Activity # 1- Assessing Horticultural Crop Suitability for the Queensland Murray Darling Basin Study Area

Economic analysis of potential horticultural crops

(1 August 2014 to 30 June 2016)

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This publication has been compiled by David Carey of Agri-Science, Department of Agriculture and Fisheries.

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The fourth step in assessing horticultural crop suitability for the QMDB Study Area was to complete an economic analysis of several example horticultural crop gross margins and a sensitivity analyses to examine the effect of changes in crop yield and market price for those crops which survive the previous three steps.

1 Gross margins vs profit

Even when a crop returns a positive gross margin, this does not necessarily indicate that a crop is profitable, as gross margin analysis only considers variables cost. Gross margins are beneficial for short-term decisions as they help to determine which crop to plant using the same capital equipment; however, gross margins should not be used as a measure of profitability or used for long-term decisions such as capital investments or strategic planning. Net profits will help a farmer to determine the benefits and costs of adopting an alternative production system. For example, we use AgMargins™ to identify the yields, income and variable costs for potential horticulture crops. This information was later expanded in specific case studies by including other overhead and capital costs to derive net profits.

The horticultural industry in Australia is a mature, highly efficient industry serviced and supplied by experienced specialist growers and underpinned by a complex supply chain. Existing growers in Queensland and other Australian production regions compete to supply fruit and vegetables to the Australian domestic market. This domestic market is adequately supplied (some would say oversupplied) and only top quality produce achieves best price in the market. There is little opportunity to sell inferior grade product in the modern national fresh food market.

Any additional horticultural production capacity from new production areas will need to be targeted specifically at replacing currently imported lines, or specifically grown for and exported to supply firm orders from overseas markets. Australian fruit and vegetable consumption capacity is currently exceeded by existing experienced producers. Any extra production in most lines sold on the domestic market will simply result in a further decrease farm gate pricing.

Horticultural crops — both annual and perennial are highly labour intensive compared to many other agricultural businesses. The perishable and fragile nature of many horticultural products often with unique handling and storage requirements means timely efficient harvest and handling is essential. Australian labour costs are some of the highest in the world and this combined with the limited supply of labour in regional areas needs to be considered when evaluating the suitability of any potential horticultural crop in any location. Taking advantage of any opportunity for mechanisation to minimise labour costs and dependency, along with economies of scale of production are essential to Australian growers being internationally competitive in export markets

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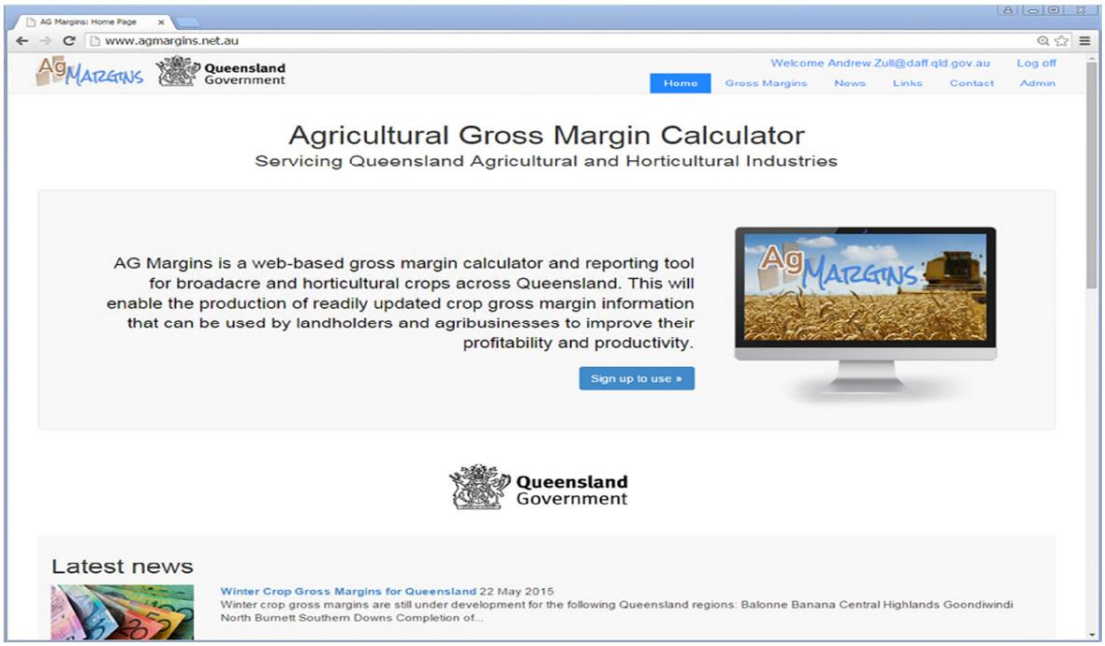
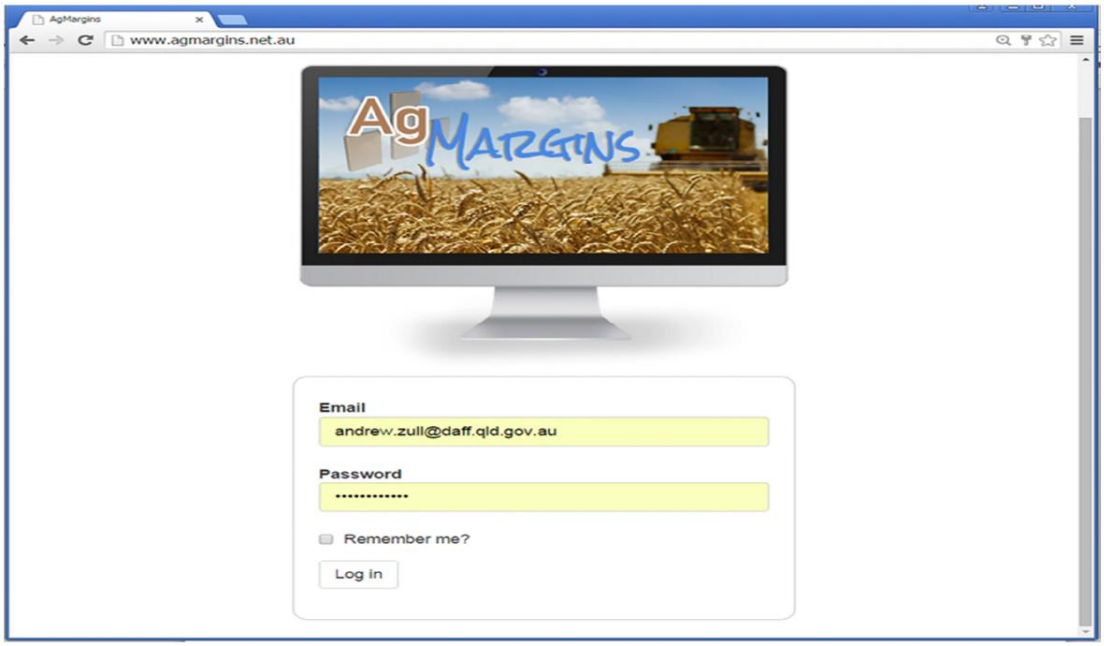
2 The development of AgMargins™ for horticulture gross margins

AgMargins™ is expected to be made available to the general public before the end of June 2017 (Figure 51).



Registered users will have access to existing selected crop gross margins on the web via a log-in page (Figure 52).



Project economists and staff have helped develop a web based gross margin tool and complimentary database for a selection of broad-acre and horticulture crops produced in Queensland2. The web based AgMargins™ tool enables access to updated selected horticultural crop gross margin information that can be used by growers and agribusinesses to compare and assess their input costs and productivity with a generic industry standard set of figures. Input costs and generally acceptable yields can be updated in the behind the scenes "look up" tables for included crops providing an up to date resource for registered users and assisting Queensland Department of Agriculture and Fisheries staff to assist and support the horticultural industry.

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Registered users will also benefit by using the AgMargins™ database to safely store personalised input and gross margin data for individual crops. This will allow later analysis and comparison of actual crop outcomes with the original "planned crop" input costs and yield. Registered users will be able to build a unique secure personalised gross margins cropping record. The tool is interactive - registered users will be able to develop their own (private) gross margin assessments and update these as often as required. This will greatly assist individual producers who wish to review gross margins on an annual basis.

Currently no interactive industry wide gross margin data base tool is available; either within DAF or as a standard item within the marketplace. The development of this web-based tool will assist the Queensland industry to assess production costs for both domestic and export markets. The web based AgMargins™ tool generates crop specific sensitivity tables calculating both gross margins per hectare and per mega-litre (for irrigated crops) with respect to changes in yield and commodity prices.

Throughout the development of the AgMargins™ tool more than 60 industry stakeholders have reviewed tested and provided feedback to assist its development. This process utilized industry knowledge and s provided feedback to project staff, helping refine the software and ensure that the tool is both easy to use and robust. Registered users are able to access the detailed crop and product specific purpose built input costs database within AgMargins™ and utilise it to build individual personalised crop gross margins. AgMargins™ allows users to select crop specific inputs such as fertilisers and pesticides - allowing a more user specific crop gross margin analysis. Individual registered users will be able to take a generic crop gross margin developed for their growing region, adjust, customise and personalise it to reflect their own on-farm operations. These personalised AgMarginsTM can then be saved within the user's profile (private & password protected) and revisited, updated or compared to the generic crop x region profile as needed.

A number of production region based generic gross margin reports that estimate transport and labour costs in the different Queensland production regions have been developed as part of this economic analysis process for high value horticulture crop the QMDB region study area.

These generic production region gross margins are based on a range of assumptions and so should be viewed and used accordingly, small changes in production variables (e.g. price or yield) can have a major impact on the gross margin outcomes. The ability to customise and personalise input costs based on a registered users own farm inputs and costs does however provide a method of better reflecting a range of site specific results. Crop specific generic gross margin templates have been developed (within AgMargins™) for major locations within the QMDB study area - Balonne, Darling Downs, and Goondiwindi. Generic gross margins have also been developed for the Lockyer Valley and Maranoa production areas to allow a general comparison between several production locations within Queensland.

Specific I generic gross margins in each comparison location are included in Section 8: Appendix III — Annual AgMargins™ examples for cotton, broccoli, cabbage, carrot, cauliflower, garlic, lettuce, onion (brown), pumpkin, and sweet corn for Lockyer Valley (Gatton), Darling Downs (Toowoomba), Goondiwindi (Inglewood), Balonne (St George), and Maranoa.

[2] The example gross margin budgets presented in this report are a guide to potential costs and returns that can be expected if specific conditions (relating to climate, prices, management, etc.) prevail. If these conditions alter so too will gross margin estimates. For this reason each AgMargins™ report has sensitivity analysis with respect to commodity price and yield.

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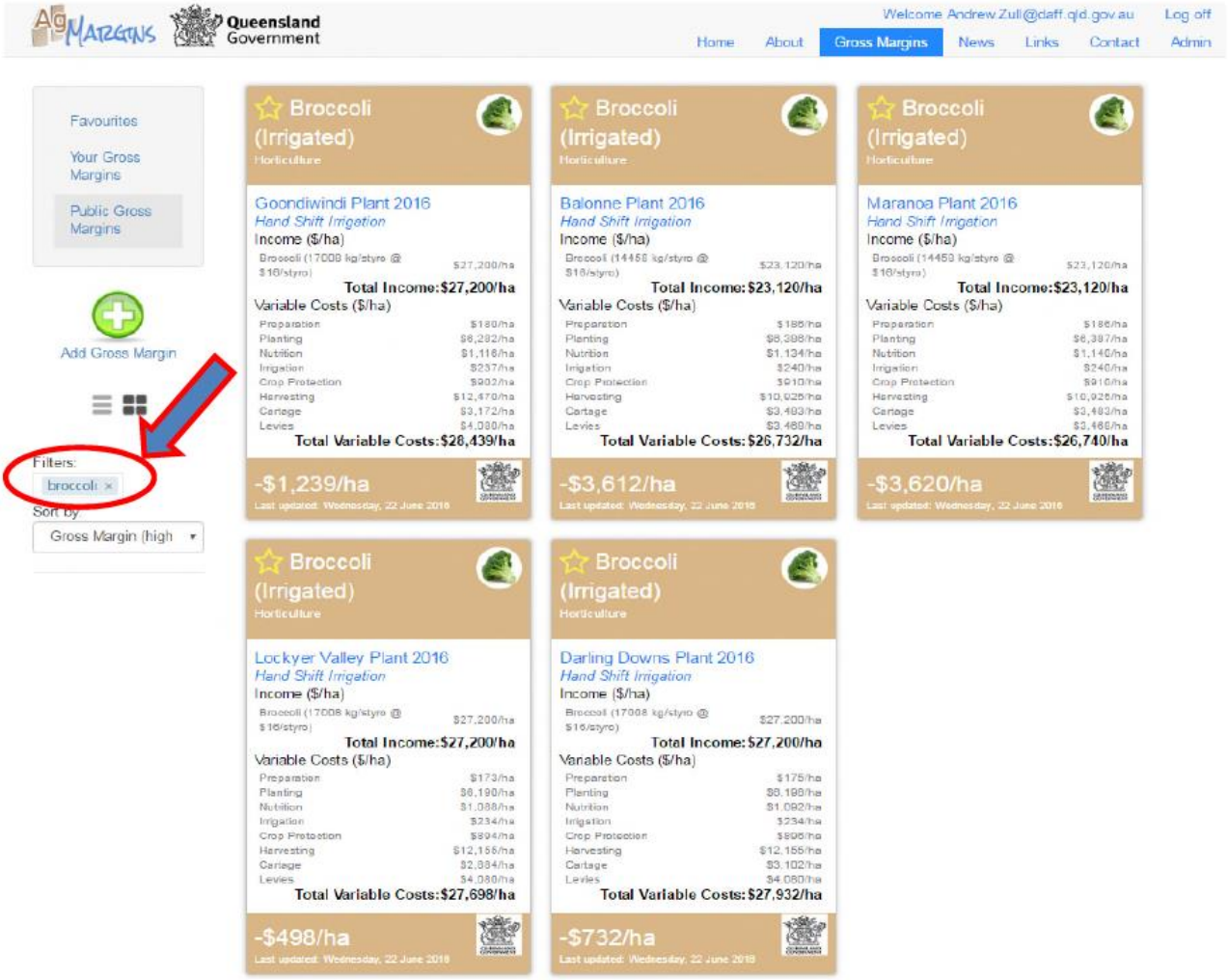
3 AgMarginsTM output example: Broccoli across the QMDB study area

Users can search the AgMargins™ library for existing generic gross margins outputs or generate their own AgMargins™. The images below show an overview of existing gross margins after using the filter for "Broccoli" which gives the result for several different Queensland regions (Figure 53). The information and crop operation variable costs for irrigated broccoli within AgMargins™ are based on recent farmer and agronomist interviews. Users can modify and personalise the existing crop AgMargins™ to create their own farm specific AgMargins™, allowing the comparison of different cropping scenarios e.g. machinery operations, crop agronomy inputs, yield and sale price.

Figure 53 - Example of an AgMargins™ output for irrigated broccoli from 5 southern Queensland regions with transport costs and yields the primary variables changing between regions.



The above examples of irrigated broccoli gross margins generated for a number of Queensland production regions have not previously been publically available, and have been based on the following inputs (Table 2). AgMargins™ is a database that can be used to compare crop yields, input costs and sale price in different Queensland regions. Within the QMDB Study Area for example, heat stress potential tends to increase in summer the more western and northern the production locations and this can reduce expected yields. Fertiliser, product packaging and agronomic input costs tend to increase as transport distances to inland locations increase. Labour availability, skill level and cost as well as transport availability and cost of transportation to market will vary with farm location.

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Table 2— Input costs that vary with respect to growing irrigated broccoli in different regions and the resulting gross margins.

Inputs	Units	Regions				
		Lockyer Valley (Gatton)	Darling Downs (Toowoomba)	Goondiwindi (Inglewood)	Balonne (St George)	Maranoa (Roma)
Yields	8 kg/ha cartons	1700	1700	1700	1445	1445
Labour costs	$/hr	$27.00	$27.00	$28.35	$30.00	$30.00
Freight cost	$/pallet to markets	$95.00	$102.20	$104.50	$135.00	$135.00
Gross Margins	$/ha	-$198	-$732	-$1,239	-$3,612	-$3,620
Change (%) in Total Variable Costs per carton compared with Locker Valley		0.0%	0.8%	2.7%	13.5%	13.6%

3.1 AgMargins^{TM} reports and sensitivity tables

AgMarginsTM users can obtain a detailed AgMarginsTM report for a region of interest by double-clicking the summary report (refer Figure 53). Below is an example of an AgMarginsTM gross margin output for irrigated broccoli grown in the Lockyer Valley in 2016 (Figure 54).

Broccoli - Hand Shift Irrigation - Plant 2016 (Lockyer Valley)

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Commodities

	YIELD	PRICE	TOTAL
Broccoli			**$27,200**/ha
Broccoli	1700 8 kg/styro	16.00 $/styro	$27,200 /ha

Total Income: $27,200 /ha

Variable Costs

	QTY	RATE	COST	TOTAL
Preparation				**$173**/ha
Operation: Ripper + FWA Light FORM	1 operation	1 ha/hr	33.24 $/hr	$33 /ha
Contract: Labour (hours)		4 hr/ha	27.00 $/hr	$108 /ha
Operation: Spreader + FWA Light FORM	1 operation	1 ha/hr	31.65 $/hr	$32 /ha
Planting				**$6,190**/ha
Seedlings: Broccoli	1 application	50000 plants/ha	0.08 $/plant	$4,150 /ha
Operation: Planting + FWA Light FORM	1 operation	3.75 hr/ha	111.89 $/hr	$420 /ha
Contract: Labour (hours)		60 hr/ha	27.00 $/hr	$1,620 /ha

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Nutrition				**$1,088/ha**
Nutrient: Calcium Nitrate - Farm Gate	4 application	100 kg/ha	0.56 $/kg	$223 /ha
Nutrient: Potassium Nitrate - Farm Gate	4 application	100 kg/ha	1.36 $/kg	$543 /ha
Nutrient: CK55 - Farm Gate	1 application	400 kg/ha	0.81 $/kg	$323 /ha
Irrigation				**$234/ha**
Irrigation: Hand Shift (FORM)		2 ML/ha	70.00 $/ML	$140 /ha
Consumable: Water		2 ML/ha	20.00 $/ML	$40 /ha
Irrigation: Water License		0 ML/ha	100.00 $/ML	$0 /ha
Contract: Labour (hours)		2 hr/ha	27.00 $/hr	$54 /ha
Crop Protection				**$894/ha**
Operation: Self-propelled sprayer FORM	6 operation	6 ha/hr	87.68 $/hr	$88 /ha
Fungicide: Azoxystrobin (e.g. Amistar 250 SC)	2 application	0.5 L/ha	51.70 $/L	$52 /ha
Fungicide: Copper Oxychloride (e.g. Coppox WG)	2 application	0.2 kg/ha	27.50 $/kg	$11 /ha
Insecticide: Flubendiamide (e.g. Belt 480 SC)	3 application	0.1 L/ha	870.72 $/L	$261 /ha
Insecticide: Imidacloprid (e.g. Confidor 200 SC)	1 application	1.8 L/ha	64.79 $/L	$117 /ha
Herbicide: Trifluralin + Hydrocarbon (e.g. Trifluralin 480 EC)	1 application	2 L/ha	9.63 $/L	$19 /ha
Insecticide: Emamectin Benzoate (e.g. Proclaim)	2 application	0.3 kg/ha	399.67 $/kg	$240 /ha
Contract: Crop agronomy/protection		4 ha/hr	102.60 $/hr	$26 /ha
Contract: Labour (hours)		3 hr/ha	27.00 $/hr	$81 /ha
Harvesting				**$12,155/ha**
Contract: Labour picking	1700 8 kg/styro	15 styro/hr	27.00 $/hr	$3,060 /ha
Contract: Labour packing machine labour	1700 8 kg/styro	15 styro/hr	27.00 $/hr	$3,060 /ha
Processing: Ice for styros	1700 8 kg/styro		0.75 $/ctn	$1,275 /ha
Cartage				**$2,884/ha**
Transportation: Refo pallet	1 (36L) ctn/ha	56 (36L) ctn/pallet	95.00 $/pallet	$2,884 /ha
Levies				**$4,080/ha**
Commission & Levies	15 %	[INCOME]		$4,080 /ha

Total Variable Costs: $27,698 /ha

Gross Margin: -$498 /ha

Effect of Yield and Price on Gross Margin ($/ha)

Broccoli Yield (8 kg/styro)	$12.80/styro	$14.40/styro	$16.00/styro	$17.60/styro	$19.20/styro
1,190.00	-$9,665	-$8,101	**-$6,577**	-$5,093	-$3,649
1,360.00	-$7,881	-$6,149	**-$4,469**	-$2,841	-$1,266
1,530.00	-$6,149	-$4,263	**-$2,443**	-$689	$999
1,700.00	**-$4,469**	**-$2,443**	**-$498**	**$1,365**	**$3,147**
1,870.00	-$2,841	-$689	**$1,365**	$3,321	$5,177
2,040.00	-$1,266	$999	**$3,147**	$5,177	$7,090
2,210.00	$257	$2,621	**$4,847**	$6,935	$8,885

Effects of Yield and Price on Gross Margin per ML (assuming 2.0ML/ha is used).

Broccoli Yield (8 kg/styro)	$12.80/styro	$14.40/styro	$16.00/styro	$17.60/styro	$19.20/styro
1,190.00	-$4,833	-$4,051	**-$3,288**	-$2,546	-$1,824
1,360.00	-$3,940	-$3,074	**-$2,234**	-$1,421	-$633
1,530.00	-$3,074	-$2,131	**-$1,221**	-$344	$500
1,700.00	**-$2,234**	**-$1,221**	**-$249**	**$683**	**$1,574**
1,870.00	-$1,421	-$344	**$683**	$1,660	$2,589
2,040.00	-$633	$500	**$1,574**	$2,589	$3,545
2,210.00	$129	$1,311	**$2,424**	$3,468	$4,443

Figure 54 - AgMargins™ for irrigated broccoli in the Lockyer Valley planted in 2016

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Market volatility (daily market price) and yield variability can have dramatic impacts on crop viability when dealing with highly perishable horticultural crops such as broccoli. To gain some insight into the effects of yield and price on crop gross-margins, each AgMargins ™ report generates a sensitivity table of gross margins per hectare ($/ha) that highlights the effect of changing yields and crop prices. For irrigated crops there is also a sensitivity table detailing gross margins per megalitre ($/LM) for changing yields and crop prices (Figure 54).

In the broccoli example above the average yield of 1700 (8kg) styro packages/ha and a price of $16.00 a pack results in a gross margin of -$498/ha. However the same yield and a price of $19.20 a pack results in a potential gross margin of $3147/ha. While a decrease in yield to 1190 cartons/ha coupled with a price of $12.80/carton would see a gross margin loss of -$9665/ha. This yield and price combination will not cover variable costs and therefore growers are likely to make both a negative gross margin and net financial loss.

3.2 Main drivers and opportunities impacting broccoli gross margins across the QMDB

AgMargins™ analysis suggests that the current gross margins for growing broccoli in the Lockyer Valley is -$498/ha and -$249/ML, for a yield of 1700 (8 kg) styro's/ha and a sale price of $16 per (8kg) styro package. When yields or price are increased to 1870 stryo's/ha or $17.60/styro gross margins are positive. An alternative way to positive returns is to look at reducing input costs. Transplanting broccoli seedlings is common practice; however, transplanting is expensive ($4150/ha). If good germination and establishment of a direct seeded crop can be obtained, then gross margins are more likely to be positive. AgMargins™ data highlights the high level of labour input usually associated with broccoli production (208hrs/ha or $6230/ha).1f this can be reduced by as little as 10%, positive gross margins can be achieved. An obvious method of reducing labour costs is through the investment in capital equipment but this will require economies of scale to dilute investment costs over the increased cropping area.

AgMargins™ results for annual horticulture crops across the QMDB Study Area Crop Gross Margin Tool

Based on the Vegetables Crop Suitability Matrix (Figure 92) and industry interest, nine irrigated annual vegetable crops were identified and analysed using gross margin analysis within the QMBD Study Area: broccoli, cabbage (drumhead), carrots, cauliflower, garlic, lettuce, onion, pumpkin and sweet corn. Based on recent farmer and agronomist interviews expected yields were estimated for five QMDB regions: Lockyer Valley (Gatton), Darling Downs (Toowoomba), Goondiwindi (Inglewood), Balonne (St George) and Maranoa (Roma) (Table 3) — note the gross margin output is highly dependent on production variables. Irrigated cotton production is common within the QMDB region and t this information has also been provided. Cotton returns can be regarded as the opportunity cost of foregoing this production in favour of irrigated high value horticulture crops.

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Table 3 - Expected yields for selected annual irrigated horticultural crops in example Queensland regions

Irrigated Horticulture crops	Units	Regions				
		Lockyer Valley (Gatton)	Darling Downs (Toowoomba)	Goondiwindi (Inglewood)	Balonne (St George)	Maranoa (Roma)
Broccoli	8 kg/ha	1700	1700	1700	1445	1445
Cabbage (drumhead)	500kg bins/ha	340	323	323	295	295
Carrots	20kg/ha 1st/2nd Grade	1425/475	1425/475	1425/475	1283/427	1283/427
Cauliflower	72L ctn/ha	2666	2533	2406	2400	2400
Garlic	kg/ha 1st/2nd Grade	2960/2820	2960/2820	2960/2820	2664/2538	2664/2538
Lettuce	62L ctn/ha	3333	3166	3008	3000	3000
Onions	20kg bag/ha	2000	2000	2000	1900	1900
Pumpkin (Jap)	kg/ha	30,000	30,000	30,000	28,500	28,500
Sweet Corn	18L ctn/ha	1100	1100	1100	990	990
Irrigated Cotton	bales & seed /ha	12b & 3.6t	12b & 3.6t	12b & 3.6t	12b & 3.6t	12b & 3.6t

Labour and freight costs utilized in developing indicative gross margin outputs for these crops are the same as those used in Table 2. The combination of these input costs and the expected yields displayed in Table 3 resulted in the crop gross margins per location (Table 4).

Table 4 - Irrigated crop gross margins per hectare and per region.

Irrigated Horticulture crops	$/Units	Regions				
		Lockyer Valley (Gatton)	Darling Downs (Toowoomba)	Goondiwindi (Inglewood)	Balonne (St George)	Maranoa (Roma)
Broccoli	$16.00/styro	-$498	-$732	-$1,239	-$3,612	-$3,620
Cabbage (drumhead)	$65/bin	$811	-$335	-$884	-$4,686	-$4,692
Carrots	$8.00 1st & $6.00 2nd /20kg	$1,576	$1,414	$1,299	-$614	-$621
Cauliflower	$13.00/carton	$1,001	-$30	-$941	-$3,356	-$3,362
Garlic	$6.00 1st & $4.00 2nd /kg	$1,278	$1,201	$555	-$3,039	-$3,045
Lettuce	$11.00/carton	$891	-$172	-$1,106	-$3,694	-$3,704
Onions	$15.50/ 20kg bag	$3,360	$3,037	$2,374	-$734	-$745
Pumpkin (Jap)	$0.45/kg	$1,715	$1,469	$1,282	-$53	-$57
Sweet Corn	$11.00/carton	$3,899	$3,741	$3,576	$2,236	$2,229
Irrigated Cotton	$480/bales & $190/t seed	N/A	$3,841	$3,814	$3,785	$3,781

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Table 4 provides an overview of the relative differences in gross margins between example horticultural crops, across different Queensland regions and within the QMDB Study Area. These example gross margins are based on common industry practices; results may improve or decline given an individual farmer's expertise, resources, available equipment/technology, growing practices or as a result of climatic or pest and disease influences.

Although higher variable costs decrease gross margins in the QMDB Study Area production systems, there may still be opportunities to grow sweet corn due to lower land costs and a lower opportunity cost of forgoing other less profitable crops (e.g. cotton or sorghum or forage production). Conversely in the Lockyer Valley, there may be a higher opportunity cost associated with growing sweet corn as there are many other potential high value crops (e.g. rockmelons, tomatoes, capsicums); in contrast Sweet corn production systems have the additional advantage over many other vegetable crops of being highly mechanised from planting through to harvest, greatly reducing overall labour requirements.

One of the main differences between broad-acre grain or cotton crops and vegetable crops is the high level of labour needed for production. Table 5 outlines the estimated crop labour inputs, which highlights.

Table 5 — Crop labour inputs and gross margins per hectare for example comparison crops.

Maranoa (Roma)		
Irrigated vegetable crops	Hrs/ha	GM $/ha
Broccoli	208	-$3,620
Cabbage (drumhead)	195	-$4,692
Carrots	25	-$621
Cauliflower	209	-$3,362
Garlic	460	-$3,045
Lettuce	221	-$3,704
Onions	397	-$745
Pumpkin (Jap)	31	-$57
Sweet Corn	75	$2,229
Irrigated Cotton	20	$3,781

There is a strong correlation of decreasing gross margins (profitability) with increasing labour inputs (Figure 55). This table highlights how through increased mechanisation, gross margins may be improved; however, overhead costs will also increase so economies of scale will need to be implemented to spread capital/financing costs over larger cropping areas. Due to the existing high domestic supply volume of most horticultural crops within Australia, any increased economies of scale make it necessary to export into international markets to ensure viability.

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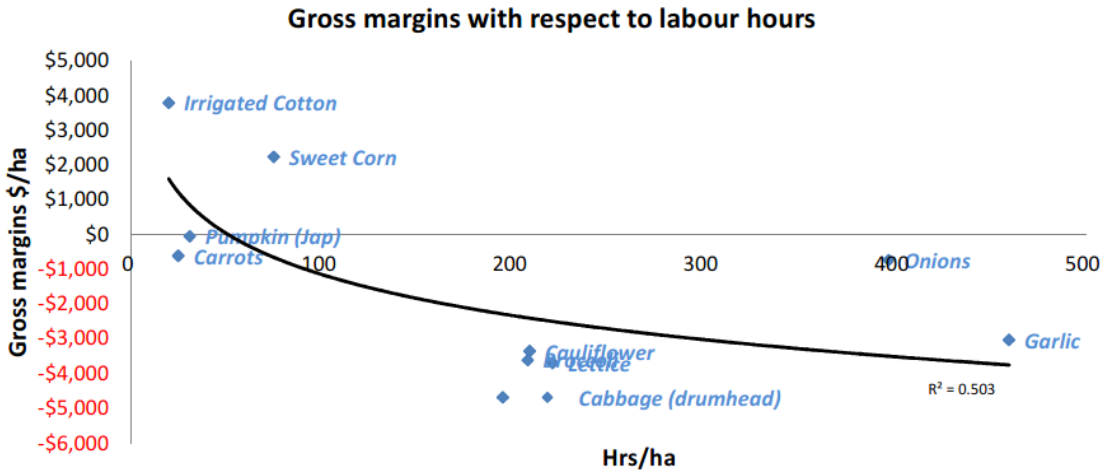
Figure 55 — Vegetable (and cotton) gross margins with respect to labour requirement impacts



4 Back Of Envelope Risk Analysis (BOERA) of example horticultural and cotton crops

Gross margins provide information about yields, returns variable costs and when combined into a sensitivity table they can also provide some information about yield and price effects; but, they provide little information about risk — especially when comparing cropping options. When considering which crop to plant, growers need to consider both production-yield and crop price risks. The sensitivity analysis within AgMargins™ indicates what gross margin is likely to occur for a given price and yield; however, this provides little information about the potential impact of marketable yield at harvest or price fluctuations. Back of Envelope Risk Analysis (BOERA) can assist growers to contrast a range of likely gross margins for the upcoming season based on minimum, expected, and maximum yields and prices of up to four crops.

BOERA uses triangular distributions of yields and prices and then implements Monte Carlo random selection to combine these distributions to generate a single range of possible gross margins. If randomness was not used when considering these two distributions (yield and price), then low yields will always have low prices and high yields have high prices. BOERA assumes that there is no correlation between farm yields and the price received as an individual grower is a price-taker; therefore it is realistic to use Monte Carlo random selection of yields and prices. The advantage of BOERA is that farmers can often provide the expected, best and worst price and yield with relative ease. BOERA also permits users to provide skewed distributions for either price and/or yield, i.e. 0.5, 2 and 2.5 t/ha. BOERA can also estimate the probability of breaking even (covering variable costs) and if fixed costs (overheads) are factored in can provide the probability of a net profit. The results are displayed as cumulative distributions functions (CDFs), where 0% is the lower end of the bell curve (worst-case) and 100% is the upper end of the bell curve (best case). A CDF can also indicate if a crop has stochastic dominance (always the best option) or the probable frequency that it can be the best option. The expected gross margin is the median value (0.5 probability on the y-axis, see Figure 58).

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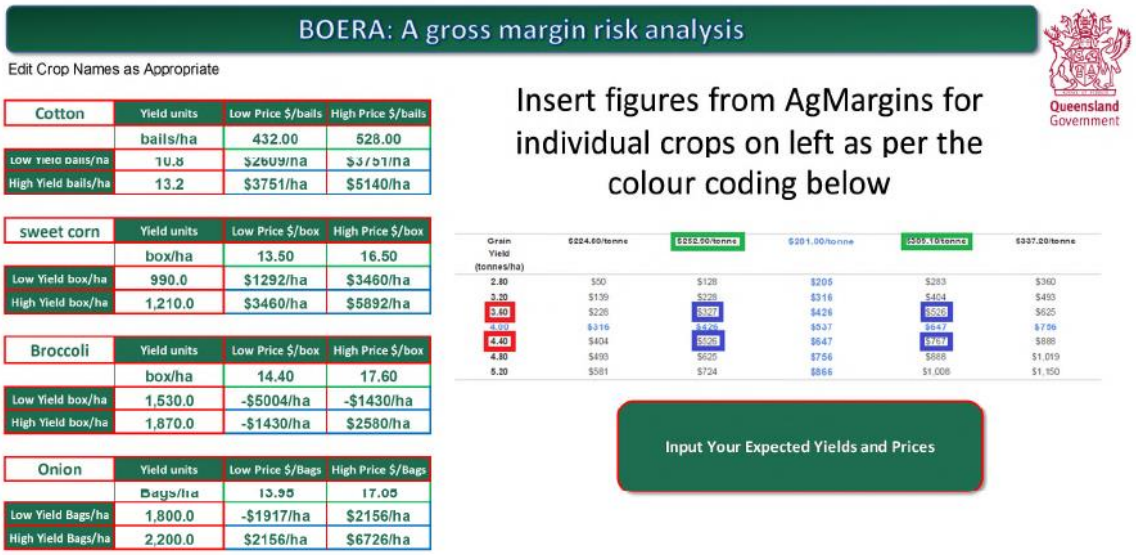
To demonstrate the functionality and output of the BOERA tool three of the vegetable crops that were identified as being suited to production conditions in the QMDB study area, sweet corn, broccoli and onion have been compared below. Cotton is also included as the "opportunity cost crop" which we assume is being foregone in favour of producing one of the above vegetable crops. In order to contrast regional differences, the BOERA tool examples below display financial outputs for crops in both the Goondiwindi (Inglewood) and Balonne (St George) production regions.

4.1 Goondiwindi (Inglewood) BOERA

The Sensitivity Table data from each AgMargins ™ report is entered into BOERA (Figure 56). As indicated in the figure, the sensitivity values are taken from the bottom of the AgMargins™ reports (see Sections 8.4.1, 8.4.10, 8.4.2, and 8.4.8). This data are used to generate a multi-regression function of gross margins with respect to price and yield.

Figure 56 -The AgMargins™ Sensitivity Table (gross margins with respect to yield and price) information from each crop in Goondiwindi (Inglewood) is entered into BOERA.



Cotton	Yield units	Low Price $/bails	High Price $/bails
	bails/ha	432.00	528.00
Low Yield bails/ha	10.8	$2609/ha	$3751/ha
High Yield bails/ha	13.2	$3751/ha	$5140/ha

sweet corn	Yield units	Low Price $/box	High Price $/box
	box/ha	13.50	16.50
Low Yield box/ha	990.0	$1292/ha	$3460/ha
High Yield box/ha	1,210.0	$3460/ha	$5892/ha

Broccoli	Yield units	Low Price $/box	High Price $/box
	box/ha	14.40	17.60
Low Yield box/ha	1,530.0	-$5004/ha	-$1430/ha
High Yield box/ha	1,870.0	-$1430/ha	$2580/ha

Onion	Yield units	Low Price $/Bags	High Price $/Bags
	Bags/ha	13.95	17.05
Low Yield Bags/ha	1,800.0	-$1917/ha	$2156/ha
High Yield Bags/ha	2,200.0	$2156/ha	$6726/ha

Grain Yield (tonnes/ha)	$224.60/tonne	$252.50/tonne	$201.00/tonne	$305.10/tonne	$337.20/tonne
2.80	$50	$128	$205	$283	$360
3.20	$139	$228	$316	$404	$493
3.60	$226	$327	$426	$526	$625
4.00	$316	$429	$537	$647	$756
4.40	$404	$526	$647	$767	$888
4.80	$493	$625	$756	$888	$1,019
5.20	$581	$724	$866	$1,008	$1,150

The distributions (minimum, expected, and maximum) yields and prices for each crop for the coming season are entered into BOERA (Figure 57) as is the fixed costs for the farm enterprise. These values are based on farmer "gut feeling" and can be changed by users based on expectations about the coming season, expected prices and estimates for their own production system. Fixed costs have been set at $400/ha, again this will change between production enterprises.

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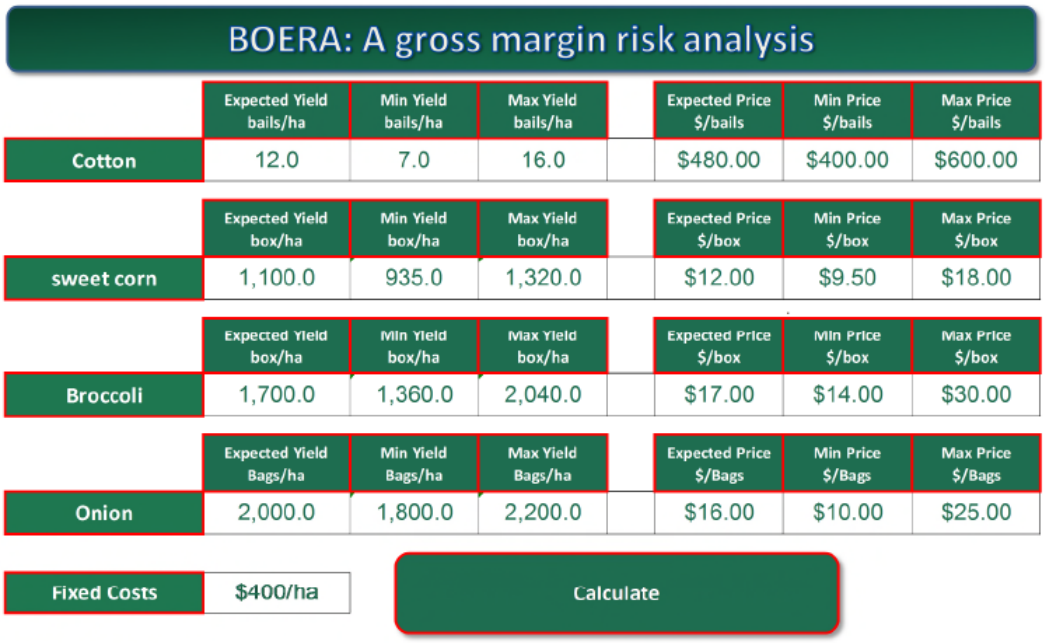
Figure 57 -The distributions (Min, Expected and Max) yield and price of each crop in Goondiwindi (Inglewood) is entered into BOERA along with fixed costs for overheads. This is constant across all crops for the paddock as overheads and capital equipment will not change in the short term (in the upcoming season).



BOERA will then generate a report that will have both graphs and tables (Figure 58). In this case we have four cumulative distribution functions of gross margins per hectare for Goondiwindi: cotton, sweet corn, broccoli and onion. The expected gross margins (P=0.5) for cotton and onion ($3969 and $4082/ha) are similar; however, the risk with onion is far greater. The flatter the CDF the greater the variance in results, onion production offers both the possibility of higher losses and profits per hectare (-$6013 to $16,400/ha) compared with cotton ($716 to $7550/ha). Similarly, onions have a greater chance of not breaking-even (17%) or making a net loss by not covering variable and fixed costs (19.4%), compared with cotton which is always expected to break even and make a net profit. The minimum cotton gross margin of $716/ha (P=0.0) is greater than the fixed cost of $400/ha. The "best option %" in Figure 58 is the likelihood of a crop offering the highest returns. If a CDF sits to the left of the graph for all probabilities (P = 0 to 1.00) then it is said to have stochastic-dominance, and is always the best option. Therefore the more frequent a CDF sits to the right of the graph compared to other cropping options the more likely it is the best option. Under the worst case scenario (P = 0 to 0.47) cotton offers the highest gross margins. Onion is the next best option 46% of the time followed by broccoli (8%).

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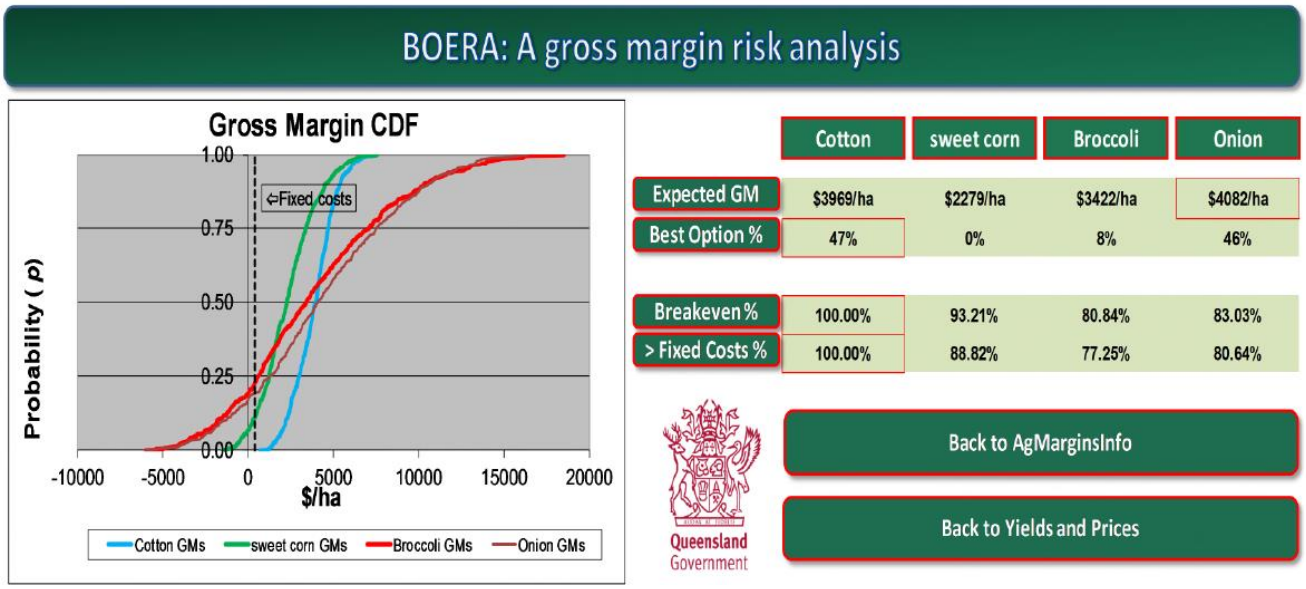
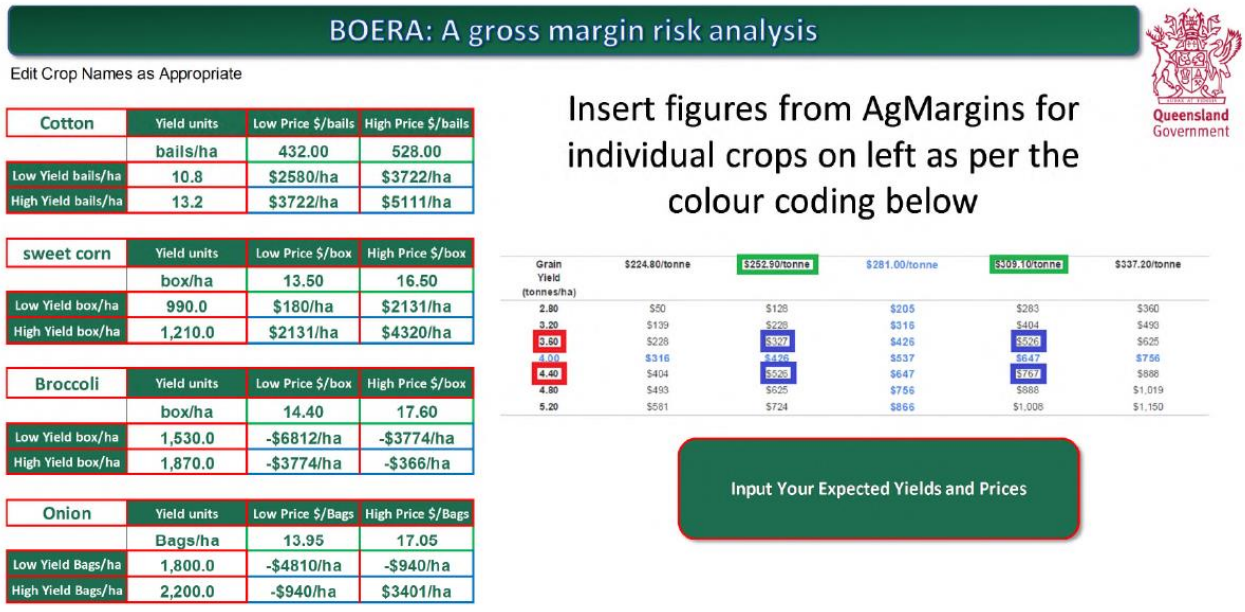
Figure 58 — BOERA results with the minimum (y=0.0), expected (y=0.5) and maximum (y=1.0) gross margin for cotton, sweet corn, broccoli, and onion in Goondiwindi (Inglewood). Where the gross margin line intersects the 0 $/ha on the x-axis is the probability of making a positive gross margin, i.e. growers will cover their variable costs. For example with sweet corn it has a 93% chance of a positive gross margin or a 17% chance of making a negative GM (being on the left of the y-axis). Likewise the threshold for net profits is where the CDF intersects the fixed cost dotted line, and for sweet corn there is an 89% probability of obtaining a positive net profit.



4.2 Balonne (St George) BOERA

The sensitivity data from each AgMargins ™ report is entered into BOERA (Figure 59). As indicated in the figure below, the sensitivity values are taken from the bottom of the AgMargins ™

Figure 59 -The AgMargins™ Sensitivity Table (GM with respect to yield and price) information from each crop in Balonne (St George) is entered into BOERA.



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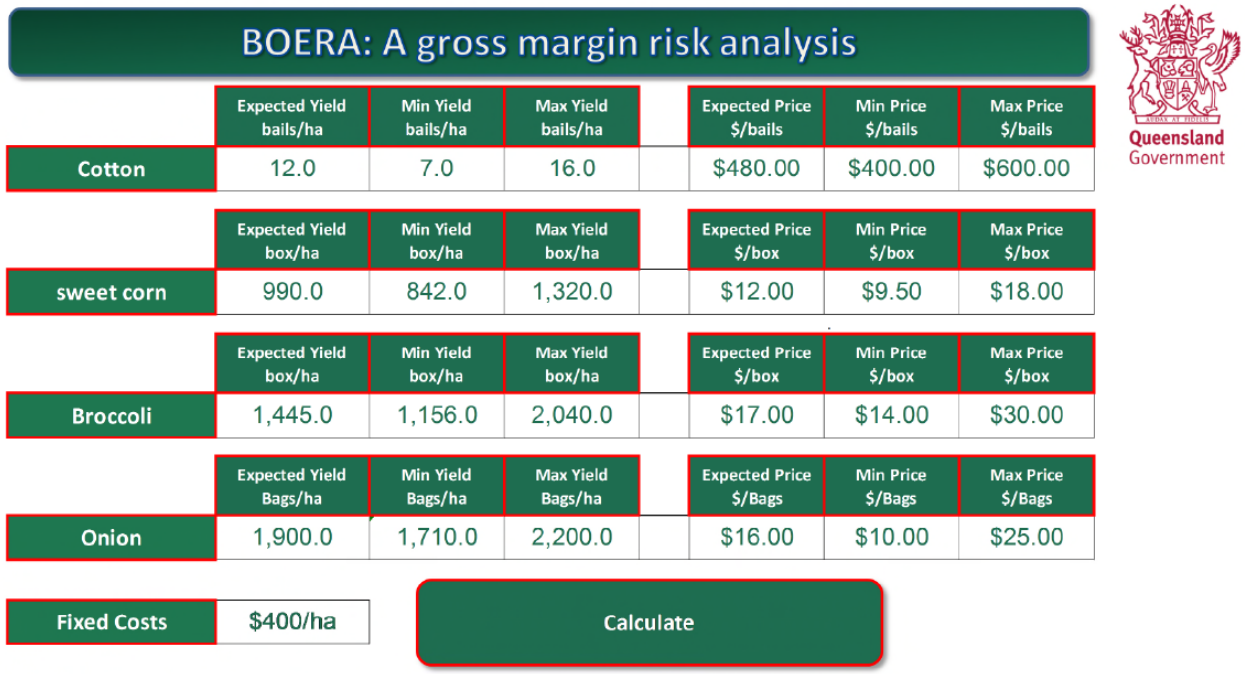
The distributions (min, expected and max) yields and prices of each crop for the upcoming growing season in Balonne (St George) are entered into BOERA along with fixed costs (Figure 60).

Figure 60 -The distributions (Min, Expected and Max) yield and price of each crop in Balonne (St George) is entered into BOERA along with fixed costs for overheads. This is constant across all crops for the paddock as overheads and capital equipment will not change in the short term (in the upcoming season).



BOERA generated gross margin CDFs per hectare for Balonne: cotton, sweet corn, broccoli and onion. The expected (P=0.5) gross margin for cotton ($3940) below is far greater than any of the three vegetable crops and has the lowest variance, breakeven and net profit risk. Sweet corn has the highest gross margin and lowest risk of the horticultural crops. It may be possible to further reduce this risk by implementing a split system production season- not planting when expected temperatures are likely to cause heat stress. As indicated earlier these gross margins may also be improved through increased mechanisation combined with economies of scale. This is common practice for cotton crops which maximise production area with minimal labour.

Based on current market price of the example vegetable crops and cotton, there appears to be limited opportunity for profitable vegetable production in the above examples using current growing practices and current market pricing. Where the gross margin line intersects the 0 $/ha on the x-axis is the probability of making a positive gross margin, i.e. growers will cover their variable costs. For example sweet corn has a 61.5% chance of a positive gross margin or a 38.5% chance of making a negative GM (being on the left of the y-axis). Likewise the threshold for net profits is where the CDF intersects the fixed cost dotted line, and for sweet corn there is a 52.3% probability of obtaining a positive net profit.

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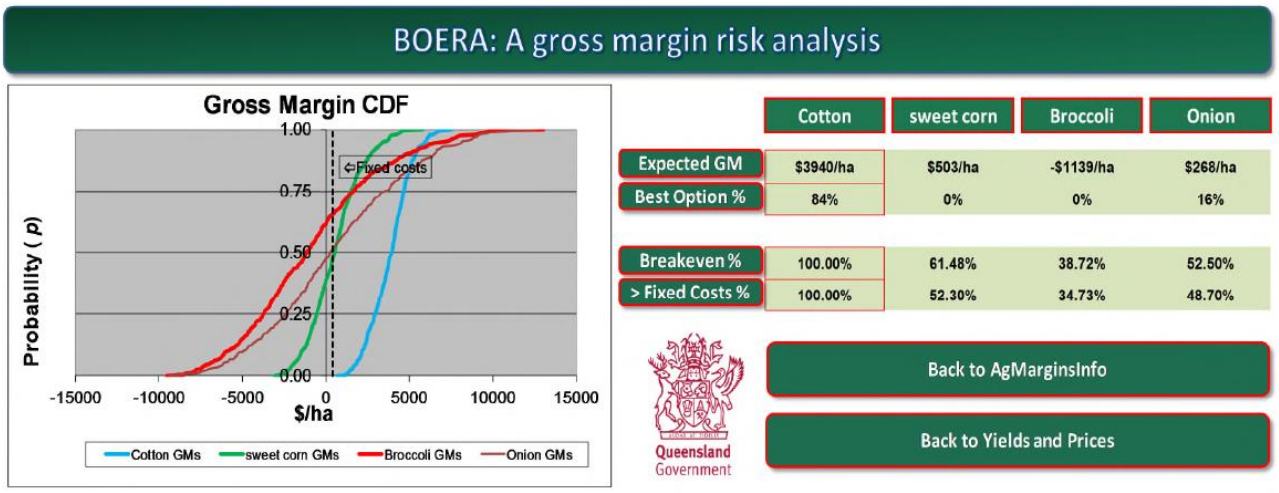
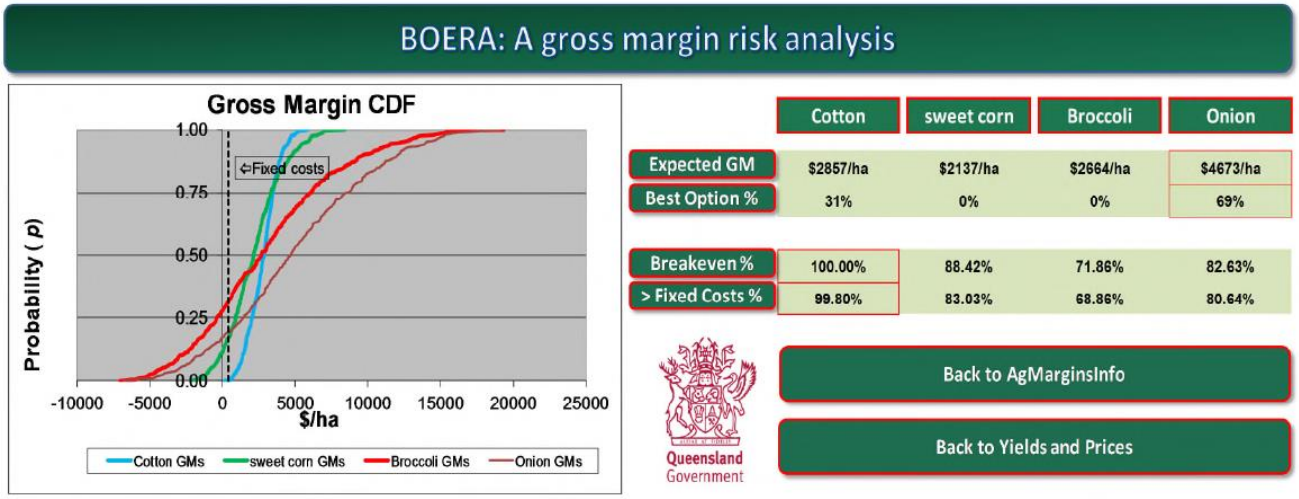
Figure 61— BOERA results with the minimum (y=0.0), expected (y=0.5) and maximum (y=1.0) gross margin for cotton, sweet corn, broccoli, and onion in Balonne (St George).



4.3 Balonne (St George) BOERA- used as a price sensitivity tool

BOERA can also be used as a sensitivity analysis tool. Users can investigate the effects of cotton prices decreasing by 20% under all scenarios (minimum, expected and maximum and this coinciding with a 20% increase in all example vegetable crop prices (Figure 62). Where the gross margin line intersects the 0 $/ha on the x-axis is the probability of making a positive gross margin, i.e. growers will cover their variable costs. For example sweet corn has an 88% chance of a positive gross margin or a 12% chance of making a negative GM (being on the left of the y-axis). Likewise the probability of having a net profit greater than the dotted line for sweet corn is 83%.

Figure 62 — using BOERA to investigate a 20% decrease in cotton prices and a 20% increase in all horticulture prices for sweet corn, broccoli, and onion in Balonne (St George).



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Although production risk (yields) has not changed some horticultural crops become viable options based on these price increases, relative to cotton. The production risk of perishable vegetables sold on a fluctuating market (often daily) is not considered in the above assumptions. The long-term trend of most agricultural crops is decreasing real-prices and increasing real-costs; therefore, unless there is a sudden increase in the demand for Australian horticultural crops by international markets, it is unlikely that alternative horticultural crops will offer higher returns than cotton in the foreseeable future. Even when cotton prices decrease by 20%, provided there is sufficient water for irrigation, there is very low risk of not breaking even or making a net loss in the Balonne (St George) region.

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