Which stand development scenario is more suitable for maritime pine stands management in centre inland of Portugal?

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Introduction

Production efficiency is greatest at lowest stocking densities that achieves full use of the site potential for timber production. However, in practice, others factors such as, timber quality, price assumptions, harvesting costs, risk of wind throw and regeneration options, also need to be considered at the time during the rotation when determining desired stocking density (Skovsgaard and Vanclay, 2008).

In this study, the working hypothesis was to test if stand management using prescriptions that led to an under stocked stand situation were the more suitable in terms of merchantable yield and economic efficiency for maritime pine stands management in centre inland of Portugal.

Materials and methods

Seven silvicultural alternative scenarios, for three levels of site index (low - SI_{50}=15, medium - SI_{50}=18 and high - SI_{50}=21) were considered :

S1 - stand prescription from Louro et al. (2002), wood production oriented - initial stand density of 1100 trees per hectare, commercial thinning at 15, 20 and 35 years and cutover at 45 years;

S2 - stand prescription from Oliveira (1999) - initial stand density of 3000 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*Fw* between 0.25 to 0.28) and cutover at 45-50 years accordingly to site inde;

S3 - stand prescription from Alves (1975) - initial stand density of 5000 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*Fw* around 0.20) and cutover at 45-50 years accordingly to site index;

S4 - initial stand density of 5000 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*CCF* around 100%) and cutover at 45-50 years accordingly to site index;

S5 - initial stand density of 1100 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*c*(*SDI*) around 0.58) and cutover at 45-50 years accordingly to site index;

S6 - initial stand density of 1100 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*c*(*SDI*) around 0.26) and cutover at 45-50 years accordingly to site index;

S7 - stand prescription from Oliveira (1985) - initial stand density between 1800 to 2700 trees per hectare, commercial thinning at 15-20, 20-25 and 35-40 years (*Fw* around 0.27) and cutover at 45-50 years accordingly to site index.

•Total and merchantable yield - e.g. round wood (*Vround*) diameter>20 cm, pulp wood (*Vpulp*) diameter between 20-7 cm and fuel wood (*Vfuel*) diameter<7 cm - along rotation and mean annual increment (*MAI*) at rotation age were simulated using the diameter class growth and yield model PBRAVO.

• Thinning grade was assessed using the following stand density indices: crown competition factor (*CCF*), stand density index (*SDI*) and Wilson´s factor (*Fw*).

• Revenue received obtained from sale of standing timber, in the year of 2005, was estimated.

• Cost paid for stand establishment (site preparation, plantation) and treatments (release, precommercial thinnings and prunning), in the year of 2005, was also estimated:

- S1, S5, S6 and S7, due to stand spacing and round wood production goal, artificial regeneration through plantation were considered and therefore costs for site preparation, plantation, release and pruning were include in the analysis.

-S2, S3 and S4, due to high stand densities and pulp or poles wood production goal, natural regeneration were considered, only the costs for two precommercial thinnings to reduce stand density were include in the analysis.

• A cash-flow was simulated and economic efficiency was assessed for each scenario using the internal rate of return (*IRR*) at rotation age.

Results

It can be seen that scenarios that led to a fully stocked stand situation resulted in the highest value for stand yield, mean annual increment and pulp wood yield. Scenarios that resulted in under stocked stand situations were among the ones of higher round wood yield (Fig. 1, 2 and 3).

Best economic efficiency were found in scenarios combining high initial stand densities obtained from natural regeneration and cultural treatments that resulted in high stand stocking level (Fig. 4).

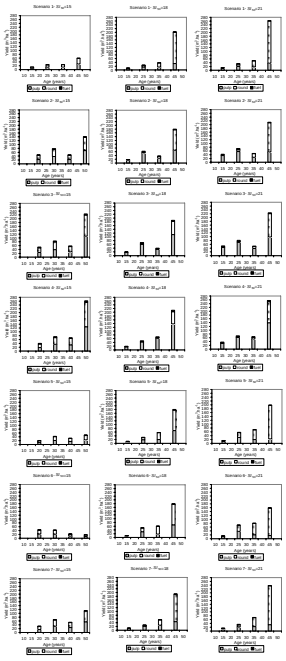

Figure 1. Scenarios - trees per hectare, commercial thinning and final harvest yield stand and stocking after thinning along rotation

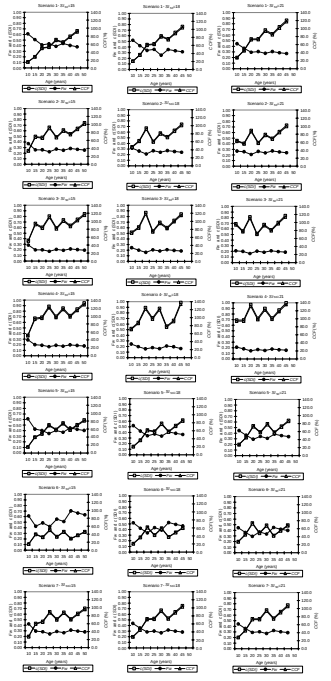

Figure 2. Scenarios - Stocking after thinning along rotation

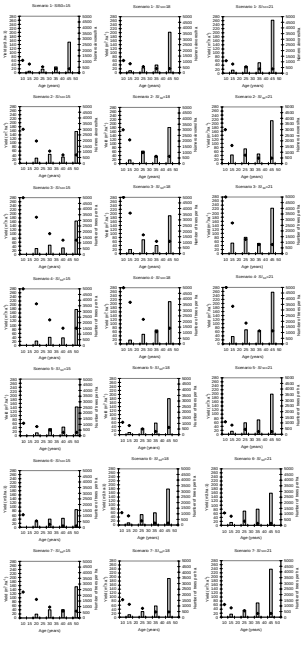

Figure 3. Scenarios - merchantable commercial thinning and final harvest yield along rotation

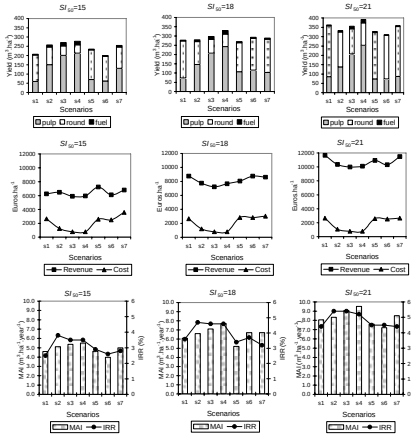

Figure 4. Scenarios - total stand merchantable yield, income and cost at cutover age, mean annual increment (MAI) at 45 years and internal rate of return (IRR) at cutover age.

Discussion

This research suggests that, if natural regeneration ensures initial high stand density, then stand prescriptions leading to a fully stocked situation (e.g. scenario S4) should be an option, since is the closer situation to reality and provides the best economic efficiency. But, if low initial stand density are observed then stand prescriptions such as explored in scenarios S1, S5 or S6 should be used, providing a more diversified wood products. The findings of this study, on assessing stand total and merchantable yield and economic efficiency of different alternative stand prescriptions, are important contributions to support technical advisory in the hard mission of encourages private owners to engage forest management.

References

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