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Economic analysis of alternatives for second rotations in *Eucalyptus globulus* plantations in southeast Uruguay

Análisis económico de alternativas para la segunda rotación en plantaciones de *Eucalyptus globulus* en el sureste de Uruguay

Análise econômica de alternativas para a segunda rotação em plantações de *Eucalyptus globulus* no sudeste do Uruguai

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Abstract

Eucalyptus globulus is one of the most planted forest species in Uruguay. However, its high susceptibility to diseases has determined that in recent years most plantations reaching harvest are replaced by other species, mainly *E. dunnii* and *E. smithii*. The decision whether to maintain the plantation for an additional rotation as coppice crop or to carry out a replanting depends on the expected economic results of both alternatives. Therefore, the objective of this research was to estimate the profitability of a coppice crop of *E. globulus* and that of a new plantation, with two different species, *E. dunnii* and *E. smithii*. In addition, a sensitivity analysis was carried out to study the impact of eventual variations in plantation productivity, in distance to the point of sale, and in the price of wood. Results showed that the three alternatives analyzed are economically viable, but that the management as coppice crop and the replanting with *E. smithii* are more profitable than replanting with *E. dunnii*. On the other hand, the coppice management is the alternative that requires less investment and that presents fewer risks, since it is less sensitive to changes in the main variables that determine the economic result.

Keywords: financial analysis, coppice, replanting

Resumen

Eucalyptus globulus es una de las especies forestales más plantadas en Uruguay. Sin embargo, su alta susceptibilidad a enfermedades ha provocado que en los últimos años la mayoría de las plantaciones que llegan a la cosecha son reemplazadas por otras especies, principalmente por *E. dunnii* y *E. smithii*. La decisión de mantener la plantación para una rotación adicional como rebrotes o de realizar una replantación depende del resultado económico esperado para ambas alternativas. Por lo tanto, el objetivo de este trabajo fue comparar la rentabilidad esperada en la siguiente rotación para el manejo de rebrotes de *E. globulus* y para la replantación con dos especies diferentes, *E. dunnii* y *E. smithii*. A su vez, se realizó un análisis de sensibilidad para estudiar el impacto de eventuales variaciones en la productividad de la plantación, en la distancia al punto de venta y en el precio de la madera. Los resultados obtenidos mostraron que las tres alternativas analizadas son económicamente viables, pero que el manejo de rebrotes y la replantación con *E. smithii* son más rentables que la replantación con *E. dunnii*. Por otro lado, el manejo de rebrotes es la alternativa que requiere menor inversión y que presenta menores riesgos, ya que es menos sensible frente a cambios en las principales variables que determinan el resultado económico.

Palabras clave: análisis financiero, rebrotes, replantación

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Resumo

O *Eucalyptus globulus* é uma das espécies florestais mais plantadas no Uruguai. No entanto, sua alta suscetibilidade a doenças fez com que nos últimos anos a maioria das plantações que chegam à colheita sejam substituídas por outras espécies, principalmente por *E. dunnii* e *E. smithii*. A decisão de manter a plantação para rotação adicional como brotos ou para replantar depende do resultado econômico esperado para ambas alternativas. Portanto, o objetivo deste trabalho foi comparar a lucratividade esperada na próxima rotação para o manejo de rebrotas de *E. globulus* e para o replantio com duas espécies diferentes, *E. dunnii* e *E. smithii*. Paralelamente, foi realizada uma análise de sensibilidade para estudar o impacto de eventuais variações na produtividade da plantação, na distância até o ponto de venda e no preço da madeira. Os resultados obtidos mostraram que as três alternativas analisadas são economicamente viáveis, mas que o manejo das brotações e o replantio com *E. smithii* são mais lucrativos do que o replantio com *E. dunnii*. Por outro lado, o manejo de rebrota é a alternativa que requer menos investimento e apresenta menos riscos, por ser menos sensível a mudanças nas principais variáveis que determinam o resultado econômico.

Palavras-chave: análise financeira, rebrota, replantio

1. Introduction

Species of the genus *Eucalyptus* have a great capacity for regeneration after harvesting. This capacity is due to the presence of adventitious shoots, as well as lignotubers at the base of the tree, which allow a second rotation managing the sprouts. *Eucalyptus globulus* shows good sprout capacity, with percentages ranging from 67% to 93%[1-3]. The productivity of the plantation as coppice crop depends on the survival of the stumps and their subsequent growth rate. According to Hamilton[4], the stock of resprouted stumps must be above 75%, otherwise replanting should be considered. Schönau[5] suggests that there should be a minimum stock of 1000 viable stumps per hectare for a successful crop. According to this author, with an adequate stock of stumps, a yield similar to the original plantation can be obtained, which represents a very attractive production alternative given the elimination of regeneration costs. A study by Drake and others[6] comparing the physiology of shoots with seed plantations of *E. globulus* showed that the large amount of biomass underground from the original tree provides the shoots with a greater reserve and a greater supply of nutrients, allowing a vigorous early growth of sprouts.

Some authors have studied the economic profitability of managing eucalypts for a second rotation as a coppice crop in relation to the alternative of replanting, considering not only the initial investment, but other factors as the increase in volume due to the use of improved seedlings or clones[7-9]. Wittock and others[7] report that productivity is one of the main factors that impact the economic results and that to obtain Net Present Values (NPV) in seedling crops similar to that of coppice crops, an increase in wood production of 20 to 25% is required. When comparing the alternative of managing the coppice with that of replanting with hybrid clones of *E. grandis* × *E. urophylla* in South Africa, Crous and Burger[8] concluded that the coppice crop is an attractive option since it only requires a low initial investment. However, each case should be considered individually as the problem is not only related to costs but also to the productivity and commercial value of both alternatives.

Wood production in Uruguay is based on commercial plantations for industrial purposes. Currently, there are approximately one million hectares of commercial forests, mainly with species of the genus *Eucalyptus* (approximately 80%) and *Pinus* (close to 20%)[10]. In 2019, the most exported forest products were cellulose and wood chips, worth 1.52 billion and 102 million US dollars (USD), respectively[11]. Although Uruguay has exported wood chips of *E. globulus* to Spain and Japan, since 2011, the main export destination has been Portugal, being in recent years its principal supplier of eucalypt wood. *E. globulus* was the most planted species in Uruguay, with 309,000 hectares in 2013[12]. However, in recent years, due to its lack of adaptation and high susceptibility to pests and diseases, it was restricted to the southeast of the country. More recently, due to the severe foliar damage caused by *Teratosphaeria nubilosa*, the species began to be replaced by *E. dunnii* and *E. smithii*[13]. Despite the aforementioned, due to its high-quality wood for kraft pulp and different types of paper[14-15], the high value of the wood, and the high demand in the international market[16], there are still about 149,000 hectares of *E. globulus* in the country[10].

In Uruguay, the wood of eucalypts has two main destinations: local pulp mills, located in the west of the country, and chipping mills for export, located near Montevideo port. The pulp production capacity in Uruguay began to develop in 2007 when the Botnia pulp mill, owned by Finnish investors (currently UPM), began operating. Then, in 2012, the pulp mill Montes del Plata, a joint venture between the Swedish-Finnish company Stora Enso and the Chilean

company Arauco, began operating. Nowadays, the total capacity of pulp production is 2.7 million tons per year, and by 2022 it should be increased to 4.8 million tons when a second UPM mill comes into operation.

While the local pulp mills are owned by large vertically integrated companies with their own plantations, mainly of *E. grandis* and *E. dunnii*, the chipping mills are owned by groups of small and medium-sized producers of *E. globulus*. Therefore, growing a species that gives access to external market is especially important for many foresters of the southeast region whose plantations are significantly closer to Montevideo port than to the local pulp mills. For this reason and taking advantage of the regrowth capacity that eucalypt trees have after being harvested, many foresters prefer to keep the species in the next rotation as a coppice crop rather than replanting with another species. Another reason to prefer the coppice crop is that this alternative has considerably lower costs than replanting. However, when the plantation in the first rotation reaches the harvest age with low population and/or it is damaged by pests or diseases, it is necessary to replant to obtain good productivity in the next rotation.

In summary, the decision to keep the plantation in the next rotation as a coppice crop or to replant will depend mainly on expected yields, production costs, and wood prices. For this reason, the aim of this work was to estimate the expected profit for a coppice crop of *E. globulus* and for new plantations with the most used replacing species, *E. dunnii* and *E. smithii*. In turn, to evaluate deviations from the assumptions considered, a sensitivity analysis was performed for the factors that determine the most important costs and income: yields, distance to the market, and wood prices.

2. Materials and methods

2.1 Study area and investment alternatives

The area of influence of the study is the southeast region of Uruguay (departments of Canelones, Maldonado, Rocha, Lavalleja and Florida). This region was traditionally afforested with *E. globulus*, but nowadays other species, mainly *E. dunnii* and *E. smithii*, are used to reforest *E. globulus* plantations after harvest. In Uruguay, the wood of *E. globulus* is mainly exported for pulp production, as roundwood or as wood chips. *E. smithii* has similar characteristics to *E. globulus* in terms of wood quality and cellulose yields, and market studies have determined that its wood has the same demand and can be sold at the same price (Alberto Rodríguez, pers. comm.). In contrast, the wood of *E. dunnii*, which is also used primarily for pulp production, generally has no external market, being sold only at local pulp mills. Therefore, three reinvestment alternatives for forestry companies with plantations of *E. globulus* that reach harvest were evaluated: the management of a new rotation as a coppice crop, the reforestation with *E. smithii*, and the reforestation with *E. dunnii*.

2.2 Capital budgeting analysis and sensitivity analysis

Investment returns were calculated using capital budgeting techniques for representative forest management regimes and sites to compare average current conditions. The land cost was not considered because the study is intended for forest owners who need to make reinvestment decisions. For the same reason, the analyzes were carried out for the effectively forested area. For the three alternatives, cash flows were set in which the harvest of the existing *E. globulus* plantation was assumed as the beginning of year 0 and that the replanting alternatives were carried out in that year. The average rotation for commercial eucalypt plantations in the study region is 11 years, so this rotation was assumed for all alternatives. The income was the sale of wood either to pulp mills or chips mills.

In eucalypts commercial plantations, sprouts are usually managed for no more than one or two rotations because productivity decreases after each rotation. In this research, the first rotation was the same for all scenarios; therefore it was not considered in the analysis. In the second rotation of the three alternatives analyzed, it was assumed that after harvest the sprouts are managed by an additional rotation. For this reason, the NPV was calculated for two rotations (second and third). For the third rotation, a decrease in the mean annual increment (MAI) of 30% in *E. globulus* and 20% in the coppice crop of the replanting alternatives was assumed.

The NPV for each management regime includes growth rates, base production costs, and wood prices in 2020. The NPV, defined as the difference between the present value of income and the present value of costs over a period[17], was calculated as:

$$NPV = \sum_{t=1}^{T} \left(\frac{It - Ct}{(1+i)^t} \right) - I_0 \qquad (1)$$

Where: T = time horizon of the investment; t = period; It = gross income in time t; Ct = cost in time t; i = interest rate; I_0 = initial investment.

As returns of forestry investments are always subject to uncertainty, a sensitivity analysis was conducted. Given that *E. smithii* and *E. dunnii* are recently used species in the study area, their productivity is not well known yet, and therefore scenarios with different productivities were considered. In addition, the distance to the market can also vary significantly compared to the baseline scenario, where the plantation was assumed to be in the center of the study area. Finally, a variation in roundwood prices was also analyzed as they can change due to market dynamics. Therefore, for the sensitivity analysis the normal ranges of operation for each variable were used: a variation (increase and decrease) of 10% and 20% in forest yields; a variation of 50 and 100 km of distance to market, and a variation of 5% and 10% in roundwood prices. The returns of each investment alternative were analyzed using a discount rate of 8%, which is commonly used in forest investment analysis[18].

2.3 Data

Data on silviculture and production costs for the selected alternatives were obtained from a survey to forestry companies (see Supplementary material, Table S1). Questionnaires were sent to the forest managers of three companies (Grupo Forestal, Iberpapel and Forestal Atlántico Sur) and of a group of associated foresters (Foresur), which represent around 45% of the total planted area of *E. globulus*. The questionnaire included a short explanation of the information required, including values of normal ranges of forest productivity, production costs, distance to market, and roundwood prices. After analyzing the answers, a second questionnaire was sent requesting acceptance of the average data obtained.

2.3.1 Production costs

Average production costs for each alternative were used in the capital budgeting analyses (Table 1). Some costs, as those of administration, harvesting and loading, and construction of roads, were the same for all alternatives. Other costs, such as silviculture, wood transport and taxes, varied for the different alternatives evaluated.

Silviculture costs considered for the management as coppice crop were stump uncovering (removal of crop residues left on the stumps), ant control, and sprout thinning. The costs for replanting alternatives included the establishment costs (soil preparation, herbicide application, seedlings, fertilization, and planting), and the costs of post-planting weed and ant control. The transportation cost for *E. globulus* and *E. smithii* wood was calculated for an average distance to Montevideo (exporting port) of 180 km, and for *E. dunnii* for an average distance to Conchillas, Colonia (where Montes del Plata, the closest local pulp mill, is located), of 360 km. Most taxes are the same to all alternatives, but there is an income tax, the economic activities income tax (IRAE in Spanish), which applies only to new plantations and not to coppice crops of plantations established before 2007. The IRAE is paid when the wood is sold and represents 25% of the stumpage value, i. e., the value of timber minus the costs of harvesting and transportation. Although other productive costs, such as planting costs, can also be deducted from this tax, in this study only harvest and transportation costs were considered as deductions for the IRAE calculation.

Table 1. Average production costs of different alternatives for the next rotation of *E. globulus* plantations in southeast Uruguay

Coppice crop of *E. globulus*		Cost (USD/ha)	Year
Ant control and stump uncovering		130	0
Sprout thinning		150	3
Reforestation alternatives		**Cost (USD/ha)**	**Year**
New planting with *E. smithii*		1250	0
New planting with *E. dunnii*		1200	0
Post-planting ant and weed control		200	1
IRAE tax		25% of stumpage value	11
All alternatives		**Cost (USD/ha)**	**Year**
Road construction		150	11
Administration		30	Annual
Other taxes		10	Annual
INIA tax		0,4% of stumpage value	11
Harvest and load	Volume	Cost (USD/m³)	11
	Up to 145 m³/ha	21	
	146 to 165 m³/ha	20	
	166 to 180 m³/ha	19	
	More than 180 m³/ha	17	
Transportation	Distance	Cost (USD/m³/km)	11
	0 to 200 km	0,084	
	More than 200 km	0,066	

2.3.2 Growth rates

The expected yields for reforestation alternatives were also obtained from the survey to forest managers. For both *E. smithii* and *E. dunnii*, a mean annual increment (MAI) of 22 m³/ha/year (cubic meters per hectare, per year) was used for the baseline scenario. For the management of *E. globulus* coppice, and according to the study by Gasparri[1], a

MAI of 12.1 m³/ha/year was used for the next rotation (Table 2).

Table 2. Growth rates, distance to market, roundwood price and NPV for each alternative in the baseline scenario

Reinvestment alternative	Growth rate (m³/ha/year)	Distance to market (km)	Wood price (USD/m³)	NPV (USD/ha)
E. globulus coppice crop	12.1	180	63	1060
Replanting with *E. smithii*	22.0	180	63	1070
Replanting with *E. dunnii*	22.0	360	62	137

2.3.3 Roundwood prices

The price used for *E. globulus* roundwood was 63 USD/m³, that is, the price at Montevideo port. The same price was used for *E. smithii*, since although a market price is not yet available, forestry companies expect to obtain the same price as for *E. globulus*. For the baseline scenario of *E. dunnii*, around wood price of 62 USD/m³ was used. This is the average delivered price at Montes del Plata, the closest pulp mill to the study area (the possibility of exporting the wood of *E. dunnii* was not considered because the external market is very occasional).

3. Results

3.1 Baseline scenario

The three alternatives analyzed showed positive NPV at the 8% discount rate (Table 2). The coppice crop and the replanting with *E. smithii* have similar NPV, while replanting with *E. dunnii* shows lower NPV. The coppice management has considerably lower costs, both for implantation and taxes, but it has lower productivity than replanting alternatives. Between the latter, the main difference is the distance to the point of sale of the wood, and therefore the cost of transportation, which in *E. smithii* is lower than for *E. dunnii*.

3.2 Sensitivity analysis

The sensitivity analysis showed that both the management of the *E. globulus* coppice and the replanting with *E. smithii* are economically profitable even if the productivity of the plantation is 20% lower than that estimated for the baseline scenario. Instead, replanting with *E. dunnii* presents negative NPV in poor sites when MAI is at least 10% lower than in the baseline analysis (Figure 1).

If roundwood prices fell by 10%, the alternatives of coppice crop and replanting with *E. smithii* would remain profitable (Figure 2). In contrast, if roundwood prices are 5% lower than in the baseline scenario, the replanting alternative with *E. dunnii* is no longer profitable. For unfavorable price scenarios, the coppice crop management is the most profitable alternative, but if roundwood prices increase more than 5% with respect to the baseline price, the most profitable alternative becomes replanting with *E. smithii*.

Regarding distances to the market, for the alternatives of coppice management and replanting with *E. smithii*, an average of 180 km was considered in the baseline scenario. The results suggest that even with a transport distance 100 km longer than in the baseline scenario, both alternatives are still profitable (Figure 3). On the other hand, if the distance to market is shorter than in the baseline scenario, the relative profitability may change. In fact, when transport distance is less than 130 km, the replanting with *E. smithii* will be more profitable than coppicing. For the alternative of replanting with *E. dunnii*, a transport distance of 360 km was assumed for the baseline scenario. When longer distances are considered, this alternative is no longer profitable.

Figure 1. Sensitivity analysis: changes in yield (MAI +/- 10%, +/-20%) in the three alternatives

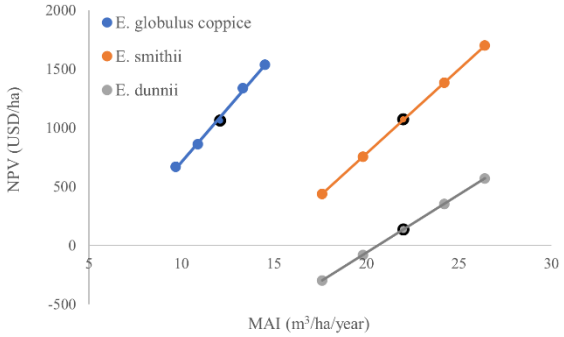


Figure 2. Sensitivity analysis: changes in wood price (+/- 5%, +/- 10%) in the three alternatives

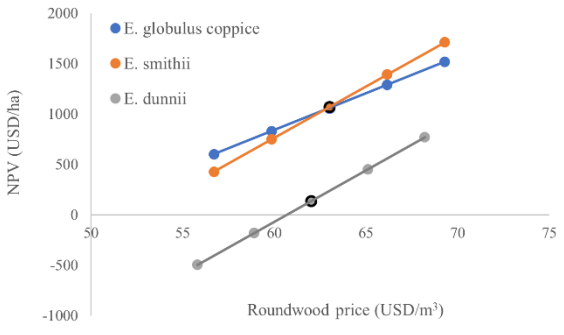
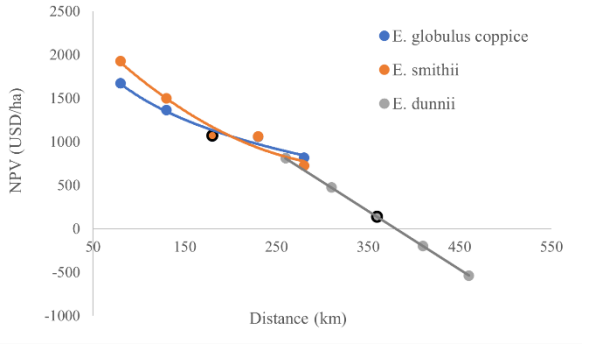


Figure 3. Sensitivity analysis: changes in distance to market (+/- 50 km, +/- 100km) in the three alternatives



3.3 Breakeven values

The breakeven values for plantation productivity, roundwood price, and distance to market, that is, the situations in which the NPV is equal to zero, are presented in Table 3. The alternative of coppice crop would have positive profitability even if its MAI were as low as 5.54 m³/ha/year, and the replanting alternatives would still have positive profitability if the MAI were at least 15.54 m³/ha/year for *E. smithii* and 20.61 m³/ha/year for *E. dunnii*.

Table 3. Breakeven values (NPV = 0) for MAI, timber price and distance to market for each reinvestment alternative

Variable	*E. globulus* coppice crop	Replanting with *E. smithii*	Replanting with *E. dunnii*
MAI (m³/ha/year)	5.54	15.54	20.61
Wood price (USD/m³)	48.43	52.51	60.66
Distance to market (km)	450	388	380

In relation to roundwood prices, the alternative of coppice crop management will be profitable if the price does not decrease below 48.43 USD/m³ (Table 3). Replanting with *E. smithii* requires a minimum price of 52.51 USD/m³ to be profitable. Finally, in the alternative of replanting with *E. dunnii* the wood price should reach a minimum of 60.66 USD/m³, which is close to the expected market price.

Finally, the management of coppice remains profitable even when the distance to the market increases 270 km compared to the baseline scenario, that is, up to 450 km (Table 3). Replanting with *E. dunnii* is again the alternative with the lowest margin, since if the distance to the market increases by more than 28 km, it shows a negative NPV. Replanting with *E. smithii* is no longer profitable when the distance to the market increases more than 200 km.

4. Discussion

The study aims to help forest owners make reinvestment decisions in their plantations before harvest. For this reason, the cost of land was not considered in the analysis and, therefore, the results do not remunerate the use of land in any of the alternatives considered.

In the baseline scenario, replanting with *E. smithii* has similar profitability than the management of coppice, even when costs and taxes are much higher. This is explained by the higher productivity assumed for *E. smithii*, which almost doubles the productivity expected for the coppice of *E. globulus*, that is, 22.0 and 12.1 m³/ha/year, respectively. In other words, the higher income made from the sale of *E. smithii* timber offsets the higher costs of this alternative. In contrast, the low profitability expected for replanting with *E. dunnii* is due to the fact that the wood of this species generally has no external market, so it must be sold to local pulp mills. As plantations are located on average 360 km from the nearest pulp mill and 180 km from Montevideo, this alternative has a considerably higher cost of wood transport than the other two alternatives. In addition, the *E. dunnii* roundwood price (USD 62/m³) is slightly lower than the price of *E. globulus* and *E. smithii* roundwood (USD 63/m³). The sensitivity analysis demonstrated that the impact of eventual variations in plantation productivity, in distance to the point of sale, and in the wood price is substantially higher for the alternative of replanting with *E. dunnii* than for the other two alternatives. In fact, although *E. dunnii* generally has good productivity, replanting with this species will have negative profitability in scenarios with small reductions in productivity or in wood price, or with a small increase in the transport distance. By contrast, if there were a permanent external market for this species, with a value of wood similar to that of the local market, the reduction in transportation cost would have a very positive impact on its profitability.

The main disadvantage of replanting alternatives, compared to coppice management, is the high initial investment required for crop implantation (soil preparation, seedlings, planting, etc.). The impact of the initial investment on the economic return could be reduced with shorter production cycles. However, a 2-year advance in the harvest age generated minimal changes in profitability (data not shown). In the case of Uruguay, the IRAE is another disadvantage of replanting alternatives as it represents a considerable reduction of income, becoming an important

factor to consider when deciding between replanting and coppice management. *E. dunnii* and *E. smithii* are the species more used to replace *E. globulus* plantations, but both present some uncertainties. *E. smithii* is a species of recent use in the country and although its wood has similar properties to that of *E. globulus*, both forest yields and wood markets remain to be confirmed. On the other hand, *E. dunnii* has high productivity and its wood has strong demand from local pulp mills. However, since usually there is no external demand for its wood, the price is lower than that of *E. globulus* and the cost of transportation is considerably higher because the distance from plantations to the pulp mills is greater than from plantations to the port of Montevideo.

Most of the roundwood of *E. globulus* produced in Uruguay is exported to Spain and Portugal, which can be considered a market niche. Although the price of pulpwood should follow the price of cellulose, the export price of *E. globulus* wood has been stable for more than 20 years. On the other hand, *E. smithii* is a recently planted species in Uruguay, and although local foresters expect to obtain the same price as of *E. globulus* roundwood, the export price is still uncertain. In the case of *E. dunnii*, the price of roundwood in Uruguay is determined by the demand of the local market, that is, it varies according to the local demand. Given that both pulp mills, UPM and Montes del Plata, have their own plantations, it is expected that in the medium or long term they will become self-sufficient and therefore the price of *E. dunnii* wood will fall.

The management as coppice crop has an additional advantage for foresters in the southeastern Uruguay, such as the maintenance of *E. globulus* plantations and therefore the access to external markets. This advantage translates into lower transport costs and attractive prices for roundwood. The latter is of great importance for this subsector since the export price is a reference price for roundwood in the local market, allowing foresters to negotiate the wood price with the pulp mills.

5. Conclusions

This research shows that for commercial plantations of *E. globulus* in the southeast of Uruguay both the management of coppice and the replanting with *E. smithii* are economically profitable alternatives for a new rotation in all the scenarios analyzed. By contrast, replanting with *E. dunnii* presents low NPV and they become negative when there are even small unfavorable changes in the main productive variables. The management as coppice crop is the alternative that requires the least initial investment and the one that presents less sensitivity to changes in productive variables, since it supports higher variations in productivity, production costs and wood price than the replanting alternatives.

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Transparency of data

Available data: The entire data set that supports the results of this study was published in the article itself.

Author contribution statement

GB conceived and designed the analysis; PG collected the data and performed the analysis; VMO contributed to data analysis. All authors contributed equally to writing the manuscript.

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Supplementary material

Table S1. Survey form sent to each company inquiring about the productive costs and the year in which each one is executed

A. Coppice crop of *E. globulus*	Cost	Year
Ant control (USD/ha)		
Stump uncovering (USD/ha)		
Sprout thinning (USD/ha)		
Administration (USD/ha)		
Harvest and load (USD/m^3)		
Wood transportation (USD/m^3)		
Road construction (USD/ha)		
Taxes (USD/ha)		
B. Reforestation with *E. smithii*		
Soil preparation (USD/ha)		
Planting (USD/ha)		
Post planting maintenance (USD/ha)		
Administration (USD/ha)		
Harvest and load (USD/m^3)		
Wood transportation (USD/m^3)		
Road construction (USD/ha)		
Taxes (USD/ha)		
C. Reforestation with *E. dunnii*		
Soil preparation (USD/ha)		
Planting (USD/ha)		
Post planting maintenance (USD/ha)		
Administration (USD/ha)		
Harvest and load (USD/m^3)		
Wood transportation (USD/m^3)		
Road construction (USD/ha)		
Taxes (USD/ha)		

Please, state the costs of each management or productive activity (in USD per effective hectare of plantation or in USD per m^3 of wood produced), and the year or years in which each cost is executed, for the different productive alternatives considered for the next rotation.