Development of cubing tariffs for some coniferous species of Canton Takerma

Because of its great plasticity and indifference to the nature of the substrate, Aleppo pine forms the backbone of the main plantations in Morocco. It is among the first species used in reforestation in Morocco (Azeba, 1981). This choice implies protection of the sloping soil against erosion and a modest production of lumber and industry that the country needs. As for the Canary pine, it is a potentially more productive species and occupies only a very limited place in reforestation. In terms of development, studies relating to these two species remain disparate and do not concern all the plantations.

When they reach the age of exploitation, the Aleppo pine and Canary pine stands are subdivided into exploitation lots and sold without in-depth knowledge of the potential of the area or of the appropriate methods to ensure the viability and continuity of the pine forests. In addition, responsible managers do not have the tools for decision-making and long-term forest development control.

It is within this framework that the present study of the Takerma perimeter falls under the objective of evaluating the current state of the Aleppo pine and Canary pine stands of the said perimeter through the construction of volume tariffs. Also, this study seeks to study the effect of mixing on the productivity of Aleppo pine.

The Takerma forest, subject of this study, is located about 15 km north of Meknes, and covers an area of 1,000 ha. The forest comes from reforestation based on several species: Pinus halepensis, Pinus canariensis, Pinus brutia, Pinus pinea, Cupressus and eucalyptus etc.

Figure 1: Location of the city of Meknes in the map of Morocco

To study the different stand types, the latter were stratified on the basis of their composition (pure / mixed stands) and the age of the plantations (Class I: 53-57 years; Class II: 58-62 years; Class III: 63-67 years). A total of 6 strata were the subject of this study, where we distributed proportionally to the area of each stratum a number of 100 circular plots of 3 ares in a random stratified manner

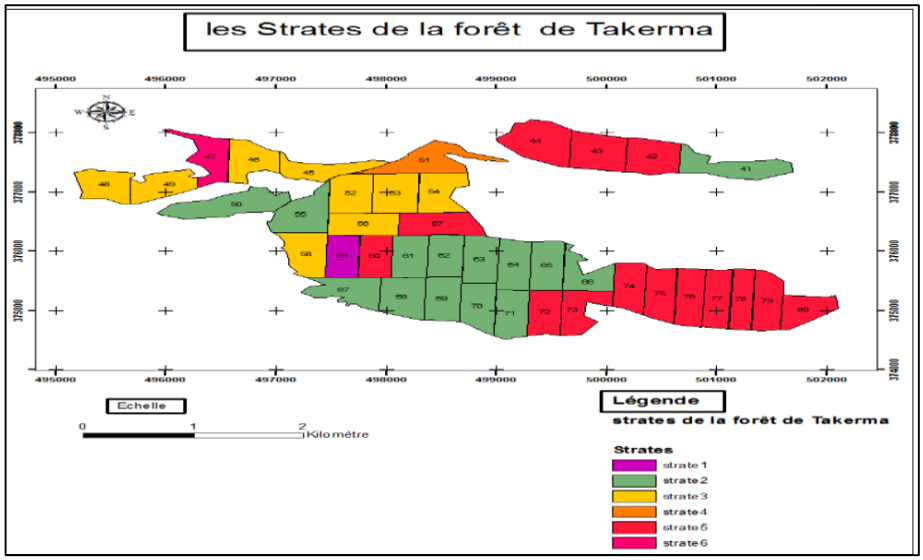

Figure 2 : Strata of Takerma Forest

To meet the objectives of this study, four types of descriptors were collected at the level of each plot. The physiographic descriptors which describe the site, the edaphic descriptors, the floristic vegetation and the inventory of the stand by: Measure the circumference at 1.30 m from all trees, Measurement of the circumference of the stumps of all cut trees and measurement by the RD1000 Criterion, of the diameter at different levels and of the total height of the largest tree, the medium tree and the smallest tree in the plot. Given that the precision and reliability of a cubing tariff is closely linked to the representativeness of the samples in relation to the structure of the stands (Parde, 1957). In our study, we paid great attention to the structures of Aleppo pine stands, which were constructed on the basis of a sample of the 100 plots inventoried within the stands in question, for a total of 290 individuals. A total of 140 sample trees of known volumes were used for the construction of the tariffs and a set of 23 test trees were used for their validation. For the construction of the Canary Pine cubing tariffs, we selected a sample of 50 trees. These tariffs were validated on a test sample of 10 trees. The graphical representation of the curves is presented in figure 3.

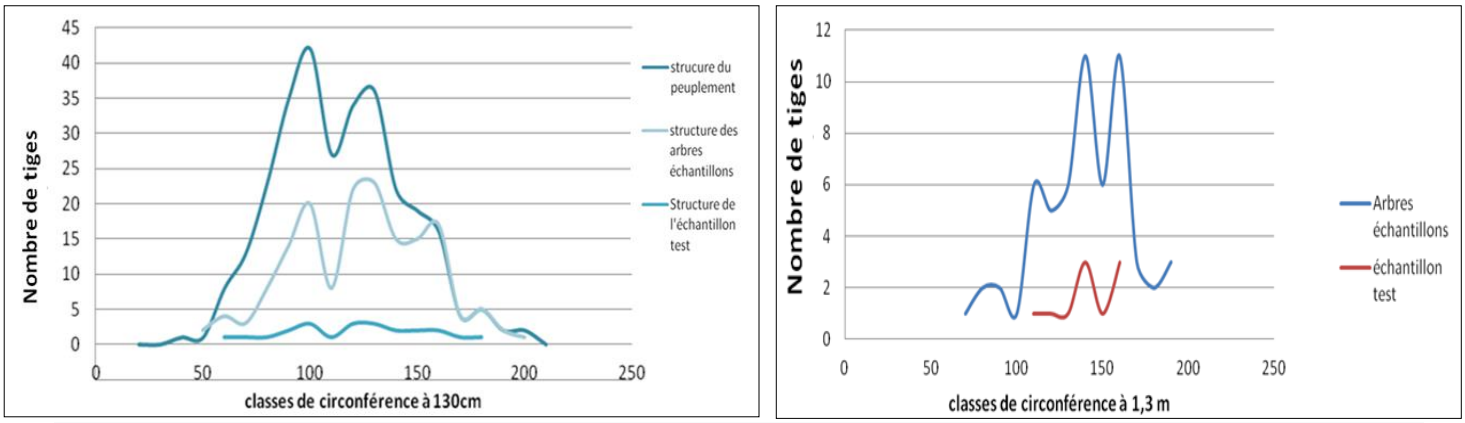

Figure 3 : Structure of the stand, sample trees and test trees (Aleppo pine on the left, Canary pine on the right)

The distribution is bimodal, and the structure of the sample trees retained for the development of the cubage tariffs is close to that of the main stand.

The structure of the test sample is also similar to that of the trees used for the development of the cubing tariffs.

The volume was calculated by the Smalian formula applied to the logs that form the log, and in order to have an estimate of the volumes, several cubage rates were adjusted. The double entry models which gave the best satisfaction with regard to the selected criteria are presented in Table 1.

Table 1: Double entry regression equations for Aleppo pine and Canary pine

List of models	R^2	$\overline{R^2}$	$\widehat{\sigma r}$	d	AIC	BIC
Aleppo pine $= -2,867.10^{-1} + 6,2.10^{-3}C - 2,991.10^{-5}C^2 + 2,911.10^{-6}HC^2$	**0,90**	**0,90**	**0,13**	**1,79**	**-165,28**	**- 150,57**
Canary pine $= 7,798.10^{-6}\ (HC^2)^{0,9395}$	**83,64**		**0,305**	**1,83**	**25,99**	**31,72**

Also models with only one entry were drawn up for the studied species, the best are presented at the table 2.

Table 2 : Single-entry regression equations for Aleppo pine and Canary pine

List of models	R^2	$\overline{R^2}$	$\widehat{\sigma r}$	d	AIC	BIC
Aleppo pine $= 4,672.10^{-5}C^2$	**0,96**	**0,96**	**0,18**	**2,14**	**-78,94**	**-73,06**
Canary pine $= 1,009.10^{-5}C^{2,462}$	**0,89**		**0,38**	**2,02**	**50,32**	**56,06**

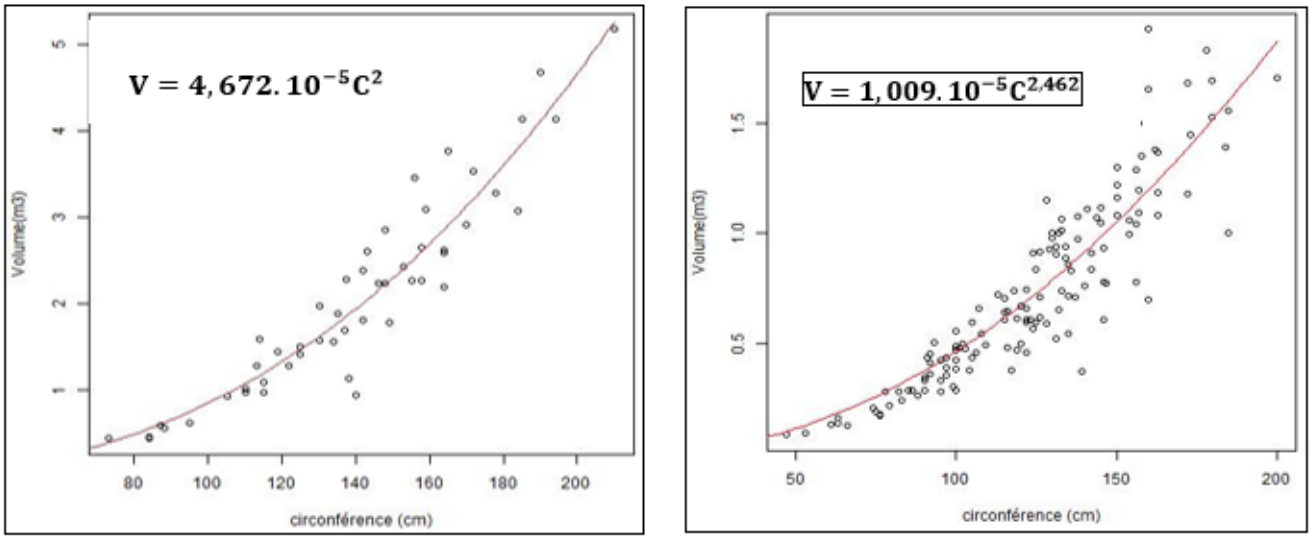

Figure 4: Curve of the single-entry scaling tariff model for Aleppo pine and Canary pine.

In order to study the effect of the mixture on the timber production of Aleppo pine. We compared the mean volumes of trees from pure stands with those in mixture. The populations are located in identical environments of the Takerma perimeter. So we used the Student test to compare the volumes produced in the two stands.

The result of the Student test, t_{obs} is equal to 0.551; compared to the theoretical risk value of 5%, (t = 0.556), it is possible to admit that there is no effect of the mixture : the competition between the two pins is not obvious. The same result was published by Oecologia volume 135, pages299–303 (2003) where a group of researchers composed of Montserrat Vilà, Jordi Vayreda, Carles Gracia and Joan Josep worked on the same theme and demonstrated the same results.

The objective of this study is to assess the current state of Aleppo pine and Canary pine stands of the Takerma canton, through the study of production and productivity. To do this, we first characterized the stand structures, samples and test samples for the two species. We then developed two types of cubing tariffs: a double-entry cubic tariff which allows the accurate prediction of the volume of trees, and a single-entry tariff mainly for landscaping. The cubing tariffs used were validated by the data from the test samples. Comparison of the volumes of Aleppo pine in pure and mixed stands showed that mixing of species has no effect on timber production ; the Aleppo pine, a rustic species, withstands competition from its neighbors.