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AN EXAMPLE OF NON-WOOD FOREST PRODUCTS IN TURKEY: PRODUCTION OF PINE NUTS

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ABSTRACT

Turkey is an important country in terms of forestry and biodiversity. In the world, it is one of the places with the highest plant diversity after the equatorial region. There are nearly 4000 endemic plant species. Local conditions have a significant share in the formation of this property. Turkey holds a good position as a wood producer in the production of forest products, which are among forest assets. However, despite its high potential for production of non-wood forest products, which are also among forest assets, it cannot take due advantage of this potential in resource management. Production and marketing problems are the main factors underlying its failure to use this potential. This study aims to draw attention to the production and marketing of pine nuts, which are non-wood forest products, and to put forward suggestions for the use of the above-mentioned potential. Systematic approach was used as a research method. In some cases, regional approaches were also utilized. The data of the Turkish Statistical Institute was used as research material. ArcGIS 10.3 package was utilized in the preparation of cartographic materials. The seed obtained from the cones of Pinus pinea (Stone pine) is a product which is traded both in Turkey's domestic market and exported abroad. The seeds, which are commercially important, are important sources of income for rural areas. Turkey is suitable for the ecological conditions of Pinus pinea, which is among the industrial wood and non-wood forest products. For this reason, Pinus pinea fields should be made widespread in order to retain population in rural areas and increase their income.

Contribution/ Originality: This research explores the different characteristics of Stone Pine, one of the non-wood forest products, in Turkey and rest of world. This makes the present study more exclusive among other research works.

1. INTRODUCTION

Non-wood forest products are any types of the plant and animal products that are grown under natural or cultural environment in the forest ecosystem for the purpose of covering the needs of humans and other creatures. In countries that have forests, non-wood products have an important place in terms of their economic, environmental, recreational and social roles as well as for a sustainable forest management. The demand on non-

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wood forest products is increasing with each passing day in the world, and forest resources acquire a new awareness. The viewpoint on forest resources do not consist merely of wood in our present day. The idea that the forests may bring other products and other revenues is understood by the ministry of forestry in countries all over the world. Non-wood forest products were not known by people other than forest villagers in the past in terms of various usage styles. Today, on the other hand, needs of people increase together with the increasing population, migration, urbanization, transportation, communication, industrial activities and technological developments, and people are inclined to find other resources to obtain revenues to cover their individual and social needs. Non-wood forest products constitute one of these sectors. Non-wood forest products are re-discovered, and the management of these products has become a vital theme and an area that has to be dealt with care for countries. It is observed that these products are the main topic of a serious commerce among countries in the world.

The geographical structure of Turkey forms high elevation differences within short distances, and prepares the ground for other climatic conditions. Precambrian, Paleozoic, Mesozoic and Cenozoic old areas are observed throughout the country in geological terms. Turkey is a different country in terms of tectonic events and lithological differences. The geomorphological, climatic, soil and lithological properties of the country change within short distances. It is possible to experience four seasons simultaneously in different areas of Turkey. These characteristics have caused that a different ecosystem, biological variety and different species have been formed in Turkey. One of these varieties is Stone Pine. Stone Pine constitutes an important place in the economy of the country and is used as wood and fruit, which is among non-wood forest products.

Stone Pine is made use of as industrial wood and as fruit, which is a non-wood forest product, and which is different from the other pine species. The edible seeds in pinecones are important non-wood forest products. Unlike the other pine species, Stone Pine is gaining a value with its pinecones and seeds day by day. Stone Pine is a species of *pinus*, which is a sub-family, i.e. the pinoidae, of the coniferae tribe. Stone Pine is distinguished from the other pine species with its umbrella-like image and pinecones. It completes the development of its pinecones within three years. Its cones are bright reddish-brown in color, and their shapes are oval and symmetrical with bright brown color.

Stone Pine has contributions to the economy with its social, cultural and aesthetic functions as well as the seeds in its cones. In this study, the purpose is to attract attention to the production and marketing of Stone Pine in Turkey, and contribute to its advantageous potential in Turkey; and in addition to this, to compare the production in Turkey and in other countries of the world and in the Mediterranean countries, and bring recommendations. Stone Pine is endurable to forest fires due to its thick bark, and because it does not have leaves under its body and is an important species for sustainable forestry; its wood and fruits are also made use of, which makes the study important because it attracts attention to the fact that it is an important species for sustainable forestry, it provides high economic revenues for forest villagers. Stone Pine must be spread both in natural and cultural terms. In addition, the fact that comparisons are made in the study among the previous studies conducted in Turkey and in the world make the study become even more important in other aspects.

Some studies conducted in Turkey are; Fırat [1]; Yazıcı and Gavcar [2]; Çukur [3]; Günal [4]; Kılcı, et al. [5]; Sülüşoğlu [6]; Arası, et al. [7]; Atalay and Efe [8].

2. MATERIAL AND METHOD

As the first step, a literature review was performed in the study, and statistical data were received; tables, graphics and cartographical materials were prepared. The data were evaluated by supporting with the literature. In preparing the cartographical material, the ArcGIS 10.3 GIS (Geographical Data Systems) package program was used. The descriptive review method was made use of in the study. In this method, a situation on a subject matter is examined and interpreted. These kinds of studies are conducted by obtaining systematic and neat data on the cases. In a descriptive study, the existence or non-existence of a situation is revealed. The results of descriptive studies,

the tables and graphics are interpreted, and the existence of any possible correlation between the variables is investigated [9]. In addition, some observations were made in the field in Stone Pine forests during the study cycle.

3. FINDINGS AND DISCUSSION

3.1. The Ecology of Stone Pine (*Pinus Pinea*)

Stone Pine grows in forests where relative humidity is high (60-70%), annual average precipitation is over 600 mm, winter precipitation is nearly 50%, spring and autumn precipitation rates are around 20% with direct solar radiation and with temperature not much lower (-18/-3°C), and with the hottest summer temperatures not very much (23-25°C). In addition, it also grows on main materials (especially granite, gneiss, etc.) which produce sandy and sandy-clayey soil [3, 4, 8]. Natural Stone Pine stands spread on various main rocks such as granite, gneiss, mica schist, volcanic tuff, quartzite and on main material and sand deposits such as flysch, alluvial main material. When the annual precipitation demand of Stone Pine is examined it is understood that the minimum values are around 250 mm. Stone Pine had a species with low-level genetic variation. Its trunk may grow as large as two meters, and the height can go up to 25-30 meters. It spreads in wide areas in the Mediterranean Basin. Since it has spread more than any other tree species in the following areas in Turkey, it is known as the dominant species **(Table 1)**.

Table-1. Meteorological Values and Elevations of Some Places Where Stone Pine Spreads Naturally

Meteorology Station	Elevation (m)	Annual Ave. Relative Humidity (%)	Annual Ave. Temperature (C)	Annual Ave. Precipitation (mm)
Aydın	57	63	17,7	677,5
Söke	38	69	17,6	1001,7
Kozak	500	-	11,4	939,8
Bergama	45	64	16	722,2
İzmir	25	64	17,6	691,1
İzmir/Değirmendere Küner	200	63	15,7	966,9
Antalya	10	64	18,2	1068,2
Manavgat	20	71	18,2	1288,1
Yatağan	376	56	16,3	673,4
Yatağan-Katrancı	650	58	14,6	896,2
Çanakkale	2	72,6	14,8	608,9

Source: Aegean Forestry Research Institute

Although it is not selective in terms of soil demand, it loves the soil type with a good drainage that has permeable sand, and prefers loose soil types. This species requires more light, and grows fast when it is younger, and has a taproot going deeper into the earth. For this reason, it makes use of the ground water when it experiences drought periods, and decreases the loss of water with its needle leaves thus eliminating the lack of water. It has spread in elevations up to 900 meters in Turkey especially in the Mediterranean, Aegean and Marmara Regions. Aside from these areas, it has also spread in Black Sea Region and Southeastern Anatolian Regions.

Table-2. The Results of Soil Analyses in Areas Where Stone Pine Spreads at an Important Level in Turkey

Some of the Areas where Stone Pine Spreads Naturally	Ph	Salt	Total Lime %	Active Lime %	Organic Matter 0%
KOZAK/Bergama	6.27	0.066	----	----	1.321
KÜNER/Menderes	6.90	0.214	0.27	----	0.554
MAZON/ Koçarlı	5.33	0.035	----	----	0.853
HELVACI/ İzmir	6.34	0.155	0.77	----	1.298
RADAR/Çanakkale	8.30	0.145	25.16	3.15	1.203
BELEK/ Antalya	8.62	0.086	49.51	1.82	0.148
GÖRDES/ Manisa	7.08	0.138	----	----	0.721
ÇORUH/Artvin	6.7	----	----	----	4.006

Source: Aegean Forestry Institute

According to the soil samples that were collected from natural spread area of stone pine, the soil varies between slightly acidic and neutral values. The pH demand in the soil is between 5 and 9. It is understood that it does not like salinity in the soil, and can tolerate calcareous soils with intense lime. In some of its natural areas, there are siliceous and sandy media. It is observed that this type prefers such places more.

This plant, which may also grow in poor, sandy, limy or clayey soils, can grow better in open areas that are open to direct solar radiation. Although the plant can grow in slightly shady areas in the first stages of its growth, it requires plenty of light in further steps especially during ripeness and fruitage. It is sensitive to cold and harsh climates. For this reason, Stone Pine has found its optimum conditions in the Mediterranean phytogeography area, especially in coastal areas; and has spread naturally in places that are open to the influence of the sea.

3.2. The Spread, Production and Use of Stone Pine in the World

The spread of stone pine in the Mediterranean Basin covers an area more than nearly 700.000 hectares. The country where it exists at the highest rate is Spain with 450.000 hectares. Portugal ranks the second with 90.000 hectares. Turkey ranks the third, and Italy fourth with 40.000 hectares. The evidence showing that this plant was used by humans was found in recent times in Gibraltar. Today, on the other hand, it is observed that it generally intensifies in Mediterranean Basin [10].

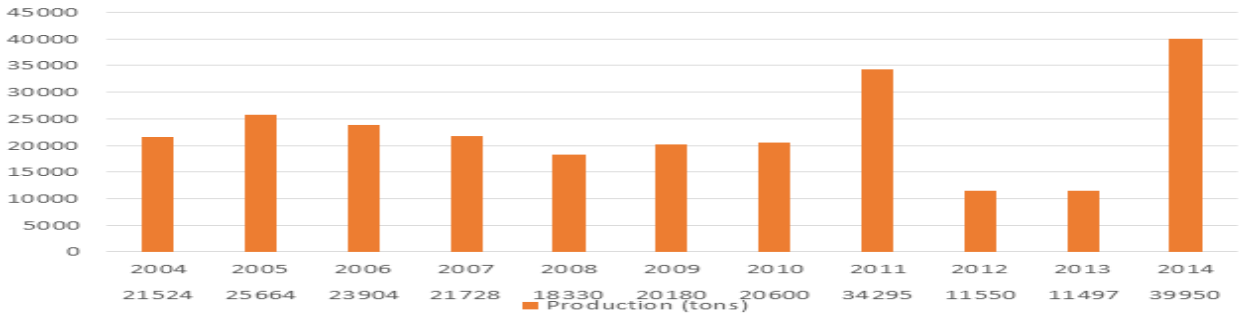
Stone Pine may be claimed to have spread along Mediterranean Basin from Portugal to Syria. In this area, it must be stated that the renewal property of the plant occurs in natural ways. When the growth areas are considered it is observed that generally it has a natural spread in areas close to coastal areas; and in Spain and Portugal, it spreads towards the inland. The production values of the countries named above are given in **Table 3**.

Table-3. Four Countries that Produce the Most Stone Pine in the Mediterranean Basin

Country	The Amount of Stone Pine Produced (Tons)	Internal Consumption(%)	Export (%)
Spain	1800-2000	60	40
Portugal	1000-1100	20	80
Italy	950-1050	100	-
Turkey	700-800	10	90

Source: (Berrahmoun et al. 2007; Narrated by Arası, et al. [7]).

When the Stone Pine production is examined through years, it is observed that there have been fluctuations in recent years. In Table 4, when the production amount in the seven years between 2004 and 2010 is examined, it is observed that the production values do not fluctuate; however, the production increased in 2011, and decreased at a rate of 60% in 2012-2013, and a fast increase was observed in 2014 again.



Graphic-1. World Stone Pine Production (tons)

Source: Istanbul Exporters Union, Secretary General

It is considered that these fluctuations happened due to occasional meteorological events in countries located outside the Mediterranean Basin such as China, North Korea, Afghanistan and Russia.

One of the most economic uses of stone pine stems from its having edible seeds. The seeds have been used and traded from ancient times. The major producers of this product are located in the Mediterranean Basin (Spain, Portugal, Italy and Turkey); and outside the Mediterranean, in China, North Korea, Afghanistan, Pakistan and Russia, which are the major countries that have stone pine.

Table-4. World Stone Pine Production (tons)

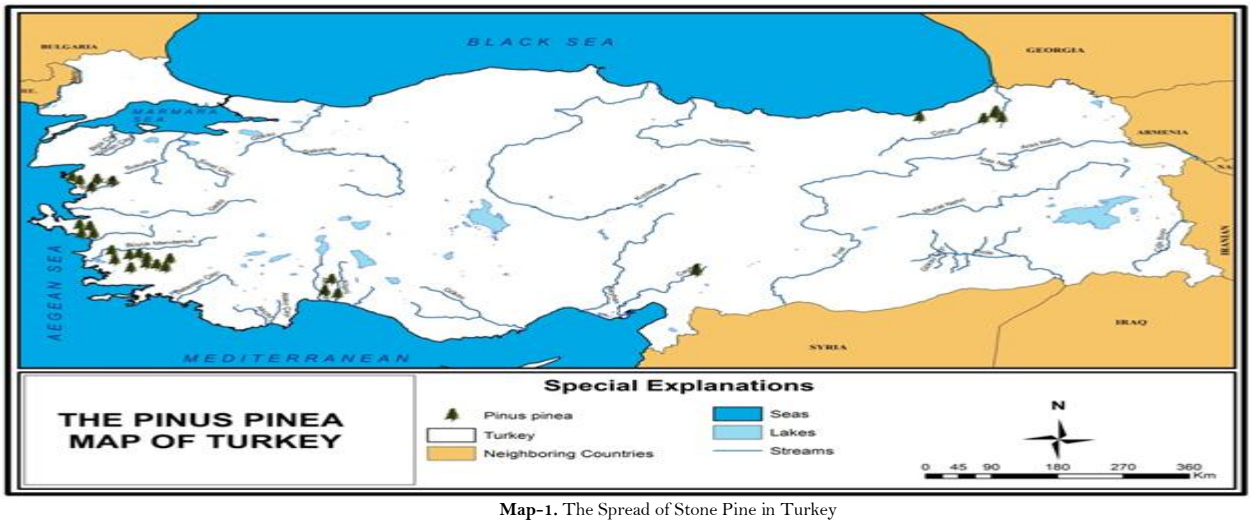
Years	Production
2004	21524
2005	25664
2006	23904
2007	21728
2008	18330
2009	20180
2010	20600
2011	34295
2012	11550
2013	11497
2014	39950

Source: Istanbul Exporters Union, Secretary General

The studies conducted on the usage areas of stone pine forests have revealed that stone pine has been used for purposes like wood, shell, resin, edible seed, etc. Aside from these purposes, Stone Pine forests constitute important ecological value and provide scenery and recreation areas. In addition to these, these areas also provide important protection against soil erosion and fire.

3.3. The Spread, Production and Use of Stone Pine in Turkey

Stone pine is a natural element of the Mediterranean phytogeographical area, and has spread in the base areas of Çoruh Valley in the southern part of Artvin, Anatolia; in Trabzon-Söğütlü Valley, and in Antalya-Serik, Kahramanmaraş-Yeniyapan. In Aegean Region, it is possible to see private and public stone pine areas in Izmir-Bergama-Kozak, Ayvalık, Menderes, Aydın-Çine, Koçarlı, Muğla-Madran, Katrancı Village and surroundings [3, 8].



Map-1. The Spread of Stone Pine in Turkey

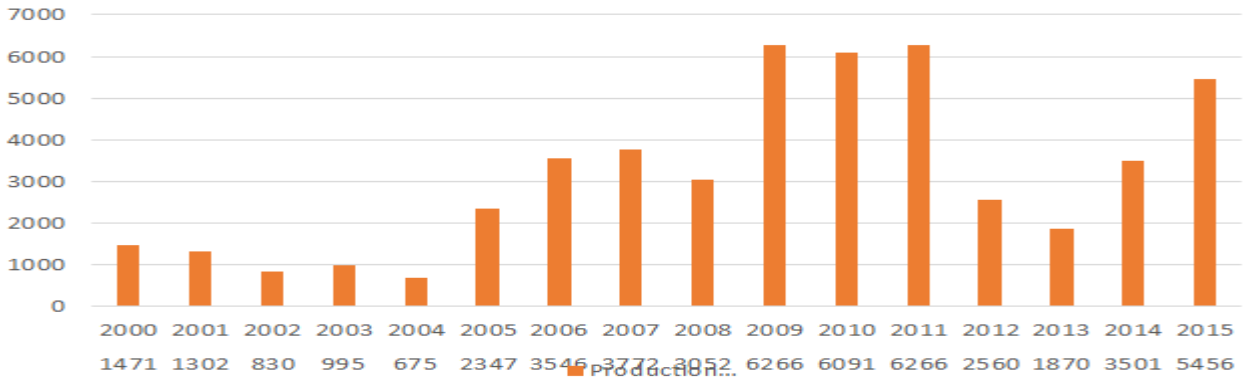
Stone Pine is one of the important non-wood forest products of Turkey, and Turkey has the production capacity of covering the needs of several countries that import Stone Pine. Stone Pine spreads at the widest manner in Bergama/Kozak, Aydın/Koçarlı and Muğla in Western Anatolian Region **(Map 1).**

Table-5. Turkey Stone Pine Areas (ha)

The Spread of Stone Pine in terms of Area		
Normal Ha	**Broken Ha**	**Total Ha**
60.888	28.139	89.027

Source: Forestry General Management

According to the data obtained from Turkey Forestry General Management, stone pine forests spread over 89.027 hectares. Within these areas, 60.888 hectares areas are in the form of normal, and 28.139 hectares are in the form of disrupted areas. Increases have been observed in the stone pine production of Turkey both in terms of the areas and the production amounts. In recent years, the Ministry of Forest and Irrigation provides serious support for forest collages in order to increase non-wood forest products.



Graphic-2. Stone Pine Production of Turkey in Years (tons)

Source: Forestry General Management 2015

The stone pine production in Turkey was below 1500 tons between 2000 and 2004. As of 2005, the annual productions rates increased, and were over 6000 tons in 2009-2010-2011.

Table-6. Stone Pine Production of Turkey in Years (tons).

Years	Production (tons)
2000	1471
2001	1302
2002	830
2003	995
2004	675
2005	2347
2006	3546
2007	3772
2008	3052
2009	6266
2010	6091
2011	6266
2012	2560
2013	1870
2014	3501
2015	5456

Source: Forestry General Management 2015

The years 2012 and 2013, on the other hand, were the years when sudden decreases were observed in the yields. In the same period, the annual production in the world was 35.000 tons and decreased to 10.000 tons; and therefore, a global decrease was observed in the yield. The annual production rates started to increase again in

2014, and reached up to 5456 tons in 2015. The Stone Pine production values in Turkey between 2000 and 2015 are given in Table 6.

Aside from the seeds, which constitute the basic economic value in Stone Pine forests, the hard shell, which is called as pinecone, is used as firewood at homes. Another by-product is the resin. The resin of this tree is used as paint, in chemistry industry, lubrication of "*nale shoes*" and in violin strings. The trunk of the tree is used as lumber and various economic revenues are received from them. Although its lumber is not precious, it is made use of at local level in making furniture and other woodwork.

3.4. The Economic Value of Stone Pine for Turkey

Stone pine cones, which have high economic value, are dried, and the seeds in them are removed, and then the remaining cones are used as firewood. The reason for its being called as *non-wood forest product* is not only due to its trunk but also due to its commercial value because of its seeds. One stone pine cone has approximately 400 grams of weight. These cones host 80-100 husked seeds, and 20 grams of hulled stone pine is obtained from them. When the fact that a tree gives at least 100 cones a year is considered, the stone pine yield appears to be 2 kg. When the stone pine in 1 hectare area is calculated as 100 pieces, nearly 200 kg yield is obtained. When it is assumed that the total stone pine areas of our country are 90.000 hectares, it is observed that the potential of Stone Pine is high.

When the fact that stone piece has high economic value in the world market is considered, it is observed that it may be considered among the important revenue recourses for Turkey. However, it is understood that the reality is not in the same shape as it is in the mathematical calculations. Stone pine forest's not being rejuvenated, inadequate fight against fungi and pests, not using graft stone pines in forestation areas, the villagers' considering stone pine as an additional income resource and similar reasons were among the problems, which also existed 10-15 years ago. Today, these problems are decreasing, and the production rates are increasing. A stone pine starts to produce cones at least 10 years later it is planted. The years when cone yield increases come much later. For this reason, the true yield in forestry activities may only be obtained in further years.

There is a high demand for stone pine all over the world. Mainly the United States of America, Germany and Italy attract attention as important purchasers. This product, which is produced as husked in Mediterranean Basin, is exported to any parts of the world. The husked stone pine importers are given in **Table 7**. If Turkey continues its support for stone pine and if the activities mentioned above are made to become more widespread, it will contribute to the development of the villagers in further 10 years, and gain its due place among the important export products of Turkey. In case the stone pine production is increased in optimum conditions in Turkey, the other producer countries may not be able to compete with the quality and taste of the Turkish stone pine.

Table-7. World Stone Pine (Husked) Import of Countries (Tons)

COUNTRY	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
USA	3722	3964	3483	2112	1496	2438	2214	3010	3718	3144
Germany	1094	1452	1798	1362	654	1657	1781	2361	2449	2259
China	75	107	103	322	881	918	1620	2481	2279	1938
Italy	1054	658	2395	1471	1284	1514	1308	965	850	1978
UK	709	764	757	665	249	527	413	636	471	710
Spain	204	134	248	282	114	175	255	200	232	91
Switzerland	30	71	71	110	71	2	14	44	25	72
UAE	78	168	28	69	25	49	80	81	46	32
Poland	0	0	0	0	0	0	0	0	5	5
Canada	75	47	66	36	18	155	145	164	166	1
Australia	366	351	305	271	174	515	427	636	860	0
Israel	361	456	154	210	128	302	228	529	384	0
Tunisia	44	71	20	44	0	90	54	277	128	0
Others	3074	4581	3251	3342	1525	2657	2380	1992	3028	0
Total	10886	12824	12679	10298	6619	10999	10919	13376	14641	10230

Source: Istanbul Exporters Union, Secretary General

3.5. Threats and Diseases

Stone Pine does not have much bio-variety and is less susceptible to threats and diseases. During its juvenile period, it is influenced by drought. The influences of some insects are also observed in them [11].

In addition to these, another biological threat for stone pine is fungus diseases. These diseases cause serious harms in the seeds and young plantations. Fungus diseases lead to decay in root systems and cause important influences in the growth and development of the plant [12].

4. RESULT AND RECOMMENDATIONS

Stone pine is a productive forest product from which humans make great use of in terms of its lumber, cone, resin and fruit. It spreads naturally in areas where the ecological conditions are suitable. It is also grown under culture conditions, which is in the mother land of stone pine, the Mediterranean Phytogeography area. As it moves away from its natural spread area, the fruit quality and natural properties decrease. The quality of those produced in Spain, Italy and Turkey, which are Mediterranean Basin Stone Pine producers, and the production is less.

The agricultural products in Mediterranean Basin are various due to the climatic conditions and soil properties. For this reason, the farmers in Mediterranean countries prefer to invest on products that do not require long durations but bring high profits. Stone pine, which is a non-wood forest product, is considered as an additional income resource in its natural spread areas. Since the areas in Mediterranean countries are formed with the governmental supports, these areas are less when compared with the natural spread areas.

It is understood that the product variety is more in Mediterranean countries, and farmers in this region do not want to wait for 10 years, which is required for the stone pine to produce income, and the stone pine areas are formed with the governmental support. In countries like China, North Korea, Afghanistan, Pakistan, Mongolia and Russia, Stone Pine production is performed under culture conditions. The plant has been adapted to the geographical conditions of the abovementioned countries and grown in these areas. It is considered that these countries have the highest production rates because of the reasons mentioned above and due to their wide planning areas.

Turkey has a forest ecosystem that constitutes 27% of its surface area. There are pure stone pine forests in these areas. Stone Pine is a valuable plant that may be used for purposes other than wood among the trees in the forests. Since its economic value is high, it poses an alternative income resource for people living in rural areas, and is important to sustain the existence of forests. Its seeds and cones have separate values, which is unlike the other trees whose sole products are lumber and wood. It is an important species in fighting against forest fires and erosion, and is among the species that has to be spread for sustainable forestry purposes as well.

According to 2015 data, there are 90.000 hectares of stone pine areas in Turkey. The stone pine obtained from these areas in that year was 5456 tons. Current stone pine production occurs much lower than the actual potential. When the fact that 1 kg of stone pine cost 100-120 TL in 2016 is considered, it becomes clear that it is an important economic resource both for the economy of the country and for the farmers in the area. For this reason, the Ministry of Forestry and Irrigation in Turkey provides serious supports for non-wood forest products. One of these supports is the works that intend to enlarge Stone Pine areas. In further years, it is expected that Turkey will increase its revenues in Stone Pine production, and Stone Pine will become an activity among our commercial activities in our country with increasing importance.

Countries must care for the best management of forest resources and present the forest products to the benefit of the country and surrounding areas for a sustainable forestry management. The forest villagers must be told that non-wood forest products may bring high revenues as well as being wood source, and the traditional understanding must be quit in this context, and further cooperation must be established with villagers.

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