Potential Land Area suitable for Poppy Production in Tasmania.

Roger Orr[1], Peter Simmul[2] and, Mathew Webb[3], May 2011.

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1. Summary

In 2010/11 an evaluation of potential land area suitable for poppy production in Tasmania was undertaken by staff from the Tasmanian Institute of Agricultural Research (TIAR) and the Department of Primary Industries, Parks, Water and Environment (DPIPWE). The outputs from this work were location mapping and total and sustainable area determinations.

A total potential crop-able area of about 349,000ha and an annual sustainable area of about 60,000ha suitable for poppies of *Land capability Class 1 – 4* has been determined based on properties 25ha or larger, on land no higher than 300m elevation and locations receiving no more than 1250mm annual rainfall. The mapping associated with these criteria aligns well with industry practice as verified by applying overlay mapping of Global Positioning System (GPS) spot locations of the 26,000ha of crops planted in 2010.

Other alternatives modelled, provide an indication of potential additional land in locations or for conditions considered marginal. These alternatives were the inclusion of *Land capability Class 5* land, higher altitude limit and no rainfall limit being applied. Lifting the altitude limit to 400m and removing the upper rainfall limit increases the annual sustainable area of *Land capability Class 1 – 4* by approximately 11,000ha to 71,000ha. The inclusion of *Land capability Class 5* adds an annual area of approximately 32,000ha for the 300m altitude and 1250mm upper rainfall limits, and 38,000 ha where 400m altitude and no upper rainfall limits are applied. Industry use would suggest that this modelled additional land is considerably less due to other limiting factors not accounted for.

The annual sustainable area estimated using current methodology is not much different to that that achieved in 1996[7]. The difference is that this latest result is expanded and more robust due to updated databases and improved methodology.

Approximately 73,000ha is estimated to be annually cropped in Tasmania (ABS 2009[8]) with the remainder of arable land utilised for pasture and grazing enterprises. The challenge for poppy production contracting companies will be enticing farmers to use their potentially suitable land for poppy growing rather than other enterprises.

A number of unquantifiable factors have not been included in these land capability calculations. They include competition from other enterprises, property owner attitude to growing poppies and company attitudes and policies to regions and soil types.

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[7] An evaluation of suitable terrain for poppy production in Tasmania by Peter Simmul, November 1996
[8] ABS Agricultural Commodities, 7121.0, 2008 - 09

2. Background

For a range of common and separate reasons growers, processors, government and regulatory agencies would like to know the potential land area capacity to sustainably grow poppies in Tasmania.

Currently and around a decade ago the annual area sought to be contracted to poppy production exceeded 20,000ha. In the 2011/12 season the area sought by the three companies will exceed 30,000ha. The companies have queried the land availability for such levels of production and, in the past, have sought approval to grow poppies outside Tasmania to find the additional land and insure against local adverse seasonal conditions.

The current project builds on the 1996 evaluation conducted by the Department of Primary Industries and Water staff and in 2009 a re-evaluation was commenced by TIAR and DPIPWE staff. In both cases the first part of the evaluation was achieved by applying a range of physical criteria in a Geographical Information System (GIS) mapping program. The Tasmanian Land Capability Classification System[9] was considered a key database source for mapping suitable land. Extracted aggregate areas from the GIS produced map were then used to calculate potential annual sustainable area by application of additional farm and rotation factors.

In 1996 the modelled potential annual sustainable area was about 64,000ha. Since then there had been considerable changes in land use, land improvements, irrigation capacity, production methods, cultivar development and updated land capability, other databases and GIS software. As a result of this and commercial demand for increased production in 2009 it was considered appropriate for a re-evaluation

3. Methodology

In 2010/11 on detailed examination of the mapped potential land and criteria it was apparent that the modelling could be improved by changes to the criteria parameters which would better match proven production areas. In addition, a means of verifying the modelling was considered necessary. In 2010 the three poppy companies contracted a record 26,000ha of poppies which effectively indicated the spread of land and locations, currently considered suitable by the industry. With a database of Global Positioning System (GPS) locations made available, this provided a means of verifying the validity and accuracy of the GIS modelling and criteria parameters.

For a series of options, variable criteria were modelled and an overlay of the GPS spot locations applied to the GIS mapping. Crops within and outside the modelled potential areas could now be visualised and were used to verify the 'best fit' options. The criteria used were land capability classes, minimum private land size, land gradient, elevation, rainfall limitation, percentage useable land on-farm and appropriate land class rotation factors.

[9] Land Capability Handbook "Guidelines for the Classification of Agricultural Land in Tasmania 2nd Ed.CJ Grose 1999

3.1. Total Potential Poppy Land Criteria

The criteria, detailed below, are from accepted industry knowledge derived from many years of poppy production. These have been selected as benchmark criteria for estimating the most reliable and suitable production areas of land.

Successful crops are known to be grown outside these criteria parameters and account for a small proportion of crops that are currently and/or have been grown. These options have been explored to estimate possible additional areas of marginal land that may be utilised where limiting factors may be overcome and considered an acceptable risk.

Starting from a base map of Tasmania the following physical limits and assumptions relevant to poppy production have been overlayed to show location, distribution and to determine area information.

Suitable poppy production land would be:

- **Not higher than 300 metres above sea level**. This is to mitigate the risk of frosting at the sensitive stages of flowering & late hook that is likely at higher elevations. With assured irrigation crops may be and are grown up to 400m elevation and are sown later to reduce this risk, but accepting possible reduced yield one year in three.
- **Where 1250 mm or less rain falls each year**. This is to mitigate the risk of washout and flood implications and sowing and harvest difficulties. With well drained soils and/or good management with drains and raised beds this limit may be and is extended in some localities.
- **Sites where gradients are less than 20%**. This is the upper limit for safe mechanical operations, sowing, spraying and harvest and is likely to need to be lower in higher rainfall localities.
- **Privately owned land that is 25 hectares or more on an ownership title.** This lower limit has been selected to exclude small properties such as hobby farms that are unable to undertake or sustain cropping. It is possible that there may be smaller holdings with Class 1 to 3 land that may lease some land to a neighbouring farm but such properties are assumed to be few. It is also possible that some farms have multi title land less than this limit. On balance aggregated small titles has had to be an accepted exclusion to deal with the very high number of small properties that will never be potential land.
- **Land that is not designated as** Crown land, State reserves, National parks, Conservation areas, Council reserves, parks, public recreation areas and other reserved land. (This was accounted for by the privately owned land criteria excluding all other areas.)
- **Land that has no obvious production** potential such as rivers, roads, swamps, buildings, rocky areas, gravel pits, military training areas, coastal dune areas, forest plantations, dedicated forest conservation areas, roadways, public recreational

areas, residential subdivisions and water storages. (This was accounted for by the privately owned land criteria excluding all other areas.)

- **Where land is in accordance with the Land Capability of Tasmania mapping; Land designated Class 1 to Class 4.** This has been chosen to select for only the most suitable land.

  The Tasmanian Land Capability Classification System details the cropping suitability of the various Land Capability Classes as follows:

  Class 1. Suited to intensive cropping and is capable of being cropped 8 to 9 years out of 10 in rotation.

  Class 2. Suited to intensive cropping with few limitations. Capable of being cropped 8 to 9 years out of 10.

  Class 3. Soils suitable for general cropping. Has some limitations and cropping recommended at 2 to 5 years out of 10.

  Class 4. Land marginally suitable for cropping. Frequently has severe limitations of both physical and structural nature. Cropping rotations should be restricted to 1 or 2 years in 10.

  Class 5. This land is generally unsuited to cropping although some portions with care and good practices may be occasionally cropped.

With the use of Land Capability Classification, assumptions have had to be made in relation to precision of classification and potential status. This modelling relies heavily on the Land Capability mapping database used and although continuously being improved, the precision cannot guarantee that the minimum mapping units of around 64ha will be 100% pure of the designated class. At worst, there can be 40% of a lower class within a unit but units are generally deemed to be 80% pure and up to 90% in more uniform soil/land locations. For Classes 1 to 3 there is little issue if they have been scored one class too high but as 85% of the poppy modelled area is Class 4 then some overestimate of the most suitable land is possible in the less uniform soil/land areas.

It is assumed that all land up to Class 4 is cleared and available for cropping and if not can still be considered potentially available.

3.2. Useable Cropping Land Criteria

Generally most paddocks are free of restrictions other than unusable space at gateways, an irrigation pathway and a headland between a fence line and the crop. However, in addition general farming infrastructure and other land use inefficiencies such as tracks, roadways, fence-line verges, waterways, water storages, random trees, hollows, and rocky patches can deny as much as 20% of a property when considering all possible hindrances. Thus, to provide for these issues, area amounting to 20% is deducted from potential land area. While this may be excessive in some instances, a conservative estimate is preferred. (An 80% Useable On-Farm land factor has been applied)

3.3. Annual Sustainable Long Term Poppy Production Criteria.

As with any crop for sustainable production poppies must only be grown in rotation with other crops or a pasture ley phase. On Class 1 and 2 land industry sources suggest that poppies may be sustainably grown every one in thee years and as a high return crop poppies compete well for this class of land. As the higher numbered land classes are less capable of regular cropping this needs to be factored in addition to rotation for pest, weed and disease management. To allow for both these considerations an appropriate rotation factor has been applied to area determinations of each class of land to derive a total annual sustainable area for poppies. These 'best estimate' rotation factors are shown in Table 2.

3.4. Class 5 Land.

Class 5 land is generally considered unsuitable for cropping but it is well known that some Class 5 land has had a history of successful poppy production; this can be for several reasons. The most likely is a result of farming practices such as irrigation, drainage and raised beds and if reclassified would be Class 4. In addition some areas classified as Class 5 have not been surveyed in enough detail to remap pockets of better land.

This has become apparent in the Midlands in recent years; hence, calculations for land Class 5 have been extracted to examine the additional potential.

There is also the issue of remnant native vegetation. This is commonly found on Class 5 land and with this evaluation there is no means of calculating and deducting for it.

3.5. Removing Annual Rainfall Limit.

Although most crops have been grown in regions of rainfall less than 1250mm, it has not been a limit that has prevented some regular successful growers.

The restriction of not producing poppies in areas of greater than 1250mm seems to be an issue of land management and equipment innovation provided that significant rain does not fall during land preparation/sowing and harvest periods. A benefit of using these locations can be reduced irrigation input. Rainfall at inappropriate times may impact on successful production and yield may also be compromised.

No minimum rainfall limit has been used in this analysis. It is assumed that the land either has irrigation available or poppies would be sown and grown under appropriate dry land production systems using soil stored moisture and rainfall.

3.6. Increasing the Elevation limit from 300 metres to 400 metres

Growers have indicated success with poppy crops at locations that are greater than 300m above sea level and this has been supported by the companies offering contracts in some of those areas. Frost risk is increased at these elevations but occasional total or partial loss are obviously considered an acceptable risk as about 5% have been contracted at these elevations.

3.7. Mapping Validation

A method of validating the modelled mapped areas was applied. Global Positioning System (GPS) data was obtained for 2010 planted crops and overlaid on the other data sets used in determining potential poppy growing locations. This has provided a good fit with the mapped areas based on the underlying criteria described in the report.

4. Results[10]

Total potential areas, suitable and useable, have been calculated from the mapped options and summarised in Table 1. The rotation and capability criteria described in the methodology section of this report have been applied to derive potential annual sustainable area (Table 2). The related mapping is appended in Maps 1, 2 and 3.

4.1. Total Potential Poppy Land

Applying the criteria listed in section 3.1 to the model resulted in the identification of a total area of about 436,000ha of Class 1 – 4 land and an additional area of about 394,000ha of Class 5 land. This calculated area is prior to any adjustment for the area of land on any property removed from production by fence lines, buildings, farm lanes, dams, head lands etc.

4.2. Useable Cropping Land

When an adjustment factor of 20% is applied as described in section 3.2, the total useable cropping area is reduced to about 349,000ha of Class 1 – 4 land and to about 315,000ha of Class 5 land (Table 1).

4.3. Annual Sustainable Long Term Poppy Production.

Suitable rotation lengths were described in section 3.3. Applying these poppy rotational factors, the annual sustainable area that could be put to poppy production is about 60,000ha of Class 1 – 4 land (Table 2).

4.4. Class 5 Land.

As shown in Table 2 the modelling indicates potentially about 50% (~32,000ha) additional sustainable area, available on an annual basis by inclusion of Class 5. The total amount of Class 5 land can be reasonably determined but the proportion that would be suitable for poppies cannot be determined with any accuracy because of the wide range and mix of limitations this class of land can have. This class of land is very variable.

All the maps show the distribution and distinguish Class 5 land (coloured red) from the aggregated 1 – 4 Class land (coloured blue).

[10] Apart from the tables, areas expressed in the results and other sections of the document are rounded to the nearest 1,000ha. This is appropriate to the level of accuracy in the use of estimates in the methodology.

4.5. Removing Annual Rainfall Limit

The effect of removing this limit increases the annual sustainable area by about 6000ha of Class 1 – 4 land if otherwise suitable (Table 2). By comparing Maps 1 and 3 it can be seen that the main additional land is located in the North West hinterland and south of Forest but currently it is only associated with a small number of crops. This does suggest that the 1250mm limit is generally appropriate for most regions and little significant additional area is likely to be found above this limit.

When the rainfall limit was removed from Class 5 land the annual sustainable area of Class 5 increased by over 7000ha.

4.6. Increasing the Elevation limit from 300 metres to 400 metres.

The effect of raising the altitude limit from 300m to 400m resulted in identification of about 4800ha additional Class 1 – 4 land (Table 2). By comparing Maps 1 and 2 the main additional land appears to be located in the Bothwell and the Oatlands localities. About 5% of crops are located in these higher frost risk localities.

When the altitude limit was lifted for Class 5 land the annual sustainable area increased by over 10,000ha.

4.7 Mapping Validation

The inclusion of black dots on the maps that accompany this report depicts those locations where crops were contracted in season 2010/11. There is a good fit between those contracted crops and the areas mapped. With land up to 400m and no rainfall limit 69% of crops fall within the modelled as Class 1 – 4 land and 79% fall within the modelled Class 1 – 5 land (Map3). With land up to 300m and a 1250mm rainfall limit 65% of crops fall within the modelled Class 1 – 4 land and 74% fall within the modelled class 1 – 5 land (Map1).

As shown by the black GPS location dots it can be readily seen that the only significant use of nominally Class 5 land is in the lower Midlands around Tunbridge. There is virtually no current use of this land class elsewhere and the extensive areas in the far North West and North East suggest that the limiting factors in those two areas are considered by the industry too high a risk.

Removing the rainfall limit expands the model to take in crops located in the North West hinterland and south of Forest, but currently it is only is associated with a small number of crops. By increasing the altitude limit from 300m to 400m the main additional land where 2010/11 poppy crops were contracted appears to be in the Bothwell and the Oatlands localities. About 5% of crops are located in these higher frost risk localities.

Table 1 Total Potential Land Area for Poppies - Suitable & Useable

CRITERIA	MAP 1	MAP 2		MAP 3
PRIVATE LAND	=or>25ha			
GRADIENT	**= or < 20%**			
% USEABLE On-Farm LAND	**80%**			
ELEVATION	= or <300m	= or <400m		= or <400m
Annual RAINFALL	= or <1250mm			no limit
LC Class	Hectares	Hectares		Hectares
1	1,471	1,471		1,471
2	7,728	7,733		10,349
3	37,959	38,988		49,991
4	301,469	329,070		348,086
LC Class 1 - 4	**348,627**	**377,262**		**409,897**
	Additional area by raising elevation to 400m		*28,635*	
		Additional area by removing Rainfall Limit		*32,635*
5	315,437	363,566		377,788
		Additional area by removing Rainfall Limit		*14,222*
LC Class 1 - 5	**664,064**	**740,828**		**787,685**
	Additional area by raising elevation to 400m		*76,764*	
		Additional area by removing Rainfall Limit		*46,857*
% INCREASE by adding LC Class 5	**90%**	**96%**		**92%**

Table 2 Potential Annual Land Area for Poppies - Suitable, Useable & Sustainable

CRITERIA	MAP 1	MAP 2		MAP 3
PRIVATE LAND	=or>25ha			
GRADIENT	**= or < 20%**			
% USEABLE On-Farm LAND	**80%**			
Annual SUSTAINABLE Rotation For LC Class 1 Year in (#) *see LC Class in Table*				
ELEVATION	= or <300m	= or <400m		= or <400m
Annual RAINFALL	= or <1250mm			no limit
LC Class (Rotation)	Hectares	Hectares		Hectares
1 (1 Year in 3)	490	490		490
2 (1 Year in 3)	1,932	1,933		2,587
3 (1 Year in 4)	7,592	7,798		9,998
4 (1 Year in 6)	50,245	54,845		5,8014
LC Class 1 - 4	**60,259**	**65,066**		**71,090**
	Additional area by raising elevation to 400m		*4,807*	
		Additional area by removing Rainfall Limit		*6,024*
5 (1 Year in 10)	31,544	36,357		37,779
		Additional area by removing Rainfall Limit		*1,422*
LC Class 1 - 5	**91,803**	**101,423**		**108,869**
	Additional area by raising elevation to 400m		*9,620*	
		Additional area by removing Rainfall Limit		*7,446*
% INCREASE by adding LC Class 5	**52%**	**56%**		**53%**

5. Discussion

A total potential crop-able area of about 349,000ha and an annual sustainable area of about 60,000ha for poppies of Land Capability Class 1 – 4 has been determined based on properties 25ha or larger, on land no higher than 300m elevation and receiving no more than 1250mm annual rainfall. The mapping associated with these criteria aligns well with industry practice. Other alternatives modelled provide an indication of potential additional land in locations or for conditions considered less favourable for production. The useable on-farm land and rotation factors in this report have been conservative to avoid over estimation.

In the absence of data suitable land on King and Flinders Islands has not been investigated but the potential should not be fully dismissed. Trials and some commercial production of poppy have been successfully undertaken on both but crop management, contractual agreements and transport issues will be a challenge at these locations.

Although this 2011 evaluation shows little annual sustainable area difference to the earlier (1996) evaluations it has taken into account changes in land utilisation, upgraded land capability classification and improved mapping software and can be viewed with more confidence.

It is well recognised that significant areas of poppies may be and are grown outside these chosen criteria and additional alternative criteria were modelled to examine their effect on potential area. Concern had been expressed regarding the previous (1996) assessment that area designated as unsuitable i.e. Class 5 land was not considered even though some Class 5 land is known to be marginal although successful for poppy production. In view of improved cropping practices, better soil management techniques, improved efficiency of machinery and increased grower expertise, land designated as Class 5 has been included as an alternative assessment in this report.

Rainfall above 1250mm is to some growers an acceptable risk (even with occasional crop or production losses) and so removal of this restriction was also separately considered. Likewise some growers consider their land above 300m and up to 400m elevation is an acceptable risk for frost. Plotting actual crop locations from season 2010/11 demonstrated that a good number of crops were grown on Class 5 land, at altitudes up to 400m and at rainfall higher than 1250mm.

Assessments of potential production areas can never be carried out to arrive at a definitive figure. Many production locations have un-useable areas and many non-preferred locations have suitable production areas particularly where transition of soil classes cross over. Traditionally wet areas can be dry in some years and thus productive. Wet areas can be drained and dry areas can be irrigated as the need arises. Producer knowledge and advanced management techniques will often contribute to success when combined with local knowledge, new equipment and modern technology.

Development of additional irrigation capacity will have positive benefits for poppy production. At low to moderate production crop volume requirements poppy

companies have required irrigation as a condition to contract. As area has been sought to meet higher production needs companies are contracting a greater proportion of dryland crops. The State government is addressing this issue through development of new irrigation schemes.

The State Government commenced activity with the formation in March 2008 of the Tasmanian Irrigation Development Board (TIDB) to supply an extra 300,000 ML of irrigation water per annum to underpin the State Government's objective of doubling agricultural production capacity by 2015. The expansion of water infrastructure will give confidence to growers in drier areas to seek contracts for crops including poppies that they may not have previously considered. While this resource in itself does not necessarilary increase production area, it does improve seasonal reliability and higher yield potential.

Technological development through industry research and development has seen a marked improvement in the productivity and reliability of poppies as a crop. Although the requirement for additional land for poppy production continues to increase the poppy companies and other research organisations have made and continue to make improvements in dry matter yield, alkaloid content, crop agronomy and harvest efficiencies. These gains have helped to mitigate the rate at which new land needs to be found.

Factors that could not be included in these land potential calculations but are of relevance include:

- Competition from other enterprises
- Property owner's attitude to growing poppies
- Capacity for optimum production (e.g. irrigation facilities)
- Production site isolation or accessibility
- Distance from processing plants (as a disincentive)
- Sites susceptible to microclimate unseasonal frosts or floods

From the latest ABS 2009 statistics about 73,000ha is annually used for all cropping enterprises (including perennial crops and poppies) and it is assumed that only Class 1 – 4 land is used for cropping. The total modelled useable cropping land calculates to around 349,000ha so this implies that the majority is utilised by the grazing industries. The challenge for poppy production contracting companies will be enticing farmers to use their potentially suitable land for poppy growing rather than another enterprise.

Poppies may compete for some of the 30,000ha used for cereals but are unlikely to displace any significant area of the 14,000ha used for vegetables or any of an estimated 80,000ha or more dedicated to dairying. Apart from cereals additional poppy land would need to compete for some of the current grazing enterprises and will require other complementary crops to fit into a rotation on converted beef and sheep land.