Potential for a Pulpwood Resource in the Esperance District—

Evaluation of the climate and soils

Project recommendations

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1. Summary

The rainfall and soils of an area near Esperance, previously identified as having the potential for the establishment of pulpwood plantations and shelter–belts were examined in more detail.

The rainfall is less than that assumed in an initial reconnaissance, however approximately 55 000 ha of alienated land, with a rainfall of >600 mm lies to the east of Esperance. An additional 47 000 ha of land, east and west of Esperance, has a rainfall of between 550 and 600 mm. Although up to 15% of the rainfall falls during summer this cannot be relied upon. A cautious approach is necessary towards any commercial tree planting in the area, and particularly so in the 550–600 mm rainfall zone.

A soil and land resource survey of the area was examined, and several major soil groups are apparent. The proportion of each of these soils is given, with deep sandy soils (46%) and sand over clay soils (50%) dominating the area. The deep sands are likely to be more readily available for tree planting than the shallower soils, which are more productive to agriculture. Although it is certain that these soils will differ in their potential pulpwood productivity, there are insufficient plots of *Eucalyptus globulus* to allow these differences to be quantified, and to ensure that it can be successfully established on deep sands.

Potential soil limitations such as sand depth, wind erosion, water repellancy, salinity and waterlogging are discussed in terms of their likely affects on tree performance. Some of these limitations may be overcome through the use of alternative commercial species. Tree planting may have some beneficial effects on the soil, such as the reduction of wind erosion and salinity control.

Economic analysis of the different options for tree establishment (viz. block plantings vs shelter–belts) should identify both the minimum production needed for profitable on-farm pulpwood production, and a viable pulpwood industry in the Esperance area. Comparisons of the profitability of tree growing with other farm enterprises can only proceed when suitable growth data has been assembled.

It is clear that the Esperance area has some potential for the establishment of trees for pulpwood production. There is insufficient growth data available on which to confidently predict the success of such an enterprise, therefore we strongly recommend the establishment of a series of trial plantings encompassing the variation in soils and climate.

2. Introduction

A preliminary reconnaissance of the Esperance area indicated that approximately 65 000 ha was potentially suitable for the establishment of a pulpwood resource on farms (Maher, McGrath and Harper, 1990).

In this report several of the recommendations made by Maher et al (1990) are examined in more detail. Specifically:-

- **Rainfall**
  Rainfall records are analysed to determine the amount, distribution and reliability of the rainfall and thereby determine the boundaries of a target area based on rainfall isohyets. In this report only those areas with a rainfall of >550 mm are considered.

- **Soils**
  Details of the range of soils present in the target area are derived from Department of Agriculture work. The properties of the most common soils, the major soil limitations and the overall potential for tree growth are summarized.

- **Productivity of proposed pulpwood species**
  Few reliable growth data are available for proposed pulpwood species, and this is the major limitation to the establishment of a tree planting scheme.

- **Area**
  A revised estimate of the area of land where trees could potentially be grown is provided.

3. Physical resources

3.1. Location and Land Use

Esperance is located on the south coast of Western Australia, 800 km south east of Perth, and 500 km east of Albany.

In areas alienated for agriculture native vegetation has now been mostly cleared and replaced with farming systems, which revolve around rotations of cropping and pasture. Approximately 10% of the alienated area is uncleared.

3.2. Climate

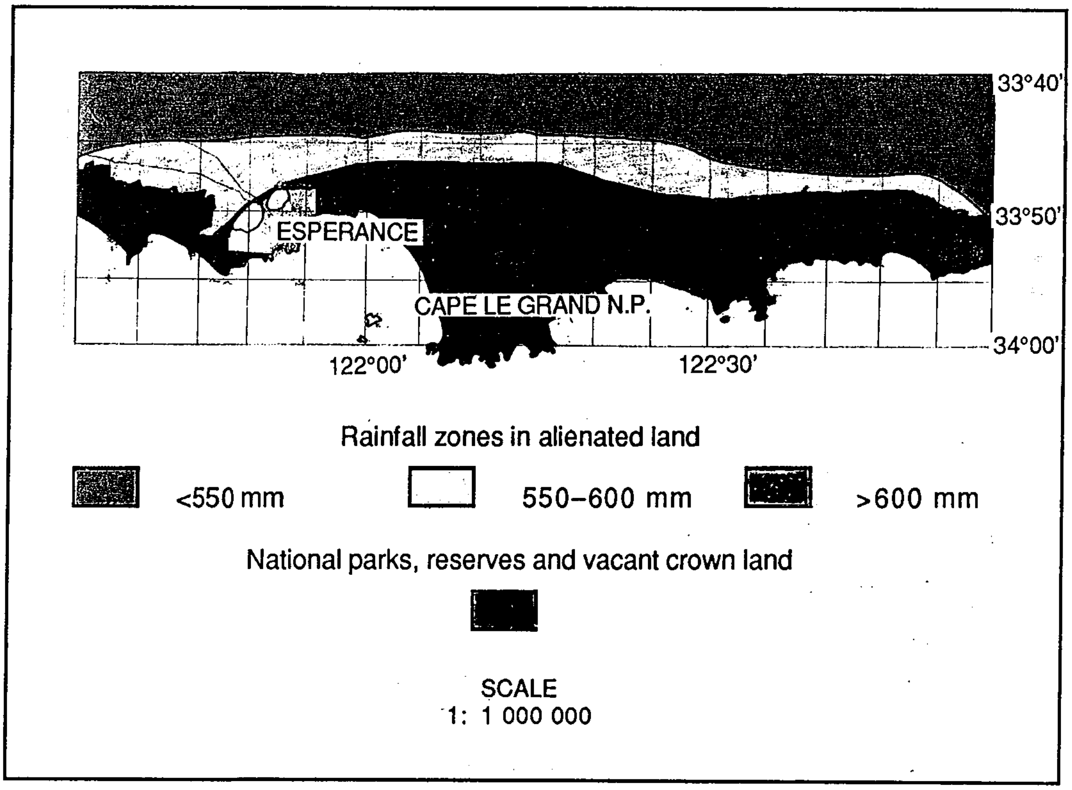
The primary factor controlling the success or failure of tree growing in the Esperance area will be the availability of moisture. This has two main components, supply and demand. These will be considered in turn.

3.2.1. Rainfall

3.2.1.1. Introduction

Rainfall records were obtained, from the Bureau of Meteorology, for 38 stations which had been recording in the Esperance area, for periods ranging from 6 to 71 years. Data from 4 stations were disregarded due to short recording periods or missing data. These data are summarized in Appendix 1.

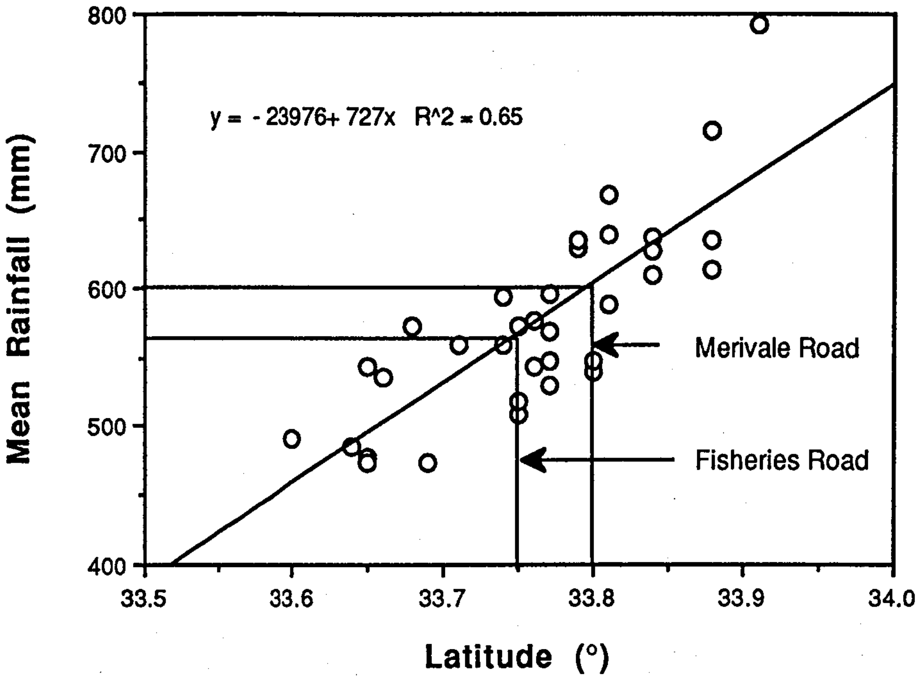
Figure 1 Revised distribution of rainfall in the Esperance area



3.2.1.2. Amount and distribution

The mean rainfall from all stations for all years has been mapped (Figure 1) with Table 1 indicating the area of alienated land with a mean rainfall of between 550 and 600 mm and of >600 mm in the Esperance area. East of Esperance these rainfall isohyets correspond to Merivale (33°48′) and Fisheries Roads (33°45′) respectively. Figure 2 illustrates that the mean rainfall decreases at a rate of 6.5 mm/km with

Figure 2 **Variation in mean rainfall with latitude**



distance north, from a maximum of 715 mm near the northern boundary of Cape Le Grand National Park.

The rainfall is in fact lower than that assumed in the initial reconnaissance (Maher et al, 1990), which placed the 600 mm isohyet at Fisheries Road. The estimate of 55 000 ha with a rainfall of >600 mm, is almost the same as that in the prior report due to the inclusion of land further east of Esperance.

If the 550–600 mm rainfall zone is also included the target area can be considered as extending from 90 km east to 30 km west of Esperance, with an area of about 102 000 ha. Land covered by lakes and farm infrastructure, and that land not yet cleared, has not been accounted for, and will possibly depress these estimates by 10%.

It will be worthwhile to obtain additional rainfall data from several of the farms within the area, to verify the isohyets developed here. Butcher (1986) describes a method of predicting rainfall at a particular location, from that of surrounding locations, and this approach could be be useful, particularly as orographic effects will be minor.

3.2.1.3. Rainfall distribution within years

The distribution of rainfall through the year is also of importance. Table 2 indicates the proportion of the rainfall which falls between April and November, and May and October, for selected stations.

Table 1 Estimate of land area within each rainfall zone in the Esperance area

Rainfall zone	Direction	Maximum Distance (km)	Land area ('000 ha)
550-600 mm	East	90	32
	West	30	15
>600 mm	East	90	55
Total			**102**

Although the *proportion* of non–winter rainfall is slightly higher in the inland, drier, areas the actual *amount* of rainfall received is similar.

Similarly, Figure 3 indicates that the summer rainfall is much more variable (i.e. less reliable) than the winter rainfall, and must be considered a bonus rather than as an assured part of the annual rainfall.

3.2.1.4. Variation of rainfall between years

It is important to know the reliability of rainfall, and in particular the characteristics of the drier years. This was assessed using three methods:-

- The variability of the data was calculated as coefficients of variation (CV), and compared with location. The CV's ranged

Table 2 Proportion of total rainfall received between April and November and May and October - selected stations.

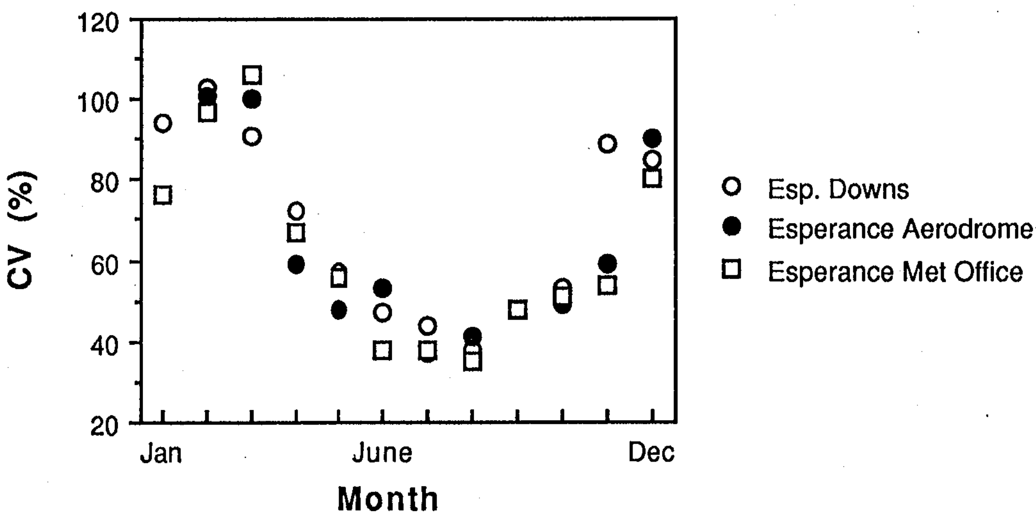
Station	Annual Rainfall (mm)	Proportion of total (%)	
		Apr—Nov	May—Oct
Esperance Downs	492	83	68
Esperance Aerodrome	573	85	70
Esperance Met. Office	627	87	72
Adina	715	88	74

between 10 and 30% and did not vary systematically with latitude or longitude.

- The 10, 25, 50, 75 and 90th percentiles were calculated. The 10th percentile for example indicates the rainfall in the driest 10% of the years. Each of these measures is well related to the mean with correlations of 0.92, 0.93, 0.91, 0.91, 0.75 respectively (n=34). Rancho X, with a mean rainfall of 610 mm, can expect a rainfall of ≤501 mm in 10% of the years and ≤540 mm in 25% of the years.

- The rainfall of the driest 10% of the years was calculated for each rainfall zone. In the 550-600 mm rainfall zone the rainfall in these

Figure 3 **Rainfall reliability varies substantially between months**



years ranged from ≤439 mm to ≤491 mm, at different stations. Similarly, in the 600–650 mm zone comparable figures range from ≤501 to ≤532 mm.

- The mean rainfall for the period 1980-89 was compared with that of 1970-79, for the 15 stations where it was available. The rainfall in the last 10 years was related to that of the previous period by the equation:-

$$Rainfall\ (1980\text{-}89) = 0.77 \times Rainfall\ (1970\text{-}79) + 103.6 \quad (r^2=0.81).$$

A site with a rainfall of 600 mm in the period 1970-79 would have received 560 mm in the period 1980-89.

Table 3 **Mean monthly and annual evaporation for Esperance and Salmon Gums (mm)** [1]

Station	LR	J	F	M	A	M	J	J	A	S	O	N	D	Total
Esperance	10	266	211	193	133	93	64	79	90	114	151	191	254	1840
Salmon Gums	7	337	260	221	156	103	73	89	97	127	187	241	297	2189

If commercial tree planting does proceed it will have to be based on the assumption that trees can produce economic returns with a mean rainfall of 550 or 600 mm, and more importantly that there is minimal likelihood of drought deaths.

3.2.2. Evaporation

The best estimates of evaporation are made with a U.S. Class A evaporation pan, however within the target area such data are only available for the Esperance Met. Office. Within a wider area, however, Luke et al (1987) also provide data for Salmon Gums, which is 107 km north of Esperance (Table 3). Evaporation increases with distance from the coast, as the maritime influence decreases, compounding the effect of decreasing water availability with reduced rainfall.

3.2.3. Wind

Strong winds represent a hazard to the establishment and survival of trees, both as a wind erosion hazard at planting and as wind–throw through the life of the trees. Although wind data are not available, the

Table 4 **Mean monthly temperatures for Esperance** [2]

Temperature (°C)	J	F	M	A	M	J	J	A	S	O	N	D
Minimum	15.5	16.0	14.9	13.1	10.3	8.9	8.2	8.5	9.4	10.6	12.7	14.4
Maximum	26.2	26.4	25.2	23.1	20.2	17.9	17.1	17.7	19.2	21.1	22.9	24.8

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[1]From Luke et al, (1987), LR = length of record (years), other figures in mm.

[2]From 1989 WA Year Book

presence of mature trees indicates that trees can be established in this area. Wind erosion is generally caused by severe winds, which have an unknown return interval.

3.2.4. Temperature

Temperature data are only available for the Esperance Met. Office (Table 4). From similar areas, such as the Eyre Peninsula and the south-east of South Australia, certain trends can be summised. Due to a maritime influence areas close to the coast will have less extreme fluctuations in temperature. Mean winter temperatures will be higher near the coast, whereas summer temperatures will be lower than those areas further inland. The inland distance of this effect is not known, however most of the target area is within 20 km of the coast.

3.3. Geomorphology and Geology

The area is underlain by Proterozoic granitic rocks on to which the Plantagenet Group sediments were deposited in the Eocene (Morgan and Peers, 1973). In the areas with a rainfall of >550 mm the land surface forms a very gently inclined plain, rising to an elevation of approximately 100 m, 20 km inland from the coast. Distinct drainage lines only influence a small proportion of the target area; drainage is mostly impeded with broad brackish swamps.

All parent materials were deeply weathered (lateritised) in the post-Tertiary period, forming a deep mantle of clayey materials with surficial ferruginous gravels. This mantle has subsequently been modified. Down–cutting by several short rivers, which run in a northerly direction from the coast, has exposed a variety of parent materials, in the river valleys. Similarly un–weathered granite is exposed on the crests and upper slopes of the granite hills.

Much of the sand which has been retained in the landscape has been re-worked by the wind, resulting in the accumulation of sand deposits, these being present both as isolated sand dunes, dunefields and sand sheets. Sand dunes are also found along the coast line, and these tend to be calcareous at depth. Sand that has been previously carried by the wind is likely to be re-mobilized if the surface is de-stabilized.

3.4. Soil distribution and Properties

3.4.1. Introduction

Broad descriptions of the soils of the Esperance area have been made by Teakle and Southern (1936), and Burvill (1982). Since 1985, the Western Australian Department of Agriculture has been mapping soils and landforms for agricultural land use purposes at a scale of 1:50 000. This work has not been published.

Table 5 Estimated proportions of the major soils in the Esperance area

Mapping Unit	Major soil features	Proportion (%)
I	Sand <30 cm deep	15
II	Sand 30-80 cm deep	24
III	Sands >80 cm deep,	46
IV	Columnar clay B horizons	11
Other	Miscellaneous soils	4

3.4.2. Major soils

The land resource survey has identified a number of units based on soils and landforms, here these have been combined into five which represent the major soils of the Esperance area. The approximate proportion of each of the soils groups is given in Table 5.

More precise estimates of the areas of each of the soils, from Department of Agriculture mapping, will be available in February 1991.

3.4.3. Major properties of soils

The general form of most of the soils is of a sandy textured surface horizon overlying ferruginous gravel and sandy clay. The soils are perhaps better understood if they are regarded in terms of individual layers which each have particular properties which will affect tree growth.

3.4.3.1. Sand layer

The major features of the sand horizons are:-

- Composed predominantly of fine grained quartz sand, with very low clay contents (<5%).
- An accumulation of organic matter is found in the surface, this causing dark staining.
- Low contents of nutrients such as phosphorus, nitrogen and various trace elements; the present content of these reflects past fertiliser applications and management. Nutrients tend to be concentrated near the surface of the sand horizon.

- Sand is of variable depth, depending on the location of the soil, ranging from a few centimetres to several metres deep on some sand dunes.

- Usually white or grey in colour. Sands which are bright yellow at depth are generally regarded as being more fertile, perhaps due to a slightly higher clay and potassium content.

3.4.3.2. Ferruginous gravels

Horizons composed of ferruginous gravels ("laterite") are a common feature of the soils. Descriptions of these horizons are limited, however the common features are:-

- Composed of loose, nodular, ferruginous gravel, which usually comprises >50% of the horizon.

- The horizon is of variable depth, tending to be deeper on old laterite surfaces.

The occurrence and extent of cemented horizons such as seen in the Darling Range is not known.

3.4.3.3. Clay

Clay horizons underlie the gravel and sandy horizons throughout the landscape.

- Clay horizons range in texture from sandy clay loams to medium clays.

- It is not clear if the clay horizon will form a barrier to plant roots. Where examined it had a weak to moderate structure, with roots penetrating along cracks and between ped faces.

- From limited analysis, the subsoil clays appear to be chemically more fertile than the sands, with accumulations of calcium, potassium and magnesium.

- Salinity often increases with depth.

- The depth of the clay horizons, above un–weathered rock is not known

3.4.3.4. Water Relations

Superimposed on the above sequence of materials, are the water relations of the soil, which are determined by local drainage conditions. Plant growth will be affected both by an excess (waterlogging) or deficiency of water.

The location of soils in the landscape is important. Deep sandy soils for example can be well drained or poorly so; deep sand on a hill crest will provide different conditions for tree growth to deep sand found within a swamp.

- **Waterlogging**
  During the winter, when rainfall is high and evaporation low, water can accumulate above the poorly permeable clayey B horizons. As soils have been mapped on the basis of their topography some indication of the relative waterlogging risk can be gauged from the landform classification.

- **Soil water storage**
  The water storage of the soil is related to such soil attributes as texture, structure and depth of the soil available to roots. Factors affecting root penetration, and thereby effective soil depth, include, waterlogging, compaction and cementation, unfavourable chemical conditions such as salinity and extremes of pH and a shallow depth to underlying rock.

3.4.4. Value of existing soil mapping

The value of the existing soil mapping appears to lie as a regional planning tool, allowing broad estimates of the range of soils and landforms. The scale of mapping, at 1:50 000, is inadequate for detailed farm planning (Dent and Young 1981), and if plantations or shelter-belts are to be established it will be necessary to survey the soils of each site at a larger scale, such as 1: 2 000 to 1: 5 000. In this way the tree plantings can be integrated objectively into the whole-farm enterprise.

With any proposed tree planting it is important to obtain information of the soil conditions below 90 cm, with particular regard to factors such as the depth, and nature, of any layers which might impede root growth.

3.4.5. Soil limitations

3.4.5.1. Introduction

Several aspects of the soils could potentially limit growth and these are outlined in this section. Several of these limitations are species specific, and could be overcome by the judicious choice of tree species. The pulping properties of these species, relative to *E. globulus* will have to be determined.

Trees may ameliorate some of the soil limitations listed below, with for example reductions in salinity hazard and wind erosion. Many of these benefits however are likely to be localised and should not be overstated.

3.4.5.2. Deep sands

The deep sandy soils are the least productive under current agriculture. Several alternative agricultural strategies have been proposed over the years, using species such as lucerne and tagasaste, however these have yet to be adopted on a large scale.

Trees could appear to be a promising land use on these soils, and large areas could be made available quite quickly. It is stressed, however, that careful evaluation should to be made of tree growth on these soils before trees are recommended as an alternative land-use.

Experience suggests that these soils, and particularly those that are very well drained, are not capable of high production. What is important is that if trees are grown that they are more profitable than present landuses.

3.4.5.3. Waterlogging

Large areas of land south of Fisheries Road are waterlogged, this ranging in intensity from permanent swamps to winter waterlogging. The effect of waterlogging on tree growth is species dependent, and the tolerance will have to be determined.

3.4.5.4. Salinity

The onset of salinity is believed to be a major problem in the Esperance area, however it appears that this is of greater importance in the country to the north of Fisheries Road. The groundwater salinity, of the Esperance area has been discussed by Morgan and Peers (1973) and Laws (1982), and several research projects are currently in progress.

3.4.5.5. Wind Erosion

The combination of fine sand grains and low clay contents predisposes many of the soils to wind erosion. The amount of surface cover provided by plants can modify the erosion risk; as plant productivity is related to soil depth deeper sands often have less cover and are more susceptible to wind erosion.

3.4.5.6. Water repellancy

Water repellancy is a condition where the soil repels water, and is particularly apparent at the start of the growing season. This the soil feature most likely to cause problems for the establishment of trees. In a survey of Esperance soils, Summers (1987) found 70% to be water repellant.

Several techniques to overcome water repellancy are currently being evaluated for agricultural purposes and these should be assessed for tree planting.

4. Tree growth and its relationship to the environment

Trees were not measured as part of this study as it is clear a large programme will be required to obtain meaningful information. Growth data, where available, is mainly for *P. pinaster* , growing in the 550-600 mm rainfall zone, and its growth is not promising. There are few established plantings of *Eucalyptus globulus* .

In this section we outline some of the information needed before we can be certain that tree growing is economically viable in the Esperance area. We recommend that a feasibility study be undertaken to determine the most suitable tree species for the Esperance area and to determine the relationships between tree growth, soils and rainfall. This will involve two approaches:-

- **Evaluation of all available tree plantings in the area**
  This would include strip plantings, plots and plantations, it should be stressed however that many of these have been established with sub-optimal techniques and therefore may not give a true indication of the regions' potential. The experience of the local landholders in tree planting should not be ignored. Several farmers are tree planting enthusiasts and should be consulted as to what techniques and species have proved viable and which ones have failed.
  Where possible trees and soils should be measured and described along slope sequences, as this will help identify the impact of soil variation on tree growth.

- **Establishing a series of trial plots**
  These would be on a range of soil types with a range of species. Selection of species for the trial plots should be based on their known environmental requirements, previous performance in the Esperance area and commercial potential.
  To reflect future broadscale plantings it is important that any new plots be planted on farmland. Soil fertility and competition control will be dramatically different on farmland compared to ex-bush sites.

5. *Economics of E. globulus planting and a processing facility*

Suitable growth data, on which to base an economic analysis is not available, therefore CALM's Economics Section should be requested to determine the minimum area of tree plantings necessary to establish a viable resource base for a processing and export facility. This "core" would be established in the >600 mm rainfall area. As assumptions will have to be made of the potential production from *E.globulus* plantings, the minimum profitable production should be determined. Indications are of a break-even Mean Annual Increment (MAI) of $8m^3$/ha/year.

Similarly the economics of planting trees in shelter–belts on farms should be determined, taking into account the comparative returns of trees relative to other farm enterprises. The beneficial aspects of tree planting to crops, pastures and stock evident in the work of David Bicknell, should be considered in this analysis, as should the soil conservation aspects of tree planting, such as the reduction of wind erosion and rising water tables.

A comparison of the profitability of shelterbelts and block plantings should also be made. Plantings integrated into an farm enterprise will have different costings to a separate endeavour.

The different soils will have different potentials, for both agricultural and wood production, and it is important to take this into account when predicting the potential regional productivity. Similarly some soils are more likely to be made available by landholders, than others. The deep sandy soils, for example, have the lowest productivity for agriculture and may appear attractive for tree planting; it is important however that the productivity of these soils is determined prior to planting large areas.

6. *Discussion*

It appears that there is an area of approximately 100 000 ha in the Esperance area that has some potential for producing pulpwood. Additionally there appears to be a strong interest in tree establishment in the region. This interest has developed due to the perception that trees can provide benefits in terms of wind erosion control and improvements in farm productivity by providing protection for crops and livestock. Trees could also provide an additional source of farm income if the trees are managed to produce specific wood products.

The integration of trees onto farms will depend on a range of environmental and economic factors. The major limitation to tree growth in the region will be drought. The extremely low rainfall in 10% of the years indicates that planting strategies will have to take account of the low rainfall. Large block plantings (plantations) may require more water than is available from rainfall, thus blocks may have to be planted in zones of water accumulation. An alternative strategy would be to plant small blocks or strips so that the available soil water is not fully exploited.

Tree planting will have to take into account the current farm management requirements and objectives. This will necessitate whole farm planning, and soil mapping will form an objective basis for this planning. The formulation of objective farm plans will require accurate information on tree performance on the range of soil types found in the target area.

7. Recommendations

A series of recommendation can be made:-

- That an analysis of the economics of establishing an *E. globulus* industry in the Esperance area by undertaken, as outlined in Section 5.

- That trial plots of a range of species, on a range of sites, be established prior to any large scale tree planting programme. This should commence in 1991, would involve the establishment of approximately 100 ha of trees, and cost in the order of $100 000. Funds for on–going maintenance would also be needed.

- That existing plantings of trees be evaluated and information on survival and performance of different species be obtained from farmers.

- Additional rainfall data be obtained from farmers in the target areas to verify the rainfall isohyets developed in this report.

- That tree planting is integrated into farm enterprises on a whole farm basis. Economic analysis and soil mapping should form an objective basis for such planning.

- To facilitate the above recommendations, a position should be established to undertake this work. Ideally the position should be based in Esperance. Technical support will also be required.

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Station	Site	Location		Mean	CV	Count	Min	Max	Percentiles				
	Nº	Lat.	Long.						10	25	50	75	90
		(°)	(°)	(mm)	(%)		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
Esp Aerodrome	9542	33.68	121.82	573	15.8	19	446	802	470	520	560	615	712
Oake Marsh Farm	9579	33.76	122.07	577	17.8	32	391	928	476	528	568	622	701
Myrup Composite	9584	33.74	121.99	595	17.9	60	414	888	491	513	588	643	754
Pleasant Valley	9626	33.71	121.56	559	18.8	40	360	778	444	487	542	626	726
Esperance Downs	9631	33.60	121.78	492	20.2	38	260	793	401	443	491	543	618
Young River	9652	33.77	121.11	547	16.3	34	397	737	454	500	521	621	696
Coolinup	9655	33.79	122.17	630	19.9	30	438	1004	504	558	605	673	752
Rancho X	9665	33.84	122.41	610	12.9	25	490	773	501	541	613	662	723
Langley Park	9674	33.79	122.15	635	15.3	30	490	923	531	569	625	670	767
Maikurra	9675	33.81	122.44	589	31.0	14	405	1030	439	461	518	632	912
Thomas River	9715	33.80	123.02	540	18.6	48	382	809	420	474	519	583	700
Rovade	9739	33.65	122.31	543	16.5	28	368	737	457	490	433	596	684
Erinair	9772	33.76	121.21	544	17.2	22	362	724	434	475	528	638	672
Boyatup	9788	33.81	122.29	668	21.3	71	359	1048	511	593	652	726	884
Esperance M.O.	9789	33.84	121.89	627	15.9	20	468	868	517	558	612	689	762
Coomelmia	9796	33.69	121.37	474	16.1	22	333	704	392	424	462	506	551
Lake Warden Farm	9800	33.81	121.85	639	18.6	6	524	861	527	554	624	643	839
The Oaks	9802	33.66	121.62	535	21.0	23	392	883	428	456	518	581	649
Adina	9804	33.88	122.21	715	11.9	21	592	902	616	640	708	782	815
Mount Howick Station	9813	33.75	122.75	519	16.0	28	373	718	394	454	532	565	597
The Duke	9815	33.88	122.56	635	11.6	12	476	731	521	604	637	689	726
Lort River Station	9816	33.74	121.29	559	16.2	24	456	728	462	482	522	633	695
The Beef Machine	9817	33.75	122.37	572	13.3	20	433	723	475	530	558	616	685
Yerritup	9818	33.77	121.10	597	17.4	12	463	746	483	522	561	712	745
Dalyup Park	9822	33.77	121.55	569	15.4	17	454	798	469	510	550	627	675
Jonegatup	9824	33.65	120.99	474	15.9	15	377	629	383	442	453	484	607
Orleans Farm North	9825	33.75	122.91	509	14.1	16	374	652	424	460	508	556	598
Orleans Farm South East	9826	33.80	122.85	547	12.0	16	422	673	469	496	558	578	638
Second Beach	9827	33.88	121.86	614	16.5	16	439	800	505	529	615	666	789
Mokine Downs	9847	33.77	122.71	530	11.7	12	457	703	471	494	524	544	601
Oceanview Farms	9849	33.84	122.76	636	14.0	9	511	836	532	590	638	653	764
Lorinna	9867	33.65	122.01	477	13.3	18	364	615	400	424	480	504	564
Cape Le Grand N.P.	9870	33.91	122.20	792	9.4	6	711	924	714	745	776	822	914
Dalston	9921	33.64	121.36	485	16.6	15	370	650	407	434	453	519	634

Appendix 1 - Esperance Rainfall Records (Bureau of Meteorology Stations)