Irrigation in transition –

changing purpose, policy, infrastructure and practice for greater productivity

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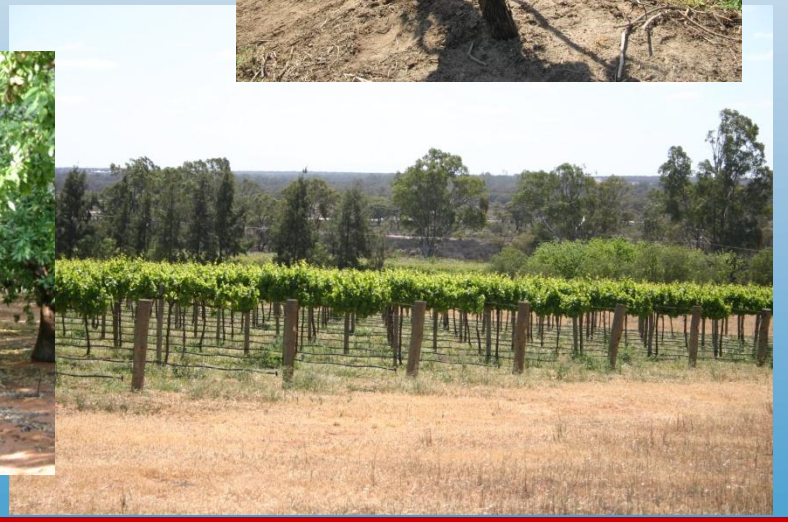


Irrigation in transition: From technology transfer to system harmonisation

- Single technology improvements rarely have significant system effects unless there is predisposition
- Changed, improved practice is more successfully enabled by whole system change
- Technology without support from policy, service and knowledge will have limited uptake
- Irrigation practice is set within a complex social-ecological system
  - As technologists we can influence, we cannot control
  - Change is effected by people, using technology

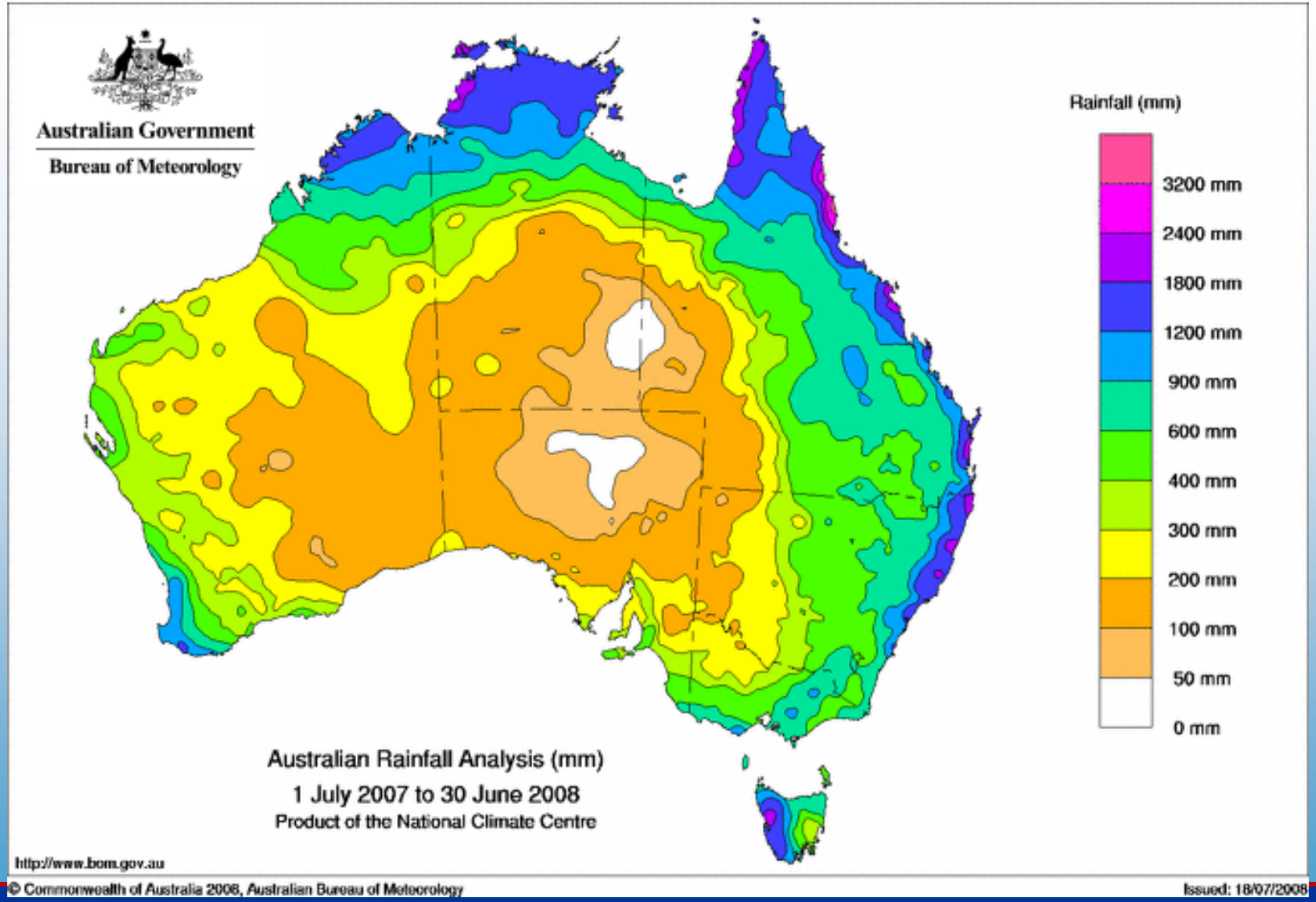
Irrigation in transition: From technology transfer to system harmonisation

- Irrigation increases total economic activity and strengthens social viability relative to rain fed areas
- Sustained water productivity improvement can occur when there is
  - An imperative to act
  - Committed community and political leaders
  - Policy that is clear and encouraging
  - Effective and controlled conveyance and application systems
  - Community education and training
  - Improved equipment and service provision

Irrigation in transition

- Context of irrigation in Australia
  - Size, location, amount water used
  - History and policy
- Drivers of change
  - “Mid life crisis”
  - Water demand and drought
- Water policy reform and water trade
- Infrastructure and management capability improvement
- Role of research and education
- Changing **our** thinking - technology transfer to system harmonisation

Context - Rainfall 2007 - 2008



Comparison – Continent rainfall and run off

Continent	Area (km^2)	Rainfall (mm/yr)	Run-off (mm/yr)	Run-off (%)
Africa	30,300,000	690	260	38
Asia	45,000,000	600	290	48
Australia	**7,000,000**	**465**	57	**12**
Europe	9,800,000	640	250	39
N. America	20,700,000	660	340	52
S. America Brazil	17,800,000 **8,500,000**	**1,630**	930	**57**

Water in Australia (2004 – 05)

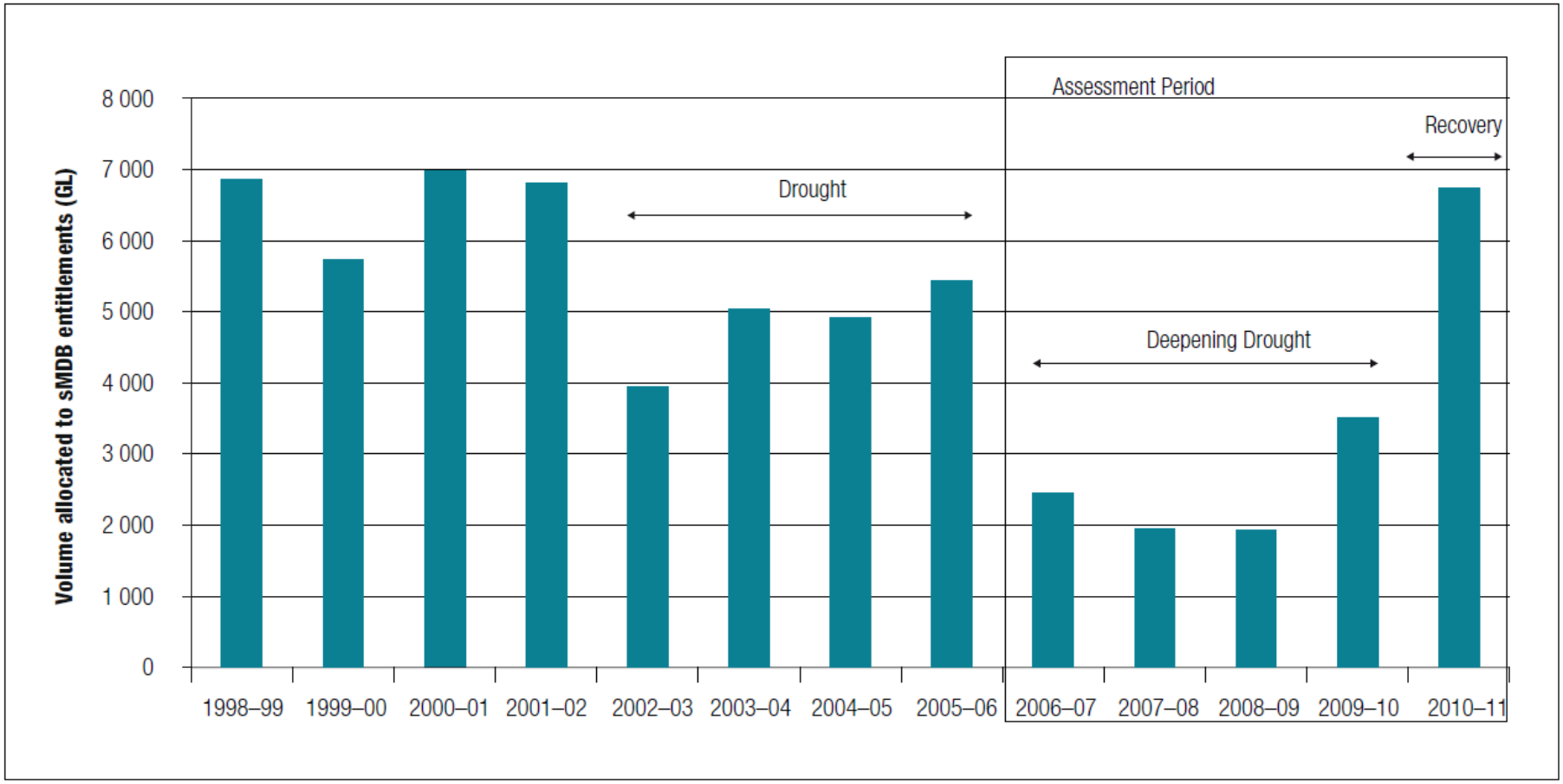
Average rainfall, 364mm (c.f. 465mm)
(90% evaporated, 8% to surface, 2% to groundwater)

Water consumed (6% of total)	**~ 19,000 GL***
Agriculture	**~ 12,000 GL (65%)**
Households	**~ 2,100 GL (11%)**
Sewage and drainage	**~ 3,400 GL (18%)**
Mining and manufacturing	**~ 1,000 GL (2%)**

*1 GL = 1 000 000 m^3
1000 GL = 1km^3

Irrigation water in s.e. Australia 1998 - 2011

Supply can be highly variable! 8 years of drought



History of irrigation in Australia (brief!)

1850 – 1900 inland rivers dammed – private schemes failed, government schemes needed

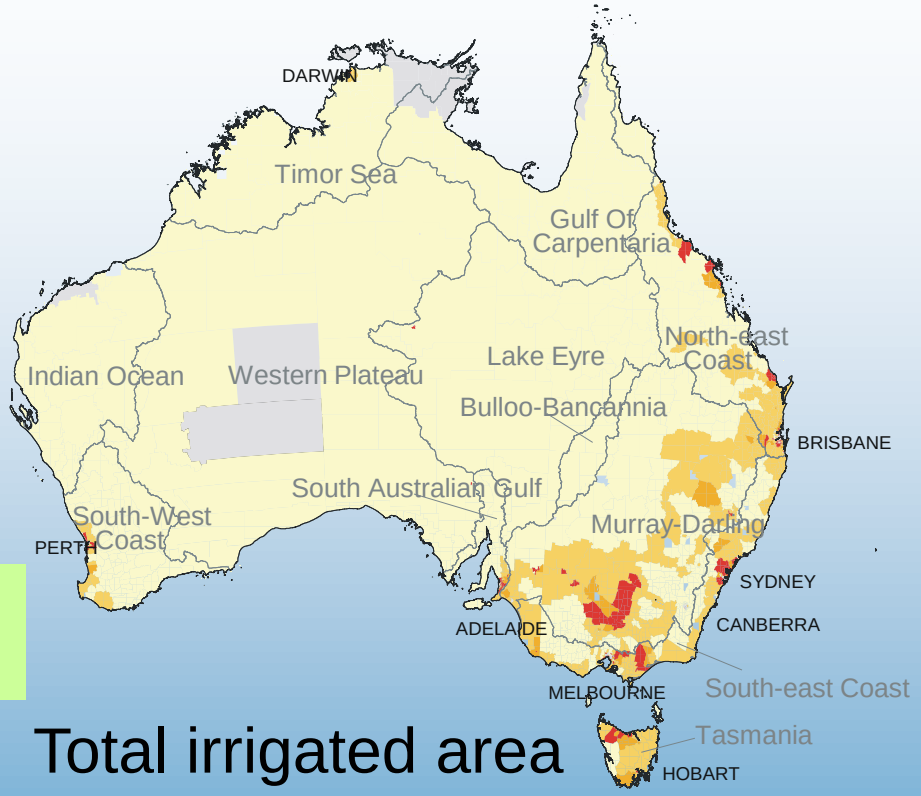
1896 – 1901 water owned by the country. Soils and water controlled by the States

After WW1 and WW2 large government schemes developed

1970 – 1990 expansion of irrigation areas in the south, new areas in n.w. & n.e.

1990 – older areas consolidating and new infrastructure needed

2010 – new areas in Tasmania and n.w. Australia



Total irrigated area
2.5 million ha
~1% of world area
c.f. Brazil ~4.5m ha

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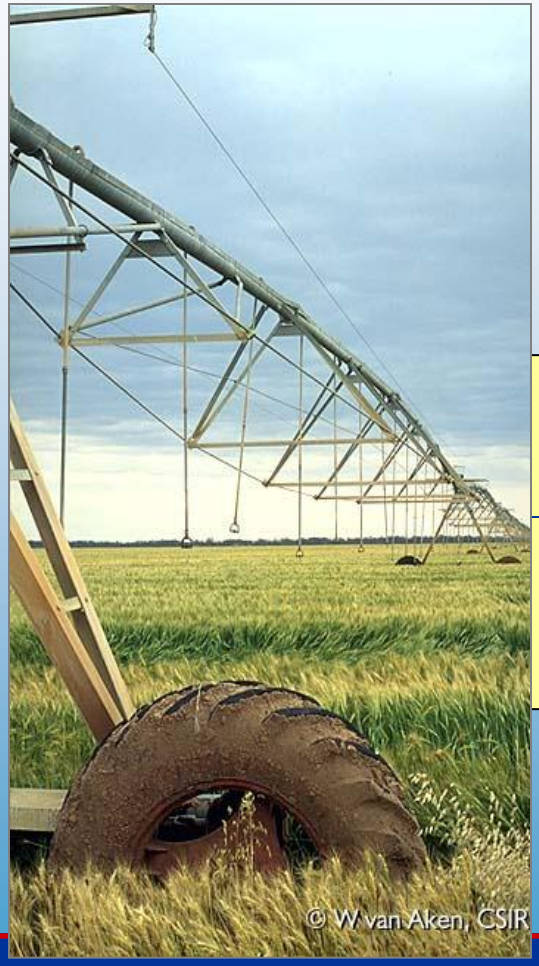
Critical policy issues

- All water is owned by the country – therefore government controlled
- In the Australian Federation, the States look after land (soils) and water
- Until very recently, access to water was tied to land
- Regulation of surface waters and ground waters are only loosely linked

Irrigated production, money earner!
Comparison of irrigated and rain fed agriculture



Irrigation in transition

Irrigated agriculture represents:

- ½ % of Australia's agricultural land area
- 51% of total profit (5 years to 96/97)

	Net return ($m/yr)	Mean Profit ($/ha)	Area (mill. ha)
Rain fed	**3,691**	**8**	**470**
Irrigated	**3,839**	**1,669**	**2.3**

Source:
Australians and Natural Resources Management
NLWRA 2002. Table 1.8

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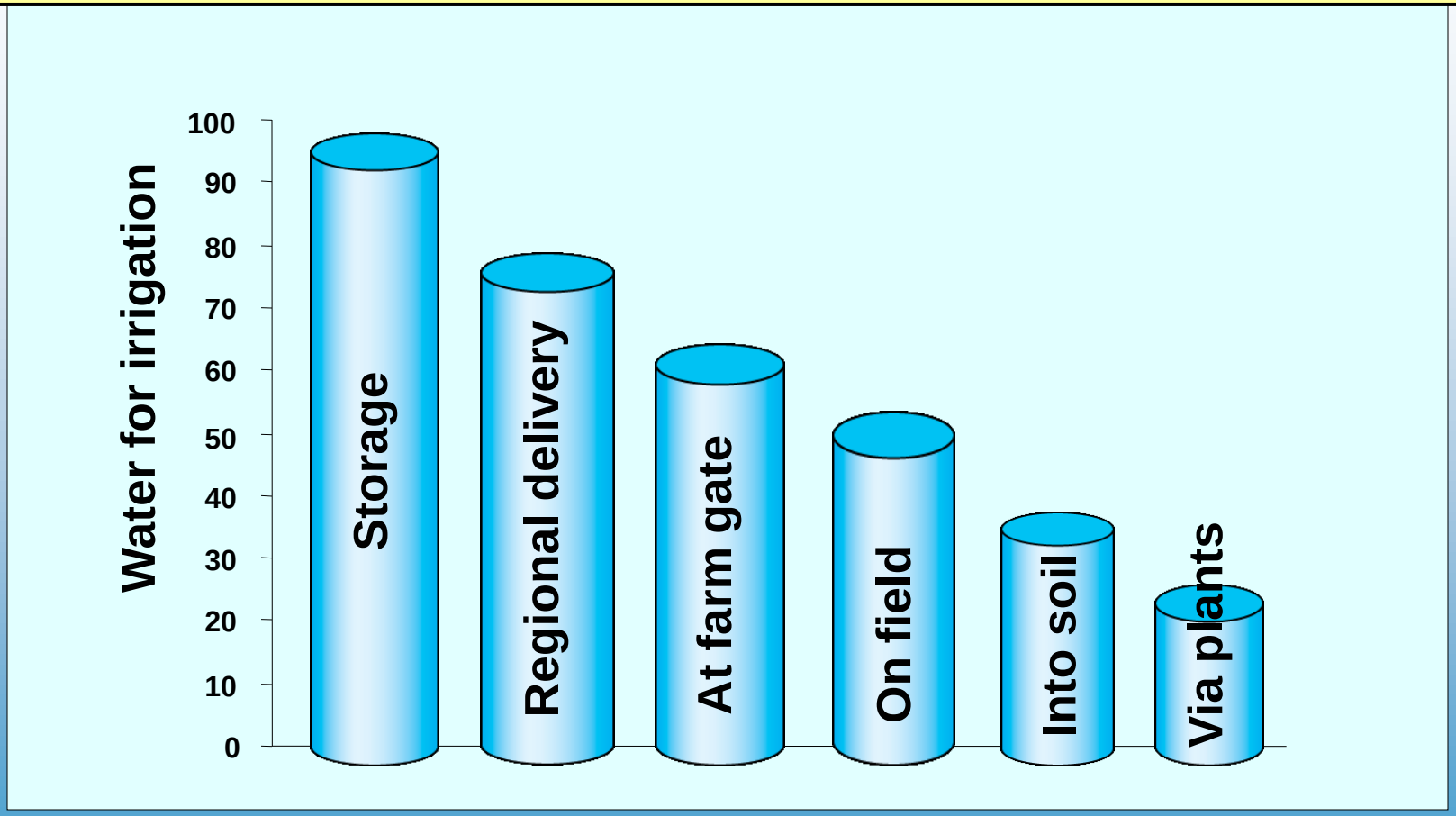
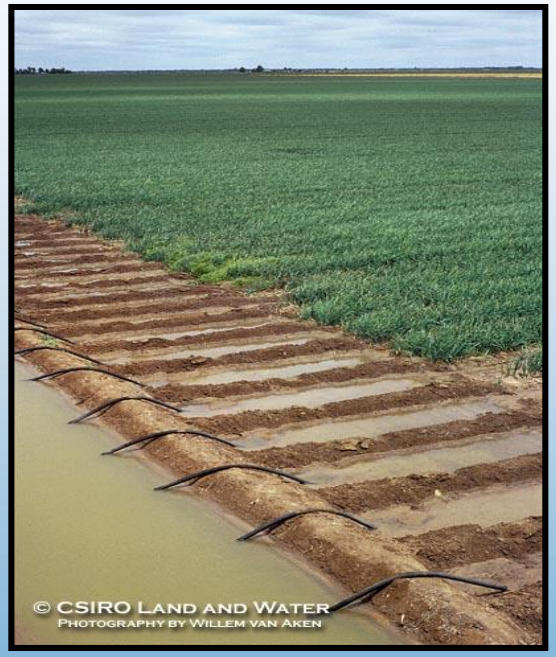
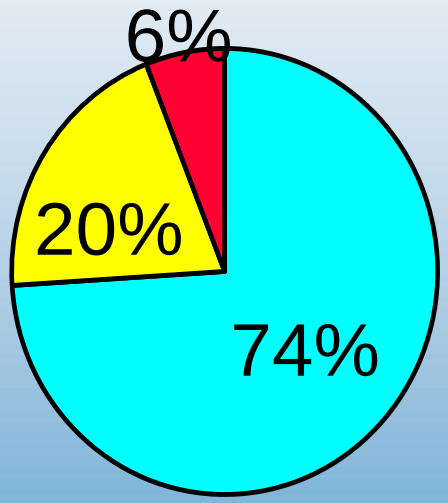
Water losses from storage to plant

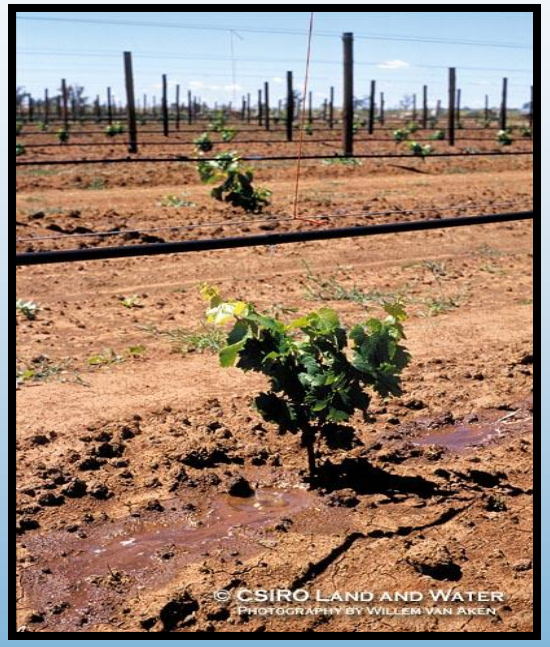
~25% stored water transpired. Opportunity to decrease losses from all elements



Irrigation types in Australia (by area)







Surface/furrow Spray Trickle/micro

Irrigation is capital intensive, can be very productive, but operating below potential

- Governance – policy needed to be modernised
- Management – new management arrangements with both government and private companies
- Infrastructure – older areas in “mid life crisis” – upgrades needed in supply structures, drainage and control and monitoring
- On farm - need to land form, increase control, decrease drainage, manage salt, improve productivity
- Skills and education needed significant improvement
- Retail and service sectors needed improved skills and information access

Restating the fundamentals of irrigation

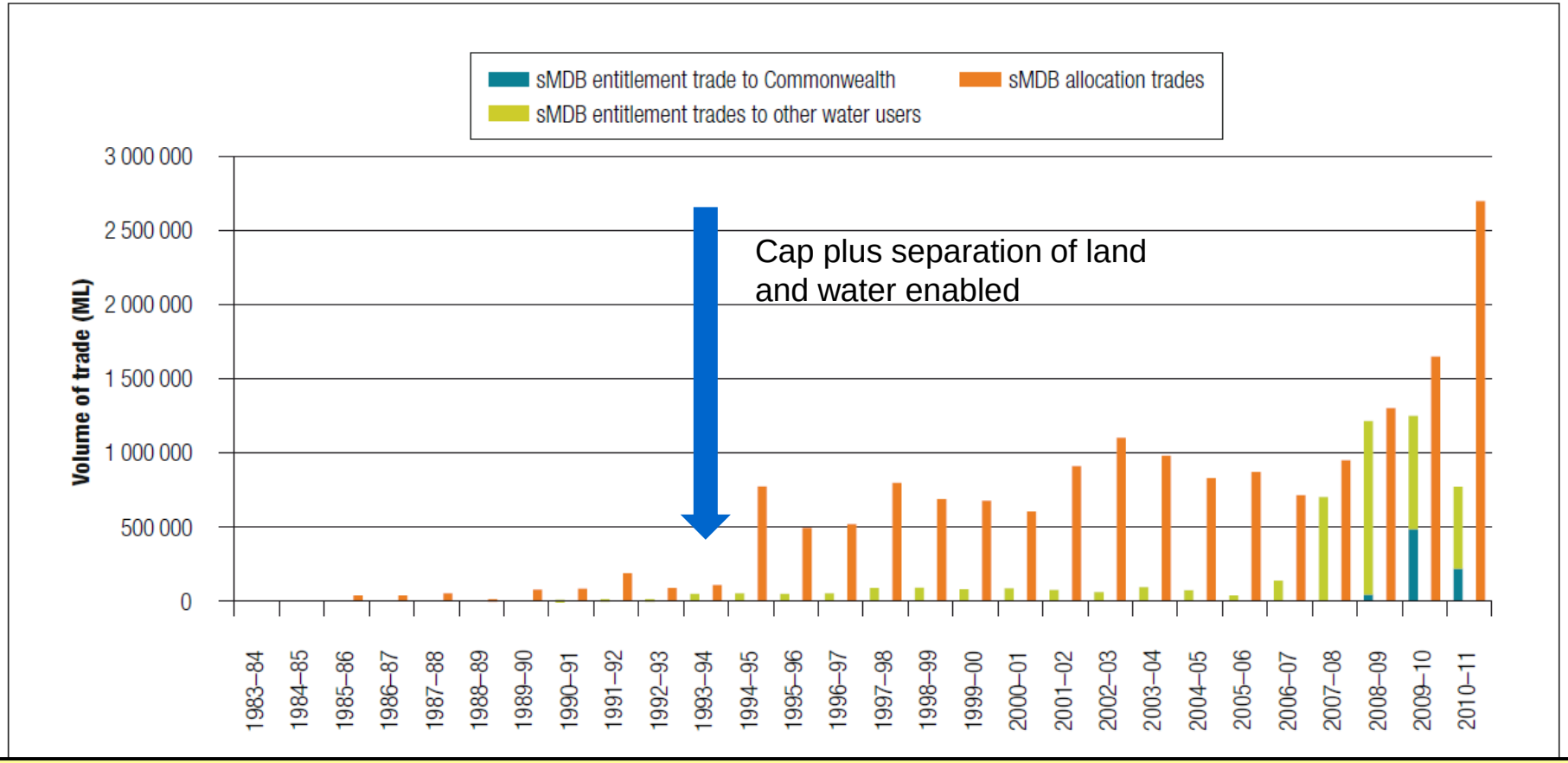
- Water extracted for irrigation will change the supply ecosystem
- Irrigation without drainage is not sustainable
- All water contains salt - irrigation will increase the accumulation of salt
- Irrigation drainage (effluent) water quality will be lower than input waters
- Irrigation practice is energy intensive
- No irrigation system is as yet renewable (energy input > energy captured, nutrients out # nutrients in, soil loss > soil regeneration, carbon captured = carbon out?, water in = water out?)

The journey to renewable systems has only just begun

Irrigation in transition – policy and governance

- Responsibility rests with the states
- The Federal and State Government water reform agenda(1994)
  - Implement full cost recovery
  - Eliminate cross subsidies
  - Define “water access entitlement” –
  - Complete separation of water ownership from land ownership
- Australian (Federal) Government has role because
  - Waters (surface and groundwater) are not confined by state boundaries
  - Different states have different rules
  - Water was being traded between states
  - Excessive extraction from major rivers
  - They have money for major investment in improving the systems

Volume of water trade 1983 - 2011



Irrigators have adapted rapidly to market and increased flexibility

Irrigated region management
Regional land and water management plans

- Guidelines
  - Spell out the problems
  - Identify and evaluate different ways of dealing with existing and developing problems
  - Satisfy government requirements
  - Seek widespread community support – need for community engagement

Helped to set what needed to be improved
Limited success without business and individual “buy in”

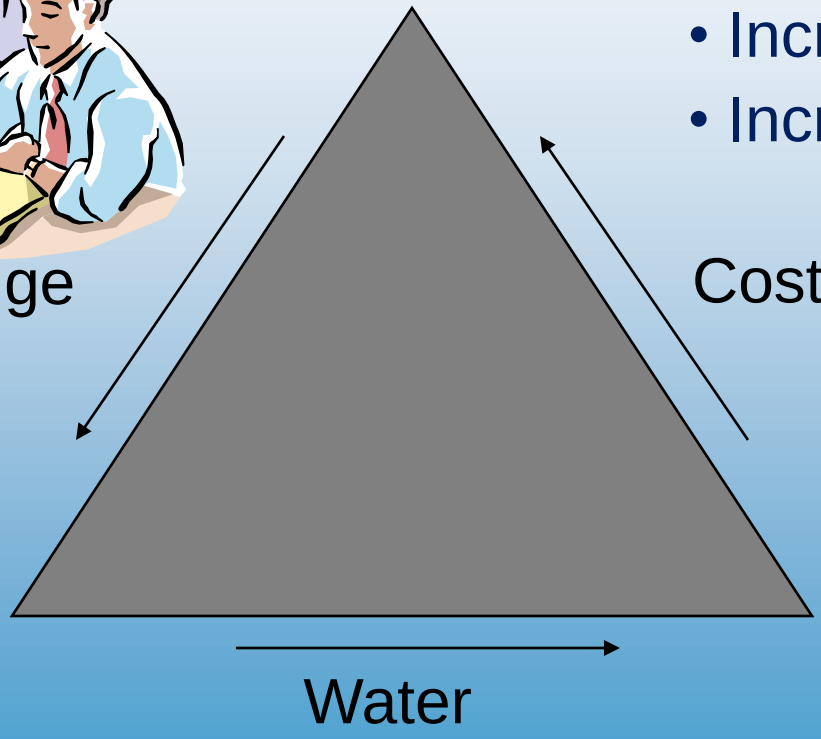
Irrigated region management
Public and private institutional arrangements

- Many areas changed from State controlled management to State owned corporations or private companies or public cooperatives – public private partnerships
- New awareness of control, monitoring and measurement
  - Distribution system upgrade – Good examples: Murray-Goulburn, Coleambally (SCADA), SA Riverland
  - At farm gate – need to improve measure of water delivered (replace Dethridge wheel)
- On farm updates – required for access to financial help
  - Measure amounts applied
  - Forecast crop needs
  - Measure crop and soil water status

On farm improved infrastructure and practice

In irrigation, water, costs and knowledge are interlinked (the social-ecological system)

Knowledge

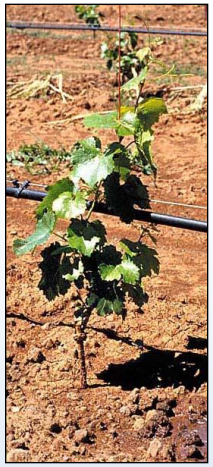


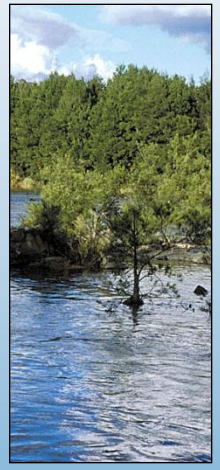
Decrease water use

- Increased cost
- Increase knowledge

Farm water control for selected productivity

- Land forming with lazer levelling (reduced labour costs)
- Increased drip and micro, steady increase in pressurised systems
- Water control for quality control
  - Already used for vegetable and grape production
- Regulated deficit irrigation
  - Manipulating vegetative growth and fruitfulness through selective water management
- Partial root zone drying
  - Controlling growth and using less water





Cooperative Research Centre for Irrigation Futures (CRC IF) 2002 - 2009

14 research, education and industry partners
$72m over 7 years

Facilitate cooperative research networks and programs which continuously improve irrigation policy, tools, practices and processes to:

- double irrigation water use productivity
- improve profitability for commercial irrigation enterprises and
- protect and enhance landscapes and the environment.

Build capacity: 50 post graduates, Industry training

System sustainability -

With the Australian water situation we need to:

- recognise the finite amount of water we have,
- identify how best to apportion this water in an attempt to
- achieve the most environmentally, socially and economically productive outcome from its use.

i.e. we need to **increase multi-purpose water use productivity**

Improving irrigation within multi-purpose water use productivity

- Recognise that irrigation practice is primarily a business
- Recognise that the most significant improvements come when
  - There is a fundamentally viable business case
  - Irrigated communities identify the need(s)
  - Institutional arrangements are simple and clear
  - Distribution and application systems are upgraded
  - Technical capacity and know how is well developed
  - Equipment, service and advisory services improve
  - Skill and management capacity is improved at all levels
  - There is an increase in production and value-add diversity

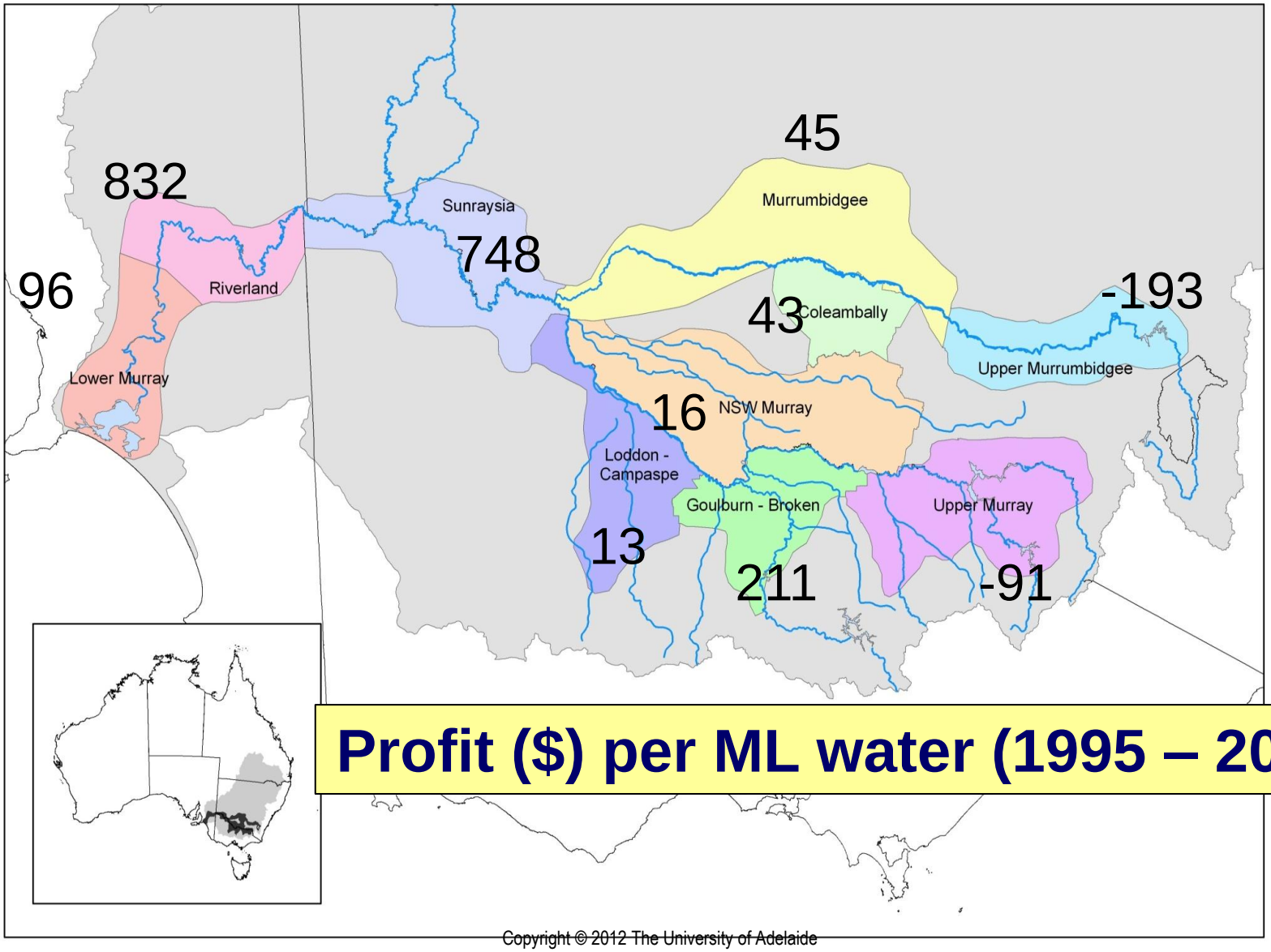
Regional irrigated business partnerships

Regional irrigated business partnerships

- Regional engagement and “ownership” is critical

For successful improvement in irrigation, all the elements need to come together – policy, management, technology, knowledge – this is **system harmonisation**

Improvement through system harmonisation:
Evidence that it works



Factors in Riverland rehabilitation

Imperative to act	■ Limited water ■ Salt load increasing ■ Restricted drainage to river ■ Productivity poor
Leaders	■ Progressive community leaders ■ Support from political leaders ■ Engaged with government
Policy setting	■ Water allocation policy clear ■ Improved productivity encouraged
Conveyance system	■ Upgraded from channel to pipe

Factors in Riverland rehabilitation

Application systems	■ Furrow to sprinkler ■ Over tree sprinkler to micro under tree
Community education	■ Government extension focused ■ Local training available
Equipment and service provision	■ Soil survey introduced ■ Systems designed for site differences ■ Equipment testing available ■ New measurement techniques developed

Irrigation practice – evidence of improvement

- Design
  - We now do soil surveys to identify variability and design planting and equipment for greater uniformity
- Implementation
  - Irrigation Australia accreditation courses for equipment installation and auditing of systems
  - Testing of equipment capability and information available (AITC)
  - Irrigation competency based training now available

Irrigation practice – evidence of improvement

- Management (on farm)
  - Level of awareness for water control is increasing
  - Anecdotal evidence that shift from furrow to drip in vines reduces water use by 30%
  - Drainage volumes have decreased
  - Use of soil water monitoring has increased
- Management (distribution)
  - Level of measurement (and reporting) increased
  - Measured drainage (in Riverland and Sunraysia) has decreased
  - Depth to water table increased (in Goulburn and Murray)
  - Active identification of leaky channels

Irrigation practice – evidence of improvement

- People and technology
  - Education opportunities improving
  - In service training is available
  - The array of delivery and control technology is increasing (~70 new variations at IA show in 2004)
  - PRD and RDI being implemented
  - Sub – surface irrigation methods being refined

Irrigation in transition: From technology transfer to system harmonisation

- Irrigation practice is set within a complex social-ecological system
- Sustained water productivity improvement can occur when there is
  - An imperative to act
  - Committed community and political leaders
  - Policy that is clear and encouraging
  - Conveyance and application system upgrades
  - Community education and training
  - Improved equipment and service provision

Irrigation in transition:
From technology transfer to system harmonisation

Successful change is made by people

- making new decisions

Our role is to identify the development, technology and management options that are well tested and well grounded

- AND highlight the consequences (positive and negative) of the options

Irrigation – water, production, people, environment