NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Maximising returns from water in the Australian vegetable industry

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3.7 – IRRIGATION SYSTEMS AND VEGETABLE PRODUCT QUALITY

The major irrigation systems used for each vegetable crop in the regions are summarised below with the production and quality issues associated with irrigation systems, water supply constraints or water quality.

Potato

Riverina – centre pivots, some fixed sprinkler

Potato production on Sandmount sandhills principally in the Berrigan–Oaklands area. Some issues with sealing and moisture penetration into the hill, which results in poor uniformity. Use of green manures/cereal rotation used to build up soil organic matter and improve water conductivity in soil. Drip irrigation trialled in past, and provides more even growth, but wind erosion/sandblasting is more severe due to an inability to wet entire area during hot, strong winds. Water quality good.

Central and Northern Tablelands – centre pivot and travelling gun irrigators

At Hillston, red soil poses fewer problems, though soil conditioning is required constantly to avoid excess run-off and poor water infiltration.

Processing tomato

Drip (lighter soils)

While 70% of the NSW processing tomato crop is grown under furrow irrigation, drip provides more flexibility, enabling cropping to take place on lighter soils in undulating blocks. Drip also allows for more precise management of the final irrigations leading up to harvest. Initial wetting up remains a problem, particularly with deep buried drip below the cultivation line (> 12 cm depth).

Furrow irrigation majority on self-mulching soils

Overwatering or rainfall following a full watering resulting in phytophthora is a major threat with furrow irrigation. Short irrigation runs and alternate row irrigation are techniques used to overcome saturation of the rootzone.

Fresh market tomatoes

Plastic mulch and drip irrigation with trellis for field production

Sydney Basin – drip, some fixed sprinkler.

Most fresh market tomatoes are now grown in polyhouses under hydroponic or drip irrigation systems. Field-grown tomatoes are now grown under plastic mulch and drip irrigation. Drip has the advantage of maintaining dry foliage and reduced disease incidence.

Lettuce

Hay – furrow, drip (less than 10% of area)

While furrow remains dominant irrigation system in Hay, it does have drawbacks. Saturation of the soil profile during winter slows crop growth and can lead to increased incidence of soil-borne diseases such as sclerotinia and big vein virus. It can also restrict field access for spraying operations which could jeopardise effective pest/disease management.

Canowindra/Central West – fixed sprinklers

Sydney Basin – fixed sprinklers, drip

Rockmelons

Forty percent of the state's crop (Sunraysia and MIA) is grown under black plastic and drip irrigation.

Furrow is the lowest cost irrigation system, but drip is increasing in popularity as growers recognise advantages of the drip/plastic mulch system. Advantages include labour reduction, simpler weed management, earlier cropping (up to 10 days), and ability to harvest during irrigation and prolong harvest.

Remainder under furrow irrigation

Furrow results in losses of fruit in furrow, and soil staining on skin, which reduces quality and lowers returns/case. Drip also allows fertigation and management for higher brix fruit, with the ability to balance potassium and nitrogen applications.

Watermelons

Seedless mainly under drip irrigation and plastic mulch

Riverina crops on furrow

Water shortages during drought have resulted in wide scale adoption of drip for seedless watermelon production in the Central West. Mulch helps to reduce soil staining on fruit. Good filtration is essential with drip systems, as turbidity can be high at certain times of the year, particularly for river pumpers.

Asian leafy vegetables

Sydney Basin – fixed sprinklers

Mainly market garden production, most of which are using traditional fixed or hand shift sprinkler systems. Water quality is important, particularly for leafy Asian vegetables to prevent bacterial contamination and tip burn in leaves due to high chlorine levels in the water.

Sweet corn

Riverina – furrow

Hillston and Central West – centre pivot and travelling gun

Sweet corn is particularly prone to stress around tasselling, and constraints in irrigation systems such as furrow can result in reduced cob size/ kernel set. Centre pivots enable use of Gemstar® (a biological control for Helicoverpa in sweet corn) which can be applied through the irrigation systems. Travelling guns don't provide sufficient uniformity to allow the use of Gemstar®.

Pumpkin

Riverina – furrow, drip (< 10% of area)

Central West – centre pivot and fixed sprinkler

Powdery mildew tends to be a problem on furrow-irrigated blocks from February to April. The humidity levels are increased under the plant canopy following irrigations, creating a favourable environment for disease development.

Fruit losses in furrows are also significant, with Fusarium-type fruit rots often causing losses of fruit in storage. These problems are less under drip irrigation as the soil surface remains drier during the fruit maturation stage.

Broccoli

Central West and Sydney Basin – fixed sprinkler and drip

Cucumbers/ gherkins

Cucumbers are mainly grown in polyhouses with drip systems.

Gherkins are grown on buried drip irrigation, without plastic mulch.

Water source or soil/nutrient medium has high electrical conductivity, can result in stunting of plant and leaf margin burn. Can occur where regular cropping is conducted on the same site.

Carrot

Riverina – furrow, centre pivot, drip (15% area)

Cooma – fixed sprinkler

Alternate row irrigation necessary on furrow during the summer period to avoid waterlogging which results in root disease. On saline soils (> 2000 EC_e soil salinity) using furrow irrigation, seed germination and seedling establishment can be limited due to accumulation of salt in the centre of the hills.

Onion

Riverina – furrow

Majority (80%) of NSW onions grown on furrow irrigation. Wide beds on self-mulching soils are used. As onions are planted in May and then given a full irrigation, soil can remain wet for long periods, increasing soil borne diseases such as Pythium and Phytophthora. Around harvest, wet soil favours development of Aspergillus, a postharvest disease which is common in the Riverina.

Central West – overhead sprinkler

Overhead sprinklers also provide more flexibility for management of foliar diseases such as downy mildew and bulb diseases such as Aspergillus black mould.

Cabbage

Central West – fixed sprinkler, travelling gun

Sydney Basin – fixed sprinkler, travelling gun

Overhead irrigation can promote development of diseases such as black rot.

3.8 – ACCESS TO INFORMATION ON IRRIGATION MANAGEMENT

Farmer training

Since 1995, WaterWise on the Farm on-farm training has been carried out by NSW Department of Primary Industries across all major vegetable production regions in NSW. WaterWise training was a prerequisite for eligibility to primary producers for grants and loans for on-farm irrigation layout improvements and investment in high tech efficient irrigation and monitoring. The $25 million Irrigated Agriculture Water Use Efficiency Incentive Scheme was administered by the NSW Rural Assistance Authority.

A summary of the number of vegetable farmers trained through WaterWise in NSW is shown in Table 32.

Table 32 – Vegetable farmers trained by WaterWise, 1995–2004

Region	Farmers trained	Year
Lower Murrumbidgee	6	2000–2003
MIA	16	2002–2005
Mid and Upper Murrumbidgee	6	1998–2003
Murray	6	2001–2003
Lower Murray	9	1995–2002
Sydney Basin	230	2001–2004
Lachlan and Macquarie valleys	4	2000–2003

Non-government irrigation training programs are also carried out by irrigation companies in the Land and Water Management Plan areas, including Murrumbidgee Irrigation, Coleambally Irrigation, Murray Irrigation, Western Murray Irrigation and Jemalong Irrigation, near Forbes. These plan areas also provide irrigation system improvement incentives.

Government incentives for irrigation system upgrades

Up until 2005, farmers completing recognised training such as WaterWise Introduction to Irrigation Management Workshops were eligible to apply for up to:

- $2000 to improve crop water use monitoring (50% of the cost of equipment or services)
- $12 000 for 80% of the cost of an Irrigation and Drainage Management Plan (IDMP)
- $15 000 for 50% of the cost of works or equipment recommended in the IDMP to improve water use efficiency

Other schemes available to vegetable growers include the Special Conservation Scheme – Irrigation, a low interest loan of up to $100 000 for irrigation system upgrades which benefit the farmer, the community and the environment.

Waterwatch PollFax Service

Date	Daily ET (mm) CSIRO - Griffith	NSW Uni - Hay
Thursday 15/2/01	8.0	9.1
Friday 16/2/01	8.8	9.4
Saturday 17/2/01	9.5	9.4
Sunday 18/2/01	9.6	11.3
Monday 19/2/01	9.0	10.5
Tuesday 20/2/01	10.2	11.2
Wednesday 21/2/01	8.9	9.5
Seven Day Total	64.0	70.4

Et at Griffith is 13 percent above normal

Plant water use will vary due to crop stage and time of season

Average daily ET (Griffith) vales can be used for forecasting

Late February 7.2 **Early March 6.7** **Mid March 5.9**

Figures are also available on the CSIRO website: www.clw.csiro.au/services/weathe

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Updated on 22/02/01 9:00

An example of the type of data available through Waterwatch.

Irrigation services

Waterwatch operates out of the Griffith NSW Department of Primary Industries office. The figures are also published in local newspapers. Waterwatch provides evapotranspiration figures for the past 14 days, enabling growers to calculate their own crop water needs. CSIRO Land and Water at Griffith collect and publish the ET_o data on their website.

Extension is primarily provided by NSW DPI District Horticulturists and Irrigation Officers who operate in all the major irrigation catchments, providing advice and training to clients. WaterWise on the Farm courses are held regularly, with horticultural producers amongst the major clients. The field vegetable team at Yanco have an ongoing program of promoting conversion to more efficient irrigation systems and to the use of soil moisture monitoring in vegetable crops in the MIA.

3.9 – RESEARCH ON IRRIGATION MANAGEMENT IN NSW VEGETABLE CROPS

In NSW, there are multiple players in research, development and extension, both as funders and providers. These players include the irrigation corporations, universities, CSIRO and NSW DPI, and relevant CRCs and research and development corporations.

Water Smart farms in the Sydney Basin

(Proposed.) *Partners* — University of Western Sydney in collaboration with NSW DPI and funded through the Department of Energy, Utilities and Sustainability Water Savings Fund.

Objectives — Reduce the use of water for irrigation from the Sydney potable water supply, and increase water available in-stream for environmental uses in the Sydney Basin.

The main target group is irrigators in the Sydney Basin using either potable supplies (from Sydney Water) or surface supplies of water for irrigation. The main activities will include:

- Extend the WaterWise on the Farm initiative to additional sectors of the irrigation industry in the Sydney Basin that have had low involvement because of, primarily, culturally and linguistically diverse background (CLDB) community issues.
- Demonstrate innovative approaches to working closely with CLDB irrigator groups to achieve environmental outcomes.
- Provide education and training advice and financial incentives to retrofit efficient sprinkler heads on current inefficient sprinkler irrigation systems or technology upgrades (targeted both at irrigators who extract water directly from streams, and at users of potable water supplies).
- Provide education and training advice and financial incentives to install water harvesting and reuse systems where the potable water supply is currently being used for irrigation.

Optimisation of water and nutrient balance inputs for greenhouse and hydroponics vegetable production

Partners — NSW DPI Gosford and University of Western Sydney with funding from the CRC for Irrigation Futures.

Objective — To optimise water and nutrient use efficiency in low to medium technology greenhouses through improved understanding of current water and nutrient management and introduction of better practices, such as water recycling, and better decision-making.

Activities — To date, 15 greenhouse growers in the Sydney Basin have participated in a survey looking at current water and nutrient management practices. Three sites for intensive investigation have been selected, and a series of carefully controlled experiments have been designed to obtain technical information on different properties of substrates, crop water use and greenhouse environmental parameters. This information will be turned into knowledge to help growers to properly manage or finetune irrigation for greenhouse-grown vegetables. Water balances from each of the 3 sites will be determined.

The main output from the investigations will be a decision support system or model to help provide estimates of crop water use requirements and optimal irrigation scheduling under a range of different environmental conditions for successful production of crops such as tomatoes and cucumbers.

There have been two major research projects conducted in the past ten years in vegetable crop irrigation management. Both projects were funded by the Murray–Darling Basin Commission (MDBC) and were based at Yanco Agricultural Institute. Conclusions from the two projects are described below. A smaller onion irrigation project funded by Horticulture Australia was also conducted at Yanco in 2004.

Project I7024 Benchmarks and best management practices for irrigated vegetables in the Southern Murray–Darling Basin (1997–2001)

The Murray–Darling Basin Commission funded this project, which focussed on development of best practice irrigation recommendations. More than 40 on-farm demonstrations were carried out in processing tomatoes, carrots, capsicums, lettuce, onions and melons throughout southern NSW and northern Victoria.

Project I7024 identified change in irrigation practice among approximately 40% of vegetable growers, but there was some way to go to achieve industry-wide adoption of best management practices (BMPs). Of concern was that some growers admitted they were not aware of how much water was being used on vegetable crops: in some industries, up to 50% of growers had little idea how much water is used. A move to pressurised systems would help to resolve this, but there remains a need to foster a culture of measurement so that effective benchmarking and therefore improvement in water use on-farm can occur.

Table 33 – Benchmark crop water use figures for NSW vegetable crops

Crop	Irrigation system	Crop water use (ML/ha)	
		from MDBC 2002	other NSW benchmarks
Rockmelons	furrow	4.6	
Rockmelons	drip	3.2	3.5
Rockmelons	sprinkler		5.5
Onions	furrow	4.71	
Onions	drip	4.3	
Carrots (winter)	furrow	4.2	
Processing tomatoes	furrow	7.4	
Processing tomatoes	drip	5.8	
Lettuce (winter)	furrow	2.2	
Potatoes (Sept–Jan)	spray		8.5
Potatoes (Feb–July)	spray		5.2
Pumpkin	furrow		4.3
Cucumber (greenhouse, warm season, run to waste estimated)	hydroponic		5.8 (3.5 L/d/plant, 20,000 plants/ha)

Source: MDBC 2002: Riverina Benchmarking Project 1998–2001, project findings presented in Hickey et al. 2001, *Best management guidelines for irrigation of processing tomatoes;* Hulme et al. 2002, *Best management guidelines for irrigation of melons;* Ashcroft et al. 2002, *Best management guidelines for irrigation of carrots and onions*, [all published] NSW Agriculture, Orange.

Project I7024 produced a set of best practice manuals for processing tomatoes, melons, and carrots and onions. The processing tomato manual was published in 2001, the others in 2002. A CD of the manuals was also released in 2003. The manuals have proved a useful tool for extending best practice recommendations. The BMP recommendations were formulated through over 40 on-farm investigations, grower surveys and literature searches during the project.

The two key elements of adoption of best management practice in vegetable production are wide-scale conversion of furrow irrigation to drip or spray irrigation, and precise management of those irrigation systems to achieve high water use efficiency (WUE).

At the conclusion of I7024, the following recommendations were made:

- State government agencies must continue to work with the irrigation industry to promote irrigation best practice. This is best achieved through adoption of soil moisture monitoring and drip irrigation. To achieve this, on-farm demonstrations are highly appropriate forms of extension for the vegetable industry.
- The grower 'best practice' manuals should be used as a basis for promotion of improved irrigation practice in the vegetable industry.
- Further work is required to more accurately benchmark crop water use by vegetable growers, particularly in the Murrumbidgee Irrigation Area. A key to this is the application of accurate on-farm water use measurement.
- Existing grower networks in the Southern Murray–Darling Basin need to be strengthened, and a communication plan developed to disseminate vegetable BMPs.

Project I2011 Enhanced adoption of irrigation best practice recommendations for vegetable crops in the Southern Murray–Darling Basin (2001–02)

This project was also funded by the Murray–Darling Basin Committee to develop strategies for better uptake of recommendations from the best practice project. Its objectives were:

- Develop a model to accelerate adoption of BMPs and benchmarks for the industry in the SMDB
- Use this model to accelerate adoption of BMPs through state agency and industry partners across the 4 target vegetable crops (processing tomatoes, carrots, onions and melons) of project I7024
- Use the model developed for these vegetable crops to extend the BMP approach to the wider vegetable industry
- Recommend adoption strategies for future work in improved water use efficiencies for vegetable crops in the SMDB
- Consolidate the success of I7024 by maintaining relevant extension activities and promoting BMPs using the grower manuals as a primary tool.

Vegetable growers in the NSW Riverina, the Mid Murray and Campaspe regions of northern Victoria and onion growers in the Lower Murray in South Australia were included in the study. Over 30 growers took part in in-depth interviews with the consultants. In addition, 25 researchers, consultants and service industry representatives took part in focus group discussions. These focus groups gave views from both sides of the fence, and helped balance the economic imperative expressed by farmers with the environmental and community concerns expressed by support industry representatives for the report.

Two reports (Hickey 2002; Kaine and Bewsell 2002, project consultants from the School of Marketing and Management, University of New England) outline the current practices

and attitudes of vegetable growers towards irrigation scheduling and new technology, water management on-farm, and related issues such as soils.

Based on the outcomes of the focus group discussions, the validation interviews and the results of the earlier study, the following recommendations were made:

- A research strategy needs to be developed to explore options for high return crops to be used in rotation with vegetables.
- A research strategy needs to be developed to understand the build-up of soil-borne diseases in different soil types.
- A strategy needs to be developed to facilitate the change from furrow to drip or spray irrigation by providing advice and assistance to vegetable growers on the management of these irrigation systems on various soil types and topography when they are first installed. In developing this strategy the information needs of growers will vary. Growers that are converting to drip or sprinkler systems on heavy soil will have different needs compared with growers that are converting to drip or sprinkler systems on lighter soils.
- Strategies to facilitate the change from furrow to drip or spray irrigation should include recommendations for growers to use soil moisture monitoring and soil testing to help establish irrigation schedules for newly installed drip or sprinkler irrigation systems.
- A strategy needs to be developed to promote the use of soil moisture monitoring and soil testing to assist growers in establishing irrigation schedules when planting vegetables on new blocks.
- A strategy needs to be developed to promote the use of soil moisture monitoring, soil testing and EM38 surveys as techniques to growers experiencing problems with crop vigour, high watertables or salinity.
- Long-term soil moisture monitoring demonstration sites should be established to provide information and assistance to growers who are choosing and installing soil moisture monitoring equipment and needing to interpret data.
- In addition to these findings from the UNE study, a concerted effort is required to encourage vegetable growers to measure water use on specific crops. This may become compulsory in future, as pressure from the community for accountability for water use on-farm increases. However, the demonstrated benefits of achieving high WUE through this project should provide reason enough for vegetable growers to commence water metering voluntarily.
- The opportunity of cross-industry sharing of the benefits of drip irrigation through exchange visits between groups of growers needs to be pursued. The processing tomato industry has many positive stories to share with others such as the melon and potato industry.

HAL VN04015 Mild onion irrigation trials 2004

Funded by the onion industry and Horticulture Australia, this trial was conducted to investigate the effect of irrigation frequency on the quality of mild onions.

Three recognised mild onion varieties, Mellow Yellow, Predator and Sombrero, were used in combination with three irrigation frequencies: every 2 days, 4 days and 7 day intervals, from the 5 leaf stage onwards. Less than 40 mm of rain fell during this period, so rain effects were negligible.

The trial was also an opportunity to better understand the feasibility of growing onions on sandy soils using conventional 1.5 metre beds. To ensure even watering of the bed, two driplines were placed at 8 cm depth and 40 cm apart. Flow meters were installed on each treatment to measure the water volumes applied.

Highest marketable yields for all three varieties were recorded in the 2 day interval treatments, with Mellow Yellow the highest at 61.6 tonnes per hectare. The 2 day treatments also gave a consistently larger bulb in all three varieties, with an average of 60% of bulbs larger than 75 mm diameter. Double and spilt bulbs were consistently lower in Predator (less than 2%), with little variation between irrigation treatments.

While irrigation intervals remained constant through the trial, the duration varied according to soil moisture levels (recorded using tensiometers, EnviroSCAN and G-bug systems). Water applied to the 2, 4 and 7 day treatments totalled 5.4, 4.3 and 4.2 ML/ha respectively. In terms of water use efficiency, the 4 day treatment was best at producing marketable bulb yield of 11.6 t/ML compared with 2 and 7 day treatments producing 10.4 and 10.6 t/ML respectively.

Pyruvic acid levels were consistently low across all three irrigation treatments. While the 7 day treatment averaged lowest at 3.63 micromoles/g, compared to the average for the 2 day at 3.84 micromoles/g, all variety and treatment combinations produced less than 4 micromoles/g, well within the acceptable range for mild onions. At 3.68 micromoles/g, the variety Predator showed significantly lowest pyruvic acid compared with other varieties.

The key recommendations from this trial are:

- Mild onions can be effectively grown on sandy soils using drip irrigation.
- Less frequent irrigations (3 to 4 day intervals) give the best quality and yield results in addition to maximising water use efficiency.
- Soil moisture monitoring is essential when using drip irrigation.
- Storage losses through disease can be minimised by careful management of irrigation.
- Two driplines per bed are essential on wide beds to ensure even water distribution.

SECTION 4 – NSW VEGETABLE GROWING REGIONS BY CATCHMENT

4.1 – CENTRAL WEST

The Central West region includes the Lachlan, Castlereagh, Bogan and Macquarie river valleys and covers an area of approximately 176 000 km^2 and is home to 340 000 people. (Description below adapted from Central West Catchment Management Authority 2005, p. 5 and Lachlan Catchment Management Authority description.]

The Central West is located in central western New South Wales, flanked by the Barwon and Darling catchments to the north and west, the Murrumbidgee to the south and the Sydney/Shoalhaven Basin to the east.

Major townships include Orange, Bathurst, Cowra, Forbes, Dubbo, Mudgee and Nyngan.

Most of the vegetable production in the region is carried out in the Lachlan, Macquarie and Boganvalleys.

The Macquarie River is formed by the joining of the Campbells and Fish rivers, which drain a high plateau area centred near Oberon with a general elevation above sea level of 900 to 1000 metres. The river flows northward through steep gorge areas in the Hill End area and is impounded by Burrendong Dam upstream of Wellington. The Cudgegong River also flows into Burrendong Dam from the north-east.

The Lachlan River rises near Gunning and terminates in the Great Cumbung Swamp near Oxley, 1450 river kilometres to the west. There are numerous weirs along the length of the Lachlan River, including Nanami, Cottons, Jemalong, Booberoi, Lake Cargelligo, Lake Brewster, Willandra, Gonowlia, Hillston, Whealbah, Torriganny and Booligal. Major tributaries of the Lachlan include the Abercrombie, Boorowa, Belubula and Crookwell rivers.

The main dam regulating flows in the Lachlan River is Wyangala Dam, which has a capacity of 1 220 000 ML and is located at the junction of the Lachlan and Abercrombie rivers. The Belubula River, regulated by Carcoar Dam, has a capacity of 36 000 ML and located about 10 kilometres downstream of Blayney.

Downstream of the Burrendong Dam the river continues to flow in a north-west direction through Wellington and Dubbo and is joined by several major tributaries from the east and western parts of the catchment. At Narromine the river takes a dramatic turn to the north and through a complex system of anabranches and effluent creeks, connecting the Macquarie, Darling and Bogan rivers commences.

Vegetable growing in the Central West is worth $19 million a year. Around 44 810 tonnes of vegetables are grown on 2 205 hectares by 75 growers. Cabbages, cauliflowers, lettuce, potatoes and sweet corn are the main vegetable crops. There are also large areas of beetroot, broccoli, peas, pumpkin and watermelons. The region grows 6% of the NSW vegetable crop.

There is a range of irrigation systems used in the Central West, from centre pivot and linear move irrigators to travelling guns, spray and drip irrigation. During the 2003/04 and 2004/05 seasons there was a significant shift to drip irrigation in the Cowra and Canowindra districts, mostly in watermelon crops.

Since 2002, the Lachlan has faced severe water restrictions. In 2002/03, general allocations were just 3%, while in 2003/04 and 2004/05 general security allocations were 0% and high security allocations in 2004/05 were just 50%.

4.2 – HAWKESBURY–NEPEAN (SYDNEY)

The Hawkesbury-Nepean catchment covers over 22 000 square kilometres (2.2 million hectares). As one of the most important and varied catchments in Australia, the Hawkesbury-Nepean

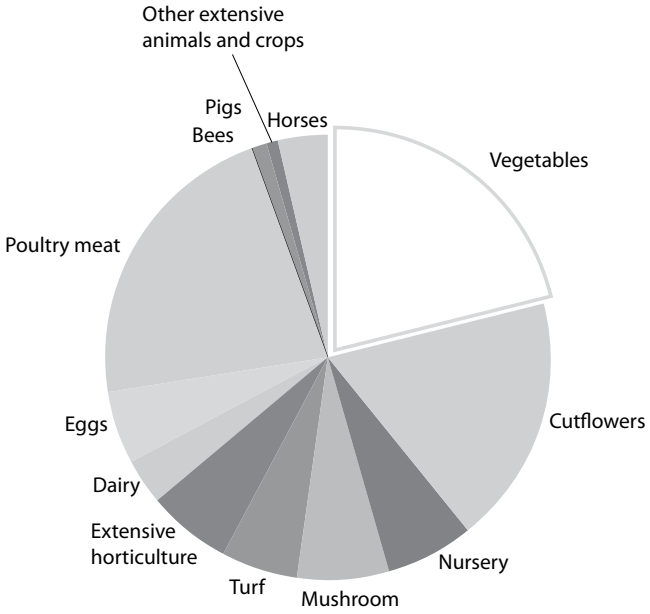
- provides nearly all of the drinking water supplied to the 4 million people living in Sydney, the Illawarra and the Blue Mountains
- supports a population of 800 000 people
- generates over $1 billion each year in agriculture and supplies much of Sydney's fresh food
- hosts an extensive range of extractive, manufacturing and processing industries
- is expected to accommodate and support the growing population of greater Sydney.

The catchment has many major rivers, including the Hawkesbury–Nepean, Wollondilly, Mulwaree, Tarlo, Wingecarribee, Nattai, Nepean, Coxs, Kowmung, Grose, Capertee, Colo and Macdonald.

The vegetable industry in the Hawkesbury–Nepean is characterised by a large number of small vegetable-growing enterprises, with the average farm holding less than 30 hectares. Irrigation is regarded as supplementary for much of the district, with growers accessing water direct from the river, Sydney town water, or from on-farm storages. The contributions of the main agricultural enterprises in the Sydney region are displayed in Figure 11 and Table 34.

Figure 11 – Agricultural production (%), Sydney region

Vegetables	21.1
Cutflowers	18.1
Nursery	6.4
Mushroom	6.8
Turf	5.4
Extensive horticulture	6.1
Dairy	3.4
Eggs	5.4
Poultry meat	21.8
Bees	0.1
Pigs	0.9
Other extensive animals and crops	0.9
Horses	3.5



Source P Gillespie, formerly NSW Agriculture

Table 34 – Vegetable statistics, Sydney Basin, July 2006

Crop industry	Growers (approx.)	Farm gate value $	Full-time on-farm jobs
Vegetables, traditional field-grown	150	43 867 500	375
Vegetables, Asian market gardens	450	42 428 500	1125
Vegetables, traditional market gardens	400	3 375 000	1 000
Hydroponic lettuce	35	11 550 000	105
Greenhouse cucumbers	100	38 334 000	220*
Greenhouse tomatoes	200	76 666 000	*

Note: Because greenhouse cucumbers and greenhouse tomatoes are often grown by the same grower, there may be some overlap in numbers of growers and jobs.

Source: Leigh James and Bill Yiasoumi

The farm gate value of the vegetable industry in the Sydney region is worth $215 million per annum (NSW DPI). Ninety per cent of some of NSW's fresh leafy vegetable and herb lines are produced in Sydney.

At least 2000 people are employed full-time in the industry: 75% of those people are of non-English speaking background (NESB); 65–70% of the NESB growers are first generation migrants to Australia.

4.3 – MURRUMBIDGEE

Covering an area of 84 000 square kilometres, the Murrumbidgee catchment is home to approximately 520 000 people. Australia's capital, Canberra, with 314 000 people, and New South Wales' largest inland city, Wagga Wagga, with 57 000 people, are both situated within the catchment. Other major urban centres in the catchment include Queanbeyan, Cooma, Yass, Cootamundra, Tumut, Gundagai, Junee, Henty, Narrandera, Leeton, Griffith, Coleambally, Hay and Balranald.

Situated in the lower Murrumbidgee Catchment are the Murrumbidgee Irrigation Area (MIA) and the Coleambally Irrigation Area. These irrigation areas have more than 10 000 kilometres of irrigation channels supplied by Burrinjuck Dam near Yass with a capacity of 1.026 million ML and Blowering Dam, near Tumut, holding 1.628 million ML. Over the last 15 years, an average of 2 390 643 ML has been diverted annually for irrigated agriculture in the Murrumbidgee River Valley. Around 48% of this (1 138 517 ML) has been used for irrigation in the MIA.

The irrigation industry in the Murrumbidgee Valley provides 25% of New South Wales' fruit and vegetable production, 42% of the state's grapes and half of Australia's rice production. In the MIA alone, 80% of the NSW onion crop is grown, along with 70% of the NSW rockmelon crop. Other major industries in the catchment include dryland agriculture, including beef production, intensive poultry production, sheep and wool, cropping and softwood plantations. Agricultural production is worth in excess of $1.9 billion annually.

Murrumbidgee Irrigation (MI) is responsible for providing irrigation water to farmers in the MIA. The MI is also responsible for water pricing, the development and maintenance of infrastructure and pollution control. MI purchases water from State Water, and supplies water to individual farmers according to their entitlements. Water supply to each farm is metered at the farm gate by Dethridge wheels, or more recently electronic flow meters. All MIA farmers now have volumetric licences. The MIA has one of the most reliable supply systems in New South Wales. MIA water is distributed to more than 3000 properties with around 160 000 ha of land irrigated each year.

4.4 – MURRAY

The NSW Murray Catchment is bounded by the Murray River to the south, the Murrumbidgee River catchment divide to the north and the Australian Alps to the east, spanning an area of 35 170 square kilometres. The Murray Catchment also has significant areas of ecological communities, remnant terrestrial and aquatic vegetation in the catchment providing habitat for a range of threatened species including birds, plants, mammals and amphibians.

The developed resources of the catchment support a highly developed, vibrant and diverse agricultural sector with grazing, cropping, irrigation, forestry and horticulture being the main enterprises, with a combined population of around 101 000 people and a rural land capital value of about $2.1 billion. The catchment plays a significant role in Australia's agricultural production, with an annual farm gate value of agricultural production in excess of $800 million. Within the Murray Irrigation region which runs in the east from Mulwala to beyond Moulamein and in the west from the Murray River to Jerilderie in the north, 50% of Australia's rice crop, 20% of NSW milk, 75% of NSW processing tomatoes and 40% of NSW potatoes are grown. Vegetable production is centred on the towns of Jerilderie

(onions and processing tomatoes), Berrigan (sandhill potatoes) and Wentworth, and further west in the catchment (rockmelons and asparagus).

Murray Irrigation Limited (MIL) covers nearly 800 000 ha of farmland and provides water to over 2400 farms owned by 1600 family businesses. Over thirty of these are large vegetable-growing farms. During 2001/02 season MIL delivered 1.23 million megalitres of water to shareholders. A water exchange exists in the Murray which provides a service for MIL shareholders and allows buyers and sellers from other valleys to trade on the exchange. In 2001/02 irrigation season the exchange traded 69 397 ML of temporary water involving over $2.6 million. With drought and low water allocations increasing the price of water, the exchange traded 60 000 ML in 2002/03, with $12 million changing hands.

4.5 – NORTHERN RIVERS

The North Coast Region covers an area of approximately 50 000 square kilometres from the Camden Haven River in the south to the Queensland border and 160 kilometres inland. Major rivers are the Tweed, Brunswick, Richmond, Clarence, Bellinger, Nambucca, Macleay and Hastings. The Clarence River discharges five million megalitres each year, the highest of all the state's coastal rivers. The major industries are beef production, dairying, horticulture and the nursery industry. New industries such as tea tree and coffee plantations are developing. The major use of water from unregulated rivers in the region is for town water supplies, followed by irrigation.

Vegetable grower numbers on the North Coast are around 200, with 1900 ha of vegetable crop planted annually. The most intensive vegetable production areas are located in the Cudgen–Duranbah plateau in the Tweed Shire, and the Dorrigo district, which is home to a significant potato industry. The North Coast is the major producer of New South Wales' sweet potato crop, and dwindling supplies of zucchinis, fresh beans and tomatoes. Over recent years, North Coast vegetable growers have faced increasing competition from Queensland districts such as Bundaberg.

The annual gross value of production ranges from $15 million to $25 million. Hydroponic lettuce is on the increase with the major expansion occurring around Coffs Harbour. Major issues facing the industry includes land degradation particularly on fragile hill slopes, acid sulfate soils, and encroachment of urban areas on traditional farming areas.

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