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PINE RESIN SECTOR IN PORTUGAL – WEAKNESSES AND CHALLENGES

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Abstract

In the past, Portugal was an important producer and exporter of crude resin (pine oleoresin) obtained from living trees. The main species used as a source of Portuguese naval stores until today is *Pinus pinaster* Ait., one of the most productive resin species. With the increase of labour costs in the forest, the international market competition from China and Brazil and the occurrence of severe forest fires, the importance of both resin yield and industry has sharply diminished. Despite of the decrease of *Pinus pinaster* area in last decades, this species still holds an important position in Portuguese forest – 885,019 ha, according to the last National Forest Inventory (NFI). In European Union (EU), Portugal remains one of the few countries with the capacity to supply and fulfil the special needs of some industries: for instance turpentine for perfumery and rosin for the manufacturing of tyres. In the present paper we estimated the potential yield capacity of the Portuguese maritime pine forest based on the NFI data, and made a summarized SWOT analysis, having in mind the weaknesses and the virtues of the remaining resin economic sector.

Key words: gum naval stores, pine resin industry, resin yield, SWOT analysis.

Introduction

Portugal was an important producer and exporter of pine oleoresin, with yields higher than 100,000 tonnes per year before 1980 (CESE 1996). As an example, in 1987 Portugal exported 110000 tonnes of naval stores with a total value of 61,000,000 USD (Leite and Morais 1988). Several factors determined the decline of this activity, namely the rise of labour power costs in Europe, concurrence of China and Brazil raw materials, wide occurrence of forest fires, which affected particularly the age structure of pine stands, and the lack of technological innovation in pine tapping operations.

Despite these setbacks, the growing demands of the world market and the European in particular, the need to maintain rural employment and avoid desertification, together with the resin sector growth potential in Portugal, require a suitable development of naval stores production. Therefore, it is important to assess the potential resin yield of Portuguese maritime pine forest. In this paper all the estimations were based on data from the most recent National Forest Inventory (NFI).

Characterization of Portuguese Forest

The Portugal mainland forest area is about 39 % of the mainland territory. According to the NFI data (AFN 2010), pure and mixed dominant stands of maritime pine occupy an area of 885,019 ha which is 28 % of the mainland total forest area.

Along the years considered in Table 1, in spite of the existence of changes in strata classification criteria as well as differences in the chronological series for different species (Sardinha et al. 1994), several considerations can be done about the evolution of forest stands area.

Thus, the analysis of available data from 1874 to 2005 shows a steady increase of the pine and cork oak until 1974. However, since 1974 the forest area has not increased significantly – only 4.6 %, and on the contrary, in the last ten years (from 1995 to 2005) there was a slight decrease of forest stands area, from 3,201,131 ha to 3,175,348 ha.

Even more worrying, however, is the strong decrease in maritime pine areas,

Table 1. Evolution of forest stands area in Portugal Mainland in the last 125 years (1874–2005), (1000 ha).

Year	*Pinus pinaster*	*Quercus suber*	*Quercus rotundifolia*	*Quercus* spp.	*Castanea sativa*	*Eucalyptus* spp.	*Pinus pinea*	Other species	Total
1874 (1)	210.0	370.0	–	60.0	–	–	–	–	640.0
1902	430.2	366.0	416.7	47.0	84.0	–	–	612.6	1956.5
1928	1131.6	559.7	380.0	107.9	85.2	–	–	67.0	2331.4
1934	1139.2	740.6	380.0	108.0	85.2	–	–	67.0	2520.0
1939	1161.0	690.0	360.0	108.0	80.0	–	–	68.0	2467.0
1956 (2)	1253.7	648.6	615.3	132.0	–	58.0	–	55.3	2762.9
1966 (3)	1287.6	636.8	578.6	–	25.6	98.9	–	164.3	2791.8
1974	1299.0	680.4	534.4	67.8	30.2	243.1	–	181.7	3036.6
1985	1248.6	659.8	464.2	85.7	32.1	386.2	–	209.0	3085.6
1990	1252.3	664.0	464.7	112.1	31.1	385.8	–	198.2	3108.2
1995	976.1	712.8	461.6	130.9	40.6	672.0	77.7	129.4	3201.1
2005	885.0	715.9	412.9	150.0	30.0	739.5	130.4	111.6	3175.3

(Azevedo 1996, DGF 2001, AFN 2010)

(1) *Pinus pinaster* stratum includes also other pines; *Quercus suber* stratum includes *Quercus rotundifolia* stands, and *Quercus* spp. stratum includes *Castanea sativa* stands.
(2) *Castanea sativa* stands were included in *Quercus* spp. stratum.
(3) *Quercus* spp. stands and another species were included in Other species stratum.

about 32 %, during the last 30 years, as shown on Figure 1.

On the other hand, since 1956 the area of eucalyptus stands, which until then had no significant value, started increasing rapidly (since the 1960s until now about 650 %).

It should be also emphasized that although forest land in Portugal suffered over the years several changes, during the last 30 years its global area stabilized slightly over 3,000,000 ha, mostly due to the replacement of conifers (mainly *Pinus pinaster*) by fast-growing broadleaves (mainly *Eucalyptus globulus*).

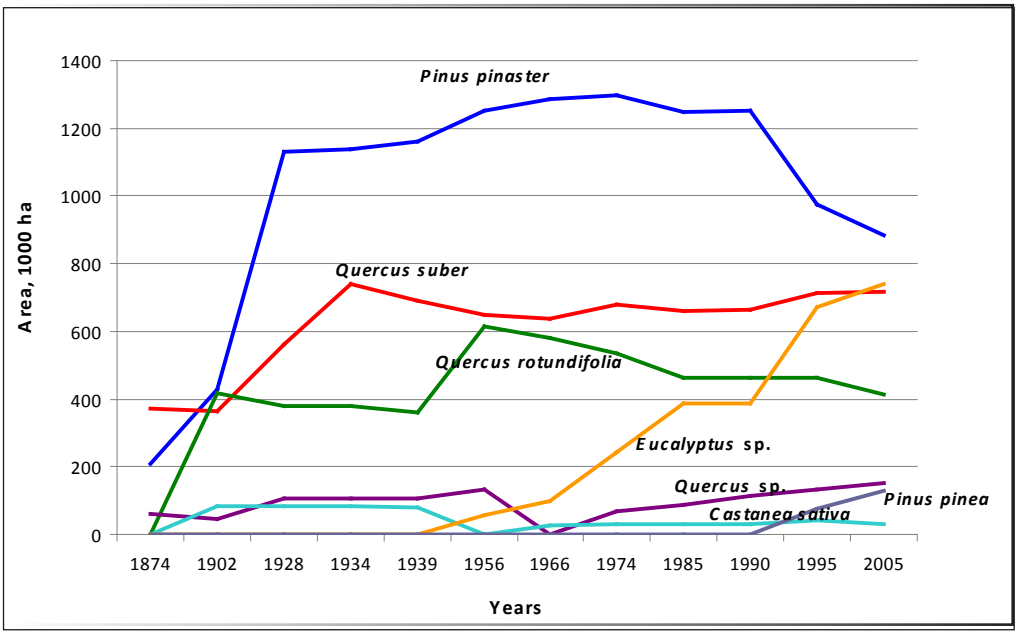

Fig. 1. Evolution of land occupation by forest species in Portugal mainland.

Table 2. Forest land ownership structure (1000 ha).

Forest land ownnership	1980	%	2005	%
Private forests	2629.5	85	2318.0	73
Industrial owners	185.5	6	317.5	10
Communities and other owners	202.1	7	349.3	11
			95.3	3
State forests	68.1	2	95.3	3
Total	3085.2	100	3175.3	100

(IPF 1991 & Barreiro et al. 2010)

Concerning forest land ownership (Table 2), the structure remained nearly unchanged since 1980: 85 % of the forest land in Portugal was under private ownership, while the State forests only attained 2 %. This fact made Portugal one of the EU countries with the lowest public forest area and has been an obstacle for an adequate management of the forest territories, including resin yield planning and improvement. Nowadays the situation is basically the

same, with the fraction detained by the industrial owners rising from 6 % to 10 %.

Evolution of Oleoresin Yield and Trade Balance of Naval Stores in Portugal

As mentioned above, until 1980 Portugal had oleoresin yields higher than 100,000 tonnes per year. However, the evolution of oleoresin yields since 1985 (Figure 2) shows that the yield decreased heavily, to less than 50,000 tonnes until 1990, and further on the reduction continued reaching extremely low values. Nowadays, according to estimates of the industrial sector, the yield is stabilized at a very low level, around 5,000 tonnes per year.

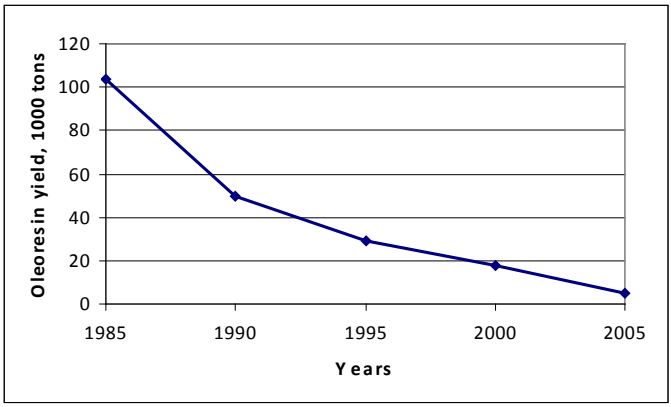

Fig. 2. Evolution of oleoresin yield in Portugal (INE 2010).

In the past resin products represented around 10 % of the forest sub-sector exports in value; however, until 2005 this fraction decreased sharply to 1 %.

Figure 3 shows the evolution of import/export balance of Portuguese naval stores in the last years.

During the last 30 years of the 20th century, resin products as a whole contributed positively to the import/export balance. However, this situation was reversed from 2005 on. Nevertheless for some of those products, for instance turpentine and rosin derivatives, the exportation trend is increasing.

Evaluation of the Potential Area for Resin Tapping

The collecting of resin is generally performed on mature trees, mainly *Pinus pinaster*, in pure or dominant stands, thus excluding young trees. That is the reason why the area of maritime pine considered for tapping – 826,075 ha, in the calculations below is lower than the one referred in Table 1 – 885,019 ha.

According to Portuguese law, resin tapping can only begin when the tree

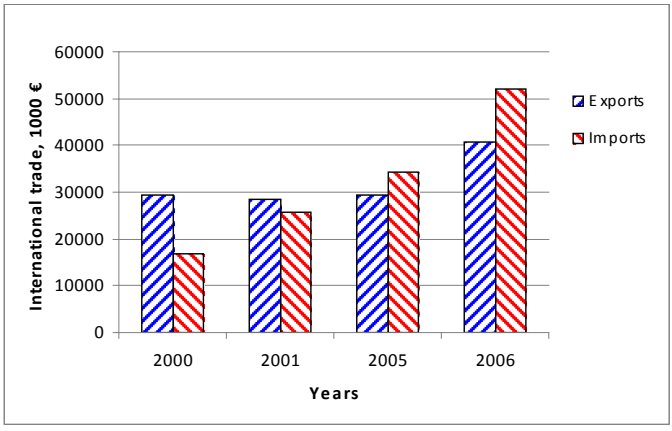

Fig. 3. Evolution of international trade of Portuguese naval stores (DGF 2003; DGRF 2005, 2007).

reaches minimum DBH of 25.5 cm. Two tapping regimes are possible: long term tapping, which begins early in the life of the tree and takes place until final cut, and tapping before final cut, which occurs only in the last 3–4 years before final cut.

In order to estimate the potential oleoresin yield from maritime pine forest in Portugal the following assumptions were considered:

– Total potential area for resin tapping was the area occupied by the trees with the appropriate diameter for exploitation (i.e., more than 25.5 cm);

– Yields per tree from 1 to 4 kg of oleoresin (these values were obtained in tapping essays which took place previously);

– Densities compatible with good or regular conditions for oleoresin production: in pure stands 200, 300 and 400 trees per hectare, and in mixed dominant stands, according to medium stand density (AFN 2010), about 63 % of those values;

– Two tapping scenarios, a less[1] and a more intensive one[2].

According to the more recent NFI, the total area of maritime pine stands, for long term and before final cut tapping is 66,609 ha for pure stands and 15,038 ha for mixed dominant. However, the estimations based on the assumptions referred above show potential resin tapping areas considerably higher in both scenarios (Table 3).

Estimation of the potential areas for tapping together with all possible combinations of both variables, yield per tree and stand density, lead to the following boundaries for potential resin yield in Portugal mainland (Table 4).

Table 3. Area of maritime pine stands for tapping, estimated for scenarios 1 and 2; tapped area according to NFI 2010.

Stand Composition	Tapping (maritime pine)				
	Scenario 1		Scenario 2		NFI 2010
	long term	before final cut	long term	before final cut	
Pure, ha	55412.1	18854.3	87329.8	41541.5	66609.0
Mixed dominant, ha	15745.3	9593.3	23300.5	16499.8	15038.0

Three percentages of potential area were considered to calculate different potential resin yields. It can be stated that for 30 % class of potential area, some values are very low. However, considering 50 % class, most values are already acceptable to assure a stronger economic resin sector, namely in long term tapping. In fact, during the golden years of resin tapping, when Portugal was responsible for the greatest values of resin yield, the area submitted to exploitation was about 50 % of the total pine forest area.

SWOT Analysis: an Approach

A summarized SWOT analysis was performed in order to identify both strengths

[1] Trees with DBH 30–39 cm in “long term tapping” and tapping “before final cut” with DBH>40 cm.

[2] Trees with DBH 25.5–34 cm in “long term tapping” and tapping “before final cut” with DBH>35 cm.

Table 4. Potential resin yield in Portugal mainland, tonnes.

Potential area, %	Tapping regime	Less intensive (1)		More intensive (2)	
		min	max	min	max
100 %	Long term tapping	26108	156646	40767	244600
	Tapping before final cut	4972	39776	10374	82994
50 %	Long term tapping	13054	78323	20383	122300
	Tapping before final cut	2486	19888	5187	41497
30 %	Long term tapping	7832	46994	12230	73380
	Tapping before final cut	1492	11933	3112	24898

and weaknesses of the resin sector and to point out the available opportunities and existing threats on the external environment.

Key pieces of information were grouped into two main categories: *strengths* and *weaknesses* (internal factors to the organization) – personnel, finance, manufacturing capabilities; *opportunities* and *threats* (presented by the external environment) – macroeconomic matters, technological change, legislation and socio-cultural changes (Détrie 1993). An inventory of most relevant factors and trends which frame this activity was made, based on official statistical data and knowledge of agents interviewed in a previous work (Palma 2008).

Oleoresin Production in the Field

Forest fires, leading to a deep unbalanced age and dimensional structure of pine stands in Portugal mainland, together with Pine Wilt Disease (*Bursaphelenchus xylophilus*) incidence, have diminished the area suitable for resin tapping.

Resin collecting is a very labour-intensive activity, which became unsustainable along the years because of the rising costs of field labour and the high prices of pine stands hiring[3]. Along the years no technological advances were achieved in resin tapping operations: the work is very hard, requiring specific skills and there are few workers available to perform it (Coppen and Hone 1995). As a result, cost prices of the national raw material are very often higher than those of imported gum rosin or turpentine.

World Production and Markets

China is by far the biggest world producer, consumer and exporter of gum naval stores – it is responsible for 70 % of the world production and controls efficiently the world market and prices. As a result of this price fluctuation, the industry undergoes cyclical instabilities.

Obviously Portugal as a small produc-

[3] Pine stands are usually hired for tapping at high prices. There is, obviously, a conflict of interests between landowners and industry, landowners want to preserve wood quality and the resin industry wants to maximize resin yield.

er does not control the market and cannot guarantee the supply of its own internal demands. Import from China and Brazil is imperative to fulfil the demands of the established industry.

However, for some specific purposes chemical industry still prefers Portuguese turpentine and rosin, based on specific quality requirements.

The main destinations for Portuguese gum resin exports are European countries: Germany, Italy, Spain, Switzerland, France and United Kingdom.

Industry and its Condition

Human resources in the sector have a low level of training but have a good knowledge of the resin products.

The total number of plants for oleoresin manufacturing in Portugal is very low and still decreasing. Currently there are 17: six for first transformation (rosin and turpentine) and the other eleven for derivatives (Anastácio and Carvalho 2008). The two types of plants are very different. The first ones are generally small, with a weak financial structure and low productivity and technological conditions. The second ones are considerably larger and are equipped with modern technology, making them competitive in markets with growing quality demands.

Tables 5 and 6 summarize the issues related to SWOT analysis.

Final Comments

As written above, the yield capacity of Portugal for gum naval stores suffered a strong blow, but the existing pine forests still have the potential to increase significantly oleoresin production.

In addition, there is a growing demand of these products in the world, particularly

Table 5. SWOT Matrix: Strengths and weaknesses.

STRENGTHS	WEAKNESSES
➢ High quality and specificity of the raw material	❖ Small dimension of companies, with inadequate equipments
➢ Contribution to increasing the profits of forest owners	❖ Non-solved environmental issues (pollution problems)
➢ Maintenance of rural employment combined with prevention of forest fires	❖ Low manpower qualification
➢ Resin tapping of a high productive species, *Pinus pinaster*	❖ Absence of suitable trade chains; strong dependence on external intermediaries
	❖ Low innovation capacity (no efforts to mechanize resin tapping)
	❖ Under exploitation of pine stands

Table 6. SWOT Matrix: Opportunities and threats.

OPPORTUNITIES	THREATS
➢ Growing apprehension of consumers with environmental concerns: resin products are natural and renewable ➢ Raising price of crude ➢ Spanish interest in maintaining the Iberian resin sector (efforts to develop new mechanized resin tapping devices) ➢ Existence of modern plants for manufacture of oleoresin derivatives; establishment of links between them and resin workers and first transformation operators ➢ New products outcome (insecticides and wood preservatives)	❖ Existence and emergence of substitutes for traditional uses of gum resin products ❖ Absence of guaranteed prices for the raw material oleoresin (marked price fluctuation during a season) ❖ Excess of punitive laws in the present crisis context, leading to manpower drain

in Europe. For instance, the recent raising value of gum turpentine as a result of the increased demand may lead to a stimulation of the resin sector as a whole. A positive factor is also the interest and efforts of Spain to develop a mechanized system for both resin tapping and collecting, in order to maintain and expand their resin sector.

The present economic crisis may also contribute to an increased interest in oleoresin exploitation. Although the unemployment is the main cause for this interest, we should point out one of the most important virtues of the resin tapping activity: it maintains rural employment avoiding desertification, and hence preventing the rising impact of forest fires.

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