table 4.6. Erosion or landslide risk and terrace status at farm

Variables	Owners	Shareholders	p-value
Erosion or Land Slide Risk			
Yes	35.10	40.70	0.59
No	64.90	59.30	
Terrace Status			
Yes	68.47	44.44	
No	24.32	40.74	0.06***
No Need	7.21	14.81	

,**, shows significant difference at 1%, 5%, and 10%**

4.2.3 Farmers' tea farming management practices

Therefore, soil test performance, and fertilizer application methods were addressed in Table *4.7*. The soil test performance was not commonly adopted in the study area regardless of the insignificant difference between owner and shareholders. Generally, 18.92% of owners and 14.81% of shareholders were performing a soil test. Commonly farmers applying the fertilizer without performing soil test which may cause soil deterioration as well as increase the production cost. The results were in line with Özcan and Yazicioğlu's findings (2013) regarding the application of the fertilizers without performing a soil test.

Three fertilizer application methods exist, but their adoption varies according to the tea orchards (uncut, newly cut tea orchard). Generally, fertilizer was applied by spreading method in both uncut and newly cut orchards. The shareholders and owners had no significant difference in terms of fertilizer application methods. In uncut tea orchards, the fertilizer application by spreading, and applying in the root zone has prevailed. In newly uncut tea orchards, additional fertilizer application method such as mix fertilizer with soil was also observed at owner-operated tea orchards. The current results are in line with those presented by Yüksek et al (2013). They also described widely adoption of fertilizer application in the root zone of newly cut tea plants, and spreading was highly adopted in uncut tea orchards.

Table 4.7. Management practices

Variables	Owners	Shareholders	p-value
Soil test performance			
Yes	18.92	14.81	0.62
No	81.08	85.19	
Do you have new planted orchard of tea			
Yes	20.72	8.00	0.14
No	79.28	92.00	
Method of fertilizer application in newly cut tea orchard			
Spreading	60.58	57.69	
In root zone	35.58	42.31	0.71
Mix with Soil	3.85	0.00	
Method of application in uncut orchards			
Spreading	61.11	76.00	0.16
In root zone	38.89	24.00	

4.3 Information Source of Fertilizer

There were many information sources of fertilizers available in the study area. The most commonly used method was the cooperative method among the tea farmers as described in Table *4.8*. Here owners and shareholders were not significantly different in getting information about fertilizer. After the cooperatives, tea farmers considered their family members as a reliable source of information. Others sources of information were the tea firm workers, the staff of agricultural chambers, fertilizer dealers, and neighbors, etc.

The time of fertilizer application was determined by their own personal experiences regardless of the owner and shareholder farmers. Here, information about fertilizer time was also obtained from the staff of agricultural chambers. In general, Yüksek et al (2013) also analyzed that tea farmers generally determine the fertilizer time by their own personal experience. Their standard time of fertilizer application is the month of April which is almost every tea farmer stated during the interviews. They were applying fertilizers in April which is the standard time for them. Varble et al

(2016) also stated that the owners frequently rely on their neighbor, friend and county extension agents, and other types of tenure were contacting federal government staff.

Table 4.8. Information source about fertilizer

Variables	Owners	Shareholders	p-value
Source of information about fertilizer			
Cooperative	28.83	37.04	
Family member	18.92	11.11	0.54
Others	52.25	51.85	
Method of determining fertilization time			
According personal experience	91.89	92.59	
From agriculture chamber	0.90	3.70	0.48
Others	7.21	3.71	

4.4 Handling Methods for Herbs

As tea is the secondly most consumed drink after water all over the world, the application of chemicals is prohibited. Similarly, farmers were also considering this rule, and were not using any type of chemical spray for weed controls and insects. As shown in Table *4.9*. There were two methods were being adopted by the tea farmers, i) pulling by hand, and ii) cutting herbs with the motor. In the first method, further peoples were pulling the herbs by hand before or during the tea harvesting. The most adopted method was pulling herbs before tea harvesting. The motor method was not common among tea farmers. The owners and shareholders were not significantly different in the use of herbs pulling method. As compares to the owners, the shareholders were pulling the herbs by hand or by motor before the tea harvesting.

Table 4.9. Handling methods for herbs

Handling herbs in tea orchards	Owners	Shareholders	p-value
Pulling off with hand before harvesting tea	79.28	74.07	
Pulling off during Tea harvesting	1.80	0.00	0.63
Others (Motor)	18.92	25.93	

4.5 Application of 2.5 Leaves Rule

Table *4.10* shows application of 2.5 tea leaves rule by the tea farmers. This rule defines the leave should be according to the Figure *4.1*. These types of leaves should be collected by the tea harvesters.

Figure 4.1. 2.5 tea leaves form

The tea firms highly appreciated this 2.5 tea leaves' collection for maintaining high tea quality. The owners and shareholders were not expected to differ in the application of 2.5 tea leaves rule. Generally, there were only a few tea farmers who following this rule attentively while mostof them following it occasionally. Similarly, the proportion of tea farmers who were not following this rule was also considerable. Tea respondents said that they harvest the tea leaves with scissors, and it is impossible to apply the two leaves rule. Collectively bringing in the leaves to the collection center of the tea firm on the appointment date was another reason not to follow this two leaves rule. Because, before the appointment day, they try to harvest high volumes of tea leaves as much as they can.

Table 4.10. Following level of 2.5 leaves rule

Response	Owners	Shareholders	p-value
Yes	19.82	22.22	
Occasionally	40.54	37.04	0.93
No	39.64	40.74	

4.5.1 Farmers' subjective judgment for quantity of 2.5 leaves

When the tea farmers were asked about their judgment on the quantity of 2.5 leaves in total harvested quantity, their responses were presented in the form of percentage in Table *4.11*. Here, there were no significant differences found in the judgment of the quantity of 2.5 tea leaves between the shareholders and owners. They stated that occasionally collected tea quantity contains large quantity of 2.5 leaves, followed by the leaves taller than 2.5, and shorter that 2.5

Table 4.11. Quantity of leaf in harvested tea (Percent)

	Owners		Shareholders		p-
Quantity of Leaf in Harvested Tea	Mean	Std. Dev.	Mean	Std. Dev.	value
Quantity of 2.5 leaves	47.12	32.36	46.11	29.36	0.89
Quantity of shorter leaves than 2.5	14.47	21.99	13.33	16.58	0.80
Quantity of taller leaves than 2.5	38.41	31.14	40.56	33.32	0.75

4.6 Benefit from Mass Communication by Farmers

Table *4.12* shows the extension sources those farmers were using are newspaper, radio, television, and internet. The frequency of using these sources is different. The shareholders and owners were significantly different in terms of reading a newspaper. The shareholder was a regular reader of a newspaper as compared to the owners. More than 50% of shareholders were reading a newspaper daily while only 26.13% of owners were reading a newspaper daily. Moreover, the owners and shareholders were not significantly different in using the frequency of other social media such as watching television, listening radio, and using the internet.

Table 4.12. Extension sources used by farmers

Extension sources	Owners	Shareholders	p-value
Reading newspaper			
Daily	26.13	51.85	
Several time a week	30.63	18.52	
Once a week	9.91	11.11	0.08***
Several time in a month	15.31	7.41	
Never read	18.02	11.11	
Listening radio			
A few hours a day	19.82	18.52	
About an hour a day	12.61	11.11	0.98
Several hours in a month	14.41	11.11	
Never listen	53.15	59.26	
Watching television			
A few hours a day	75.68	74.07	
About an hour a day	12.61	14.81	0.94
Several hours in a month	10.81	11.11	
Never watched	0.90	0.00	
Internet			
A few hours a day	53.15	51.85	
About an hour a day	8.11	3.70	0.84
Several hours in a month	12.61	11.11	
Never used	26.13	33.33	

,**, shows significant difference at 1%, 5%, and 10%**

4.7 Farmer's Participation in Agricultural Events and Discussion

The owners and shareholders were insignificant regarding their participation in the agricultural events as presented in Table *4.13*. Usually, tea farmers were meeting less frequently with the agricultural engineer and technicians. Most of the shareholders (55.56%) were considering the other's opinions in tea farming. Few of the farmers were bearing in mind other's opinions every time. Moreover, farmers usually never attended any symposiums, conferences, meetings and workshops regarding tea farming.

Table 4.13. Farmer's participation in agricultural events and discussion

Variables	Owners	Shareholders	p-value
Frequency of meeting with agricultural engineers and technicians			
Daily	5.41	3.70	0.60
Several time a week	7.21	3.70	
Once a week	15.32	18.52	
Several time in a month	6.31	11.11	
Once a month	14.41	3.70	
Less frequent	51.35	59.26	
The use of others' opinions in tea farming.			
Every time	26.13	22.22	0.26
Sometime	38.74	55.56	
Never	35.14	22.22	
Participation in any meetings, symposiums, conferences related to agricultural issues			
Many time	10.81	11.11	
Several time	22.52	22.22	0.99
Never	66.67	66.67	

4.8 Tea Farms Sustainability

4.8.1 Composite tea farms sustainability index (CTFSI)

Table *4.14* describes the tea farms economic, social and environmental sustainability as well as their CTFSI. Total 80 farmers (57.97% tea farmers) were in low-level sustainability group. These farmers' average CTFSI was 0.34. These farmers' low sustainability was due to serious economic limitations (0.19). Total 48 farmers' sustainability level was in between the range of 0.41-0.50 which comprised of 34% farmers of the sample size. These tea farmers had better social (0.57) and environmental (0.50) sustainability even their economic (0.25) sustainability was unsatisfactory. Only 10 out of 138 tea farmers were highly sustainable with the average of 0.53 CTFSI. These growers were secured high economic (0.40) sustainability, and these farmers' average social and environmental sustainability level was 0.60 and 0.61 respectively. The average CTFSI of these 10 tea farmers was 0.53. Generally, the low sustainability depended on the economic dimension. The economic limitations need to be tackled to increase tea farms sustainability. The possible steps such as early replanting, terrace practicing, adoption of modern techniques for fertilizer application, removing the quota system may enhance the economic sustainability in the area. The table also shows that most of the farmers' sustainability level is low, and only 7.25% of tea farmers were having good sustainability level above the 0.50 points.

Table 4.14. Composite tea farming sustainability index

	No. (Percent)	Economic Sustainability	Social Sustainability	Environmental Sustainability	Tea farming Sustainability
<0.40	80 57.97*	0.19 (0.07)	0.47 (0.11)	0.36 (0.14)	0.34 (0.04)
0.41 to 0.50	48 34.78*	0.25 (0.08)	0.57 (0.08)	0.50 (0.10)	0.44 (0.03)
>0.50	10 7.25*	0.40 (0.12)	0.60 (0.07)	0.61 (0.13)	0.53 (0.02)

Figures in parenthesis shows standard deviation (SD); * presents the percentage of farmers

4.8.2 Analysing the variation of tea farms' CTFSI

Table *4.14* enlightened the overall average CTFSI of tea farmers. To facilitate the explanation of the individual farmers and individual dimensions' sustainability level, the graphical presentation was given in Figure *4.2*. The farmers' economic sustainability in the graph also remains below among all the other sustainability dimensions. The farmers' environmental sustainability only touches the highest point in sustainability. However, generally, social sustainability is comfortable as compared to the other sustainability levels. The average CTFSI was 0.39, which varies between 0.18 and 0.58. This implies that the tea farms sustainability could not touch the good mark based on the selected indicators. The average score of economic sustainability was 0.23, which shows a low level of economic sustainability of tea farms. Farmers only obtained the highest score of 0.78 in the environmental dimension of which minimum score was 0.09. Although the farmers generally did not have a good level of sustainability in general, including the economic sustainability, they had no intentions to leave tea farming. Just they want to adopt new economic sources such as dairy farming to increase their income level. Moreover, Rize province has favorable climate conditions for tea cultivation and there is a need for some policy measurements to undertake in order to enhance economic sustainability with good social and environmental sustainability.

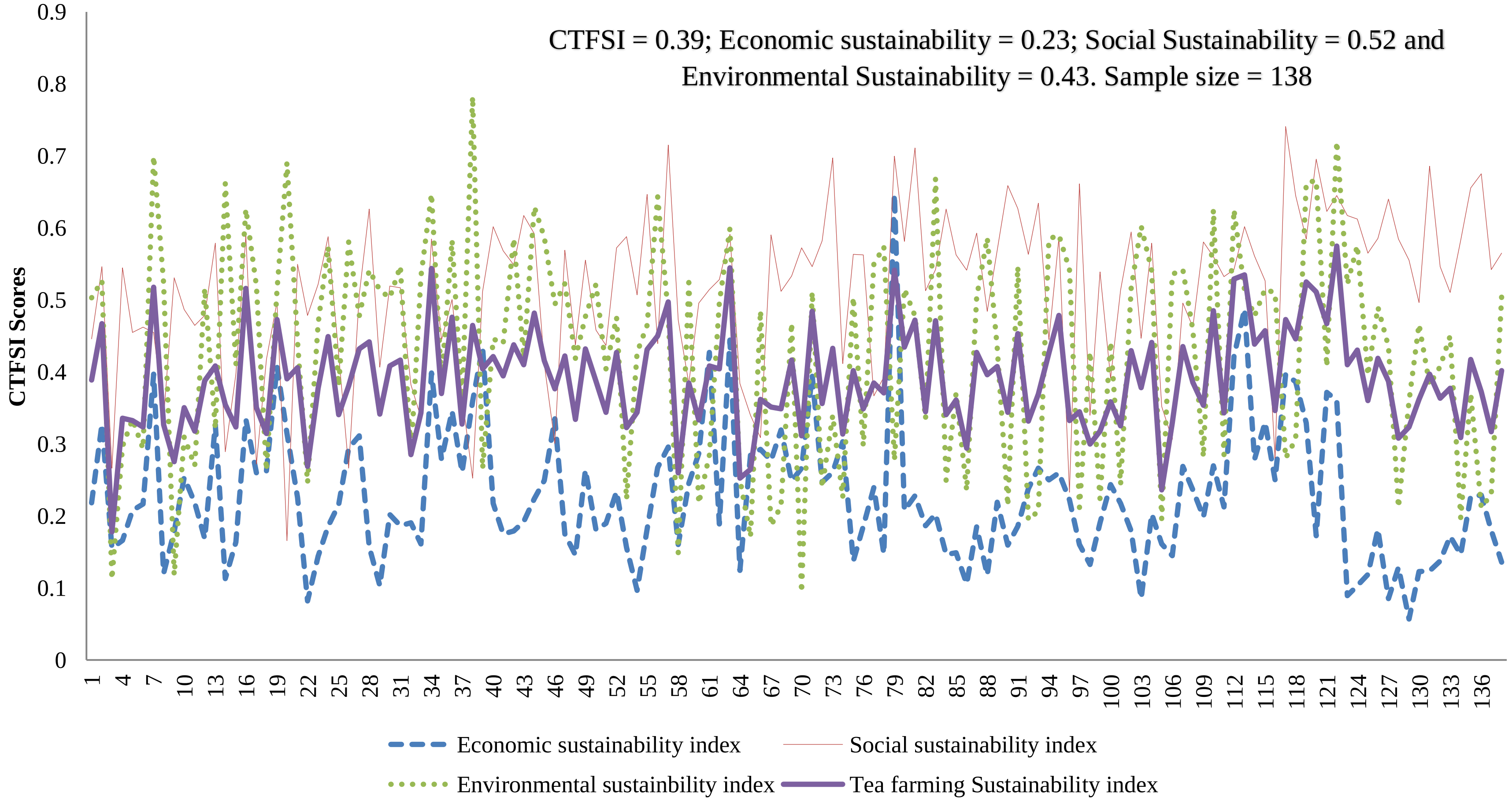

Figure 4.2. Graphical representation of CTFSI scores of sampled farmers

4.8.3 Comparison of sustainability level of owned and shareholders

Table *4.15* explains the tea farming sustainability of self-operated and shareholder-operated farms. The average CTFSI of the owner and shareholder-operated farmers was 0.42 and 0.37, respectively. That describes the owner-operated farms were more sustainable as compared to the shareholder-operated farms. This may be due to the interest of the shareholders earning more income without looking at their cost and management activities at their farm(e.g. the shareholders not practicing terracing at their farm even when it is necessary). The owners and shareholders also had low economic sustainability as compared to the other dimensions. It implies that both types of farmers should focus on economic sustainability, which is possible by reducing fertilizer quantity as well by practicing good management activity at the farm.

Table 4.15. CTFSI of self-owned Operated and shareholder farmers

Sustainability dimensions	Owned		Shareholder		p-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Economic	0.28	0.10	0.27	0.09	0.92
Social	0.52	0.12	0.49	0.10	0.27
Environmental	0.46	0.16	0.33	0.14	0.00*
CTFSI	0.42	0.08	0.37	0.08	0.00*

,**, shows significant difference at 1%, 5%, and 10%**

Frequency distribution of owner and shareholder farmers based on their farm sizeFrequency of owner and shareholder farmersTable *4.16* describes the total of 30 self-operating owner farmers were large tea growers that comprised 27.03 % of 111 land owning, self-operating farmers. After that, 29.72% of the owners were medium farmers based on their farm sizes, and 43.25% of them were small farmers. On the other hand, the proportion of small shareholders tea farmers was only 22.22% while 51.85% of shareholders were large tea farmers based on their farm sizes.

Table 4.16. Frequency of owner and shareholder farmers based on their farm size

	Owner		Shareholder	
Framer's categories	Frequency	Percentage	Frequency	Percentage
Large Farmer	30.00	27.03	14.00	51.85
Medium Farmer	33.00	29.72	7.00	25.93
Small Farmer	48.00	43.25	6.00	22.22
Total	111.00	100.00	27.00	100.00

4.8.4 Sustainability level of owner operated tea farms with different farm sizes

Table *4.17* shows the CTFSI of owner-operated tea growers with different farm sizes. A significant decline in economic sustainability was observed with different farm sizes. The large owner operated farms had high economic sustainability levels (0.34) followed by the medium (0.27), and small farmers (0.24), respectively ($p<0.05$). Similarly, the trend of CTFSI was also seen among the owner farmers with different farm sizes ($p<0.10$). Therefore, the large owner-operated farms were highly sustainable as compared to medium and small-sized farms. Economic limitations weakened tea farms sustainability among owners with different farm sizes.

Table 4.17. Owner farmers' sustainability level based on their farm size categories

	Large Farmer		Medium Farmer		Small Farmer		p-value
Sustainability	Mean	SD	Mean	SD	Mean	SD	
Economic	0.34	0.11	0.27	0.09	0.24	0.09	0.00*
Social	0.53	0.12	0.49	0.11	0.53	0.12	0.24
Environment	0.46	0.17	0.48	0.14	0.44	0.17	0.48
CTFSI	0.44	0.08	0.41	0.07	0.40	0.07	0.06***

,**, shows significant difference at 1%, 5%, and 10%**

4.8.5 Sustainability level of shareholder operated tea farms with different farm sizes

Table 4.18 describes the sustainability level of shareholders operated tea farms. All sustainability dimensions, economic, social and environmental, were not different significantly among shareholders based on different farm sizes ($p>0.05$). Generally, economic sustainability decreased with the decline in the farm size. The overall tea farm sustainability of shareholders was not satisfactory as that of owner-operated farms with different farm sizes.The shareholders with different farm sizes were having satisfactory level of social sustainability . The economic sustainability at medium and small shareholders' farms was lower than the large shareholders. However, the overall tea farms sustainability of large, medium and small shareholders was almost the same.

Table 4.18. Shareholder farmers' sustainability level based on their farm size categories

Sustainability	Large Farmer		Medium Farmer		Small Farmer		p-value
	Mean	SD	Mean	SD	Mean	SD	
Economic	0.31	0.10	0.26	0.05	0.24	0.04	0.14
Social	0.50	0.11	0.47	0.10	0.51	0.10	0.72
Environment	0.32	0.16	0.37	0.11	0.32	0.11	0.68
CTFSI	0.37	0.10	0.36	0.03	0.35	0.06	0.89

,**, shows significant difference at 1%, 5%, and 10%**

4.8.6 CTFSI's graphical presentation of owner and shareholder tea farms

Figure *4.3* explains the graphical presentation of CTFSI of sampled owner-operated farms. The drastic fluctuation was found among the sustainability of farmers even among the dimensions of sustainability. Economic sustainability score of farmers as depicted in the figure is more concentrated near the axis; it means the owner-operated farms had not good economic sustainability. After that, environmental sustainability was far away from the axis. Most of the owner-operated farms were having high environmental sustainability. Among the dimensions of the sustainability, the owners had good social sustainability which is far away from the axis as compared to two other dimensions such as economic, and environment.

Figure *4.4* also presents the similar pattern of sustainability dimensional fluctuation of shareholder-operated farms. Again, the economic sustainability of the shareholder-operated farms was also low. Social sustainability of shareholder-operated farms appears better among all sustainability dimensions of sustainability. This same pattern of the sustainability between owner and shareholder-operated farms describes the need for improving the economic sustainability.

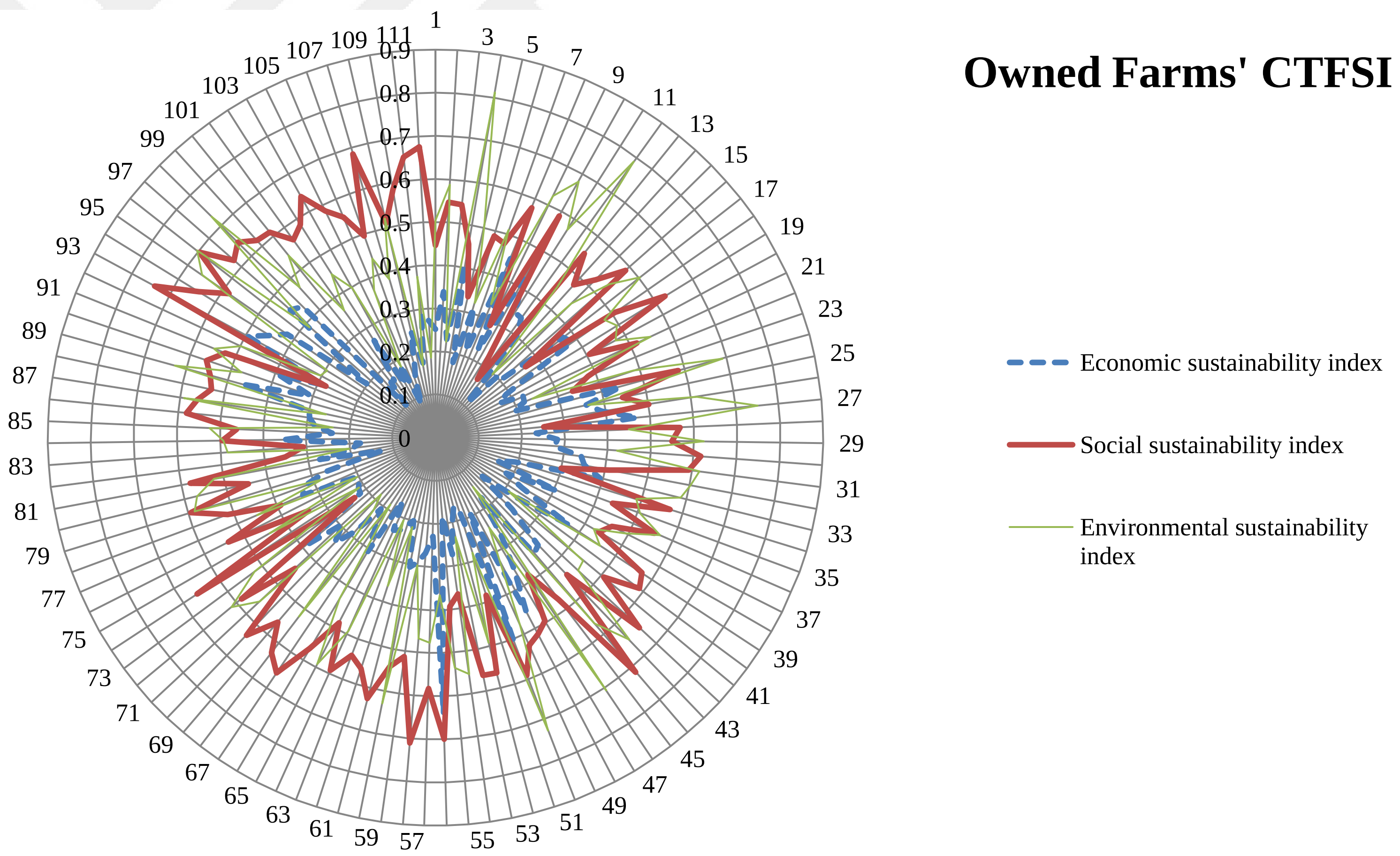

Figure 4.3. CTFSI of sampled self-owned operated farmers

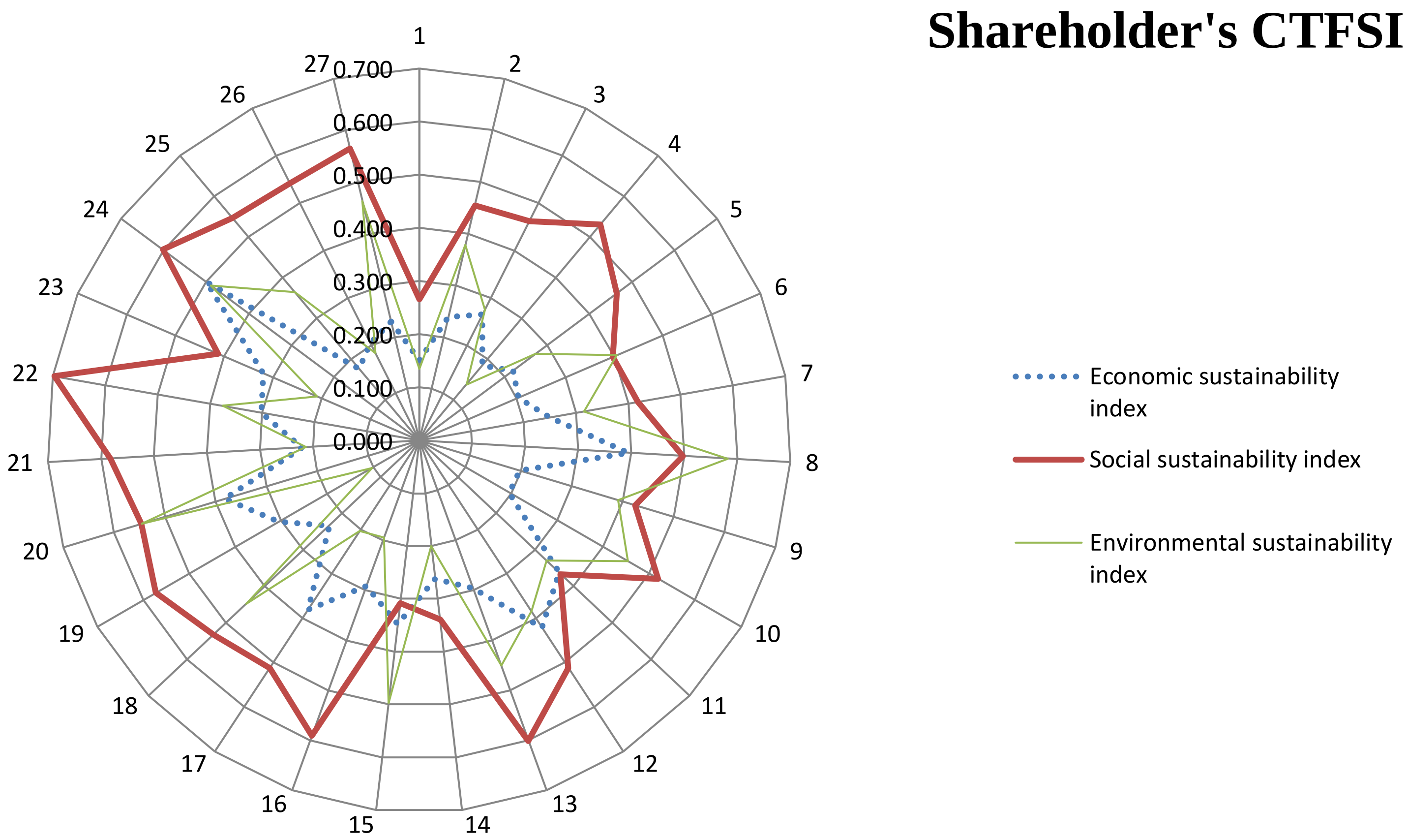

Figure 4.4. CTFSI of sampled shareholder farmers

4.9 Comparison of the Tea Farmes Based on Their CTFSI

4.9.1 Categorization of the tea farms

To compare the tea farmers based on their CTFSI, they were clustered into two groups as presented in Table *4.19*. To classify the farmers, K- means cluster analysis was applied for avoiding subjective interference. The final CTFSI was used for the application of cluster analysis. The cluster analysis resulted in two groups that one had a low sustainability average index score while the second group had a high index score. Based on these average index scores, the farmers with low index were titled as low sustainable tea farmers, and others with a high index were termed as high sustainable tea farmers. The frequency of the farmers' sustainability levels was calculated. The low sustainable tea farmers were 75 who covered 54.35% of the total sampled farmers. The high sustainable tea farmers were 63 in number and comprised 45.65% of the total sampled farmers.

Table 4.19. Frequency and percentage of farmers

Tea Farms	Frequency	Percent	Valid Percent	Cumulative Percent
Low sustainable	75.00	54.35	54.35	54.35
High sustainable	63.00	45.65	45.65	100.00
Total	138.00	100.00	100.00	

4.9.2 CTFSI of low and high sustainable tea Farms

Table *4.20* shows the CTFSI of the low and high sustainable tea farmers. The average CTFSI value of high sustainable tea farmers was significantly higher than the low sustainable tea farmers. The average CTFSI of high and low sustainable tea farmers was 0.45 and 0.34, respectively. The high sustainable tea farmers experienced greater economic, social and environmental sustainability level than low sustainable tea farmers. (Vague and repetitive)

Based on the dimensional comparison, the economic sustainability level of both low and high sustainability farms was low than social and environmental sustainability. Only high sustainability tea farms touched the marks greater than 0.50 in social and environmental sustainability level, and their economic sustainability was also not problematic.

Table 4.20. CTFSI of farm's categories

Sustainability dimensions	Tea farms				p-value
	Low sustainable		High sustainable		
	Mean	Std. Dev.	Mean	Std. Dev.	
Economic	0.19	0.06	0.27	0.11	0.00*
Social	0.46	0.11	0.57	0.08	0.00*
Environmental	0.36	0.14	0.51	0.11	0.00*
CTFSI	0.34	0.04	0.45	0.04	0.00*

,**, shows significant difference at 1%, 5%, and 10%**

Figure *4.5* and Figure *4.6* presents the high and low sustainable tea farmers' CTFSI. The social and environmental sustainability scores scattered away from the axis except for their economic sustainability scores. The fluctuation of the dimensional scores was intensive, and farmers were different in their CTFSI as well as their dimensional sustainability level. Only one among all other high sustainable tea farmers had crossed the 0.60 axis value in the economic dimension. Moreover, high sustainable tea farmers have fluctuated in the environmental score not lower than the axis value of 0.20. Furthermore, all high sustainable tea farmers, excluding one farmer, were having index value above the axis value of 0.40.

The low sustainable tea farmers were highly concentrated to the axis value of 0.1, and only a few farmers were having a value greater than 0.20. These farmers could not cross the axis value of 0.70 by their social and environmental sustainability, differently from the high sustainable tea farmers. Their social and environmental sustainability remained lower than 0.70 axis value. Only two low sustainable tea farmers experienced environmental sustainability of 0.60 points. Additionally, few of them crossed the axis value 0.60 by their social sustainability.

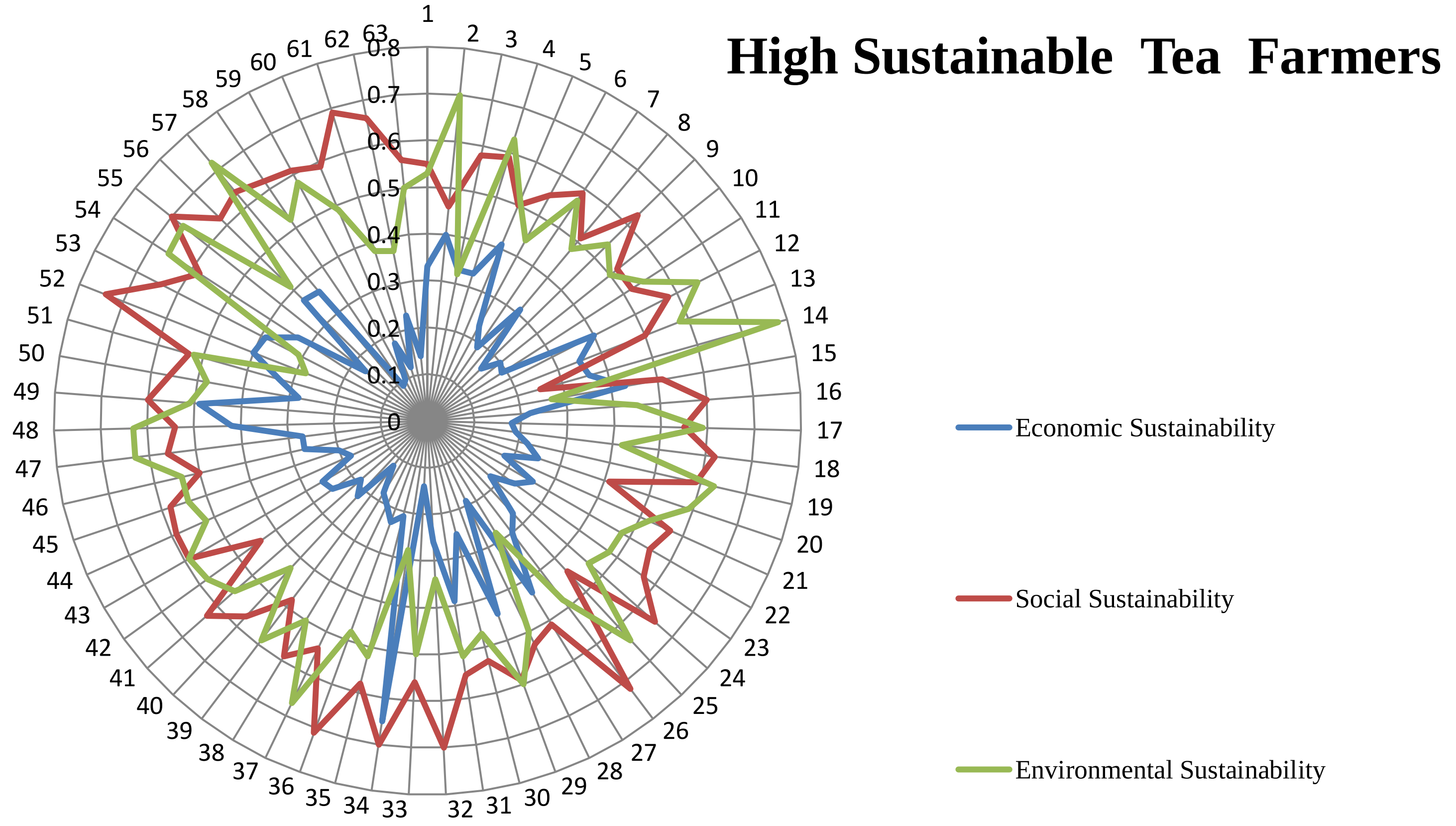

Figure 4.5. High sustainable tea farmers' CTFSI

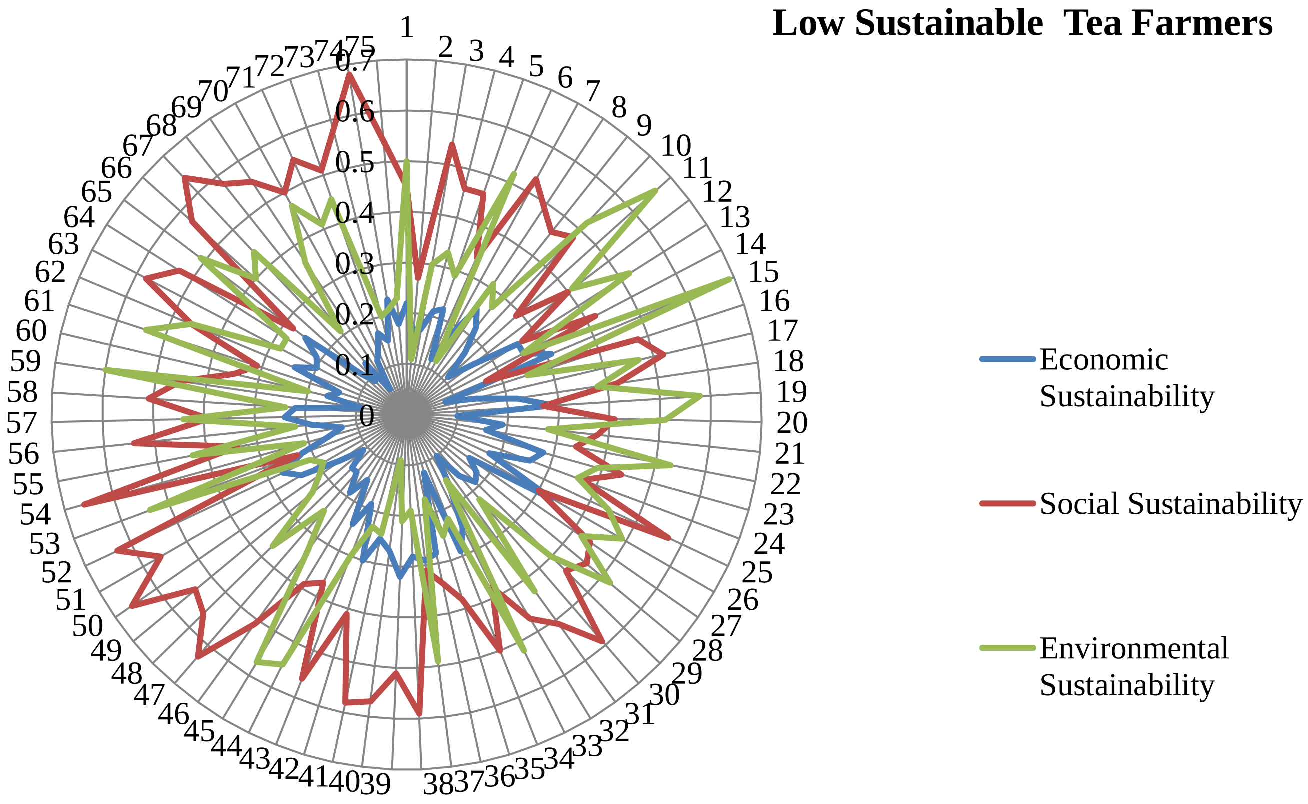

Figure 4.6. Low sustainable tea farmers' CTFSI

4.10 Demographic Characteristics of Low and High Sustainable Tea Farmers

Table *4.21* explains some demographic characteristics of high and low sustainable tea farmers. The high and low sustainable tea farmers were significantly different in their age. The high sustainable tea farmers were younger than the low sustainable tea farmers. The average age of high sustainable tea farmers was 44.51 years and of low sustainable tea farmers' was 54.21 years. Similarly, the significant difference was found in the farming experiences of low and high sustainable tea farmers. The experience of the high sustainable tea farmers (27.51 years) was low than the low sustainable tea farmers (35.93 years). There were no any significant differences between the low and high sustainable tea farmers in terms of their family size, yearly income, and the number of family members having an off-farm occupations as well as the number of university-graduated family members.

Table 4.21. Demographic characteristics of low and high sustainable tea frams

	Tea farms				
	Low sustainable		High sustainable		p-
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Value
Age[1]	54.21	11.47	44.51	10.61	0.00*
Faming experience[1]	35.93	11.43	27.51	12.59	0.00*
Family size[1]	4.59	1.60	4.73	1.95	0.64
University graduated family member[2]	1.00	1.09	1.11	1.05	0.55
Family members having other occupation[2]	1.21	1.41	1.33	1.15	0.59
Family income[3]	29932.00	27385.33	34277.78	20954.94	0.30

Variable units; 1 = Years, 2 = Numbers, and 3 = TL per Year
,**, shows significant difference at 1%, 5%, and 10%**

4.10.1 Education level of low and sustainable tea farmers

The education levels of the high and low sustainable tea farmers was compared on Table *4.22*, and insignificant differences were found between the farmers in terms of their education levels. The high sustainable tea farmers' general education levels seem higher than the low sustainable tea farmers. The few high sustainable tea farmers had their masters or doctorate degrees, and no one in the low sustainable tea farmers was a high degree holder.

Table 4.22. Education level of low and high sustainable tea framers (Percent)

Education levels	Tea Farms		p-value
	Low sustainable	High sustainable	
Primary school graduate	46.67	38.10	
Secondary school graduate	18.67	19.05	
High school	21.33	17.46	0.34
University graduated	13.33	22.22	
Master/doctorate	0.00	3.17	

4.10.2 Income level and social factors of low and high sustainable tea farmers

Table *4.23* describes the income level and some social factors regarding tea farmers. The farmers signified themselves as low, medium and high-income groups. The significant differences existed between the high and low sustainable tea farmers in terms of their self-classification of their income. Most of the high sustainable tea farmers (66.67%) consider themselves as they belong to medium income groups. The 37.33% low sustainable tea farmers belonged to low-income groups while 20.63% high sustainable tea farmers were considered themselves as low-income farmers. The 12.70% of high sustainable tea farmers supposed themselves as they belong to high-income group, and only less than 10% of low sustainable tea farmers characterized themselves as high-income farmers. Tea farmers were insignificantly different in terms of having social security or cooperative memberships, and participating in the village administration.

Table 4.23. Income level and social factors of low and high sustainable tea farmers

Variables	Tea farms		p-value
	Low sustainable	High sustainable	
Farmers' income group			
Low income group	37.33	20.63	
Medium income group	53.33	66.67	0.09***
High income group	9.34	12.70	
Cooperative membership			
Yes	61.33	66.67	0.59
No	38.67	33.33	
Participation of farmer in village administration			
Yes	25.33	31.75	0.45
No	74.67	68.25	
Social security			
Not any	6.67	0.00	
Bağ kur	12.00	14.29	0.60
SSK	69.33	80.95	
Other	12.00	4.76	

*,**,*** shows significant difference at 1%, 5%, and 10%

4.10.3 Farm structure and management practices of low and high sustainable tea farmers

Table *4.24* shows the farm structures, and some other management and output related variables. The high and low sustainable tea farmers were insignificant in terms of owning a tea land and the numbers of parcels. The significant differences were found between high and low sustainable tea farmers in terms of parcel age, slop of the land, and tea planted fields.

The low sustainable tea farmers had 0.75 hectares, while high sustainable tea farmers had 0.96 hectares of tea lands. The high sustainable farmers had younger tea orchards as compare to low sustainable tea farmers. They had 27.75 years old tea orchards while the low sustainable tea farmers had 47.47 years old tea orchards. Similarly, the slop of the farms cultivated by the high sustainable tea farmers was not greater, 32.17%, while the slop of low sustainable tea farmers' was more than 45%. Moreover, the high sustainable tea farmers were technically more efficient than low sustainable tea farmers.The technical efficiency score of high sustainable tea farmers was 0.60, and of low sustainable tea farmers' was 0.47. This implies that the low sustainable tea farmers wasting their farm inputs by more than 50%. Furthermore, the high sustainable tea farmers had a significantly high yield of tea than low sustainable tea farmers.

The average yield of high sustainable tea farmers was 16.15 tons per hectare, while low sustainable tea farmers' average tea yield was 14.32 tons per hectare. Farmers were not significantly different in labor productivity and the amount of chemical fertilizer used. The high sustainable tea farmers were applying significantly lower amounts of chemical fertilizers than the low sustainable tea farmers.

Table 4.24. Farm structure of low and high sustainable tea farmers

Farm Characteristics	Tea farms				
	Low sustainable		High sustainable		
	Mean	Std. Dev.	Mean	Std. Dev.	p-value
Total land under tea[1]	0.75	0.59	0.96	0.79	0.07***
Number of parcels[2]	4.95	3.35	5.24	3.32	0.61
Age of parcels[3]	47.47	12.78	27.75	5.62	0.00*
Pruning time period[4]	9.84	0.83	10.00	1.15	0.44
Slop of orchards[5]	47.36	16.71	32.17	12.35	0.00*
Altitude[6]	303.83	294.11	363.68	281.71	0.22
Distance from reception point (m)	1011.40	860.98	1226.19	958.70	0.17
Chemical quantity[7]	1.20	0.58	0.98	0.61	0.03**
Technical efficiency	0.47	0.17	0.60	0.22	0.00*
Labor productivity[8]	251.89	55.54	261.43	74.38	0.39
Yield of tea[9]	14.32	4.22	16.15	4.58	0.02**

1=Hectare, 2=Number, 3 & 4=Years, 4, 5=Percentage, 6=Meter, 8=Kg per day per person, 7 & 9= Tons per Hectare
*,**,*** shows significant difference at 1%, 5%, and 10%

4.10.4 Low and high sustainable tea farmers management practices

In terms of tea management practices, the existence of soil erosion at the farms of high sustainable tea farmers was significantly lower than the farms of low sustainable tea farmers, as explained in Table *4.25*. Almost more than 73% of high sustainable tea farmers had reported no soil erosion at their farms while 56% of low sustainable tea farmers concluded that they had soil erosion problems at their farms. Another management practice which significantly differentiated the high and low sustainable tea farmers was the application of fertilizer methods in newly cut tea orchards. Most of the high sustainable tea farmers were applying fertilizers by mixing with soil (42.20%) and at the root zone (4.70%). Moreover, 28.40% low sustainable tea farmers were applying fertilizers by mixing with soil, and 1.40% of them were applying at root zones of the tea plants. Both low and high sustainable farmers were not significantly different in terms of the terrace practices, soil test performances, and fertilizer application methods in uncut tea orchards.

Table 4.25. Low and high sustainable tea farmers management practices

Variables	Tea farms		p-value
	Low sustainable	High sustainable	
Erosion or land slide risk			
Yes	44.00	27.00	0.04*
No	56.00	73.00	
Terrace status			
Yes	63.50	64.11	0.60
No	25.70	29.69	
Not necessary	10.80	6.30	
Soil test performance			
Yes	14.90	21.90	0.27
No	85.10	78.10	
Method of fertilizer application in newly cut tea orchard			
Scattering	70.20	53.10	0.09***
At root zone	28.40	42.20	
Mixing with soil	1.40	4.70	
Method of application in uncut orchards			
Scattering	70.30	59.40	0.18
At root zone	29.70	40.60	

,**, shows significant difference at 1%, 5%, and 10%**

4.10.5 Information sources for fertilizer of low and high sustainable tea framers

Low and high sustainable tea farmers were not significantly different in information source of fertilizers, and methods of determining the fertilizer time. The farmers were significantly different in terms of the methods of determining soil's needs of fertilizers. Most of the high sustainable tea farmers (47.62%) were taking information from their elder family members. About 42% of them were not consulting anyone. Only 26.68% low sustainable farmers were consulting with their elder family members, and 6.35% - 2.67% of them were determining if the soil in need of fertilizers, by testing soil and contacting with the staff of agricultural organizations, respectively. Similarly, 6.67% and 3.17% of high sustainable tea farmers were performing a soil test and contacting with the staff of an agricultural organization, respectively for determining the soil in need of fertilizer.

Table 4.26. Low and high sustainable tea framers' information sources for fertilizers

Information sources	Tea farms: Low sustainable	Tea farms: High sustainable	p-value
Source of information for fertilizer			
Cooperative	28.40	32.80	0.26
Family member	13.50	21.90	
Others	58.10	45.30	
Method of determining fertilization time			
According personal experience	93.33	90.48	0.57
From agriculture chamber	1.33	1.59	
Others	5.34	7.93	
Method of determining soil need of fertilizer			
By testing soil	6.35	6.67	
From neighbor farmer	6.67	0.00	
Elder family member	26.68	47.62	0.03 **
Staff of agricultural organization	2.67	3.17	
Others	57.33	42.54	

,**, shows significant difference at 1%, 5%, and 10%**

4.10.6 Method of handling the herbs of low and high sustainable tea farmers

Both low and high sustainable tea farmers were the same in terms of handling herbs in their tea orchards. Generally, 80.95% high and 76% low sustainable tea farmers were pulling the herbs by hand before harvesting the tea. Not any of the high sustainable farmers were pulling herbs during harvesting, but 2.67% of the low sustainable tea farmers

Table 4.27. Low and high sustainable tea framers' methods of handling the herbs

Handling herbs in tea orchards	Tea farms: Low sustainable	Tea farms: High sustainable	p-value
Pulling off with hand before harvesting tea	76.00	80.95	0.59
Pulling off during tea harvesting	2.67	0.00	
Others	21.33	19.05	

4.10.7 Application of 2.5 leaves rule in tea collection by low and high sustainable tea framers

The low and high sustainable tea farmers' responses regarding their application level of 2.5 rules in tea leaves collection were given in Table *4.28*. The results described an insignificant difference in application response of both low and high sustainable tea farmers. However, the 19.05% high sustainable tea farmers were taking it into account , 44.44% of them were occasionally considering it , and only 36.51% were not taking care of this 2.5 rule in tea leaves collection. Similarly, 21.33% of low sustainable tea farmers were conscious about the rule, 36% of them were occasionally following it , and 42.67% were not keeping it.

Table 4.28. Application of 2.5 leaves rule in tea collection by low and high sustainable tea farmers

Application of rule	Tea farms: Low sustainable	Tea farms: High sustainable	p-value
Yes	21.33	19.05	
Occasionally	36.00	44.44	0.59
No	42.67	36.51	

4.10.8 Quantity of leaves in harvested tea by low and high sustainable tea farmers

The low and high sustainable tea farmers’ judgments of the quantity of 2.5 leaves as well as leaves shorter and taller than 2.5, were asked. They responded differently in terms of the quantity of 2.5 leaves. Table *4.29* describes the farmers' responses that the high sustainable tea farmers estimated their collected tea contained more than 50 % of 2.5 leaves, while low sustainable tea farmers concluded it was only 41.8%. Moreover, according to the farmers’ responses, the high sustainable tea farmers harvested lower quantities of taller tea leaves as compared to the low sustainable tea farmersBoth types of farmers were not significantly different in their responses regarding the quantity of shorter leaves in harvested tea.

Table 4.29. Quantity of leaves in harvested tea by low and high sustainable tea farmers

	Tea farms				
	Low sustainable		High sustainable		
Leaves types’ quantity	Mean	Std. Dev.	Mean	Std. Dev.	p-value
Quantity of 2.5 leaves	42.02	30.32	52.42	32.56	0.05**
Quantity of shorter leaves than 2.5	14.66	20.79	13.76	21.37	0.80
Quantity of taller leaves than 2.5	43.17	33.80	33.81	27.95	0.08***

,**, shows significant difference at 1%, 5%, and 10%**

4.10.9 Types of mass communication between low and high sustainable tea framers

Table *4.30* describes the low and high sustainable tea farmers in term of using social media. The most commonly used mass communication sources were asked based on the farmers' use of those sources frequently.The significant difference was found between the low and high sustainable tea farmers in using the internet. Most of the high sustainable tea farmers were using the internet more frequently than low sustainable tea farmers. Only 17.46% of high and 36% of low sustainable tea farmers have never used the internet.

Table 4.30. Types of mass communication by low and high sustainable farmers

Mass communication	Tea farms: Low sustainable	Tea farms: High sustainable	p-value
Newspaper reading frequency			
Daily	28.00	34.92	
Several time a week	29.34	26.98	
Once a week	9.33	11.11	0.81
Several time in a month	4.00	6.35	
Once a month	9.33	7.94	
Never read	20.00	12.70	
Frequency of listening radio			
A few hours a day	17.33	22.22	
About an hour a day	9.34	15.87	0.26
Several hours in a month	13.33	14.29	
Never listen	60.00	47.62	
Television watching frequency			
A few hours a day	81.33	68.25	
About an hour a day	10.67	15.87	0.23
Several hours in a month	8.00	15.88	
Never watched	0.00	0.00	
Frequency of using the internet.			
A few hours a day	42.67	65.08	
About an hour a day	6.67	7.94	0.04**
Several hours in a month	14.66	9.52	
Never used	36.00	17.46	

,**, shows significant difference at 1%, 5%, and 10%**

4.10.10 Low and high sustainable tea farmers' participation in agricultural events and discussion and meeting with others

Table *4.31* presents the low and high sustainable tea farmers' participation in agricultural events and their discussion with other tea growers. The high sustainable tea farmers frequently met with the agricultural technicians and engineers as compared to the low sustainable tea growers. Only 34.92% of the high sustainable tea farmers concluded meeting an agriculturist less frequently, while the number was 68% for the low sustainable farmers. Similarly, the high sustainable tea farmers also considered the opinion or views of other tea growers regarding tea farming. 36.51% of the high sustainable tea farmers were using other tea growers' views in tea farming, while only 16% of the low sustainable tea farmers were using this source . Moreover, those never used the other farmers' opinions were 37.33% of the low, and 26.98% of the high sustainable tea farmers. Furthermore, the high sustainable tea farmers were also participating in symposiums, conferences, and corner meetings about tea farming, held in study area. Almost 73% of the low sustainable tea farmers had never participated in such events. Almost more than 40% of the high sustainable tea farmers participated in tea farming related events, many times or at least several times, during the last fiscal year.

Table 4.31. Low and high sustainable tea farmers' participation in agricultural events and discussion and meeting with others

Variables	Tea farms: Low sustainable	Tea farms: High sustainable	p-value
Frequency of meetings with the agricultural technician and engineer			
Daily	4.00	6.35	0.01*
Several time a week	2.67	11.11	
Once a week	12.00	20.63	
Several time in a month	5.33	9.52	
Once a month	8.00	17.46	
Less frequent	68.00	34.92	
The use of others' views on agricultural issues.			
Every time	16.00	36.51	0.02**
Sometime	46.67	36.51	
Never	37.33	26.98	
Participation in meetings, symposiums, conferences, etc. Related to agricultural issues			
Many time	4.00	19.05	0.02**
Several time	22.67	22.22	
Never	73.33	58.73	

,**, shows significant difference at 1%, 5%, and 10%**

4.11 Frequency of Owners and Shareholers with Low and High Sustainability Level

Table *4.32*. Frequency of owners and shareholders with low and high sustainability levelTable *4.32* explains the frequency distribution, and calculated percentages of owners and shareholders participation in agricultural events, by considering the low and high sustainable tea farms. The results depict that the 54 (49.60%) of the farm owners were tiltled as the low sustainable tea farms, and 57 with 51.40% were as the high sustainable tea farms. Moreover, 20 of the shareholders were identified as the low sustainable tea farms, and 7 of them as the high sustainable tea frams.

Table 4.32. Frequency of owners and shareholders with low and high sustainability level

Framer's categories	Owner		Shareholder	
	Frequency	Percentage	Frequency	Percentage
Low	54.00	49.60	20.00	74.10
High	57.00	51.40	7.00	25.90
Total	111.00	100.00	27.00	100.00

4.11.1 CTFSI of low and high owner tea frams

describes CTFSI of the low and high sustainable owners' tea farms. The results denoted that the low sustainable tea orchard owners experienced low economic and environmental sustainability than that of the high sustainable tea orchard owners. Overall, the high sustainability owners' tea farms were highly satisfactory at their higher sustainability levels as compared to the low sustainability owners' tea farms. The low economic sustainability of the low sustainable tea farms was the reason for the overall low tea farms sustainability.

Table 4.33 describes CTFSI of the low and high sustainable owners' tea farms. The results denoted that the low sustainable tea orchard owners experienced low economic and environmental sustainability than that of the high sustainable tea orchard owners. Overall, the high sustainability owners' tea farms were highly satisfactory at their higher sustainability levels as compared to the low sustainability owners' tea farms. The low economic sustainability of the low sustainable tea farms was the reason for the overall low tea farms sustainability.

Table 4.33. CTFSI of low and high sustainbale owner tea frams

Sustainability Dimensions	Low sustainable		High sustainable		p-value
	Mean	SD	Mean	SD	
Economic	0.22	0.07	0.33	0.10	0.00
Social	0.48	0.11	0.55	0.11	0.00
Environment	0.36	0.14	0.54	0.12	0.00
CTFSI	0.36	0.04	0.48	0.05	0.00

4.11.2 CTFSI of low and high shareholder tea frams

explains the CTFSI of low and high sustainable shareholder tea farms. The results denoted that the low sustainable shareholder tea growers also experienced lower economic and environmental sustainability than that of the high sustainable shareholder tea farms. The overall tea farms sustainability levels of shareholder farms in the high sustainability group were also highly statisfactory as compared to shareholder tea frams those were in the low sustainability group. The low economic sustainability of low and high sustainable shareholder tea frams was the reason of the overall low tea frams sustainability.

Table 4.34 explains the CTFSI of low and high sustainable shareholder tea farms. The results denoted that the low sustainable shareholder tea growers also experienced lower economic and environmental sustainability than that of the high sustainable shareholder tea farms. The overall tea farms sustainability levels of shareholder farms in the high sustainability group were also highly statisfactory as compared to shareholder tea frams those were in the low sustainability group. The low economic sustainability of low and high sustainable shareholder tea frams was the reason of the overall low tea frams sustainability.

Table 4.34. CTFSI of low and high sustainability shareholder tea farms

Sustainability Dimensions	Low sustainable		High sustainable		p-value
	Mean	SD	Mean	SD	
Economic	0.25	0.07	0.36	0.09	0.00
Social	0.46	0.09	0.57	0.07	0.01
Environment	0.29	0.12	0.47	0.08	0.00
CTFSI	0.33	0.05	0.47	0.04	0.00

Note: Although the interaction effect of owner and shareholders with low and high sustainability category was not significant, the economic sustainability of low and high shareholder tea frams was high as compare to the economic sustainability of low and high owner tea farms.

4.12 Assessment of Factors or Variables Affecting the Tea Farms' Sustainability

Table 4.35 shows the factors responsible for tea farms sustainability. The results of Tobit model includes independent variables such as farm characteristics, and socio economic characteristics of the farmer. The model was overall significant at $p<0.000$. The explanatory variables describe the tea farms sustainability by 42%.

The farm sustainability and age of farm manager has negative association. This relationship can be explained by the fact that the younger farmers, as compared to older ones, are less likely to abandon the agriculture in the long term (greater social sustainability), and more sensitive to the ecological problems associated with farming which leads them toward adoption of more ecologically friendly technologies, as well as their more participation in agro-environmental programs (greater environmental sustainability), as described by Gould et al (1989); Vanslembrouck et al (2002) and Muñiz and Hurlé (2006). Moreover, increasing age also affects agriculture negatively, and output is tended to decline as the age of the farmer increases. Guo et al (2015) reported that additional input and experience of the older farmers are not enough for compensating the adverse impacts of aging on agriculture as elder farmers look to resist in the adoption of new agricultural technologies, and also more likely to abandon the farming.

As farmers' education level increases, the tea farming sustainability also increases. These results are in line with those reported by Gunduz et al (2011). As formal school education of farmers increase, the farm sustainability also tends to increase because the higher education also has a significant positive impact on efficiency (Mburu et al, 2014; Xu et al, 2015); and educated farmers are better to observe, interpret and adopt the new information and technologies (Abdulai and Eberlin, 2001). Saltiel et al (1994) also described a positive but insignificant effect of education on the adoption of sustainable agricultural practices.

Family labor also has a positive and significant impact on sustainability. Having more family members employed at the farm contributes positively to social sustainability. Moreover, family labor looks more efficient-user of the inputs as well as more productive than the hired labor, and it also leads to higher economic sustainability. The main argument in favor of family labor is the positive effect of sustainability that is the timelines of operation as well as the quality control of the resources. Family labor enables the farm operator to put family labor in action at the farm during the peak seasons when hired labor becomes comparatively scarce (Dhungana et al, 2004; Rahman and Rahman, 2009). These positive impacts of family labor prove its contribution to the social as well as economic sustainability.

Farm sustainability increases as the tea planted areas increase in size. The area under the tea plants is also equal to the area of farm hold by a farmer. Therefore, the positive significant effect of the area under tea on sustainability can be explained by three aspects: a) the higher the farm area the better the yield, which in turn leads the farm to its existence of economies of scale (Alvarez and Arias, 2004; karagiannis and sarris, 2005), thus, economic sustainability becomes greater, b) the sufficient income generation leads toward the continuity of farming, which contributes to achieve greater social sustainability, c) higher generation of environmental benefits like large farm area make the farmer to better implement the new technologies, and it also allows the farmer lower their variable costs. Many earlier studies also reported same results that larger the farms are more efficient in supplying environmental benefits (Burton and walford, 2005 and Cahill and Hill, 2005).

The tea farms sustainability and the age of the tea parcel have significant negative relation. It describes that the older tea plants or orchard leads to low tea farm sustainability. This older tea orchards' negative effect can be described in terms of three sustainability dimensions. Old tea orchards cause low tea productivity, which declines the earnings from the tea (low economic sustainability). Moreover, low economic return may cause the migration of the farmers, in search of additional income sources (low social sustainability). At last,older tea orchards are applied greater amounts of chemical fertilizers that cause soil erosion as well as water pollution in such a rainy area (low environment sustainability). Dutta et al (2010) and Dutta (2011) also stated that as the age of the parcel increases its negative effects on tea productivity increases. That may reduce the income that affects economic sustainability.

The slope of the tea land also negatively affects the tea farms sustainability. As slope of a land increases, it makes the management difficult in tea orchards, which negatively affects the sustainability of the farm. The negative effect of a high slope can be explained as it is one of the main causes of soil erosion, soil degradation and landslide (Böttcher et al, 2009 Eliasson et al, 2010; Jarasiunas, 2016). Therefore, high slope causes soil degradation, landslides, and soil erosion: and eroded soil has a negative impact on productivity of crops,and a major environmental threat to agricultural sustainability (Pimentel et al, 1995). The lands with soil erosion negatively influence the environmental sustainability by contributing in greenhouse gasses (Van Oost et al, 2007), and also reducing the productivity of the land by loss of water, organic nutrients, matter, and depth of soil (Pimentel and Kounang, 1998).

The tea farm sustainability increases as use of chemical fertilizers decrease. Greater use of chemical fertilizers tends toward the low environmental sustainability by creating many ecological problems. More chemical fertilizer application is described as nonpoint contamination source of irrigation and underground water (Shamrukh et al, 2001), high N concentration on surface and emission of nitrate and ammonia from farmland (Zhu and Chen, 2002). Long term application of chemical fertilizer can worsen the soil and environment via accumulation of heavy metal, inorganic acid, etc. (low environmental sustainability), and also become a source of harmful components in products of agriculture (Li and Wu, 2008). The negative coefficient of fertilizer in the model reflects the fact that increase in the use of chemical fertilizers is a negative phenomenon, the harm is greater than the contribution in profitability obtained from the use of them (Gomez-Limon and Fernandez, 2010).

The sale value of the product (tea) has a significant positive impact on sustainability. Logically as sale value increases, the farm becomes more profitable, which is a positive contribution to economic sustainability, and also farmer becomes more stable in tea farming (greater social sustainability).

As the farmer hires the labor, it reduces the sustainability. This situation can be explained by the negative impact of hired labor on gross margin from tea crop due to the significant difference between the high variable cost, and low margin analyzed here. Sometimes labor is required to be hired, but it is also a possibility of not having any significant effect on farm efficiency or profitability. Labor hiring depends on the time availability of the operator and family members' availability to work at the farm. It was analyzed that the farmers can manage the operatio of a tea farm by themselves, and they should hire labor only when they need. Bojneca and Latruffe (2009) also explained that hiring labor has a very limited but not significant effect on efficiency .

The participation of farmers in agricultural meetings, symposiums, and training has a positive impact on the tea farm sustainability. It may be noted that the participation of the farmer increases his technical knowledge, which makes the operator able to run his farm better, and making them more profitable and eco-compatible (Kalirajan and

Shand, 1985; Phillips, 1994 and Muñiz and Hurlé, 2006). Cavatassi et al (2011) reported that participation in training programs enhanced the yield through the general shift in technology as well as increased the use of inputs.

Farmers' discussions with other tea growers and his consideration of their opinions, which seems good for tea farming has positive contribution to tea farm sustainability. Its positive effect is explained by high social sustainability because the farmers share their experience with each other. Moreover, time passing in discussion explains good social activity among farmers, which depicts greater social sustainability and application of opinions in tea farming ables the farmer to manage tea better than before.

Owning the land describes higher sustainability. This would be logical, if we bear in mind that owning the land makes the proprietor implement and adopt long term strategic management policies, instead of short term perspective that is commonly associated with leased land.In this current study similar results were found that if farmers operating the land as shareholders, it would reduce the tea farms sustainability, and owning the land and self-operating leads toward higher sustainability. That reinforces the intentions of the owners to keep their land for their heirs. Both of these aspects describe that the lands are managed with strict criteria by the owners of the lands. These results are in line with Drost et al (1998); Soule et al (2000) and Fraser (2004). It should be notable that tenure has not been found to be significant in use and maintenance of the agricultural resources, even though many studies explained its importance in the opposite direction (Knowler and Bradshaw, 2007 and Prokopy et al, 2008). Clay et al (1998) and Neill and Lee (2001) described that owned farms are more likely to be maintained and managed better, and more tended toward the adoption of agricultural conservation practices. Therefore, the owner-operated farm tended toward high tea farms sustainability as compare to the shareholder-operated farms.

Table 4.35. Influencing factors on sustainability

Variables	Coefficient	Std. Error	t	p-value
Constant	0.4074	0.0328	12.42	0.00*
Age of Farmer	-0.0009	0.0004	-2.43	0.02**
Education	0.0025	0.0039	0.64	0.53
Family labor	0.0087	0.0043	2.03	0.04**
Land under Tea	0.0014	0.0006	2.18	0.03**
Age of parcels	-0.0016	0.0003	-4.79	0.00*
Slope	-0.0013	0.0003	-5.00	0.00*
Cost of Chemical fertilizer	-0.00004	0.0000	-2.34	0.02**
Tea Sale value	0.00002	0.0000	4.73	0.00*
Labor hiring	-0.0134	0.0091	-1.47	0.14
Participation In Agri. Training, Symposium etc.	0.0144	0.0091	1.58	0.12
Use of other opinion in tea farming	0.0355	0.0089	3.99	0.00*
Land tenure status	0.0622	0.0107	5.79	0.00*

(*) shows coefficient with p<0.01, (**) coefficient with p<0.05; N= 138; Log Likelihood 239.78; LR χ^2 (10) = 140.33; p> χ^2= 0.000; Pseudo R^2=-0.42

4.13 Exploring the Factors Influencing the Decision of Existing or Entering Tea Farming

Literature confirms the different land tenure systems all over the world. There are different forms of land tenure such as owner, renter, and shareholder. (Alam et al, 1995; Kurosaki, 2005; Habiba et al, 2012; Bashir et al, 2012; Ul-Haq et al, 2016 and Shahbaz et al, 2017). It was explained earlier that all forms of tenure may be different in their farming practices.Consequently, different objectives motivate landowners and

tenants that may have an impact on adoption of best management practices at the farm (Cox, 2010). Land tenure and adoption of best management practices were deeply explained; land tenure farming in favor and in contradiction of adoption of best management practices were also explored globally. The cash renter and share renter are less likely to adopt best management practices as compared to owner-operators, and insecure land tenure is a real obstacle of long term soil conservation (Soule et al, 2000; Fraser, 2004 and AFT, 2013). Praneetvatakul et al (2001) also reported that insecure land tenure might reduce the incentives of improving land productivity. Although land tenure affects the soil conservation, and land productivity through low-level adoption of best management practices, but there was a lack of studies entails the factors those influence the decision of the landlord to give their land to other, and leaving tea farming as well as factors those also influence a person to become a shareholder.

4.13.1 Assessing the factors influencing the landlord to give their land to others

Table *4.36* depicts the relationship between predictors and the landlord's situation of giving their lands to others. The factors those used in the Logit model affecting significantly the decision of the landlord to give their land to others were age of the landlord, his education, having an off-farm occupation, and membership of any cooperative. The first variable age of the landlord describes that as the landlord's age increases, his probability to give his land to others also increases. Similarly, the highly educated landlords were more likely to give their lands to others as compared to the low educated landlords. Moreover, having an off-farm occupation increase the chance of a landlord to give his land to others. The farmers having off-farm occupations are more likely to give their lands to shareholder as compared to those have no off-farm occupations, by a factor of 10.01. The last variable is cooperative membership; it means the landlords having cooperative memberships are less likely to give their lands to others. The household who actively participates in the off-farm activities or occupation has a high probability to supply land in the rental market (Kung, 2002; Zhang et al, 2004).

Table 4.36. Factors influencing the probability of giving land to shareholder

Parameters	Estimate (βs)	Std. Error	t	P-value	Odd ratios	Marginal effects
Intercept	-4.76	1.24	-3.82	0.00*	0.0002	
Age (years)	0.04	0.01	2.60	0.01*	1.07	0.006
Education (years)	0.13	0.04	3.11	0.01*	1.27	0.022
Family size (no.)	-0.05	0.11	-0.45	0.65	0.90	-0.009
Having off-farm occupation	1.29	0.39	3.32	0.00*	10.01	0.214
Family member having other occupation (no.)	0.01	0.13	0.07	0.94	1.05	0.002
University graduated family members (no.)	0.15	0.15	0.99	0.32	1.27	0.026
Membership of cooperative	-0.73	0.35	-2.05	0.04**	0.28	-0.120

Independent variable (Y) = 1 for real owner of land otherwise 0; Log Likelihood = -41.193; AIC Value = 98.386; SC Value = 121.804; Likelihood Ratio = 54.045; χ^2 =54.05 Pseudo R^2 = 0.396; Correctly Classified = 85.51%

The marginal effects of the independent variables were also included in the above table. The one year rise in age, the probability of giving land to other increases by 0.006 (or 0.6%) while all other variable held constant. The one unit change in education, the chance of giving the land to other increases by 2.2%. The one unit change in family size resulted in the 0.9% decline in the probability of giving land to others. If the landlord has other occupation, then he is 21.4% more likely to give his land to others. One unit change in number of university graduates, and family members having other occupations increase the probability of giving land by 2.6% and 0.20%, respectively. If the landlord is a member of a cooperative, then he is less likely to give his land on share basis by 1.20%.

4.13.2 Assessing the factors influencing shareholder to act in this position

Table 4.37 explains the factors influencing the decision of a person to become a shareholder. Only two among eight total independent variables had a significant effect on the probability of a person to become a shareholder. First one is the age, which describes that the probability of a person to become a shareholder decreases as the age of a person increase. The second variable was education, which reduces the chance of a person to become a shareholder as he has high education. Deininger and Jin (2008) described that the head of a tea farm family at a young age is more likely to rent than the one at an older age; - having a higher education level as well as an off-farm occupation reduces the probability of renting the land. The marginal effects describes that one unit rise in age of farmer reduces the probability of becoming a shareholder by 0.61%. Similarly, more education reduces the chance of a person to become a shareholder by 1.87%.

Table 4.37. Factors influencing the likelihood of a farmer to act as shareholder

Parameters	Estimate (βs)	Std. Error	T	P-value	Odd ratios	Marginal effects
Intercept	1.61	0.91	1.77	0.08**	19.58	
Age (years)	-0.02	0.01	-1.88	0.06**	0.96	-0.006
Family size (no.)	-0.01	0.08	-0.10	0.92	1.00	-0.002
Education (schooling years)	-0.08	0.04	-1.90	0.06**	0.87	-0.018
University graduated family member (no.)	-0.15	0.15	-1.00	0.32	0.76	-0.036
Family member having other occupation (no.)	-0.08	0.11	-0.67	0.51	0.88	-0.018
Membership of cooperative	-0.18	0.27	-0.64	0.52	0.73	-0.043
Dummy for off-farm occupation	-0.01	0.27	-0.05	0.96	0.99	-0.003
Dummy for farmers' wish	-0.48	0.29	-1.67	0.10	0.44	-0.117

Independent variable (Y) = 1 for shareholder otherwise 0; Log Likelihood = -60.75; AIC Value = 139.50; SC Value = 165.84; Likelihood Ratio = 14.93; Pseudo R^2 = 0.11; Correctly Classified = 81.16%

4.14 Social Cost of Shareholding in Tea Farming

Table 4.38 describes the social cost associated with shareholding tea farming in the study area. The shareholders were getting 79 kg per hectare of tea yield as well as applying 73.61 kg per hectare of more chemical fertilizers as compare to owners. Their use of extra inputs and low yield exert the social cost equal to 879.32 TL per hectare. Although the cost is very low, the shareholders need need to consider the adverse effects of chemical use on society even they were harvesting low yield. If they reduce their inputs by 5%, they can minimize the social cost regarding their farming.

Moreover, the average area tenured by the shareholders in the locality was 1.18, which comprised 0.61% of the total average area of the sampled farms. Considering this proportion, the tea cultivated area in Turkey denotes that the total area tenured by the shareholders would be equal to 57413.50 hectares that amount to the total of 44.14 million TL in social cost for the country associated with shareholder tenure. Similarly, 61% of Rize's tea cultivated area was equal to 57413.50 hectares cultivated by shareholders . This describes the 30.55 million TL social cost of shareholder tenure in the Rize province. This 5% high use of inputs and 79 kg low output create expence of millions of Turkish Liras at the aggregate level.

Table 4.38. Social cost of shareholding in tea farming

Parameters	Values
TE_O	0.52
TE_S	0.47
$TE_O - TE_S$	0.05
I_{CH}	73.61 Kg/Hectare
I_L	5.25 Days/Hectare
$\{(TE_O - TE_S)*I_{(CF,L)}\}*IP_{(CF,I)} = A$	726.85 TL/Hectare
TY_O - TY_S	79 Kg/Hectare
$(TY_O - TY_S) * P_{TY} = B$	152.47 TL/Hectare
$SC_{shareholding} = A+B$	879.32 TL/Hectare
Tea area	1.95 hectares
Tea area $_{shareholder}$	1.18 hectares
Taea area$_{shareholde}$ / Tea area	0.61 = 1.18/1.95
Tea area (Turkey)	82950.50 Hectares
Tea area (Rize)	57413.50 Hectares
SC_{Turkey}	44.14 Million TL = (82950.50*0.61*879.32)
SC_{Rize}	30.55 Million TL = (57413.50*0.61*879.32)

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Turkey has a very diversified climate which enables the country to cultivate many annual and perennial field crops as well as orchards. The geographical distribution of the country also facilitates the site-specific cultivation of crops in different regions. Eastern Black Sea Region is very famous for its climatic and geographical conditions which empower the residents to cultivate the perennial crops, such as tea. With the pace of increasing population, the demand for tea cultivation is also increasing with the limited tea cultivated areas. . This growing demand for tea with area limitation pressure, the farmers use extensive human-made inputs such as chemical fertilizers like NPK fertilizer. The use of such types of fertilizers threats the sustainability of the tea farms.

Consequently, sustainable development is the need for maintaining the natural resources, and necessary for the survival of the species. It describes the ability of the present generation to fulfill their needs without compromising the needs of future generations. Similarly, tea needs a humid and heavy rainy environment with no stagnation of water, and also requires fertilizers. These tea requisites show that the present tea farmers should utilize the available limited natural resources, and use them for tea cultivation to fulfill their needs in ways that do not affect future generations' abilities to use these resources also for tea cultivation. In this context, sustainable tea farms can be defined as growing economically viable, socially acceptable, and environmentally friendly tea plants.

The current study is planned to analyze the shareholder tea farming system and its effects on the sustainability of the tea farms. More specifically, this study explains the selection of indicators for measuring the tea farms sustainability composite index. The study also fulfills the research gap associated with the sustainability assessment of the tea farms as well as the selection of indicators and methodology to compute composite tea farms sustainability index. Furthermore, the shareholder and owner-operated tea farms were also compared based on their socio-economic characteristics and their sustainability level. The user friendly and widely acceptable indicators had been proposed together with comprehensive methodology for combining the selected indicators. To complete this study, Rize province of the Eastern Black Sea Region, which has been famous for tea cultivation, was selected.. Tea farming provides a source of income to thousands of families of the region those directly and indirectly involved in as farmers, extension agents, and staff of tea firms.

The final sample size for this study was selected by applying the stratified sampling approach. For this, the list of the tea farmers collected from the provincial agricultural department. Total 1647 registered tea farmers were the accessible population, and they were arranged with their tea cultivated land in ascending order. Three strata of these ascendingly ordered tea farmers were defined. With the stratified sampling formula, finally 138 tea farmers were the sample size of this study. The tea farmers were randomly selected and directly interviewed by the research team consisted of experienced Masters and Ph. D experienced .

To measure the sustainability of these selected tea farmers, the selection procedure was based on the site specific characteristics, climatic condition of the region, and the literature. First, literature was reviewed for determining the adoptable farm level indicators. Second, criteria were defined to select the indicators. Third, basic factors were defined based on the site-specific characteristics, and climate conditions of the region. The analysis of adoptable farm level indicators was conducted to analyze whether these were according to the selection criteria and defined basic factors or not. The indicator fulfilled the criteria, and also according to the basic factors was passed to the validation procedure. The 3S-methods of validation were applied. Moreover, new indicators were also chosen to complete the specific and certain numbers of indicators for measuring unbiased tea farms sustainability.

First, owner and shareholder-operated farms were compared in terms of their farm characteristics, their management practices, and personal characteristics. The owner farmers were older, highly educated, and also had greater farming experiences. The numbers of university-graduated as well as having off-farm occupation family members of owners were greater as compared to the family members of the shareholders. Most of the shareholders categorized themselves as they belonged to the low-income group as compared with owners. Most of the owners were considered themselves in the medium income category.

The land held by the shareholders under tea was 1.18 hectares which was significantly greater than the land held by the owners (0.76 hectares). Moreover, a person collected 281.48 kg per decare tea leaves at the farm of shareholders while the productivity of a person to collect the tea leaves at owners' farms was only 250.11 Kg per decare. The soil erosion problem was commonly existing at the farms of the shareholder and owners, but the terracing practices was significantly high at owner's farms. The shareholders were using the internet more frequently than the owners.

Although the shareholders had more tea cultivated area as well as labor productivity per day to collect tea leaves at the farm, the owners were managing resources very well. The owners were good in terrace practicing, which reduced the risk of soil erosion, landslide, and also make the management of tea easy. The owner and shareholder were insignificantly different in terms of other management, farm, and personal characteristics. However, most of the owners were testing their farm soil, and also using good fertilizer application methods than the shareholders. Moreover, the farmers were also not different in obeying the 2.5 rule of tea leaves, and they were occasionally following this rule during the collection of tea leaves. The variable cost, return and gross margin of the owner-operated farms was lower than the shareholders-operated farms. The owner-operated farms average variable cost was 5659.50 TL per hectare, and their gross margin was equal to 22911.40 TL per hectare. Similarly, shareholder-operated farms' average cost was 6198.70 TL per hectare, and their gross margin was equal to 25284.10 TL per hectare.

The landlords' decision of giving their lands to others were influenced by their ages, education levels, having anoff-farm occupation, and having a cooperative membership. The results of logistic regression described that the older, highly educated landlord as well as having off-farm occupation increase their chance to give their land to others. Moreover, the landlord having a membership of any cooperative could be less likely to give their land to others. On the other hand, to become shareholders, the tea farmers were affected significantly by their age and education levels. The older person could be less likely to become a shareholder as compared to the younger person. Similarly, the higher the education level of the tea farmer, the lower the probability of a person to become a shareholder was observed. The average economic social and environmental sustainability was 0.23, 0.52 - 0.43, respectively.

The tea farms' sustainability was calculated with a certain set of carefully selected numbers of the indicators under each dimension as for the economic, social and environmental sustainability. The overall Composite tea farms sustainability index (CTFSI) varies in the range of 0.18 to 0.58. The average CTFSI was 0.39, which describes the low tea farms sustainability based on the selected indicators. The average economic social and environmental sustainability was 0.23, 0.52, and 0.43, respectively. The low sustainability was due to the low economic sustainability, followed by environmental sustainability. The social sustainability was satisfactory than all other dimensions. The owner-operated farms were more sustainable than shareholders based on all sustainability dimensions. The cluster analysis results classified the tea farmers into low and high sustainable tea farmers based on their CTFSI. This analysis resulted in 75% of the tea farms as low and 63% as the high sustainable tea farmers

Considering the farm sizes of the farms, most of the owners were small farmers, but most of the shareholders were large farmers. The interaction effect between the land tenure styles (owner and shareholder), and farm size categories (small, medium and large frams) was insignificant. The sustainability comparison of the small, medium and large owner-operated tea farms denotes that the economic sustainability decreases by lowering the farm sizes. Similarly, a declining trend was found in overall tea farms sustainability. Remaining two dimensions, social and environmental, did not show this declining trend in comparison to the farm size. In terms of the social sustainability, at large, the small farmers were the same. The environmental sustainability was high at medium-sized owner farms.

There was no significant difference that was found among small, medium and large shareholder tea farms. However, economic sustainability decreased with the decline in farm size. The overall tea farms sustainability denoted same declining trend with a decrease in the farm size.

The comparison of the low and high sustainable tea farmers described that the high sustainable tea farmers were younger, and low experienced than the low sustainable tea farmers. Moreover, the high sustainable tea farmers were having young tea orchards as well as the low slope of their tea land. Additionally, they were technically efficient, and their tea yield was also high than low sustainable tea farmers. The soil erosion problem was also not severe at the farms of high sustainable tea farmers. Furthermore, they were applying the fertilizers by mixing with soil and applying at the root zone in newly cut tea orchards. Similarly, high sustainable tea farmers were collecting more 2.5 tea leaves followed by the leaves taller than 2.5 as compare to the low sustainable tea farmers.

The high sustainable tea farmers were also applying significantly lower amounts of chemical fertilizers as compared to the low sustainable tea farmers. Moreover, they were frequently participating in agricultural related events such as symposiums, training and conferences. Similarly, they were also frequently consulting tea farming issues with other tea farmers in their villages or town. Furthermore, high sustainable tea farmers were frequently meeting with an agriculturist.

The sustainability levels of the owners and shareholders were also compared by considering the low and high sustainability tea farmers. The 51.40% of sampled owner farmers were categorized as high sustainable owner tea farmers, and 49.60% were categorized as low sustainable owner tea farmers. On the other hand, 74.10% of sharholders were classified as the low sustainable shareholder tea farmers, but only 25.90% of them were ordered as the low sustainable shareholder tea farmers. The interaction effect between land tenure (owner or shareholder) and low and high sustainable tea farms was found insignificant. However, all sustainability dimensions economic, environmental, and social were significantly different between the low sustainable owners' and the high sustainable owners' tea farms . Similarly, the high sustaianable tea farmers have experienced a significant difference from the low sustainable shareholder tea farmers in economic, social and environmental sustainability dimensions.

The total of 12 independent variables were included in the Tobit model. These variables were the farmers' personal characteristics, management practices and farmers' decisions for tea farming. The size of the tea orchard, tea sale value, consulting with other farmers, using their opinions in tea farming, and owner-operated farms were having a significant positive effect on tea farms sustainability.

The age of the farmer, older tea orchards, land with high slope, high amounts of chemical fertilizer application were ffecting negatively and significantly tea sustainability. Farmer's education, family labor, and participation in agricultural trainings and symposiums were positively affecting sustainability of tea farming. The insignificant and negative effect was observed in labor hiring activities on tea sustainability.

The shareholders held 61% of the land in the region. Considering Turkey, the area held by the shareholders was 82950.50 hectares, and based on this, the social cost of shareholder tea farming system in the country was 44.14 million TL. On the other hand, the area held by shareholders was 57413.50 hectares, and the social cost of the shareholders' tea farming system in Rize province was 30.55 million TL.

5.2 Recommendations

5.2.1 For farmers

The suggestions for farmers, government and extension agents was were separately developed based on the study conclusions. First of all, sSuggestions for the farmers were written as the first part.

- It was suggested to increase the sustainability level that; The high use of chemical fertilizers led toward high production costs while there is a minimal positive effect on the tea yield which lowers the economic sustainability. In addition, it is has been causing significant environmental problems such as disappearing the extinction of snakes and rats from the tea orchards as well as degrading natural balances which causing low environmental sustainability. Avoiding excessive use of chemical fertilizers will probably make significant contributions to both economic and environmental sustainability.
- Farmers should not apply the chemical fertilizers more than recommended quantities y, and should also prefer the application at root zones or mixing with the soil that should lead to increase the economic (low production cost) as well as the environmental sustainability (low chance of health associated problems, and natural resources depletion problems).
- When the land slope is high, farmers should make more parcels, and should also practice terracing which leads toward better management and low soil erosion/landslide risk which make the environmental sustainability good.
- The soil need of fertilizer should be determined by soil test performance or with the consultation of agricultural technicians (increase the social sustainability by raising social influences).
- Farmers should avoid to hire hiring unnecessary additional hired labor while family labor is enough to harvest and to apply the fertilizer. Although hiring labor increaseincreases the social sustainability, it also decreasedecreases the economic sustainability as well. The first important thing is to control the production cost to increase the economic sustainability which may lead to sustainable tea cultivation.

- Farmers should replant the tea orchrds those reaching economic life of 50 years which to increase the yielding capacity and that directly affects the economic sustainability.

5.2.2 For the government

To increase the tea sustainability, government should focus to stabilize the lives of the residents by providing additional income sources. As Rize province is well suitable for tea cultivation, the possible income source may be animal husbandry. For that;

- Farmers need government assistance to start animal husbandry. for this, government lprovincial and local governmental agricultural offices should assist them with the provision of medium or long term loan options to start dairy farming.
- Furthermore, farmers should also be provided the technical assistance to make dairy farming successful in the region. These types of side-sources will lead toward long term sustainable agriculture in region.
- In this way, tea growers can also have the opportunity to reduce the use of chemical fertilizer by replacing it with farm yard manure available.
- The government also can promote the sustainable practices in tea farming by paying higher prices to adopters than non-adopters. This is possible by the Çaykur which is highly engaged with the tea farming in the region.
- The government should regularly conduct the tea farm related trainings workshops, and symposiums for farmers to increase their knowledge about the new technologies for tea cultivation.

5.2.3 For extension organizations

Since pluralistic extension system in common in Turkey, different organizations are engaged in extension services. Among these are public organizations such as Ministry of Agriculture and Forestry, and Ministry of Industry and Development. Ministry of Agriculture and Forestry is organized throughout the country as province provincial and districtive directorate offices employing hundreds of agricultural engineers, agronomists, veterinarians, horticulturists, soil scientists, agricultural economists, and etc. Duties and responsibilities of these personnel staff include the preparation and delivering extension programs to farmers and living in the rural areas. They analyze the present situation, identify the needs, and set the program objectives considering the resources owned by the organization. Ministry of Industry and Development, on the other hand, established regional development presidencies in different regions of Turkey. These organizations also identify the preliminary issues in every region and try to develop programs to develop to support the agricultural and industrial sectors.

The General Directory of Tea Operations (ÇAYKUR) is one of the related organizations of the Ministry of Agriculture and Forestry that and directly involved in tea farming, processing, marketing, and exports. If public extension activities regarding these issues are carried out by ÇAYKUR, they would be more effective since this organization is very functional in the region. The personnel staff employed by ÇAYKUR are familiar with agricultural problems and farmers' socioeconomic characteristics. But the problem here is to develop a long-term extension program by identifying the current situation and issues d related to tea farming and agriculture in general, on which the program objectives should be based. The roles, responsibilities, and competencies of extension personnel should be clarified, and in-service training programs should be developed to update and upgrade their skills considering the changing situations. Extension programs can provide specific information of reducing the use of chemical fertilizers, increasing the use of manure and organic fertilizers, timely harvesting the tea product, replanting the old tea orchards, seminars and workshops about fertilizer application methods, and measures for encouraging farmers to raise livestock.

Besides public organizations, private sector is also engaged in tea processing. They may also provide extension services considering their quality purposes involvement in the sector. For example, if they intend to market very high-quality tea, they have to provide top quality extension services, from production to marketing. This requires the employment of highly skillful extension personnelskilled staff and engineers.

Extension methods to be suggested dependsExtension methods suggestably depend on the objectives of the programs. For example, if the objective is to inform farmers about some issues in a short time of period, mass media methods such as radio, television, and printed materials can be useduseful. However, if the purpose is to convince farmers to adopt new technologies or to change their attitudes and behaviors, group and individual extension methods can be used more effectively. Among these results and method demonstrations, field days, and farm visits can be effective in the region.

- They need to contact conduct regular visits to tea farms, particularly when tea farmers are applying the fertilizer at their tea orchards. They should instruct the farmers to apply the fertilizer as low as possible with an efficient way.
- The extension agents should educate the farmers about the possible yield loss as well, as the high possible amounts of fertilizer requirements whichapplication lowers the economic and environmental sustainability.
- The extension agents should motivate the farmersthe farmers to participate the in any ongoing symposiums, conferences related to agricultural issues for enjoying all dimensional tea, especially related to tea farming sustainability.

In order to develop a sustainable tea sector in Turkey, future research should focus on a couple of issues more specifically. First of all, factors influencing the quality of Turkish tea should scientifically be determined. How quality of the tea is influenced in production, transportation, processing, packaging, storing, and distribution. The problems associated with the quality in every stage should be identified and solutions must be proposed accordingly. Another research priority dDirected by the finding of this study, the future research may focus on is consumers studies. Since tea consumers in Turkey, particularly in the southern regions are becoming addicted to foreign tea brands., the reasons of thisThe reason behind this situation should be scientifically be elaborated manipulated. This research Research may come up with adequate recommendations for producing high quality tea which to meets the desires tastes of the southern citizens. Finally, future research should focus on perceptions of sustainable tea farming among the peasants of the Eastern Black Sea Region of Turkey.

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Appendix

Studye Area Photographs


BABA OCAĞI
RİZE'DE
kararımız

Çay Üreticisi Anketi

Açıklamalar: *Ankette sizlere sorulan sorular sadece bilimsel amaçlarla kullanılacak ve hiç kimseyle paylaşılmayacaktır. Bu yüzden düşünce ve görüşlerinizi tam olarak açıklamanız, çalışmanın başarısını artıracak ve çay tarımında sürdürülebilir kaliteli üretim, işleme ve pazarlama olanaklarını geliştirmek için uygulanacak politika ve stratejilere katkı sağlayacaktır.*

İli:

İlçesi:

Köyü:

Çiftçinin Adı Soyadı:

İletişim Bilgileri:

A. ÇAY TARIMI İLE İLGİLİ SORULAR

1.Toplam kaç dekar çay araziniz vardır? (Belirtiniz) ------------------------------ dekar.

2. Çay araziniz kaç parselden oluşmaktadır? (Belirtiniz)-------------------------- parsel.

3. Çay parselleri için aşağıdaki bilgileri doldurunuz?

Parsel no:	1	2	3	4	5	6	7	8	9	10	Ort
Yaşı (İlk dikimden sonra)											
En son kesim ( ) yıl önce											
Kaç yılda bir kesim yapılıyor?											
Eğim-(slope) (%)											
Erozyon / heyelan riski var mı?											
Rakım (m)											
Alım yerine mesafe (km)											
Teras durumu*											
Hasat miktarı: Kg/işçi/gün											
Dekara verim: Kg/da											
Toprak testi yapılıyor mu?	i) Evet ii) Hayır										

* 1 = Var, 2 = Yok, 3 = Gerekli değil

4. Son yıllarda yeni tesis edilmiş çay bahçeniz var mıdır?

a) Evet ______dekar   b) Hayır

5. Cevabınız evet ise bu bahçe için kullandığınız tohumluğu nereden temin ettiniz?

a) İl/İlçe Gıda Tarım ve Hayvancılık Müdürlüğü

b) Kendi arazimden topladım

c) Kooperatiften

d) Ziraat Odasından

e) Tohum bayii, tüccar vs.

f) Diğer (Belirtiniz)_____

6.Yeni kesilmiş çaylarda kimyasal gübreleri uygulama metodunuz nasıldır?

a) Serpme b) Kök bölgesine bırakma c) Toprağa karıştırma

7. Kesilmemiş çaylara kimyasal gübre uygulama metodunuz nasıldır?

a) Serpme b) Kök bölgesine bırakma c) Diğer (Belirtiniz)_______

8. Yeni kesilmiş çaylarda ahır gübreleri uygulama metodunuz nasıldır?

a) Serpme b) Kök bölgesine bırakma c) Toprağa karıştırma

9. Kesilmemiş çaylara ahır gübresi uygulama metodunuz nasıldır?

a) Serpme b) Kök bölgesine bırakma c) Diğer (Belirtiniz)_______

10. Çay üretiminde kullandığınız gübre miktarı ne kadardır ve gübreyi nezaman kullanıyorsunuz? (Yağmurdan önce, sonra?)

Kimyasal gübre, __________kg/dekar; Ahır gübresi, ________kg/dekar

11. Çay üretiminde gübreler için bilgi kaynaklarınız belirtiniz.

a) Kooperatif b) Gübre bayii c) Aile bireyleri d) Komşu çiftçiler e) İl/İlçe Gıda Tarım ve Hayvancılık Müdürlüğü f) Ziraat Odası g) Diğer

12. Çayda gübreleme zamanını nasıl belirliyorsunuz?

a) Kendi deneyimlerime göre

b) Aile bireylerine sorarak

c) Komşu çiftçilere sorarak

d) İl/İlçe Gıda Tarım ve Hayvancılık Müdürlüğü elemanlarına sorarak

e) Ziraat Odasına sorarak

f) Gübre bayiine sorarak

f) Diğer (Belirtiniz)____________

13. Toprağın gübre ihtiyacını ve ne kadar gübre verileceğini nasıl belirliyorsunuz?

a) Toprak testi yaptırarak

b) Komşu çiftçilere sorarak

c) Aile büyüklerine sorarak

d) Tarım teşkilatındaki teknik elemanlara sorarak

e) Diğer (belirtiniz)

14. Çay bahçesindeki yabancı otlarla nasıl mücadele ediyorsunuz?

a) Çay hasadından önce ot ilaçları kullanarak

b) Çay hasadından önce elle kopararak

c) Çay hasadı sırasında elle kopararak

d) Diğer (Belirtiniz)_________

15. Yabancı ot ilacı kullanıyorsanız kullandığınız miktar ne kadardır?

________kg/dekar

16. Çayı toplarken (hasat ederken) 2.5 yaprak kuralını uyguluyor musunuz?

a) Evet b) Kısmen c) Hayır

17. Toplam sattığınız çayın,

%_____2.5 yaprak iken

%_____2.5 yapraktan daha küçük iken

%_____2.5 yapraktan daha büyük olduğunda satılmıştır.

18. Eğer çay toplama işlemini geç yaptıysanız (2.5 yaprağı geçmiş) bunun nedenleri nelerdir?

a) Zamanım olmadığından dolayı

b) Alım yerine araba geç geliyor

c) Çay toplayacak işçi bulamadığımdan

d) Satış kontenjanı bulunduğundan

e) Diğer (belirtiniz)_____________

19. Çay bahçesi topraklarından numune alarak toprak testi yaptırdınız mı?

a) Evet b) Hayır

20. Çay Tarımında Sürdürülebilirlik İndeksi

A. Ekonomik Faktörler

1. Tarımdan elde ettiğiniz gelirde yıllar itibariyle bir istikrar durumu? -----------------

a) Artış b) Durağan c) Azalış

2. Tarımsal faaliyet dışından elde ettiğiniz yıllık gelir ne kadardır? (Belirtiniz)_____

3. Tarım araziniz kendinize mi aittir? a) Evet b) Yarıcı c) Kiralık

İşletmeyi çocuklar arasında eşit olarak bölmeyi düşünüyor musunuz?	Evet	Hayır
İşletme arazisini fabrika, konut vb. amaçlarla kullanmayı düşünüyor musunuz?	Evet	Hayır
işletmeden yeterli gelir elde ediyor musunuz.	Evet	Hayır

B. Sosyal Faktörler

1.Tarım işletmenizde kaç yetişkin kadın çalışmaktadır? (Belirtiniz?_______

2. Yöre içinden (Karadeniz Bölgesi) gelerek işletmenizde çalışan kaç işçi vardır? (İşçi /gün olarak belirtiniz)___________-

3. Yöre dışından (Başka bölgelerden) gelerek işletmenizde çalışan geçici tarım işçisi sayısı kaçtır. (İşçi/gün olarak belirtiniz)___________

İşletmeye yakın yerde çocuklar için okul/eğitim olanakları bulunuyor mu?	Evet	Hayır
İşletmeye yakın yerde sağlık kuruluşları-bulunuyor mu?	Evet	Hayır
Köyde sağlıklı içme suyu bulunuyor mu?	Evet	Hayır
Köyden ilçeye ve ile kolay ulaşım olanakları bulunuyor mu? (Otobüs dolmuş vs)	Evet	Hayır
Yeni arazi satın alarak işletmeyi büyütme arzusu var mı?	Evet	Hayır
Yeni çay bahçesi kurarak işletmeyi büyütme arzusu var mı?	Evet	Hayır
Son yıllarda aile bireylerinden göç ederek başka ilçe veya şehre yerleşen var mıdır?	Evet	Hayır
Elde edilen gelirle ailenizin ihtiyacına uygun değişik gıdalar (bakliyat, et, bal, reçel, tavuk vb. satın alabilir misiniz?	Evet	Hayır
Elde edilen gelirle çocukların okul ihtiyaçları (giyim, kitap, defter vb) rahatlıkla karşılanabiliyor mu?	Evet	Hayır

C. Çevresel Faktörler

1.Bir dekarlık çay arazisinde kullandığınız gübre miktarı ne kadardır?

--------Kg/Da

2.Diğer ürünler için dekara kullandığınız kimyasal gübre miktarı ne kadardır?

--------Kg/Da

3.Bir dekarlık çay arazisinde kullandığınız tarımsal mücadele ilacı miktarı ne kadardır? --------Kg/Da

4.Diğer ürünler için dekara kullandığınız tarımsal mücadele ilacı miktarı ne kadardır? --------Kg/Da

5.Bir dekarlık çay arazisinde kullandığınız ahır gübresi miktarı ne kadardır? --------Kg/Da

6.Diğer ürünler için dekara kullandığınız ahır gübresi miktarı ne kadardır?

--------Kg/Da

Kimyasal gübre kulanırken sağlık ilgili problemler oluyor mu?

i) Evet ii) Hayır

7. İşletmenizde aşağıdaki uygulamalardan hangilerini sürdürüyorsunuz?

a) Bitkisel ve hayvansal üretimi aynı anda sürdürüyorum.
b) Sadece bitkisel üretim yapıyorum.
c) Sadece hayvansal üretim yapıyorum.
d) Diğer (Belirtiniz)___________________________________

8. Çay bahçenizi veya diğer tarım arazinizi konut fabrika vb amaçlarla satmak istiyor musunuz? i) Evet ii) Hayır

9. Mısır, fasulye, salatalık, domates vb. ürünleri yetiştirdiğiniz alanda münavebe yapıyor musunuz? i) Evet ii) Hayır

Çay üretimindeki masraflar

Tarımsal ilaç		Kimyasal gübre (Kg/da)		İşçilik			Çiftlik gübresi		Ürün miktarı (Kg/da)	Ürün fiyatı (Tl/Kg)
Kg	Tl/Kg	Kg	Tl/Kg	Sayı	Gün	Tl/gün	Miktar	Tl/Biri		

3. Yetiştirdiğiniz diğer ürünler için toplam masraflarınız ne kadardır?

Ürün adı	Toplam masraflar											Toplam gelir	
	Arazi hazırlığı	Tohum maliyeti		Tarımsal ilaç		Kimyasa l gübre		İşçilik			Hassat Maliyeti	Ürün miktarı	Ürün fiyatı
	Tl/da	Kg	Tl/Kg	Kg	Tl/Kg	Kg	Tl/Kg	Sayı	Gün	Tl/gün	Tl/da	Kg/da	Tl/Kg

10. Aşağıdaki soruları beşli Likert ölçeğine göre cevaplandırınız?

Ekonomik Faktörler					
Devletin ürün alım garantisi olmadan üretime devam durumu.	1	2	3	4	5
Gübre vb. girdi desteği olmadan üretime devam etme durum	1	2	3	4	5
Çayda alan bazlı destek olmadan üretime devam etme durumu.	1	2	3	4	5
Banka ve kooperatiflerden kredi almadan da üretime devam etme durumu.	1	2	3	4	5
İşletmeniz çocuklarınız ve torunlarınız için ne ölçüde yeterli gelir sağlayacak?	1	2	3	4	5
Çay bahçesi satın alıp işletmeyi büyütmekle ilgili görüşünüz.	1	2	3	4	5
Daha çok gelir elde ederseniz organik çay üretimine geçme durumu.	1	2	3	4	5
Sosyal Faktörler					
İşletmeye yöre içerisinden gelen geçici işçilerle kaynaşma durumu	1	2	3	4	5
İşletmeye yöre dışından gelen geçici işçilerle kaynaşma durumu	1	2	3	4	5
Çay alım yeri personeli ile kaynaşma durumu	1	2	3	4	5
Tarım İl/İlçe Müdürlüğü personeli ile kaynaşma durumu	1	2	3	4	5
Çay fabrikası personeli ile kaynaşma durumu	1	2	3	4	5
İşletmecinin Ziraat Odası personeli ile kaynaşma durumu	1	2	3	4	5
İşletme personelinin tarımsal girdi tedarikçileri ile iyi iletişim kurma durumu	1	2	3	4	5
İşletme bireylerinin köyde ve ilçedeki önder/lider çiftçilerle iletişim halinde olması durumu	1	2	3	4	5
Köyde çiftçilerin birbiriyle sosyalleşmesi ve hoş vakit geçirmesi durumu	1	2	3	4	5
Köyde çalışma saatlerinin düzenli olması durumu	1	2	3	4	5
Aile bireylerinin tarımda çalışma isteği durumu	1	2	3	4	5
İçinde barınılan evin sağlık koşulları durumu	1	2	3	4	5
Aile bireylerinin sosyal güvence durumu	1	2	3	4	5
Aile bireylerinin sağlık sigortası durumu	1	2	3	4	5
Aile bireylerinin sağlık durumu	1	2	3	4	5
Çocukların tarımsal faaliyetlerde çalışarak başarılı çiftçi olma isteği durumu	1	2	3	4	5

Aşağıdaki soruları beşli Likert ölçeğine göre cevaplandırınız?

Çevresel Faktörler					
Çay bitkisine musallat (infested/attack) olan hastalıklarla yeterince mücadele edebilme durumu	1	2	3	4	5
Diğer bitkilere musallat olan hastalıklarla yeterince mücadele edebilme durumu	1	2	3	4	5
Hayvan hastalıkları ile yeterince mücadele edebilme. Edebilmesinin durumu	1	2	3	4	5
Heyelan (landslide) veya erozyon riski olan alanlarda tek yıllık bitki ekimi için sürüm yapılmaması	1	2	3	4	5
Eğimli araziye çay dikerken sağlam teraslama yapılması.	1	2	3	4	5
Heyelan veya erozyon riski olan alanlarda ağaç dikimi veya çok yıllık bitki ekimi yapılması	1	2	3	4	5
Tarım arazisinden geçen yol, su, elektrik, telefon, doğal gaz vs tesislerin güzergahları doğru seçilmesi.	1	2	3	4	5
Mısır, fasulye, salatalık, domates vb. ürünleri yetiştirdiğiniz alanda ahır gübresi kullanılması.	1	2	3	4	5
Fındık alanlarında kış mevsimlerde koyun otlatılması	1	2	3	4	5
Çay bahçesinin içerisine meyve ağacı bulundurmak	1	2	3	4	5
Çay bahçesinin içerisinde yabancı otlar ve ağaçlar bulundurmak	1	2	3	4	5
Eğimli arazideki yol, su, doğal gaz, kanalizasyon vb. tesisatlardan sonra yağmur sularını kontrol altına alacak sağlam oluk ve hendek açılması.	1	2	3	4	5
Eğimli arazilerde yapılan yollardan sonra toprağın ve taşların yola ve tarım alanlarına akmaması için sağlam duvar yapılması ve açık alanların ağaçlandırılması	1	2	3	4	5
Bir tarım işletmesinde birden çok konut yapılması	1	2	3	4	5

1= Çok kötü, 2= Kötü, 3=Kararsızım, 4=İyi, 5= Çok iyi

Aşağıdaki soruları beşli Likert ölçeğine göre cevaplandırınız?

Politik Faktörler					
Çay üretiminin devlet tarafından desteklenmesi	1	2	3	4	5
Özel sektörün çay alımı, işleme ve pazarlamasının teşvik edilmesi	1	2	3	4	5
Bölgede kırsal yatırımlara destek verilmesi	1	2	3	4	5
Belediyelerin yol su elektrik vb. altyapı hizmetlerine önem vermesi	1	2	3	4	5
Yurda kaçak çay sokulmasının önlenmesi	1	2	3	4	5
Çay üretiminde kalitenin artırılması için Ar-ge çalışmalarına destek verilmesi	1	2	3	4	5
Yerli ürün tüketme konusunda farkındalık yaratma kampanyaları düzenleme	1	2	3	4	5
Çay tarımı ile ilgili çiftçilere yönelik eğitim ve yayım çalışmaları	1	2	3	4	5
Çiftçinin hasat ettiği çayın anında satın alınması	1	2	3	4	5
Çayın alım yerinde bekletilmeden derhal fabrikaya iletilmesi ağının kurulması	1	2	3	4	5
Yaş çay yapraklarının zaman geçirmeden işletilmesi	1	2	3	4	5
Ürün işleme ile ilgili teknolojinin ve hijyenin geliştirilmesi	1	2	3	4	5
Paketleme işleminin modern bir şekilde yapılması	1	2	3	4	5
Depolama işleminin uygun bir şekilde yapılması	1	2	3	4	5
Ürün paketleme standardizasyon, dağıtım vb işlemlerin zamanında yapılması	1	2	3	4	5
Kaçak çay tüketim nedenlerinin araştırılması	1	2	3	4	5
Her bölge tüketicilerinin damak zevkine uygun çay işlemesi yapılması	1	2	3	4	5

1= Çok kötü, 2= Kötü, 3=Kararsızım, 4=İyi, 5= Çok iyi

HAYVANCILIKLA İLGİLİ SORULAR

1.Kaç baş hayvanınız var?

Süt ineği_____________________ Besi sığırı_________________________

Koyun_______________________ Keçi___________________________

Diğer____

2.Sahip olduğunuz hayvanları hastalık veya diğer problemler için hangi sıklıkla kontrol ettiriyorsunuz?

a) Günlük b) Haftalık c)Aylık d)Yıllık e)Hiçbir zaman

3.Köyünüz veya mahalleniz civarında bulunan mera arazilerinin uygun şekilde otlatıldığı ve korunduğunu düşünüyor musunuz?

a) Evet b) Hayır

4.Otlak arazilerin korunması, ıslahı ve verimli kullanımı için aşağıdaki yöntemlerinden hangisini veya hangilerini kullanıyorsunuz?

a) Yakma yöntemiyle tüm zararlılardan kurtulup yeniden ekim metoduyla otlak arazi tesis etmek.
b) Kimyasal maddeler kullanarak zararlı otları yok etmek.
c) Mekanik metotlar kullanmak (yabancı ve zararlı otları kazma veya çeşitli makinelerle söküp kopararak)
d) Koyun ve keçi gibi hayvanları da belirli aralıklarla otlatmak.
e) Arazinin bir kısmını çevirip belirli bir dönem sonra otlatmak.
f) Erken ve aşırı otlatmaktan kaçınmak.
g) Diğer (Belirtiniz)___________________________

5.Hayvan hastalıkları ve hayvancılıkla ilgili diğer konularda nereden bilgi ediniyorsunuz?

a) Ziraat fakültesinin zootekni bölümündeki elemanlara sorarak
b) Komşu çiftçilere sorarak
c) Aile büyüklerine sorarak
d) Tarım teşkilatındaki teknik elemanlara sorarak
e) Diğer (belirtiniz)

6. Hayvancılıktaki masraf kalemleriniz nelerdir?

Yem Masraflar	Miktar/Sayı	Fiyatı
Kaba yem (Kg/yıl)		
Kesif yem (Kg/yıl)		
Veteriner hekim/ilaç		
Hayvan sigortası		
Suni tohumlama		
İşgücü (Saat/gün)		

7. Hayvanlardan elde edilen gelir

Gelir kaynağı	Sayı/Miktar	Fiyat
Büyükbaş hayvan satışı		
Küçükbaş hayvan satışı		
Süt satışı		
Yağ/peynir/yoğurt		
Tavuk/ördek/gaz		
Yumurta		

KİŞİSEL SORULAR

1.Bitirdiğiniz yaş (belirtiniz) ___________________

2. Ailedeki kişi sayısı (Belirtiniz)_________________________

3.Eğitim düzeyi (Uygun seçeneği işaretleyiniz)

a) Okuma yazma bilmiyor b) Okuma yazma biliyor c) İlk okul mezunu d) Orta okul mezunu e) Lise mezunu f) Üniversite mezunu g) Yüksek lisans/ doktora

4. Ailedeki bireylerden üniversitede okuyan veya mezun olan sayısı (Belirtiniz)________

5. Ailedeki bireylerden tarım dışı mesleklerde çalışan sayısı (Belirtiniz)_____________

6.Kooperatif üyeliği.

a) Evet (Hangi kooperatif)________________ b)Hayır___________________

7.Ailenin köy yönetimine katılımı. a) Evet b) Hayır

8.Arazi varlığı.

a) Kendi arazisi________dekar

b) Kiraya tuttuğu_______dekar

c) Ortağa tuttuğu_______dekar

d) Kiraya verdiği_______dekar

e) Ortağa verdiği_______dekar

9.İşletme arazisinin ne kadarı sulu arazidir?

a) Kendi arazisi________dekar

b) Kiraya tuttuğu_______dekar

c) Ortağa tuttuğu_______dekar

d) Kiraya verdiği_______dekar

e) Ortağa verdiği_______dekar

10.Traktör varlığı.

a) Evet b) Hayır

11.Sosyal güvenlik.

a) Yok b) Bağ kur c) SSK d) Diğer

12.Girdiler için kredi kullanılıyor mu?

a) Evet b) Hayır

13.Tarımsal yatırımlar için orta veya uzun vadeli kredi kullanım durumu.

a) Evet b) Hayır

14.Gelir düzeyiniz yaklaşık olarak ne kadardır?________Tl/Ay; Tl/yıl ___________

15.Köyünüz gelir düzeyi bakımından düşük, orta ve yüksek gelir grubu olarak üç gruba bölünse siz bunlardan hangisine ait olursunuz?

a) Düşük b) Orta c) Yüksek

16.Bu gelirin yüzde kaçı tarımsal faaliyetlerden sağlanıyor? %__________________

17.Kaç yıldır tarımla uğraşıyorsunuz? ___________________________________yıl.

18.Yıllık gelirinizin bitkisel ve hayvansal üretime yüzde olarak dağılımı nasıldır?

Bitkisel üretim %__________________ Hayvansal üretim %________________

19. Kendi çabanızla geleceğinizi belirli ölçüde değiştirebileceğinizi düşünür müsünüz?

a) Evet b) Kısmen c) Hayır

20. Tarımda aılenizden kaç kişi çalışıyor ve onlar kaç yaşındadır?

1)...... 2)....... 3)........ 4)......... 5)........ 6)......... 7)............

KİTLE İLETİŞİMİNDEN YARARLANMA

1.Gazete okuma sıklığı.

a) Her gün b) Haftada birkaç kez c) Haftada bir d) Ayda birkaç kez

e) Ayda bir f) Hiç okumaz

2.Radyo dinleme sıklığı.

a) Günde birkaç saat b) Günde yaklaşık bir saat c) Haftada birkaç saat

d) Haftada yaklaşık bir saat e) Ayda birkaç saat f) Ayda yaklaşık bir saat

g) Hiç dinlemez

3.Televizyon izleme sıklığı.

a) Günde birkaç saat b) Günde yaklaşık bir saat c) Haftada birkaç saat

e) Haftada yaklaşık bir saat e) Ayda birkaç saat f) Ayda yaklaşık bir saat

g) Hiç izlemez

4.İnternetten haberdar mısınız?

a) Evet b) Hayır

5.İnternet kullanma sıklığınız.

a) Günde birkaç saat b) Günde yaklaşık bir saat c) Haftada birkaç saat

d) Haftada yaklaşık bir saat e) Ayda birkaç saat f) Ayda yaklaşık bir saat

g) Hiç kullanmaz

YAKIN VE UZAK ÇEVREYLE OLAN İLİŞKİLER

1.İlçe merkezine gidiş sıklığı.

a) Her gün b) Haftada birkaç kez c) Haftada bir d) Ayda birkaç kez

e) Ayda bir f) Daha seyrek

2.İl merkezine gidiş sıklığı.

b) Her gün b) Haftada birkaç kez c) Haftada bir d) Ayda birkaç kez

e) Ayda bir f) Daha seyrek

3.Ziraat mühendisi, teknisyeni ile görüşme sıklığı.

c) Her gün b) Haftada birkaç kez c) Haftada bir d) Ayda birkaç kez

e) Ayda bir f) Daha seyrek

4.Tarımsal konularda başkalarının görüşüne baş vurma durumu.

a) Her zaman b) Bazen c) Asla

5.Tarımsal konularla ilgili toplantı, sempozyum, konferans vs. katıldınız mı?

a) Birçok kez b) Birkaç kez c) Hiç katılmadım

SADECE İŞLETMESİNİ YARICIYA VERECEK KİŞİLERE SORULACAK

1.Bitirdiğiniz yaş (belirtiniz) ___________________

2. Ailedeki kişi sayısı (Belirtiniz)_________________________

3. Herhangi bir işte çalışıyor musunuz?

a) Evet b) Hayır

4. Ailedeki bireylerden tarım dışı mesleklerde çalışan sayısı (Belirtiniz)___________

5. Ailedeki bireylerden üniversitede okuyan veya mezun olan sayısı (Belirtiniz)____

6.Eğitim düzeyi (Uygun seçeneği işaretleyiniz)

a) Okuma yazma bilmiyor b) Okuma yazma biliyor c) İlk okul mezunu d) Orta okul mezunu e) Lise mezunu f) Üniversite mezunu g) Yüksek lisans/ doktora

7.Kooperatif üyeliği.

b) Evet (Hangi kooperatif)____________________; Hayır________________

8.Ailenin köy yönetimine katılımı.

a) Evet b) Hayır

9. İşletmenizi neden yarıcıya verdiniz? (Açıklayınız)

10. Yarıcıdan memnun musunuz?

a) Evet b) Kısmen c) Hayır

11. Şimdiye kadar kaç yarıcı değiştirdiniz?

12. Yarıcı değiştirme nedenleri nelerdir?

a) Memnun kalmadım b) Kendisi ayrılmak istedi c) Diğer (Belirtiniz)

13. Çay tarımının sürdürülebilir bir şekilde devam etmesi ve ülke ekonomisine katkısının artırılması için alınması gereken üç önlem neler olabilir?

1...

2...

3...

CURRICULUM VITEA (CV)

Shamsheer ul Haq

Phone: +90-553-1517577
Address:
Permanent ; Chak No. 213 G. B. Tehseel Samundri District Faisalabad.
Postal ; City Mall Anarkali Bazar Samundri, Faisalabad, Pakistan
Email: shamsheer213@hotmail.com

The motivating, talented and professional person having the ability to inspire the learner and students to pursue academic and personal excellence through creating a challenging and engaging learning environment. Distinguished record of publication in academic journals all over the world. Commitment to helping university students develop their full potential in their studies.

A strong philosophy of teaching, and knowledge of many different methods to motivate students to develop their expertise in specific areas. Dedicated partner to university programs and outreach events that help promote learning and support the community.

EDUCATION

Govt. High School 476 G. B. Samundri Faisalabad
(Matric (Science) — 663/850 (1st division)

Govt. Degree College Samundri, Faisalabad
F. Sc. (Pre- Medical) — 770/1100 (1st division)

University of Agriculture, Faisalabad
B. Sc (Hons.) Agricultural and Resource Economics — 3.57/4.00 (1st division)

University of Agriculture, Faisalabad
M. Sc (Hons.) Agricultural Economics — 3.95/4.00 (1st division)

Ondokuz Mayis Univerisity Samsun Turkey
Ph.D. (Agricultural Economics) — 4.00/4.00

LANGUAGES

Punjabi (Native), **Urdu** (Native), **Turkish** (Limited working proficiency)
English (Professional Working Proficiency),

SKILLS

Computer Skills: Microsoft office; SPSS; Internet Browsing; MS Windows; **SAS; Eviews; Stata; Minitab; Win QS; DEAP; EMS; SFA-Program, SPSS**

Activities and Research Skills: Writing Research Proposal; Writing Research Articles; Data Analysis and evaluation; Efficiency Analysis; Agricultural Sustainability Assessment; Farm Managment; Field Research; Multivariate Statistical Analysis; Risk Analysis

EXPERIENCE

Technology Transfer institute (PARC) AARI, Faisalabad
Research Internee (*March 2010)*

The experience of the internship was helpful to conduct the basic field research. statistical analysis was studied and applied to the collected filed survey data. In the end, the research report entitled "**Impact of Sugar Mill Development Activities on the Sugarcane Productivity in District Faisalabad**" was prepared. a research article was also written from this report

EDO Agriculture (Extension) Samundri
Wheat production Maximization Campaigner (November, 2009)

The main objective of this campaign to conduct the farmer days along with the company of the agricultural officer and filed officers to train the wheat growers to increase the wheat production.

Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad

Research Associate (*September 2012 to August 2013)*

The one year experience as the research associate in the project entitled "Economic Analysis of Analysis of Challenges in Development of High-Value Agriculture: The Case of Livestock Diseases in Punjab" Funded by International Food Policy and Research Institute (IFPRI) which was written by me under the supervision of Master degree supervisor. the Master degree research thesis was also completed and different statistical methods and economic analysis of dairy sector were learned. In the end, the final working paper was written.

PUBLICATIONS

Developing a set of indicators to measure sustainability of tea cultivating T farms in Rize Province, Turkey
Ecological Indicators
Shamsheer ul Haq and Ismet Boz
Vol. 95; 219-238; 2018

Technical and water use efficiency estimation of adopters and non-adopters of pressurized irrigation systems among hazelnut farmers
African Journal of Agricultural Research
Ismet Boz, Shamsheer Ul Haq, Cagatay Yildirim, Hatice Turkten and Pomi Shahbaz
Vol. 13, Issue. 43; 2449-2459. 2018

Impact of Sugarcane Mills Development Activities on Cane Production in Punjab
Pakistan Journal of Agriculture Research
Arshed Bashir, Shamsheer-Ul-Haq, Mazher Abbas, M. Aamir Munir and Aneela Afzal
Vol. 25 Issue. 1, 21-27;2012

Effect of Livestock Diseases on Livestock Production and Income in District Faisalabad Punjab
International Food Policy Research Institute (IFPRI).
Muhammad Ashfaq, Ghulam Muhammad, Shamsheer ul Haq and Amar Razzaq
WORKING PAPER No. 023; November 2014

Factors Effecting the Economic Losses due to the Livestock Diseases: A Case Study of District Faisalabad
Pakistan Journal of Agriculture Sciences
Muhammad Ashfaq, Amar Razzaq, Sarfraz Hassan and Shamsheer ul Haq
Vol. 25, Issue, 5, 1482-1495; 2015

Economic Analysis of Dairy Animal Diseases in Punjab: A Case Study of Faisalabad District
The Journal of Animal and Plant Sciences
M. Ashfaq, A. Razzaq, Shamsheer-ul-Haq and G. Muhammad
Vol. 30, Special Issue, 176-183; 2016

Problems Encountered by Dairy Farms and Their Possible Solutions in Punjab Region of Pakistan
Journal of Agricultural Faculty of Uludag University
Shamsheer ul Haq, Ismet Boz and Pomi Shahbaz
Vol.6, Issue 12, 106-114; 2016

Effect of Different Crop Management System on Technical Efficiency in Sugarcane Production in Faisalabad, Punjab Region of Pakistan
Journal of Biology, Agriculture and Healthcare
Shamsheer ul Haq, Vedat Ceyhan, Ismet Boz and Pomi Shahbaz
Vol. 13, Issue, Apr/Jun, 218-236; 2017

Exploring the determinants of technical inefficiency in mango enterprise: a case of Muzaffargarh, Pakistan
Custos e @gronegócio on line

Shamsheer ul Haq, Pomi Shahbaz, Ismet Boz, Cağatay Yildirim and M. Rameez Murtaza

Nonparametric Efficiency Analysis of the Shareholding and The Owned Tea Farming System in Rize, Turkey
PONTE; International journal of science and Research
Shamsheer ul Haq and Ismet Boz
Vol. 73, Issue, 12, 23

Mixed Farming and its impact on Farm Income; A study in District Faisalabad, Punjab Pakistan
Vol. 3, Issue 8, 16-25; 2017

IJRDO- Journal of Agriculture and Research
Pomi Shahbaz, Ismet Boz, shamsheer ul Haq and Umer Bin Khalid

An Assessment of Determinants Responsible for Low Mango Productivity in District Muzaffargarh, Pakistan — Vol. 7, 400-405; 2017
Journal of Food Science and Engineering
Pomi Shahbaz, Shamsheer ul Haq, Ismet Boz and Ramiz Murtaza

Determinants of Crop Diversification in Mixed Cropping Zone of Punjab Pakistan — Vol. 5, Issue 11, 360-366; 2017
Direct Research Journal of Agriculture and Food Science
Pomi Shahbaz, Ismet Boz, and Shamsheer ul Haq

Economic Analysis of Integrated Farming Systems on Farm Income. A case Study of Sahiwal District, Punjab, Pakistan — Vol. 3, Issue, 11, 1434-1444
International journal of Management and Economics
Umer Bin Khalid, Pomi Shahbaz, Shamsheer Ul Haq, and Sikandar Javeed

CONFERENCE PUBLICATIONS

Assessing the Food Security Situation among the Rural Household of District Faisalabad of Pakistan — 2014 Islamabad
Sustainable Development in South Asia Shaping the Future by SDPI
Muhammad Ashfaq, Shamsheer ul Haq and Amar Razzaq

Developing Sustainable Agriculture Indicators Framework for Tea Farms in Rize Province Turkey — 27th-28th April 2017 Alanya Alaaddin Keykubat University, Turkey
International Conference on Food and Agricultural Economics
Shamsheer ul Haq and Ismet Boz

THESIS WORK

An Economic Analysis of Livestock diseases in District Faisalabad — 2012-13
M. Sc. (Hons) Agri. Economics Thesis

CERTIFICATIONS

Developing guidelines on Social Mobilization of Farmers' Organizations — 21-26 November, 2011
JICA and UAF
A training workshop of one week (JICA-funded project held at University of Agriculture Faisalabad, Pakistan)

Development in Applied Forecasting for Business and Economics — 16-17 January, 2013
Monash University Australia and University of Agriculture Faisalabad, Pakistan

Improved Irrigation/Water Saving Technologies — 20-22, March 2013
water Management Research Centre, UAF in collaboration with ICARDA and USDA