Department of Primary Industries
primefact

Hazelnut industry expansion

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Jacquelyn Simpson, Research Horticulturist, Horticulture Unit, Yanco Agricultural Institute

Introduction

Global awareness of the health benefits of nuts, including hazelnuts, is driving an increased demand for nuts and nut products. The Australian hazelnut industry is one of the fastest growing tree nut industries in Australia, with planting area increasing from 144 ha to 2144 ha since 2011 (ANIC, 2014). Hazelnuts are purchased for consumption both in shell and as a kernel. Hazelnuts are a major ingredient in some international confectionary brands and are also used in baking and cooking. A small niche market exists for hazelnut oils.

This information package is supplementary to the high resolution maps available online. The information provided should be used as a guide to find potential regions for expansion. However, specific and comprehensive site analysis must precede the final decision regarding site suitability for any orchard establishment. A further use of this work would be to provide information of suitable regions for sentinel plantings to determine the most appropriate regions for expansion of the Australian hazelnut industry.

Hazelnuts

Hazelnuts or filberts (*Corylus avellana* L.) are native to Europe and Asia Minor. Hazelnuts have a long history in the human diet, dating back to 8000 BC. Today, hazelnuts are primarily produced in Turkey (70% of global production) and in the United States (U.S.) (~15%). Hazelnuts are self-incompatible trees with small pistillate flowers and staminate male catkins. Flowering and pollination occurs during the winter months and the trees are wind pollinated (Snare, 2010). After pollination, the pollen remains on the flower pistile for 40–60 days when fertilisation occurs during spring. There are many hazelnut cultivars, of which approximately 10 are being grown in Australia. The phenology of cultivars continues to be investigated and will require further research to determine the best cultivar for production and compatibility under Australian conditions.

Commercially, hazelnut trees are grown with a central trunk to approximately 600 mm from ground level, after which branches are trained into a vase form. This tree structure has been shown to be the most productive form of canopy management and trees are maintained up to 6 m tall (Snare, 2010). Mother plants are used to propagate new plants, which are planted bare rooted and without using root stock. This planting method makes hazelnuts susceptible to changes in nutritional status and the effects of herbicide and insecticide use.

Australian Hazelnut Industry

Historically the Australian hazelnut industry has been relatively small, approximately 144 ha in 2011. The industry has primarily operated in south-eastern Australia where the climate is cooler then regions further north. The main production regions have been the New South Wales (NSW) Central Tablelands and north-eastern Victoria. There is also some production occurring in Tasmania and other regions of Victoria. More recently, large scale hazelnut production has commenced in the Riverina, within the Murrumbidgee Irrigation Area (MIA).

The popularity of nuts and nut products is growing, not only in Australia, but around the world. Huge potential exists for exporting Australian grown hazelnuts into Asian countries where a premium is sought for products grown under the high food-safety standards of Australian industries (ANIC, 2014).

Hazelnut growth requirements

Chill

Hazelnuts, like other nut trees, require a minimum chill accumulation throughout dormancy (May–October) for phenological processes, including budbreak and flowering. Successful hazelnut plantings combine sufficient chill with the compatible cultivars. The quantity of chill portions required varies between cultivars, and ranges from 48–60 (Table 1).

Table 1. Chill portions (low from Hall's Giant variety, high from Ennis variety) and water (1 October to 30 April mm) requirements of hazelnut trees

	Requirement
Chill	48–60
Water	366

Water

Hazelnuts require regular water, but do not perform well when water-logged. Scientific literature and industry publications suggest a minimum water requirement of 366 mm throughout the growing season (1 October to 30 April). This is likely to be an underestimate of water requirements for maximising crop yield and quality. Regions capable of supplying more water are recommended, for example within irrigation schemes.

In traditional hazelnut growing regions, such as Italy, there is sufficient rainfall, negating the need for irrigation. Conversely in Australia, for many horticultural crops, irrigation is necessary in most regions. In the absence of demand from large growing regions elsewhere in the world and the relatively small scale of Australian production, research into the water requirements of hazelnut is limited. We are unable to define a volume of water that ensures productive hazelnut crops; ergo the provided volume (366 mm) is a minimum only.

Soil

Hazelnuts prefer deep, well-drained fertile soils. Heavy clays should be avoided with preference given to loam or sandy loam soils. Australian soils are often poorly structured and have low fertility and high salinity. Establishing highly productive, sustainable and long-term hazelnut plantings requires individual site analysis followed by careful planning and preparation.

The depth, clay content, structure and previous use of the soils at each site will potentially vary greatly within a small area. With chemical and physical amendments and additions, the scope of potentially suitable and productive soils is broadened. Using the Australian Soils Classification and data obtained from the Australian Soil Resource Information System (ASRIS, 2011) the soil layer was added as a 5th layer to the hazelnut bioclimatology model map (see Figure 2).

Risk factors

Hazelnuts are susceptible to certain risk factors including late spring frosts, high heat events, and rainfall during harvest, but there are many other risks that affect different locations. The severity of the impact of risks varies each year, from region to region and even within small areas on an orchard. Furthermore, these risks are potentially negated or reduced by orchard management strategies, and are influenced by orchard size and local infrastructure. These factors are not incorporated into the model as we are not able to accurately account for the high variability between locations, farm management, infrastructure and the severity of each risk factor from year to year. We strongly recommend local research to assess the potential for negative climatic conditions.

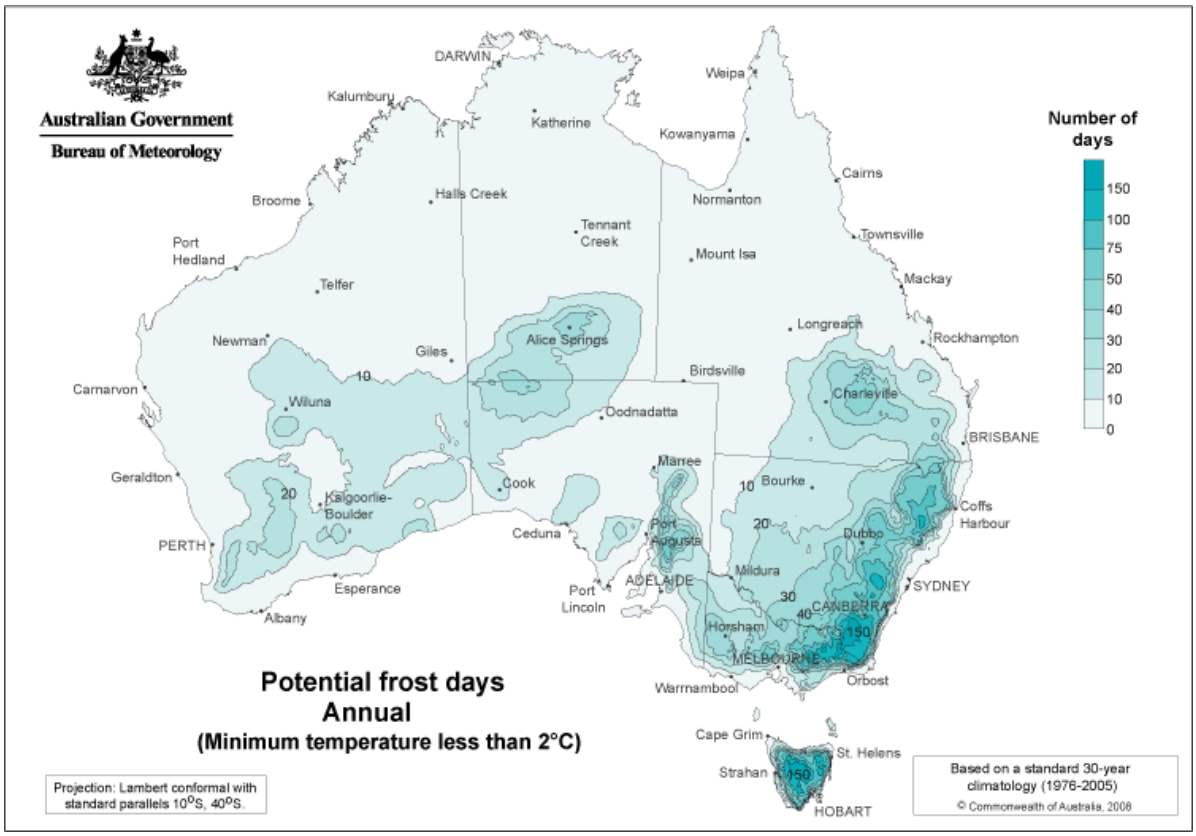

Figure 1. Annual average potential frost days for Australia. Regions with an average number of frost days greater than 100 are likely to have late spring frosts (BoM, 2015).

Hazelnut pistillate flowers are damaged by late spring frosts, which can significantly reduce crop yield. Historical frost-day data can be used to judge region suitability based on the average of annual frost days (Figure 1). Late spring frosts are more likely to occur in regions that experience more annual frost days, presenting a risk for hazelnut production.

Bioclimatology model for hazelnut industry expansion

Potentially suitable regions for hazelnut industry expansion throughout Australia have been modelled using bioclimatology – the study of the effects of climate on living organisms. The aim of this work is to provide an objective basis for expansion of the Australian hazelnut industry.

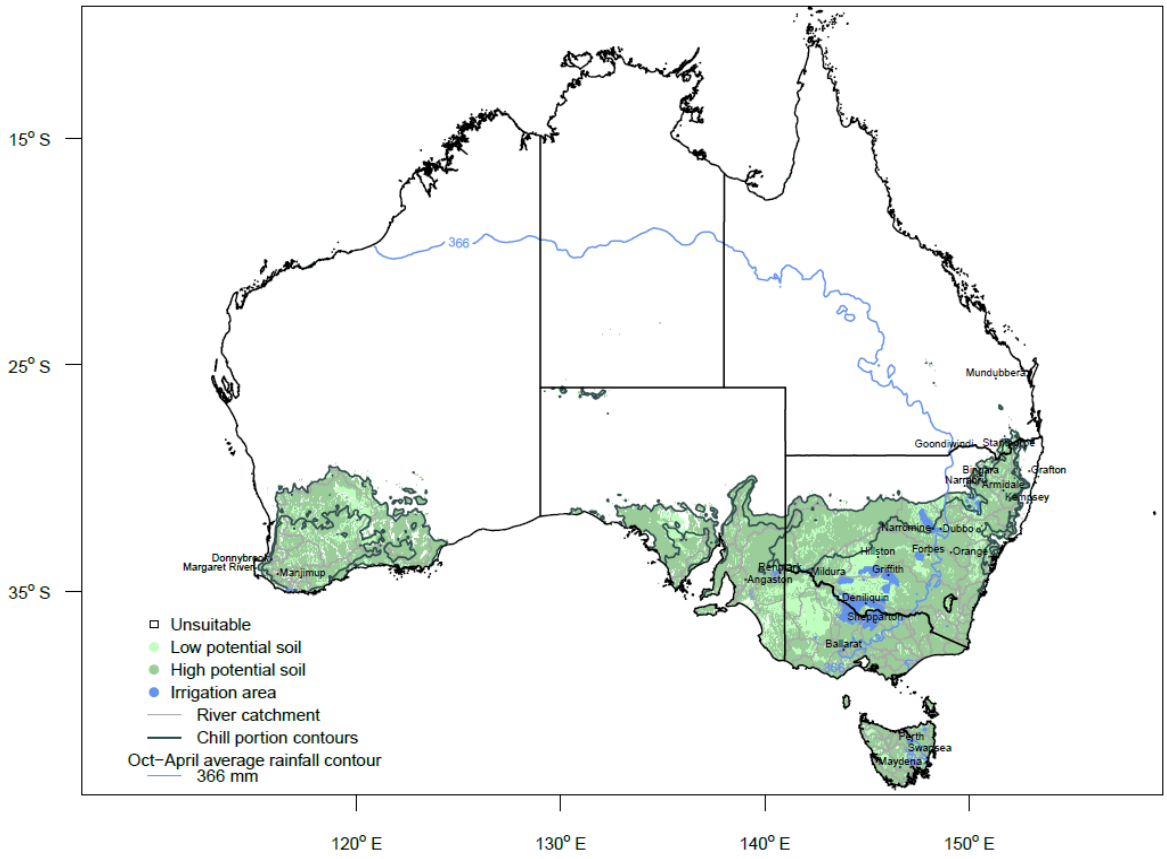

Figure 2. Bioclimatology model for hazelnut industry expansion.

The bioclimatology model was generated based on hazelnut tree phenology. The Dynamic Model of Chill Portions (Dynamic Model) quantifies chill hours (hours between 0 °C and 7.2 °C) accounting for the cancelling effect of heat. This model has been extensively tested on many crops in Australia and California (Luedeling, 2011; Zhang, 2011). Chill portions were determined as the most limiting factor to regional suitability so were the primary factor to be modelled.

Additional layers were added to the chill portion map to incorporate water availability and soil suitability. Water availability has been added in the form of blue contour lines for rainfall, blue shaded vectors for irrigation schemes, and grey lines show the river catchment areas. The depth of green shading increases with increasing soil suitability.

Interpreting the model

A sample section of the hazelnut industry map (Figure 3) outlines the key features of the bioclimatology models: chill portion contours, river catchment regions, rainfall contour, irrigation scheme areas and soil suitability. These are features common to each nut industry model. The two chill portion contours represent the range in chill portion requirements of the range of commercial cultivars for each nut crop (as describe further in the following sections for each specific nut crop).

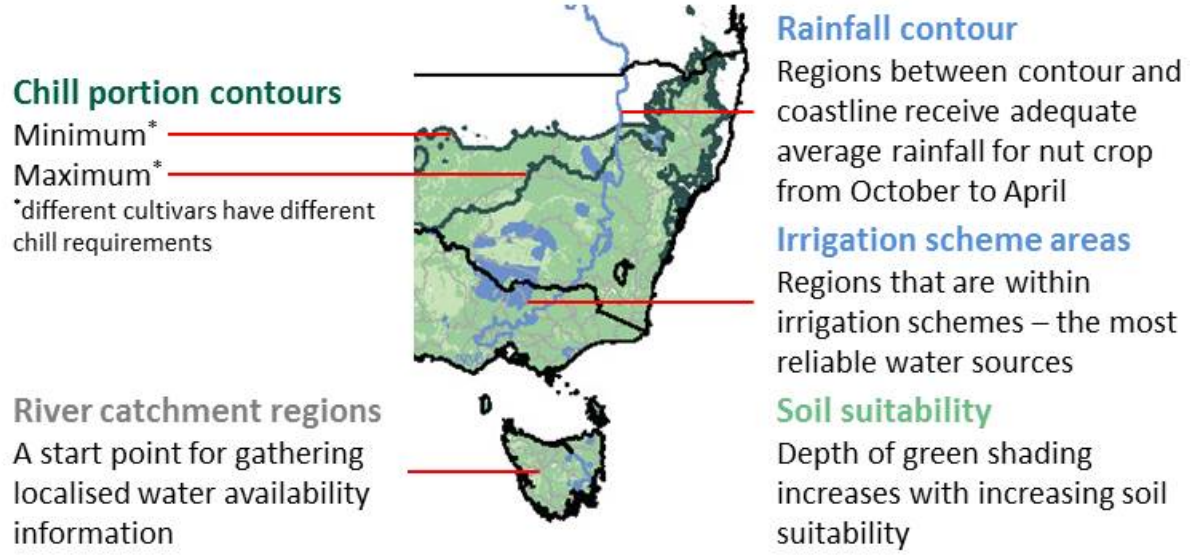

Figure 3. Key to interpretation of bioclimatology model – an example using the hazelnut bioclimatology map.

Using the Dynamic Model to predict chill portions

The Dynamic Model was used to predict chill portions for 5 km × 5 km grid points covering the entirety of Australia. The Dynamic Model uses daily temperature maxima and minima to generate hourly temperatures for the midpoint of each grid. Chill portions were calculated for 1 May to 31 August. The 'R' statistical package was used to plot dark green chill portion contour lines on a digital map of Australia for each of six temperate nut industries (Figure 2). The upper dark green contour represents the minimum chill requirement and the lower dark green contour represents the maximum chill requirements for a range of commercial cultivars for each nut type.

The Bureau of Meteorology (BoM) historical temperature records date back to 1911. However, this data is often subject to spatial and temporal discontinuities. For this reason, temperature data gathered since 1996 was used to interpolate the chill portion data used to map regions suitable for nut expansion The Moree site in NSW was selected to compare chill portion estimates derived from the interpolated data with those calculated using actual recorded daily temperatures. There was good agreement between the two methods.

Water availability

Catchment areas are outlined on the bioclimatology map (grey). Due to the dynamic nature of water availability in some catchment areas, these are provided as a guide and starting point; further information will be needed to form your final decision. For example, Figure 4 shows the Snowy River, Towamba River and East Gippsland catchment regions near the NSW–Victoria border. The water availability in these catchments is variable and depends on many factors including rainfall and temperature.

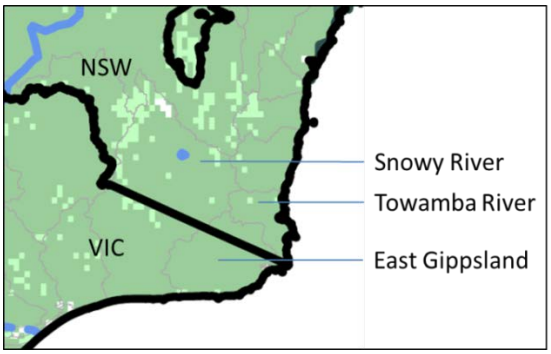

Figure 4. Example of river catchments on the bioclimatology map.

There are some river catchment areas that are highly suitable for establishing nut tree plantings. The most suitable river catchment areas contain perennial rivers that constantly flow and are relatively reliable sources of stable water, compared with non-perennial or seasonally flowing rivers (Figure 5).

The main perennial river systems with the capability to supply water for irrigation are the Murrumbidgee and Murray rivers, which run through NSW, Victoria and South Australia (SA). There are also coastal perennial river systems on the east coast of Australia and small perennial rivers in south-western Western Australia (WA).

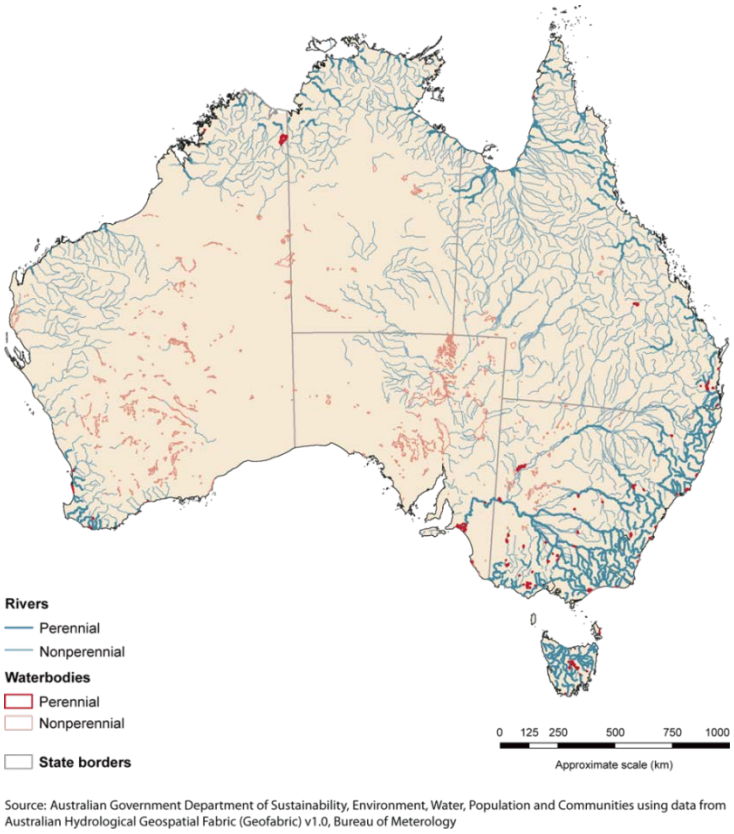

Figure 5. Australian perennial (permanently flowing) and non-perennial (seasonally flowing) river systems and water bodies (SoE, 2011)

Recommendations

There are suitable regions for Australian hazelnut industry expansion throughout southern NSW and northern Victoria. Areas are within the irrigation schemes of the MIA or Murray–Darling rivers are particularly suitable due to the availability of water (Figure 6).

The Central Tablelands (around Orange) region within the rainfall contour is suitable. The Central Tablelands experience lower average maximum temperatures than other regions in southern NSW, reducing the potential for heat damage to hazelnut trees throughout the summer; however the region is also more prone to late spring frosts.

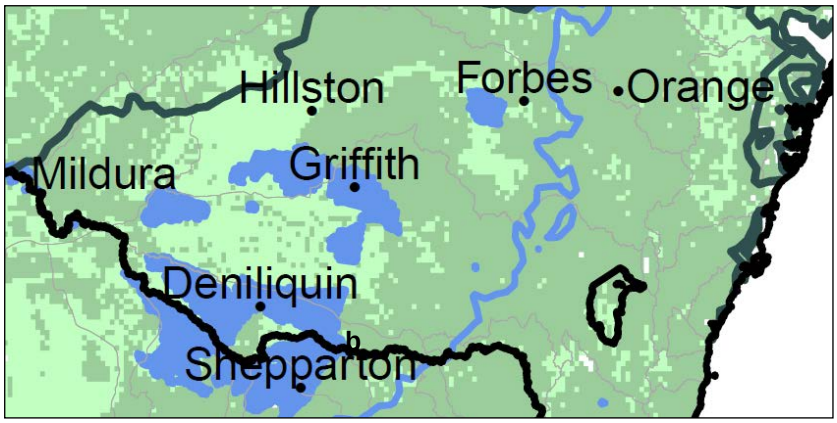

Figure 6. Example of potentially productive regions throughout southern NSW including the regions encompassed by the MIA and Murray River

Perennial river systems with the chill portion areas mean that it is theoretically possible to produce hazelnuts in:

- South Australia, such as Renmark and near the Adelaide Hills (Figure 7a)
- Tasmania, including Flinders and King islands (Figure 7b)
- Western Australia on the south-western coast near Margaret River (Figure 7c)
- throughout much of Victoria (Figure 7d).

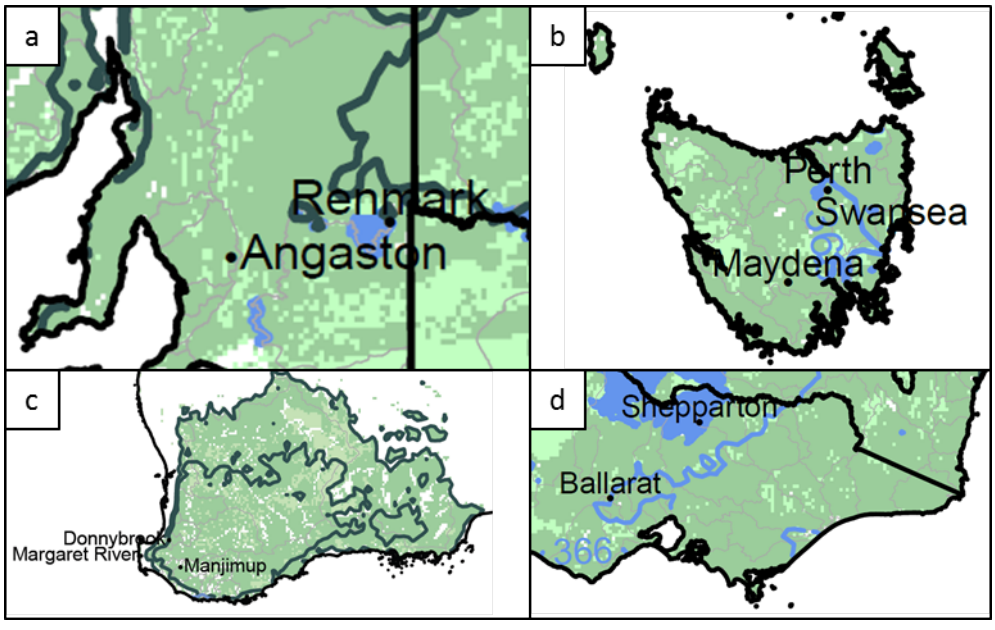

Figure 7. Potentially productive regions (a: SA, b: Tasmania, c: WA and d: Victoria)

Online resources

Model available for download as PDF

The model generated is available online as an extremely high-resolution map on the NSW DPI website with this Primefact (Hazelnut industry expansion). This map is able to be interrogated, by zooming, to a resolution of 5 km × 5 km. The model is based on bioclimatology and the phenological requirements of hazelnuts. Models for other temperate nut industries (almonds, chestnuts, pecans, pistachios and walnuts) have also been developed and are also available online from the NSW DPI nuts page.

Multi-industry information package and map

This Primefact is one of six industry specific Primefacts available online (NSW DPI nuts page). In addition, we have a multi-industry information package, which includes more information than these industry specific documents and a more user friendly map. This user friendly map does not include all the information (rainfall, soil or irrigation schemes) that the PDF maps do and we suggest using the two map types to get the maximum possible use out of the resources available.

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More information

Jacquelyn Simpson 02 6951 2611 email: jacquelyn.simpson@dpi.nsw.gov.au

Acknowledgments

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For updates go to www.dpi.nsw.gov.au/factsheets

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