Anadolu Orman Araştırmaları Dergisi
Anatolian Journal of Forest Research
http://dergipark.gov.tr/ajfr

The Economic Analysis of The Mastic Tree (*Pistacia lentiscus* L.) Cultivation Projects[x]

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ARTICLE INFO

Recieved : July 8th, 2019
Accepted : October 22nd, 2019

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[x] An earlier version of this work presented at the International symposium on Forest Areas and Peri-urban Forests "Dynamics and Challenges" 3-5 November 2016 in Agadir, Morocco.

ABSTRACT

The mastic tree is mostly grown on the island of Chios in Greece. According to local people in Izmir it had formerly grown in the Western side of Turkey. The aim of this study is to bring mastic tree to grow in the Aegean region and for the region to contribute to rural development and national economy by project analysis of gum cultivation in the area to determine whether it is economically feasible. Some information such as elements of cost of production, harvesting and marketing opportunities and problems, competition with Chios and data for the economic analysis were collected at first. At the second stage, to determine the project's cost, elements were collected using the average market prices and some economic evaluation methods such as Net Present Value (NPV) method. To incorporate the time and value of money, more complex cash flows were applied for the project, which can be achieved economically. At the end of the study, we reached the conclusion that mastic tree cultivation projects are not feasible in the region because of the high rent prices of land and that this is a touristic region of Turkey. Until 100 years ago, mastic tree was grown in the region. However, after the local producers migrated to the island of Chios, mastic production disappeared in the region. Nowadays, the attempts to revive this production system are not economically feasible due to land rent. Therefore, it is possible for production to shift to natural forests and damage to forests.

Keywords: Economic evaluation, IRR, mastic, NPV, payback method.

Sakız Ağacı Yetiştirme Projelerinin Ekonomik Analizi

ÖZ

Sakız ağacı çoğunlukla Yunanistan'ın Sakız Adasında (Chios) yetiştirilmektedir. İzmir'in yerli halkına göre eskiden Türkiye'nin Batı bölgelerinde de yetiştirilmekteydi. Bu çalışmanın amacı son yıllarda İzmir yöresinde kırsal ve ulusal ekonomiye katkı sağlamak üzere sakız üretimini yaygınlaştırmak amacıyla yapılmak istenen projelerin ekonomik analizini yatırım değerlendirme yöntemlerine göre yapmaktır. İlk aşamada sakız ağacı üretimine yönelik üretim maliyetleri, hasat ve pazarlama fırsatları ve önlerindeki engeller, Sakız Adası ile rekabet ve ekonomik analize yönelik veriler sahada yapılan çalışmalarla toplanmıştır. İkinci aşamada projenin gelir ve giderleri pazar fiyatları kullanılarak belirlenmiş, elde edilen bu verilerle paranın zaman değerini ve nakit akışlarını dikkate alan Net Bugünkü Değer ve İç karlılık Oranı yöntemleri kullanılarak projelerin ekonomiklikleri hesaplanmıştır. Çalışmanın sonunda proje sahası olan Çeşme, Urla ve Karaburun bölgelerinde turistik etkinliklerden kaynaklanana arazi rantının çok yüksek olmasından dolayı sakız ağacı yetiştirme projelerinin ekonomik olarak yapılabilir olmadığı saptanmıştır. 100 yıl öncesine kadar sakız üretimi çalışma bölgesinde de yapılmaktaydı. Ancak Mübadeleden sonra bölgeden ayrılan üreticilerle birlikte bu üretim tarzı yavaş yavaş yok olmaya başlamıştır. Son zamanlarda devletin de desteği ile bu üretim sistemini bölgede yeniden canlandırmak için yapılan girişimler vardır. Ancak yapılan bu çalışma ile bu üretim sisteminin toprak rantının yüksekliğinden dolayı ekonomik olmadığı ortaya konmuştur. Ayrıca bu üretim sisteminin bölgede ormanlık sahalara yayılma ve ormanlara zarar verme riski vardır.

Anahtar Kelimeler: Ekonomik değerlendirme, İKO, sakız, NBD, geri ödeme süresi.

Citation:
Özden, S., 2019. The Economic Analysis of The Mastic Tree (*Pistacia lentiscus* L.) Cultivation Projects. Anatolian Journal of Forest Research 5(2): 100-107.

1. Introduction

The mastic tree (*Pistacia lentiscus* L.) is a plant that with recognized importance by humankind since ancient times. This species spreads naturally Chios in Greece and western side of Turkey. The resin derived from this tree's chia variety has been registered as originating from Chios according to European Union (EU) legislations. However, this plant also naturally grows in the west of Turkey. However, mastic production is not common in Turkey. So, almost the entire demand of the world mastic gum is met by the Chios Island. Mastic is an expensive agricultural product as it is rare and the production on the island is kept under control by the Council of the Union of Chios. Mastic is sold for between € 100-125 / kg in the market based on its quality. Each three produces 60-250 grams. € 22,500 gross annual incomes from a hectare can be obtained assuming an average of 150 grams of the product received. This project is planned for calculating whether mastic cultivation is economical or not in regions like Çeşme, Urla and Karaburun, where land rent prices are high.

Research was conducted in Çeşme, Urla and Karaburun on the western part of Turkey. The province of İzmir is in the first socio-economic development group in Turkey. Aliağa town of İzmir is in the first development group, Çeşme, Urla, Karaburun, eleven other towns are in the second, six towns in the third, and only Kiraz town is in the fourth development group. There is no district in the fifth or sixth group (Figure 1). As it can be understood from this description, the study area is located in the upper rows in the socio-economic development scale in Turkey. Naturally, if the level of development increases, land rent also increases. In this case, the return of the project will be expected to be higher than the land rent.

1.1. Botanical characteristics of mastic trees

Pistacia lentiscus L. belongs to *Pistacia* genus of Anacardiaceae family of Sapindales section of the plant kingdom. Other important members of the same family are *Pistacia atlantica* (hackberry), *Pistacia terebinthus* (turpentine tree) and *Pistacia vera* (pistachio) (Nahida et al, 2012; ITIS, 2016). Mastic resin has been used as raw material from the leaves and fruits as a drug in many countries since the very old times.

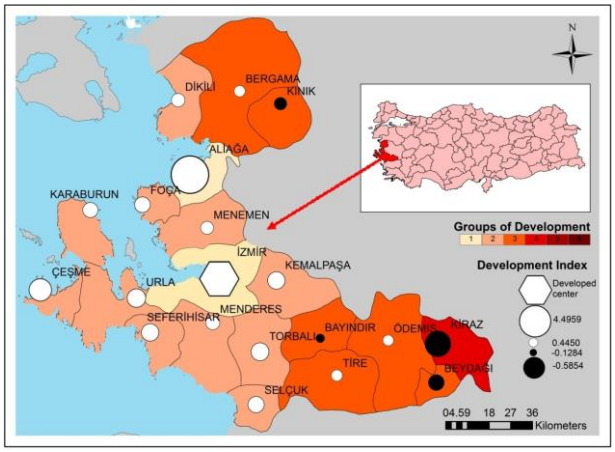

Figure 1. Socio-economic development situation of the regions in the study area.

Pistacia lentiscus is still an important raw material today in the pharmaceutical and food industries (Boztok, 2007). Mastic is a shrubby plant that can grow up to five meters and it has evergreen, long oval leaves. It is widely available in the sunny southern slopes of Chios Island of Greece, as well as Çeşme, Karaburun and Urla districts of İzmir. It has been reported that the *Pistacia lentiscus* L. var. *Chia* plant, whose resin is valuable, is a cultivar developed by selection rather than a variety (Padulosi et al., 1995). The naturally growing type in the region is not sufficient in terms of productivity. It is projected that budding on these trees may increase productivity.

Humanity has grown and protected the mastic tree since the day it discovered the uses of its resin. The information we have on mastic reaches back to Heredotus and Hippocrates (Browicz, 1987).

Economically, the resin secreted by male individuals is valuable. While females also secrete it, males are preferred while establishing plantations as resin of females is lower in quantity and quality. The plant starts secreting mastic from the age of 5-6. However, optimum production starts between the ages of 12 and 15. The trunk is dashed in the middle of summer and mastic is obtained.

1.2. The ecology of the mastic tree

Mastic tree spreads in the dry and hot regions in southern parts of the Chios Island (Browicz, 1987). It does not flourish under high groundwater levels as they prevent its roots from aeration; high groundwater levels may cause it to dry up (Perikos, 1993). These plants are usually seen in southern slopes in Chios on well-textured and calcareous soils (Theocharopouloset et al., 1996). It may reach up to 500 meters of altitude in humid southern slopes that are closed to the Northeast Wind, and its yield

decreases under temperatures that are too high or too low. Slope of the trunk and the branches to sunlight increases the yield of mastic (Parlak and Albayrak, 2011).

1.3. Usage areas of mastic

Mastic tree has a wide range of usage areas from protection of soil from erosion to food industry, and pharmaceuticals to cosmetics. Such plants are called multi-purpose plants (Deidda and Mulas, 2004). It is used especially in the Middle-East to protect teeth and gums, as well as achieve a fresh breath. It is also used in alcoholic beverages due to its aromatic properties. It is used in the arts to wax painting, as well as for medicinal purposes (Coppen, 1995). It is seen in the literature that mastic is widely used in medicine and pharmacy. It is used in dyspepsia treatment, against anti-atherogenic microbes, as an anti-mutagen, anti-oxidant, anti-fungal, against liver fattening, to treat wounds, as a hypotensive, anti-arthritis, and anti-gout (Nahida and Siddiqui, 2012). Some studies report positive outcomes by mastic oil in prevention and treatment of some types of cancer, as well as treatments for peptic ulcer and *helicobacter* (Chadzopulu et al., 2011)

Mastic tree may be economically utilized for an average of 50 years. Mastic tree, which has been produced in Chios for a very long time, has an important place in the economy of the island. The legislation in place in Greece contains provisions to control mastic production and market. In the hands of the producers' union in the island which has almost a monopoly in the world, mastic production has increased exponentially, therefore leading to growth in the island's economy.

1.4. Mastic production process

Chios is a small island in the Aegean Sea 8 km far from Çeşme coast of Turkey. Tourism, maritime and especially mastic production are important economic sectors in the island. The island has an 850 km^2 of land with 50 km of the longest length and 30 km of the widest width. The island has a mountainous geography and limited fresh water resources. The vegetation in the south of the island usually consists of mastic trees. The north is covered by *Pinus brutia*. Forests were considerable harmed in the forest fire on the island in 2012. Mastic production was under the control and supervision of the state also in periods of Ottoman rule. As the new generation prefers tourism and service sectors, there are concerns in the island regarding the future of mastic production.

Chios and the mentioned districts of İzmir were visited in order to see mastic production on the scene and converse with producers and local officials, and some information was collected. The following information was obtained as a result of meetings with the producers and local residents:

While most trees provide 250 grams of the product at most, a yield of 400-500 grams may be obtained per tree from the trees in the southern part of the island. Since 1997, the product has been categorized among the products of Protected Designation of Origin (PDO) by the EU. PDO is an indicator belonging to an agricultural product or food originating from a region, or exceptionally, a country. PDO is a protective measure defining a product whose quality or fundamental characteristics originate partly or entirely from a specific geographical region, natural conditions of that region and its human capital, or a product whose production, processing and preparation are achieved in the same region. This indicator not only certifies the quality of the product, but also provides price advantages against competitor products.

Mastic production technique has not changed a lot since the ancient times. As the mastic tree is a complacent species, it is able to continue its development in bad soil conditions, enduring dry environment. Some studies report that it is resistant against the salt in sea water. However, the tree is sensitive against cold and frost. Therefore, mastic trees are found rather on southern slopes that get abundant sunlight.

Locals describe mastic production like the following:

Mastic trees are pruned in winter months to give shape to the tree and collect the dripping resin easily. In the same periods, the area is superficially plowed. As the tree's roots are close to the surface, deep plowing is avoided. In the beginning of the summer, the area below the trees where the mastic will drip is levelled and the soil is compressed. In the next stage, in order to prevent the mastic from falling on the soil and losing its quality, calcium carbonate is spread under the tree (locals call it white soil) (Figure 2). In July, the trunk and thick branches are dashed in the length of 10-15 mm and depth of 2-3 mm. Based on the tree's age, 20-100 cuts are opened during 6-8 weeks. The mastic leaking from these cuts are dried on the white soil for up to 1 month. The dried drops of mastic are collected in the early hours of morning starting from the middle of August, and cleaned off dust and other impurities. They are stored in a dry and chilled environment in wide wooden containers. Drops remaining on the ground and the trunk of the tree are collected in the middle of September after the

weather cools down. Starting with November, cleaning of the drops is done by small knives with the contribution of family members, and the drops are washed. After this stage, products are handed to the Mastic Producers Union for sale.

Figure 2. Calcium carbonate is spread under the tree.

2. Materials and Methods

This study was conducted in Çeşme, Urla and Karaburun, which are western districts of the province of İzmir. The region was visited 4-5 times, the data to be used in economic analysis were collected and local residents and producers were interviewed in the years 2015-2016. Up to date costs were collected and availability of suitable land was investigated in order to calculate production costs in the field. With this purpose, cost factors such as m^2 or 1000 m^2 cost of the land to be used for production, land preparation, soil processing (by 1000 m^2) and fencing costs, per 1000 m^2 cost if there is a need for irrigation, fertilization costs, sapling cost and planting distance, and annual labor cost were collected.

Methods that account for the time value of money were used for the economic analysis. These methods are based on the principle of degrading future cash inputs and outputs down to today based on a certain rate of discount (Daşdemir, 2015, 2012; Türker, 2013; Gedik et al. 2005; Klemperer, 1996; Anbar and Alper, 2009). It was seen in the interviews with relevant people that they expected at least 20% annual profit from this investment. Therefore, the discount rate was taken as 20%. This investment would provide production for an average of 50 years. At the same time, the discount interest rate of the Central Bank of Republic of Turkey (CBRT) is 9% in the year of the study. This ratio was also used in the calculation.

In Discounted Payback Period Method, the values of cash inputs this project will provide during its life span discounted to the present based on a certain discount rate, is matched with the amount of investment. The year the discounted values are equal to the amount of investment gives the Payback Period (Anbar and Alper, 2009).

$$\sum_{t=0}^{n} \frac{C_t}{(1+k)^t} = \frac{NCI_{n+1}}{(1+k)^{n+1}} + \frac{NCI_{n+2}}{(1+k)^{n+2}} + \cdots$$

$$\sum_{t=0}^{n} \frac{NCI_t}{(1+k)^t} \geq 0 \rightarrow 0 = -C + \sum_{t=0}^{p} \frac{NCI}{(1+k)^t}$$

Formula 1: Discounted Payback Period Method

In this formula;
C: Investment Amount
NCI: Net Cash Input
k: Discount Rate
t: Time

This method provides more reasonable results in comparison to the Payback Period method that does not account for the time value of money.

Net present value and equivalent annual cost are two discounted cash flow criteria for comparing investment proposals (Jones and Smith, 1982; Daşdemir, 2012).

$$NPV = \frac{R_1}{(1+k)^1} + \frac{R_2}{(1+k)^2} + \cdots + \frac{R_n}{(1+k)^n} + \frac{S}{(1+k)^n} - I$$

$$= \sum_{t=1}^{n} \frac{R_t}{(1+k)^t} + \frac{S}{(1+k)^t} - I$$

Formula 2: Net Present Value (NPV) Method

Here;
R_1, R_2, … R_n = Net Revenues
k= Desired return rate or capital cost
I= Investment cost
n= Economic life-span of the investment
S= Salvage value.

Internal Rate of Return (IRR) Method is the ratio that equalizes cash inputs and outputs in a project. So, it is the discount ratio that makes the investment's NPV zero. The fundamental difference of IRR from NPV is, while cash inputs and outputs are degraded to a certain time in the NPV method using a certain discount rate taken as information, IRR method seeks the discount rate which equalizes the present values of cash inputs and outputs (Anbar and Alper, 2009, Daşdemir, 2012). Assuming a one-year completion time for a project, the formula is like the following:

$$I_0 = (\sum_{i=1}^{n} \frac{R_i}{(1+r)^i}) + \frac{S}{(1+r)^n}$$

Formula 3: Internal Rate of Return Method

Here;
r: Internal rate of return
I_0= Initial investment amount
n= Economic life-span of the project
R_i= The revenues the project will provide during its economic life-span
S= Salvage value of the project at the end of its economic life-span.

Depreciation was not calculated as no buildings or machines were projected for the project.

3. Results and Discussion

An investment has to be made firstly to start production in the study area and some costs should be accounted for in this investment, just like every other investment. In order to determine these costs, the production process was analyzed, management time of the tree was determined, and the costs and revenues for this time were calculated. We will analyze these under the sub-titles of costs and revenues below.

3.1. Production costs

3.1.1. Land cost

1000 m^2 prices of land in the study field, in districts of Urla and Çeşme are around 30-50 thousand TL. This amount is lower in Karaburun. The production will be made either in such lands, or in public property or forested lands in scope of special reforestation permits. Assuming in this study that the production will be made in agricultural areas, average hectare cost of land was taken as 400 thousand TL.

3.1.2. Field preparation and soil processing

Current digging cost for a field of one hectare for 50-60 cm digging and preparation of the place is 8000 TL. As the hoeing process by a tractor costs 3000 TL per hectare, the total soil preparation and processing costs become 11000 TL.

3.1.3. Fencing cost

Animal harm possibility of the mastic tree is low. Fenced mastic tree gardens were not seen in Chios. Therefore, this cost item was ignored in order to avoid increasing the costs.

3.1.4. Irrigation cost

One of the factors increasing success is the indispensable irrigation process in the first and second vegetation periods after plantation. There is no need for irrigation after this point. We did not see a garden with an installed irrigation system in Chios. In the first year, irrigation may be made once a week from April to the end of August, and it may be reduced to once in every ten days in the second year. Thus, 20 occasions of irrigation in the first year, and 15 in the second year will be sufficient. Irrigation will be made by a water tanker. As it will be done for two years during the time of management, digging a well is not economical. It is expected that a tanker of 10-12 tons will be able to irrigate a 1000 m^2 of land. As the ton of water costs 10 TL, the total cost of water will be 1000-1200 TL. As the tanker will be kept busy during irrigation, this cost item is projected to be around 2500 TL.

3.1.5. Sapling cost – planting distance

The planting interval was seen to be in the form of 2x7 m, 2x5 m, and 3x4 m in Chios. More frequent placement was seen in young stands, while less frequent plantation was seen in old stands. Planting the stand sparsely may be preferable as it increases mastic yield and allows placement of a second product between trees as an agroforestry implementation. However, this requires an economic analysis for a second product and is a subject of another study. In this study, planting interval was taken as 3x4 m. In this case, 825 saplings will be used per hectare. Saplings are sold in the island for 10-15 € / piece. They are sold for 80-100 TL / piece in our country, which makes the cost per 1000 m^2 for an average 90 TL / piece price 74,250 TL.

3.1.6. Labor

Labors costs should be assessed under three distinct categories in this production system. The first is the labor costs in the stage of establishment; the second is the annual costs of labor, and the third is the seasonal costs of labor. The highest labor costs are the ones in the stage of establishment. In this stage, labor costs will be born from preparation of soil, sapling plantation and irrigation. It was calculated that a total of 90 days and two workers will be needed in the stage of establishment. Current daily cost of one worker is 100 TL. In this case, 90x2x100 = 18,000 TL is the labor cost in the establishment stage. The second category of labor costs includes the cost of yearly maintenance and

product harvest. This will be done annually for a month by two workers. In this case 30x2x100 = 6,000 TL is the annual labor cost. While produce will start to come out by the sixth year, it was projected that the same cost will be born starting from the first year because of the increased intensity of maintenance in these periods. Third labor cost item is pruning costs. Pruning is recommended for once every six years in order to achieve formation of the tree, reach of sunlight to trunks and ease of working with the tree for trees that are prone to dead wooding. The first pruning will be done in the sixth year where the product will be received, and it will be repeated every six years from there on. The pruning process may be dealt with in a week by a worker who is an expert in this subject. Thus, pruning labor cost is around 1,000 TL for once every six years.

3.2. Revenues

The fundamental revenue of this project is the annual revenue that will be received from the mastic starting with the sixth year. It is reported in the literature that each tree provides 60-250 grams of product annually. It was previously stated that 400-500 grams may be reached in southern slopes and good site index in the island. It is stated by producers that 300-400 grams have been reached in trial productions in the Çeşme area. In this study, it will be assumed that 300 grams of product will be received from each tree. It was previously calculated that there are 825 trees in a hectare. Accordingly, cash flow accounts are shown in Table 1.

Table 1. Cash flow of the project.

	Revenue (TL/year/1000 m^2)	Costs (TL/year/1000 m^2)
Harvest revenue	81,000	
Salvage value#	6,000	
Land cost		400,000 (only in establishment)
Field preparation		11000 (only in establishment)
Irrigation		2500+2500 (first two years)
Sapling cost		74250 (at start of each period)
Labor		
Establishment stage		18000 (at start of each period)
Annual labor		6000 (starting with 6th year)
Pruning		1000 (once in every 6 years)

Value of the wood obtained at the end of the time of management.

In this case 825x300 = 247500 grams, that is, 248 kg of product will be obtained from a hectare of land. These products are called *pitta, teardrop, small teardrop* based on their sizes. On average, every 100 grams contain 11 grams of *pitta*, 27 grams of *teardrop*, and 62 grams of *small teardrop* (Anonymous, Undated). As the quality and price of the product changes based on its size, the product price was taken as 100 € / kg, whereas the market prices are between 100 and 125 €. Price by kg sometimes reaches up to 180 € in Chios based on demand. It may be projected that the price will partly drop when production starts in our county and the supply increases in competition with the products of Chios. Therefore, the price was preferred in the lower limit of 100 € / kg. 24,800 € revenue by 1000 m^2 will be achieved in this price point. The value of this product is around 81,000 TL in the current exchange rate. At the end of the time of management, during the reforestation of the stand, wood will also be obtained. An average of 25-30 tons of wood is obtained from 825 trees with a diameter of 20 cm. The value of this wood is 5000-6000 TL with market prices.

Total costs in the beginning of the period amount to 490 thousand TL. Net annual revenue was calculated to be 75 thousand TL (74 thousand TL with pruning costs every 6 years), and the net present value was calculated as 374,455.97 TL with the discount rate of 20%. (Table 2). This amount is calculated for the minimum profitability expectation of 20%. Net Present Value is calculated 820,752 TL for CBRT Interest Rate of 9%.

Table 2. Cumulative sum of cash flows based on the discounted payback period method.

Years	NCI	PV of 1 i=20%	PV of NCIs	NCI Cumulative Sum
1	75000	0.833	62500	
2	75000	0.694	52083	114583
3	75000	0.579	43403	157986
4	75000	0.482	36169	194155
5	75000	0.402	30141	224296
6	74000	0.335	24782	249078
7	75000	0.279	20931	270009
8	75000	0.233	17443	287452
9	75000	0.194	14536	301988
10	75000	0.162	12113	314101
11	75000	0.135	10094	324195
12	74000	0.112	8300	332495
13	75000	0.093	7010	339505
14	75000	0.078	5841	345346
15	75000	0.065	4868	350214
16	75000	0.054	4057	354271
17	75000	0.045	3380	357651
18	75000	0.038	2780	360431
19	74000	0.031	2316	362747
20	75000	0.026	1956	364703
45	75000	0.000	21	..
46	75000	0.000	17	..
47	75000	0.000	14	..
48	75000	0.000	12	..
49	74000	0.000	10	..
50	75000	0.000	8	374456

NCI: Net Cash Input, PV: Present Value

Mastic growing is a traditional way of production that had been followed for long years in the study area of western districts of İzmir until the beginning of the century. This production style was interrupted as a result of international political developments in the beginning of the century, and now production does not exist in almost anywhere in our country. There are recent attempts by the Ministry, civil society organizations like TEMA and local initiatives towards pursuing this production in the region. As the market prices, demand and added value of mastic products are high, some scientific studies are being conducted in order to increase the prosperity of local residents by producing this tree from the slip. However, there are no studies focusing on the economic analysis of this production form. Land rent is considerably high as the region has an economy based generally on tourism. Therefore, it is important to investigate whether mastic production is economical or not according to alternative usage forms, in order to use resources economically and efficiently.

According to the calculations made, the total costs to be considered in the beginning of the period would be 490 thousand TL; net annual revenue would be 75 thousand TL (74 thousand TL considering the pruning costs every 6 years), and net present value with 20% discount rate would be 374,455.97 TL. Net Present Value is calculated 820,752 TL for CBRT Interest Rate of 9%. On the other hand, according to the calculation made using the internal rate of return method, the IRR was found to be 15%. According to the Discounted Payback Period method, it was determined that the investment cannot reach its break-even point during its economic life-span.

Although NPV seems to be acceptable for 9% (820,752 >490,000) producers will not accept 9% as they expect at least 20% profitability. Moreover the IRR must be at least 15% as mentioned above. Consequently, in the analyses conducted for the districts of Çeşme, Urla and Karaburun, which are the fields of research here, it was seen that mastic production in the region is not economically feasible as the Net Present Value was found negative (374,456 TL <490,000 TL) and the Internal Rate of Return was found lower than expected.

4. Conclusions

The mastic product attracts demand in the international market as a product with a high added value. As the producers in Chios in Greece, which may be counted as the only producer in the world, are well-organized, and the rules of both production and marketing are heavily regulated by the Producers Union, the island's position of monopoly in mastic production continued up to our day. Therefore, it may be argued that there is a price of monopoly conditions on the product. As spreading this production style in neighbor country will increase the supply of the product, a decrease in prices may be expected because of the disruption of the monopolistic production form of Chios. Increasing supply with a constant demand in competition conditions leads to a decrease in price. In this case, it should be expected that the existing prices will fall after producing mastic in Turkey. The product prices used in this study were current prices. Therefore, the calculations were made using current prices. Even in the current conditions, investment is not economical due to the high land rent in the regions that are the field of study. This is because there is no possibility to decrease the cost of land, which is the highest cost item, due to the tourism activities in the region. It may be argued that land rent will decrease as we move from the coast to the inner areas. However, this will be ignored due to two reasons. Firstly, forest areas start from the coastal areas to the inner regions. Secondly, mastic tree does not grow on every altitude and slopes because of its ecological requirements. Mastic production has a risk of new forest clearing or over utilization of forests.

Acknowledgement

This Project supported by the Scientific Research Projects Unit of Çankırı Karatekin University. Project Number: OF171215B36.

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