AN ECONOMIC ANALYSIS OF PLANTING CHINA FIR IN TAIWAN

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JEN, I-A. 1992. An economic analysis of planting China fir in Taiwan. The mean internal rate of return (IRR) on China fir plantation in Taiwan at the end of the first 15-year rotation was determined by Hert'z method, a computer-based capital investment risk analysis procedure, to be 5.8% with standard deviation of 2.9%. The cumulative probability of obtaining an IRR greater than 3% (the government secured loan rate) is 82%. Thus there is some potential for making a profit from planting China fir in Taiwan, if one can secure loan from government only.

Key words: China fir - 15-y rotation - cumulative probability - IRR

Introduction

China fir (*Cunninghamia lanceolata*) is a commercial tree species in Taiwan, growing especially in the lower elevation area in the island. It was introduced from mainland China more than two hundred years ago. Risk from disease and insect is not so high like other introduced tree species (Jen 1988). Planting of this and other tree species has been significantly reduced during the past ten years due to increase in plantation cost and decrease in timber price; 45,000 m^3 of it were cut in 1988 (China fir is a key species for traditional tree farmers in this island). With this decrease in planting activity of the tree, many timber producers and foresters in Taiwan are concerned about its future. The government tries to reduce the rate for silvicultural secured loan to a lower level of 3% per *annum* in order to encourage tree farmers to grow trees. But still, there is little increase in China fir plantations. Tree farmers still consider the rate as too high. The purpose of this paper is to present an economic analysis of planting China fir in Taiwan.

Economic analysis of China fir plantation

To evaluate the investment potential of China fir plantation, cost and yield information was collected and analysed from 48 China fir plantations. The economic analysis was carried out in four steps: (1) estimation of planting cost; (2) estimation of yield; (3) estimation of stumpage price; (4) calculation of the rate of return on investment. These data were analysed to obtain the probability of occurrence for varying establishment cost, stand yield and stumpage price. Based on probability distribution for these factors, Monte Carlo simulation of the rate of return for investment potential was carried out following Hertz's method of risk

assessment of investment. The formula to calculate the rate of return with a 15-y harvest period is:

$$(1+R)^{15} = \frac{FVI}{PVG}$$

where R : the rate of return; FVI : the stumpage value at age 15; PVC : the present value of plantation cost.

The computer programme to calcutate the rate of return and its distribution is a modified version of the programme published by Engelhard and Anderson (1982).

Probability distribution of the plantation establishment cost

The plantation establishment cost can be divided into seven parts, that is site preparation, planting, replanting, first weeding, second weeding, third weeding and fourth weeding costs. Since weed grows very fast in the tropics, at least four times weeding needs to be practised during the planting period. A brackdown of the establishment costs based on the 48 plantations surveyed is given in Table 1.

Table 1. Plantation establishments per hectare for China fir

Type of cost	Percentage of cost (%)	Range of cost ($)
Site preparation	25	1568 - 1960
	46	784 - 1529
	29	392 - 745
Planting	29	1019 - 2549
	40	784 - 980
	31	235 - 745
Replanting	4	627 - 1176
	48	235 - 588
	48	0 - 196
1st weeding	33	1803 - 3529
	27	823 - 1529
	40	329 - 1176
2nd weeding	36	1568 - 3137
	43	823 - 1529
	21	392 - 784
3rd weeding	14	1219 - 2749
	65	627 - 1176
	21	392 - 588
4th weeding	25	823 - 1764
	50	431 - 784
	25	239 - 392

Probability distribution of the stand volume

Stand yield for plantations ranged from 60 to 240 m^3 ha^{-1}. Nine percent of the plantations had a yield between 170.1 to 240 m^3 ha^{-1} at age 15. Fifty-eight percent

of the plantations had a yield between 110.1 to 170 m^3 ha^1 and 33% of the plantations a yield between 60 to 110 m^3 ha^1 at this age.

Probability distribution of stumpage price

It is quite difficult to predict future prices. However, stumpage price is closely related to timber price. Stumpage price of China fir was found to be related to its timber price with a correlation coefficient of 0.63 (Jen 1971). According to the past 30-y trend of the timber price, it is estimated that 15% of the annual growth rate of China fir timber price will be between 5.1 and 6%, 50% between 4.1 and 5% and 35% between 3.1and 4%. On the basis of this estimation, it is expected that 15% of future China fir stumpage price will be at the range between \$146 and \$166 m^3 at the age of 15, 50% of the price between \$127 and \$144 m^3 and 35% of the price between \$108 and \$125 m^3.

Calculation of investment rate of return

Using Hertz's method of risk analysis, the rate of investment return for China fir plantation was calculated and shown in Figure 1. The mean rate of return was 5.8% with a standard deviation of 2.9%. The average rate of return is not high when compared with 9%, the general secured loan rate from banks in Taiwan, but it is higher than the rate of 3%, a special secured loan rate from the government for silvicuture purpose only. Only tree farmers can secure this loan. A rate of return of 3% and higher has a cumulative probability of 82%. In other words, if reforestation monies were borrowed at a 3% interest rate, there would be a 82% chance of not losing money. It is evident that the government silvicultural loan rate is reasonable for tree farmers to make a profit, if we consider planting China fir.

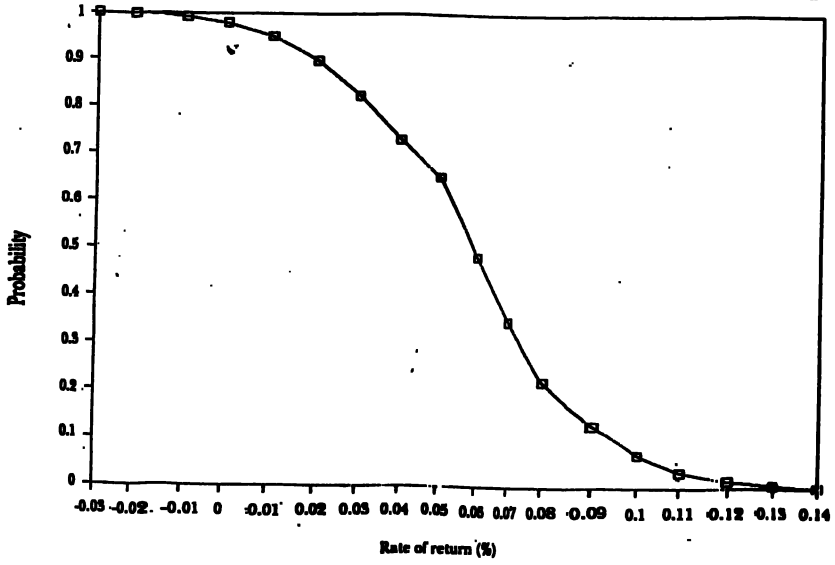

Figure 1. Risk profile for investment in China fir plantation based on cumulative probabilities for 10,000 iterations

Conclusion

Based on results obtained from first rotation harvest, the rate of return for investment in China fir averaged 5.8%. This is lower than the 9% current interest rate from banks, but higher than 3%, the special government silviculture loan rate. Although China fir is a native tree species in mainland China, it was introduced to Taiwan more than 200 years ago. So it has had a faily long period of growth on this island. Risk from disease and insect is low. Thus, investment in China fir plantation has less risk compared with other introduced tree species. If tree farmers can secure loan with 3% rate, there is some potential to make a profit from planting China fir in Taiwan.

References

ENGELHARD, R.J. & ANDERSON W.C. 1983. A Method of Assessing Risk in Forestry Investments. *Research Paper So-189.* USDA Forest Service, Southern Forest Experiment Station, New Orleans. 13pp.

JEN, I-A. 1971. Studies on Relationship between Stumpage Price of Important Tree Species and their Price Determinants in Taiwan. (1) China fir and *Cryptomeria. Bulletin Taiwan Forestry Research Institute, Taipei* 205: 799.

JEN, I-A. 1988. An economic analysis of planting *Leucaena leucocephala* in Taiwan. *The International Tree Crops Journal* 5: 179-189.