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The importance of Linden(*Tilia* spp.) in agroforestry practices in Rize province

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Abstract

Purpose: Linden is one of the significant tree species that has the potential to be used in agricultural forestry practices. In the observations made in the research area, the Rize region, it was observed that *Tilia rubra* DC. and *Tilia platyphyllos* Scop. species were being cultivated. This study aims to evaluate the potential utilization of linden (Tilia spp.) in agroforestry practices.
Method: In this study, the usability of linden in agroforestry practices were investigated based on a survey conducted in 32 villages and neighborhoods across five districts (Pazar, Hemşin, Çayeli, Ardeşen, Çamlıhemşin) of the Rize region. The surveyed householders were randomly selected from among those who volunteered.
Findings: When examining the various uses of linden in the region, it was determined that the utilization of linden for fodder leaves ranks first at 90.4%, followed by its use as timber and fuelwood at 84.9%, and cultivation for its flowers at 83.6%. The local people do not prefer any specific aspect for the planting of linden trees.
Conclusion: Linden trees are planted on lands that are not used for agricultural purposes, along streams and rivers, in strip patterns around agricultural crops, and intercropped with other agricultural products using integrated cultivation methods. It has been determined that Linden is most commonly cultivated around agricultural crops, at a rate of 79.4%. This planting pattern prevents yield reduction of the region's main crop, tea, caused by the shading effect of other trees. Thus, it enables the multifunctional utilization of Linden. The second most common cultivation practice, at 49.3%, is mixed planting with other tree species. Local people should be educated on conscious land use. Considering the multifunctional benefits of Linden, its planned cultivation should be expanded through agroforestry practices. Since the Linden tree exhibits vigorous growth in the Eastern Black Sea Region, it is a tree that should be emphasized and cultivated more for commercial purposes. The cultivation of Linden should be supported by the state which would contribute to reducing social pressure on forests, protecting the soil, strengthening the economic position of the local population, and fostering rural development.

Keywords: Linden**(***Tilia* spp.), Rize, agroforestry, rural development.

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Ihlamurun*(Tilia* spp.*)* Rize ilinde tarımsal ormancılık uygulamalarındaki önemi

Özet

Amaç: Ihlamur, tarımsal ormancılık uygulamalarında kullanım potansiyeli olan önemli ağaç türlerimizdendir. Rize yöresinde araştırma alanında yapılan gözlemlerde *Tilia rubra* DC. ve *Tilia platyphyllos* Scop. türlerinin yetiştirildiği görülmüştür. Ihlamurun(*Tilia* spp.) agroforestry uygulamalarındaki kullanılabilirliğinin belirlenmesi amaçlanmıştır.
Metot: Bu çalışmada, Rize yöresinde beş ilçede (Pazar, Hemşin, Çayeli, Ardeşen, Çamlıhemşin) toplam 32 köy ve mahallede anket esasına dayalı olarak ıhlamurun tarımsal ormancılık uygulamalarında kullanılabilirliği araştırılmıştır. Anket uygulanan haneler gönüllülük esasına dayalı olarak rastgele seçilmiştir.

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Bulgular: Yörede ıhlamurun farklı kullanımlarına bakıldığında; ıhlamurdan yemlik yaprak yararlanması %90.4 ile ilk sırada, %84.9 ile yapacak- yakacak odun yararlanması 2. sırada, %83.6 ile çiçeği için yetiştirilmesi 3. sırada olduğu belirlenmiştir. Ihlamur ağacı dikimi için yöre halkı herhangi bir bakı tercih etmemektedir.
Sonuç: Ihlamur ağaçları, tarımsal amaçlar için kullanılmayan boş yerlere, dere ve ırmak kenarlarına, tarımsal ürünlerin etrafında şeritler halinde ve de diğer tarımsal ürünler ile birlikte iç içe kültivasyon yöntemi ile dikilmektedir. Ihlamurun %79.4 ile en fazla oranda tarım ürünleri etrafında yetiştirildiği tespit edilmiştir. Bu dikim şekli; başka ağaçların gölge etkisi ile yörenin ana tarım ürünü olan çayın verim düşüklüğüne uğramasını önlemektedir. Bu sayede ıhlamurdan çok yönlü yararlanma gerçekleşmektedir. İkinci en sık yetiştirmeyi ise %49.3 ile diğer ağaç türleri ile karışık dikim oluşturmuştur. Yöre halkı bilinçli arazi kullanımı konusunda eğitilmelidir. Ihlamurun çok yönlü yararları dikkate alınarak tarımsal ormancılık uygulama teknikleri ile planlı dikimi yaygınlaştırılmalıdır. Doğu Karadeniz Bölgesi'nde ıhlamur ağacı iyi gelişme gösterdiğinden üzerinde önemle durulması gereken ve ticari amaçlar için daha fazla yetiştirilmesi gereken bir ağaçtır. Yetiştiriciliği devlet tarafından desteklenmelidir. Böylece, ormanlar üzerindeki sosyal baskının azalmasına, toprağın korunmasına, yöre insanının ekonomik olarak güçlenmesine ve kırsal kalkınmaya katkı sağlanacaktır.

Anahtar kelimeler: Ihlamur, Rize, tarımsal ormancılık, kırsal kalkınma.

1. Introduction

The genus *Tilia* L. (linden), a member of the Malvaceae family, is represented in Turkey by four species: *Tilia rubra* DC., *Tilia cordata* Mill., *Tilia platyphyllos* Scop., and *Tilia tomentosa* Moench.Davis [1], [2].
In the scientific literature, linden (*Tilia* L.) is classified as a medicinal plant. A pharmaceutical form of the plant is currently available in pharmacies throughout Europe [3]. In the Rize region of northeastern Turkey, it is traditionally known by the local name 'Flamuri'. Today, agroforestry practices based on land capability classes play a significant role in addressing critical environmental issues such as climate change, desertification, and soil erosion.[4]. Non-timber forest products make significant contributions to poverty reduction and local economic development in certain countries or specific regions within countries [5].

Rural development is a common challenge not only for Turkey but for all developing countries. This issue contributes to low economic performance and significantly undermines social stability [6]. Ensuring food security through sustainable agriculture is of critical importance for achieving the sustainable development goals [7].

The adverse impacts of global climate change, along with increasing forest fires and the rising and diversifying demand for forest products in industry, have intensified social pressure on forested areas. Given that expanding forest areas is a long-term and costly process, it is essential to ensure the functional and sustainable use of existing forests to prevent resource waste. In Turkey, the low income levels of forest-dependent rural populations, combined with the need for fuelwood and timber, contribute to further social pressure on forests. Additionally, population growth in urban areas has led to the conversion of fertile agricultural lands into residential and industrial zones.

Consequently, agroforestry techniques — which involve the cultivation of multiple products — have gained increasing importance for forest conservation, reducing social pressures on forest lands, and developing more rational agricultural production systems. Agroforestry is one of the main approaches used to produce multiple outputs from the same land while increasing income per unit area. More broadly, multiple-product systems refer to integrated land-use practices that combine agriculture, forestry, and livestock production in different ways and are known by various names. Agroforestry practices have become increasingly widespread in both the world and Turkey in recent years. Agroforestry generally aims to reduce social pressures on land by applying a variety of techniques. In this context, it is defined as a land-use system that seeks to increase the productivity of a given area through the combined or separate implementation of agricultural, forestry, and livestock activities, thereby improving the living standards of rural populations. However, each country differs in terms of its social realities, traditional production methods, customs, habits, needs, market conditions, and most importantly, economic structure. In Turkey, agroforestry practices are particularly significant in the Black Sea region, where agricultural land is limited. This study focuses on the regional importance of Linden (*Tilia* spp.) and evaluates its potential uses within agroforestry systems.

1.1. Agroforestry

Agroforestry can be defined as a land-use system that enables the diversified and sustainable use of a specific area through the simultaneous or sequential integration of forest, pasture, and/or agricultural lands. This system combines the cultivation of forest trees, fruit trees, various agricultural crops, beekeeping, and large- or small-scale livestock production using a range of techniques. Its main goals are to increase product diversity on the same plot of land, maximize yield per unit area, and enhance farmers' income levels. Agroforestry represents a long-term, sustainability-oriented land management approach that incorporates a wide array of continuous land-use techniques.

Agroforestry is a land management approach that has many benefits [8]. Agroforestry is the interaction between agriculture and trees, including the agricultural use of trees [9].

From a forestry perspective, agroforestry (multipurpose use) refers to the multifunctional utilization of forest lands. In contemporary forestry, this approach should be regarded as a land-use technique that must be included in functional forest planning, as it involves forest cultivation alongside agricultural production and the diverse use of forest areas. This multifunctional use includes recreation, providing food and habitat for wildlife, water production, grazing, beekeeping, forage or leaf production, and the harvesting of non-timber forest products.

(Mac Brayne, 1981) defines Agroforestry as the close integration and intertwined application of agriculture and forestry [10]. (Borough, 1979) defines it as the application of pasture management and afforestation work in the same place. (Raintree, 1986) expresses it as methods developed for the production of herbaceous and woody plants together. The aim is to increase production by introducing forestry to the area where agriculture is done or agriculture to the area where forestry is done [10]. According to Nair (1987), agroforestry is a land-use method that maximizes profit through the ecological and economic interactions of trees, crops, and animals within the same spatial and temporal arrangement on a given piece of land [11]. In a broader sense, "Agroforestry" is a continuous land-use method that enhances land productivity by integrating forestry, agriculture, and livestock production simultaneously or sequentially on the same land, while incorporating planning practices aligned with the local community's cultural activities [12].

Agroforestry practices are primarily a land-use system and a scientific approach. They are purpose-driven and must be conducted in a planned and controlled manner. In agroforestry, forestry, agricultural, and livestock activities are implemented within a specific plan and discipline. The goal is to achieve the highest productivity per unit area.

1.2. Purpose of Agroforestry

The purpose of agroforestry is to maximize benefits from a given area by improving the living standards of people who generate economic income from the region, and to develop various methods to achieve this goal. The objectives of agroforestry include:

-To enable local communities to generate income from their own land through timber and fuelwood, animal feed, non-timber forest products, and other agricultural products.

-To improve the welfare level of the regional population [13].

-To prioritize the allocation of produced resources for local community use and to meet their economic needs [13].

-To improve forest-community relations by encouraging the participation of rural residents in forestry activities.

-To establish cooperation between forest management and local villagers aimed at the conservation and development of forests [13].

-To achieve maximum efficiency in land use.

1.3. Importance of Agrororestry

Today, the adverse effects of global climate change (such as fires, landslides, and floods), combined with the increasing demand for timber resources, pose a threat to the sustainability of forest areas.
Moreover, the low economic income levels of forest villagers living within and around forest areas represent a significant social pressure on forests.

Through planned agroforestry techniques that incorporate region-specific functional combinations of agriculture, forestry, livestock, and pasture use, land-use practices can be adopted by the local community, thereby increasing their economic income levels. Guaranteeing the purchase of these products by the government would help increase market supply. State support should be ensured during the planning process; thus, the supply of agricultural and livestock products can be steadily increased in the long term. In regions with rainy climates, such as the Eastern Black Sea, forest and fruit trees cultivated alongside agricultural crops gain particular importance due to their soil-protective functions.

In order to promote agroforestry practices in Türkiye, it is essential to identify the regions with agroforestry potential and to determine the systems that can be implemented in those regions. In conclusion, the identification and implementation of "Multipurpose Land Use" techniques, which can help address or at least mitigate existing forestry-related problems in Türkiye, highlights the importance of agroforestry.

In the Rize region of the Eastern Black Sea, linden (*Tilia* spp.) cultivation is particularly notable for its integration with agricultural crops either in intercropped strip patterns surrounding cultivated fields or in gallery formations along riverbanks and stream edges.

The region's predominantly rainy climate, combined with improper agricultural practices, has led to an increase in floods and landslides in recent years. In order to partially mitigate these disasters, the planting of linden trees (*Tilia* spp.) through agroforestry techniques should be promoted. This would enhance the soil-conservation function of linden in the area.

In the region, the planting of forest and fruit trees together with agricultural crops should be encouraged for soil protection, as windbreaks, and for multifunctional use. The local population should be made aware of this issue.

The increase in monoculture farming and the widespread use of pesticides have reduced the availability of nectar sources for honeybees [14]. In the Eastern Black Sea Region, the monoculture-based agricultural approach must be definitively abandoned.

1.4. Benefits of Agroforestry

-In general, the benefits of agroforestry can be listed as follows. -Reduction of erosion: Trees cover the soil with their branches and leaves, protecting it from heavy rainfall and thereby reducing the risk of soil erosion [15
-It reduces the risk of crop losses [15].
-Structural support for climbing crop species: Trees serve as natural supports (similar to stakes) for vine crops [15].
-The production of vegetables and fruits needed by people is ensured.
-To improve the living standards of rural communities, create employment opportunities in rural areas, and prevent population growth in cities [15].
-To increase the supply of agricultural products and prevent price increases caused by supply shortages.
-To protect existing natural forests and prevent desertification, as desertification leads to a decline in the yield, production, and diversity of agricultural and livestock products [15].
-To prevent floods and water overflows, and to extend the economic lifespan of dams [15].
-It provides shelter and refuge for livestock, contributes to the protection of water resources, and creates recreational areas for the local population [10].
-Many plant species used in both traditional and modern rural home gardens are also utilized for landscaping purposes, and their preservation is given significant importance.
-Windbreak function [15]. Trees planted in strips around agricultural crops and along field boundaries serve as windbreaks, helping to prevent crop losses and contributing to increased yield productivity.

1.5. Botanical properties of Linden

Linden (*Tilia* spp.) is distributed geographically across the temperate and subtropical regions of the Northern Hemisphere. In Turkey, there are four naturally occurring linden taxa [16].
Linden (*Tilia* spp.) is primarily a deciduous woody plant that typically grows as a tree, though some may appear as tall shrubs. The shoots can be either glabrous or pubescent Leaves are arranged alternately, usually with serrated margins, though rarely entire. The leaf blade is heart-shaped, asymmetrical, and distinctly petiolate [17].
The leaves are mostly covered, especially on the underside, with simple or stellate (star-shaped) hairs. The flowers do not occur singly but form drooping inflorescences composed of at least three flowers. On the main axis of the inflorescence,the bract is elongated and developed, resembling a long wing [17].
It blooms in June and July. The flowers are yellowish in color and have a distinctive pleasant fragrance. The fruits are spherical, enclosed, and have a hard, leathery or woody texture [17].
Lindens are commonly planted for landscaping purposes in parks and as avenue trees along roads. Due to their active compounds, linden flowers are extensively utilized for medicinal purposes and in the cosmetic industry [18].

1.6. Silvicultural Properties of Linden

Linden grows in various soil conditions except in waterlogged, saline, and dry soils. It thrives better in moist, soft, fertile, and sandy soils. Lindens exhibit optimal growth in loose, moist, and nutrient-rich deep soils. In loose and soft soils, linden trees develop deep and well-established root systems. Lindens have a heart-shaped system. They are shade-tolerant trees and exhibit low sensitivity to late frosts. Their deep main root and strong lateral roots provide resistance against wind stress [19], [20]. Saplings can be propagated from shoots that emerge after the linden tree is cut or by layering shoots arising from the root collar. Additionally, seedling production is also carried out in forest nurseries.

2. Materials and methods

The material used in this study consists of surveys conducted in 1995–1996 within the scope of agroforestry practices with certain households engaged in linden cultivation at various altitudinal levels in selected villages and neighborhoods located within the administrative boundaries of the districts of Pazar, Ardeşen, Çamlıhemşin, Hemşin, and Çayeli in Rize province, as well as field observations carried out in 2024. The location map of the study area is presented in (Figure 1). The surveys were conducted with local residents who own farmland in the region. No other criteria were applied. The location map of the study area is presented in (Figure 1).

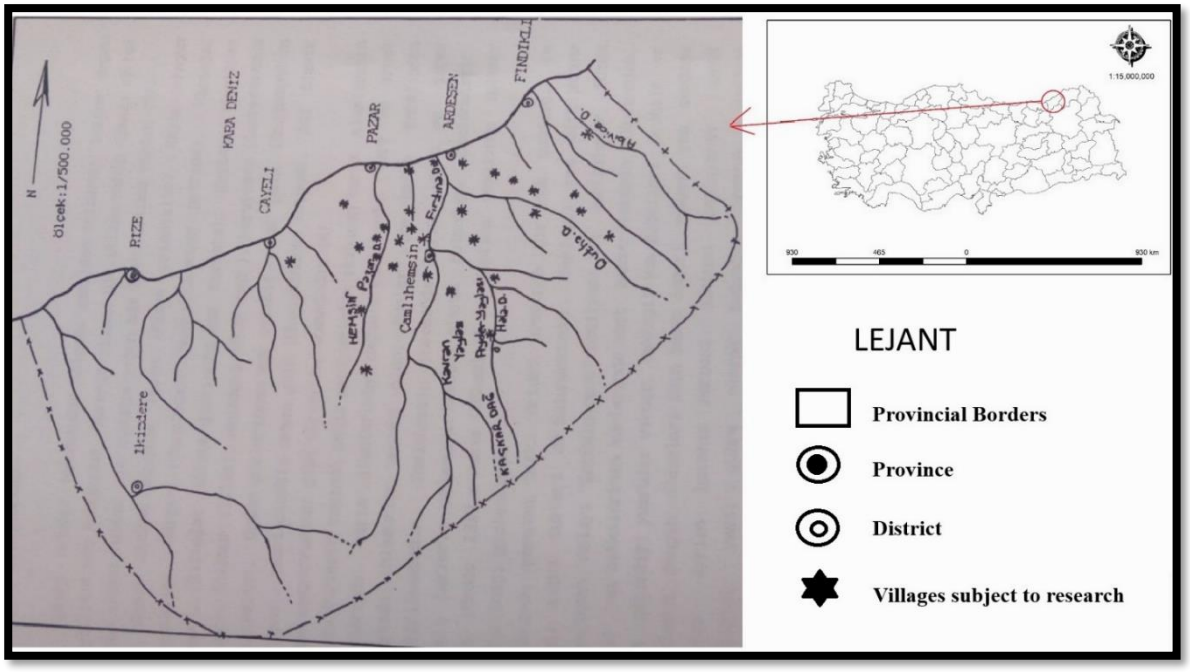

Figure 1. Research area location map

The surveys were conducted through face-to-face interviews with household owners. Surveys were conducted by visiting local coffeehouses, establishing social rapport with community members, administering survey questions, and collecting their responses.

A total of 19 questions, divided into two sections, were posed to household heads through face-to-face interviews. The aim was to clearly convey the intent of the questions to obtain the most accurate information possible.

The survey form used in the study is provided in (Appendix 1) at the end of the article.

3. Results

According to the survey results from the study area, 5.5% of the local population reported that linden grows naturally. The remaining household respondents indicated that they cultivate linden themselves (Table 1). No specific aspect is preferred for linden tree planting; it is generally planted in unused lands not utilized for agricultural purposes, along riverbanks and streams, and intercropped alongside various cultivated agricultural products.

Table 1. Linden Cultivation Methods

Location	Number of Households	Natural growth	By Planting			
			Propagation by stem cuttings	Propagation by layering-rooting	Planting of self-seeded saplings	Planting of saplings obtained from others
Pazar	24	-	-	9	18	1
Hemşin	9	-	-	9	1	-
Çayeli	3	-	-	2	2	1
Ardeşen	24	3	1	18	5	-
Çamlıhemşin	13	1	1	12	3	-
Total	73	4	2	50	29	2
%		5,5	2,7	68,5	39,7	2,7

71.2% of respondents stated that they do not use Linden (*Tilia* spp.) for commercial purposes. Among those who do use it commercially (28.8%), the common statement was that they conduct this activity illegally. Their common demand is to be allowed to trade Linden (*Tilia* spp.) freely and to use it for their own needs without restrictions. Regarding whether Linden (*Tilia* spp.) is utilized in a conscious and informed manner, 63% of the local population stated that they have sufficient knowledge about linden, while 37% reported lacking adequate knowledge.

In conclusion, the importance and value of the linden tree (*Tilia* spp.), which is cultivated in the region, have been recognized. Its versatile benefits have been acknowledged. The widespread use of linden (*Tilia* spp.) timber, particularly in apiculture, combined with the fact that its free sale is prohibited due to existing legal restrictions, is shifting the local community's perceptions and attitudes toward forests.

Figure 2. Planting for soil conservation purposes-utilization of fodder leaves

In the research area, the benefits obtained from Linden (*Tilia* spp.) include the use of its leaves as fodder, its role in apiculture, its flowers (for tea), its wood for timber and fuel, its use for soil conservation purposes, its use in landscaping and as an alley tree, and its use in beehive construction, providing various benefits. In the utilization of Linden (*Tilia* spp.), the use of leaves as fodder ranks first with 90.4%. This is followed by timber and fuelwood at 84.9%, flowers (for tea) at 83.6%, soil conservation at 50.7%, beehive construction at 28.8%, and alley planting and landscaping purposes at 23.3%. The benefits obtained from linden (*Tilia* spp.) cultivation were evaluated by location, and the resulting data are presented in (Table 2).

Table 2. Purposes of Linden use in the research area

Location	Number of Households	Purposes of Linden use						
		For soil conservation purposes	As fodder leafs	In beehive construction	Apiculture	Use of its flowers (for tea)	As timber and fuelwood	As an alley ttree and for landscaping
Pazar	24	7	21	1	6	17	18	4
Hemşin	9	6	8	6	5	8	8	1
Çayeli	3	1	2	-	1	1	3	-
Ardeşen	24	15	22	7	6	22	20	8
Çamlıhemşin	13	8	13	7	10	13	13	4
Total	73	37	66	21	28	61	62	17
%		50,7	90,4	28,8	38,4	83,6	84,9	23,3

Linden flower tea has significant use in the region because of its recognized medicinal properties for treating colds and flu. In the flowering season, the flowers of linden trees pruned for fodder are gathered and preserved for later use as tea. It has been reported that linden has antimicrobial properties. In the region, linden flowers are traditionally used for health by boiling them and drinking as tea. Linden flowers are consumed as tea along with their bracts.

It has been determined that Linden is most commonly cultivated around agricultural crops, at a rate of 79.4%. This planting pattern prevents yield reduction of the region's main crop, tea, caused by the shading effect of other trees. Thus, it enables the multifunctional utilization of Linden. An example of the planting pattern where linden is cultivated in rows within tea and corn gardens is presented in (Figure 3).

Figure 3. Linden row planting pattern (Rize Ardeşen-Zeytinlik Village)

Although the linden tree is a forest species, it is an important cultivated species in the region, especially near rural home gardens (RHG). It is planted for landscaping purposes, along RHG boundaries, and in gallery formations along stream banks, providing multiple benefits such as fodder leaves, flowers, and timber.

Figure 4. Agro-silvo-pastoral agroforestry practice in the Pazar Hamidiye rural homegarden

In the region, agrosilvopastoral systems a type of agroforestry practice, are commonly observed in land use (Figure 4). Honey is produced using beehives made from linden wood. Thus, maximum benefit is achieved per unit area. The percentage distribution of linden occurrence across the landscape in the research area is presented in (Figure 5). It was observed that some household surveys contained data indicating multiple forms of linden presence on the land. Thus, each finding (regarding the forms of linden presence on the land) was expressed as a percentage by proportioning it to the total number of surveys.

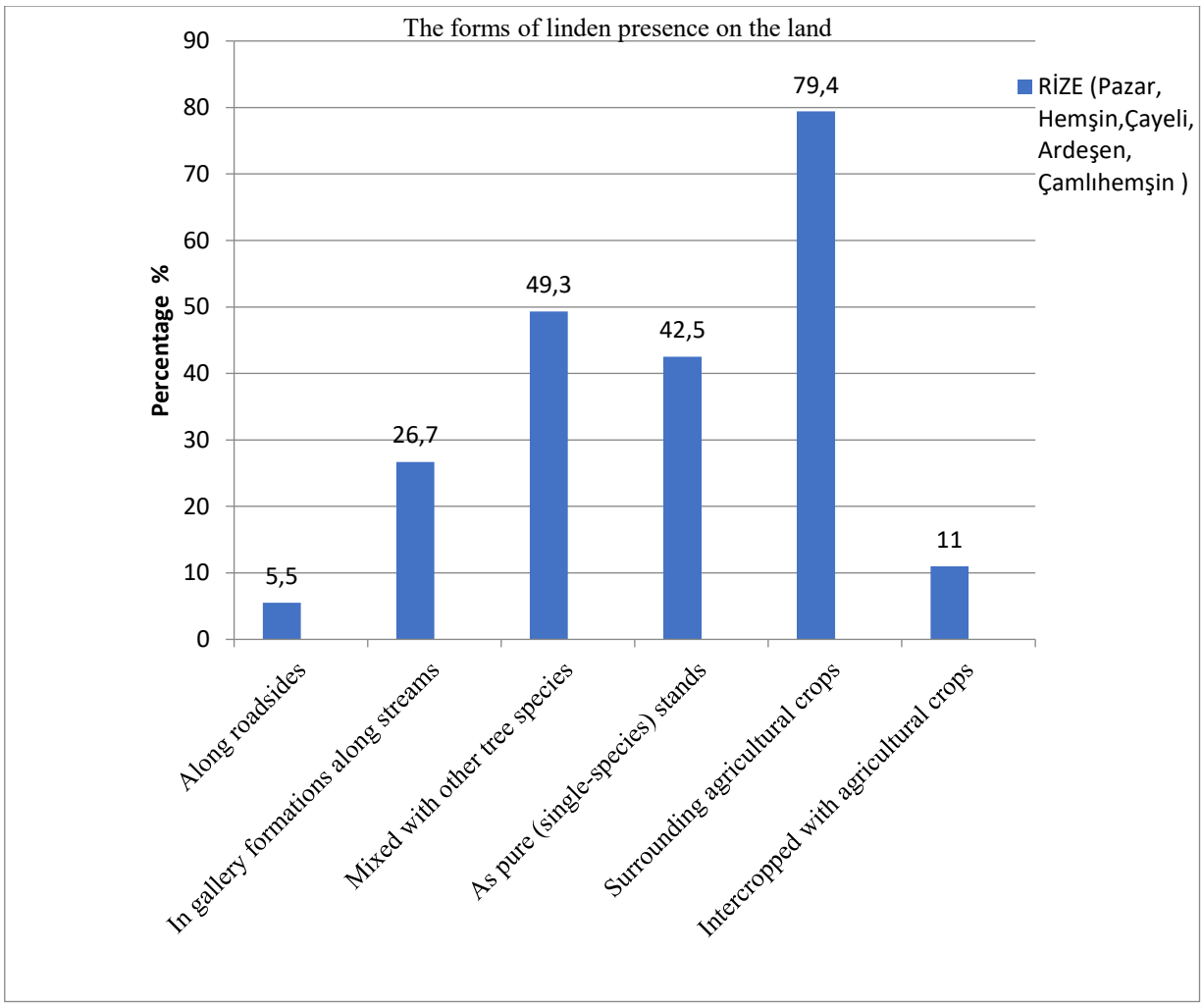

Figure 5. The forms of linden presence on the land

In the region, agroforestry practices are implemented without systematic planning. These include cultivation intercropped with agricultural crops, random mixture, inter-row mixture, boundary planting, alley cropping, windbreaks around agricultural crops, mixed with pasture plants (silvopastoral systems), and planting alongside agricultural crops for soil conservation purposes. Linden trees are commonly found surrounding agricultural crops in the region. When evaluating the survey results from the research area, it was found that 79.4% of linden trees are grown around agricultural crops, 49.3% in open areas mixed with other tree species, 42.5% in open areas as single species, 26.7% along streams in gallery formations, 11% intercropped with agricultural products, and 5.5% along roadsides as alley trees (Table 3).

Table 3. The forms of linden presence on the land

Location	Number of Households	The forms of linden presence on the land					
				In open area		Surrounding agricultural crops	Intercropped with agricultural crops
		Along roadsides	In gallery formations along streams	Mixed with other tree species	As pure (single-species) stands		
Pazar	24	1	11	8	10	21	3
Hemşin	9	-	3	5	4	1	-
Çayeli	3	3	-	2	-	2	-
Ardeşen	24	-	2	11	9	22	4
Çamlıhemşin	13	-	2	10	8	12	1
%		5,5	26,7	49,3	42,5	79,4	11

In Turkey, the Regional Directorates of Forestry where linden flowers are harvested as non-timber forest products are Sakarya (Adapazarı), Amasya, Balıkesir, Bolu, Bursa, Çanakkale, Isparta, Istanbul, Kastamonu, and Zonguldak [18]. In addition, in the province of Rize, which is under the jurisdiction of the Trabzon Regional Directorate of Forestry, linden flower harvesting is conducted in areas where linden cultivation is practiced using agroforestry techniques. The local population uses the linden flowers primarily for their own needs, while surplus production is sold in local markets (Table 4).

Tablo 4. Forest Regional Directorates where Linden flower harvesting is conducted

Name of the Regional Forest Directorate	Linden flower harvesting	Linden flower harvesting through agroforestry practices
İstanbul	There is production of non-timber forest products	
Bursa	There is production of non-timber forest products	
Balıkesir	There is production of non-timber forest products	
Zonguldak	There is production of non-timber forest products	
Sakarya (Adapazarı)	There is production of non-timber forest products	

Çanakkale	There is production of non-timber forest products	
Bolu	There is production of non-timber forest products	
Isparta	There is production of non-timber forest products	
Amasya	There is production of non-timber forest products	
Kastamonu	There is production of non-timber forest products	
Trabzon	There is no production of non-timber forest products	There is production through agroforestry practices

4. Conclusions and discussion

This study aimed to reveal the importance of linden cultivation in the Rize region based on surveys, particularly in terms of its agroforestry potential. As a result of the study, it has been observed that the cultivation of linden, which is grown and widely used by the local people in the Rize region, should be strongly emphasized and promoted in other provinces with suitable ecological conditions.

Because in the Rize region, the local people have identified the multifunctional benefits of linden and have utilized it for their own needs.

In addition to its use for fodder leaves, flowers (for tea), apiculture, timber and fuelwood, soil conservation, and landscaping purposes, the fact that linden can also be used in beehive construction and can grow successfully in all aspects has further increased its importance in the region.

The linden tree is capable of being established in agriculturally unsuitable areas, where its diverse benefits are utilized.

One of the reasons for the preference of linden is that its timber is suitable for furniture making and holds polish well, in addition to being used by local beekeeping families for the construction of beehives.

In the region, the presence of erosion makes linden a preferred species due to its erosion-preventing characteristics and its suitability for landscape planting. In the honey production season, bees benefit from linden flowers, enabling the harvest of linden-specific honey in the region.

Due to its attractive appearance and pleasant fragrance when in bloom, linden is a tree species highly appreciated by the local community.

Linden (*Tilia* spp.) gains value as a medicinal plant, primarily through the use of its flowers for the preparation of herbal tea. Linden tea, valued for its healing effects especially against colds and flu, is commonly prepared and kept ready in almost every household during the winter months. In the region, particularly in areas with a high presence of linden trees, the honey produced by bees from linden blossoms is referred to as linden blossom honey. In the Eastern Black Sea Region, due to the insufficient and partly unproductive pasturelands, the forage needs required for livestock cannot be fully met. Therefore, the use of linden leaves as fodder holds particular importance in the area. The local people prefer linden trees both to make efficient use of the land and to benefit from their multiple uses including fodder leaves, beekeeping, tea, branch wood, fuelwood, timber, windbreaks, and landscaping purposes.

The local people plant linden trees in suitable areas of their land, having recognized its various benefits. In addition, the local people plant linden trees as alleys along roadsides, in galleries along rivers and streams, as boundary trees along borders, and around agricultural crops as windbreaks and for soil conservation purposes. They also plant linden on ditch banks, thus utilizing the tree in a multifunctional manner.

Linden trees have traditionally been planted in prominent locations. They are considered among the most decorative trees used to adorn areas such as water channels, roads, streets, home gardens, and water pools, providing a rich and attractive appearance. When in bloom, they fill the air with a pleasant fragrance [12].

Linden flowers have significant applications in the pharmaceutical industry. However, the local population is generally unaware of their use in this sector. Therefore, pharmaceutical companies should be informed about linden cultivation in the region, and local people should be made aware that they can generate income through this channel, which would encourage the wider adoption and expansion of linden cultivation.

In other provinces of the Black Sea Region where the climate is suitable but linden cultivation is not yet practiced, it is considered beneficial to provide the local population with the necessary information and offer incentives to encourage them to engage in linden cultivation.

Thus, the local community's economic empowerment and fair compensation for their labor will be ensured. Achieving harmony between forest villagers and the forest is possible through the socioeconomic development of the rural population.

Since the linden tree exhibits vigorous growth in the Black Sea Region, it is a species that warrants special attention and should be cultivated more extensively for commercial purposes. Linden, which is also cultivated in rural home gardens, should be propagated in private or state nurseries alongside seedlings of other species suitable for agroforestry practices and distributed to local communities. In order to improve the economic well-being of local communities, state-supported seedling distribution programs should be implemented to promote the widespread cultivation of linden. This would facilitate the use of harvested linden flowers in the pharmaceutical sector. Additionally, collection centers should be established to ensure that linden flowers intended for pharmaceutical use can be efficiently delivered to processing factories. Local communities should be granted the opportunity to freely benefit from the linden trees they cultivate. While they are allowed to freely harvest and utilize fruit trees from their own fields, they currently do not have the same freedom with linden trees. It is necessary to introduce a new regulation in national legislation regarding forest tree species cultivated under agroforestry practices in order to improve forest-community relations. Forest trees growing on privately owned lands, which are not part of the forest ecosystem, can be evaluated within this scope. The local community feels uneasy because they are not allowed to freely use the linden trees they have personally cultivated. Indeed, their request to the government is to grant permission for unrestricted use of linden trees. Since current laws do not provide this right, the local people resort to unauthorized use of linden timber and other collective benefits.

As a result, forest community relations in the region are not at the optimal level, the forest cannot be effectively conserved, and illegal logging cannot be prevented.

It should be remembered that preventing illegal logging is nearly impossible without enabling forest villagers to achieve economic independence. These people, who live in close connection with the forest, must be brought to a level of economic well-being. If this cannot be achieved, part of these people's livelihood will inevitably come from the unauthorized use of forest resources.

This situation applies to state-owned forests. Additionally, the fact that citizens are legally unable to benefit from the linden trees they have personally cultivated on their own land negatively affects forest-community relations. In the long term, this will also have adverse effects on the sustainability of the forest ecosystem.

Linden cultivation plays a significant role in addressing the existing socio-economic problems in the region. The application of planned agroforestry techniques can offer solutions to these challenges. Through various forms of linden cultivation, the goals of agroforestry are effectively achieved.

As a result of the study, the removal of linden from the category of forest trees and the distribution of linden saplings by the forestry authority emerged as a common demand of the local people. Due to its resistance to warping and swelling under humidity, linden wood is particularly preferred for beehive construction.

Its majestic and decorative appearance, along with the pleasant fragrance of its flowers, makes linden an important species in landscaping projects. Historically, linden has attracted human interest not only as an ornamental plant and for its ethnobotanical properties but also for its lightweight, durable, and valuable wood.

Especially in recent years, the use of linden flowers as non-timber forest products and the need to expand its planting through agroforestry practices on agricultural lands have become prominent considerations in land-use planning.

Considering the multiple uses of linden and the benefits derived from its cultivation in the region, the government should provide incentives to support its planting. The role and importance of linden in agroforestry practices should be emphasized.

As a result, it will be possible to see more linden plantations in the region as well as in other provinces. When planted in parks and gardens, the linden tree serves as a species that meets people's recreational needs. Municipalities should be encouraged to include linden planting in landscaping projects across various parts of the city.

If the proper uses of linden are presented to the local community as a source of income, the local community's income will increase, social pressures on forests will decrease, and the principles of agroforestry will be fulfilled. To promote livestock development, pastures should be improved, and regular grazing plans must be prepared.

Agroforestry practices worldwide are being implemented in a planned manner with government support, yielding positive outcomes. In rural areas, the planned use of pasturelands increases productivity and quality in livestock farming. Interest-free loans should be provided for livestock production, and planned production should be encouraged. Awareness-raising activities must be conducted to promote informed agricultural and livestock practices.

The industrial uses of linden should be conveyed to the public, and its cultivation should be encouraged. In this way, agroforestry techniques will be applied consciously in the region, contributing to progress in solving social problems. Linden tea, obtained as a non-timber forest product from forest stands within forest areas, also holds export potential, which underscores the importance of its cultivation. In recent years especially, its flowers have been used within the scope of non-timber forest products. The need to expand its planting through agroforestry practices has become a prominent consideration in land-use planning. Considering its multiple benefits, the planned expansion of linden planting through agroforestry application techniques should be ensured. This will contribute to the economic empowerment of the local people, soil conservation, and have positive effects on rural development.

In recent years, linden flowers have been increasingly used as non-timber forest products. It is necessary to promote the expansion of linden planting through agroforestry practices in land-use planning. By expanding linden cultivation using planned agroforestry techniques in other provinces of the region as well, economic benefits will be achieved, and an important step will be taken toward rural development. Since the linden tree exhibits vigorous growth in the Eastern Black Sea Region, it is a species that warrants special attention and should be more extensively cultivated for commercial purposes. Its cultivation should be supported by the state.

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Appendix

Appendix 1. Survey questions on researching linden cultivation in Rize region

Family: Malvaceae	
Spcies: *Tilia* spp. (*Tilia platyphyllos* Scop., *Tilia rubra* DC.,)	
Local Name: Flamuri	
CHAPTER I	
1-Province:	District: Village:
2-The village	Number of households:
3- The village	Altitude: ……Aspect: ……..
4- The village	Land use and vegetation cover……..
5- The village	Is there any pastureland? If present, what is its total area?
6- The Village's Relationship with the Forest	A) Inside the forest……..B) Forest Edge…… C) Outside the forest……
CHAPTER II	
This section will be filled in by asking the householders who own linden trees or their representatives.	
1. How do you currently use the land you own (or use)? - As wooded area (…) - As agricultural land (...) - As meadow/open field (…) decares	
2. What is the size of your livestock? -Number of large ruminants……..heads -Number of small ruminants…….heads -Others……..	
3. Do you have enough pasture land for your animals? - Yes (…) - No (…)	
4. What is your annual feed requirement ? (kg or ton) (...)	
5. What type of fodder do you provide to your animals, and where do you obtain it from? (…)	
6. How many linden trees do you own? (young or mature) - (...) flowering trees -(…) non-flowering trees	
7. For what purpose do you cultivate (plant) linden trees? -Fodder leaves (…) - Fuelwood and timber (…) -Beekeeping (…)	

-Soil conservation (…) -Flowers (for tea) (…) -Others (…)
8.Is the linden tree naturally occurring or cultivated by you? - Naturally occurring (…) - Cultivated by us (…)
9. If you cultivate the linden tree yourself, how do you do it? - By stem cuttings (…) - By planting from seeds (…) - By layering-rooting (…) - Others (…)
10. If you do not cultivate the linden tree yourself, where and how do you obtain seedlings, cuttings, or seeds? - By purchasing from the forestry enterprise (…) - By purchasing from the market (...) - Others (...)
11. In what form and on what type of land are your linden trees located? - Intercropped with agricultural crops (…) - Mixed with other trees in a wooded area (…) - In open areas as pure (single-species) stands (…) - Surrounding agricultural crops (...) - Along roadsides (...) - In gallery formations along streams (...)
12. After how many years (or at what age) do you obtain products from the linden tree, and what type of products do you obtain? - Leafy branches: (...) years old - Flowers: (...) years old
13. How often and how do you prune your linden trees? ……
14. Do you think that using Linden leaves as animal fodder affects meat and milk production? - Positive effect (…) - Negative effect (…)
15. What is the general aspect of the land where you have planted Linden? - North (…) - South (…) -East (…) -West (…)
16. Do you use Linden for commercial purposes?.....
17. How much Linden product do you harvest annually?
18. Do you have enough information about Linden?.....
19. Please share your thoughts or comments on this topic: …….