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Dryland and irrigated cropping systems: comparing the impacts of consumptive water use

Sustainable Agriculture Flagship

Brad Ridoutt and Perry Poulton

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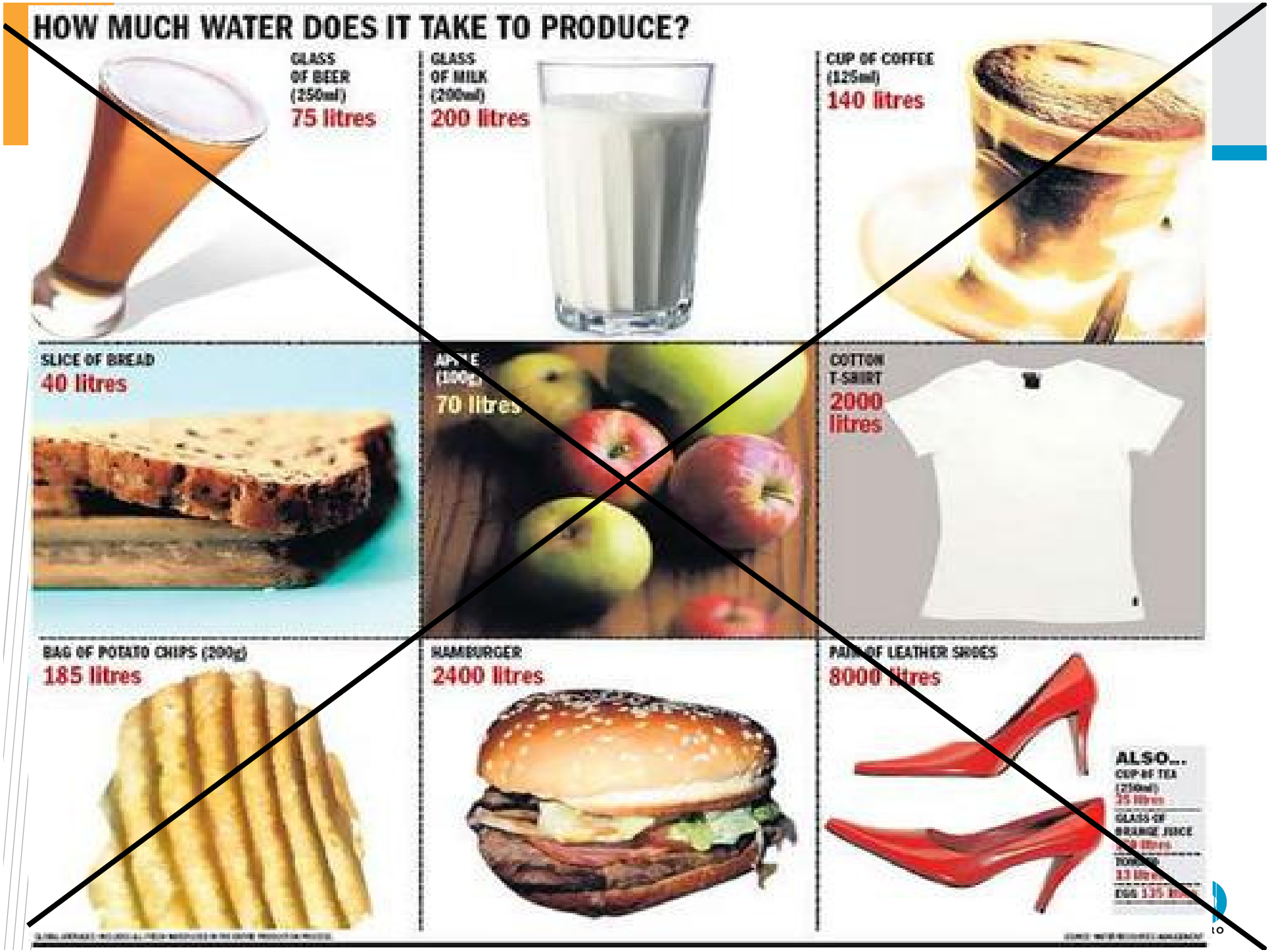
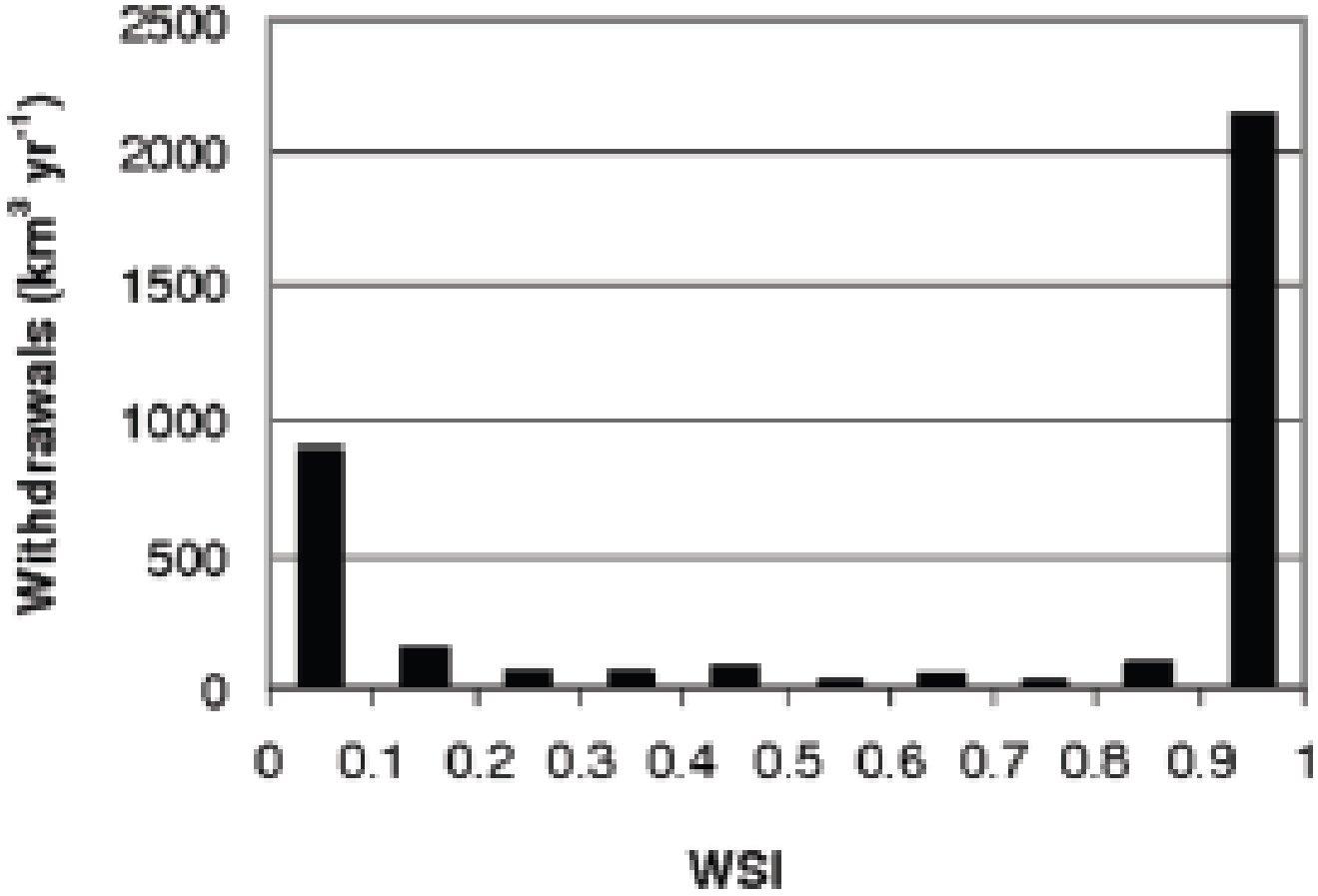
CSIRO


HOW MUCH WATER DOES IT TAKE TO PRODUCE?
GLASS OF BEER (250ml)
75 litres
GLASS OF MILK (200ml)
200 litres
CUP OF COFFEE (125ml)
140 litres
SLICE OF BREAD
40 litres
70 litres
COTTON T-SHIRT
2000 litres
BAG OF POTATO CHIPS (200g)
185 litres
HAMBURGER
2400 litres
8000 litres
ALSO...
CUP OF TEA
GLASS OF ORANGE JUICE

Humanity's consumption of freshwater is skewed toward highly stressed watersheds



(Ridoutt and Pfister, 2010 ES&T, 44:6019-6021)

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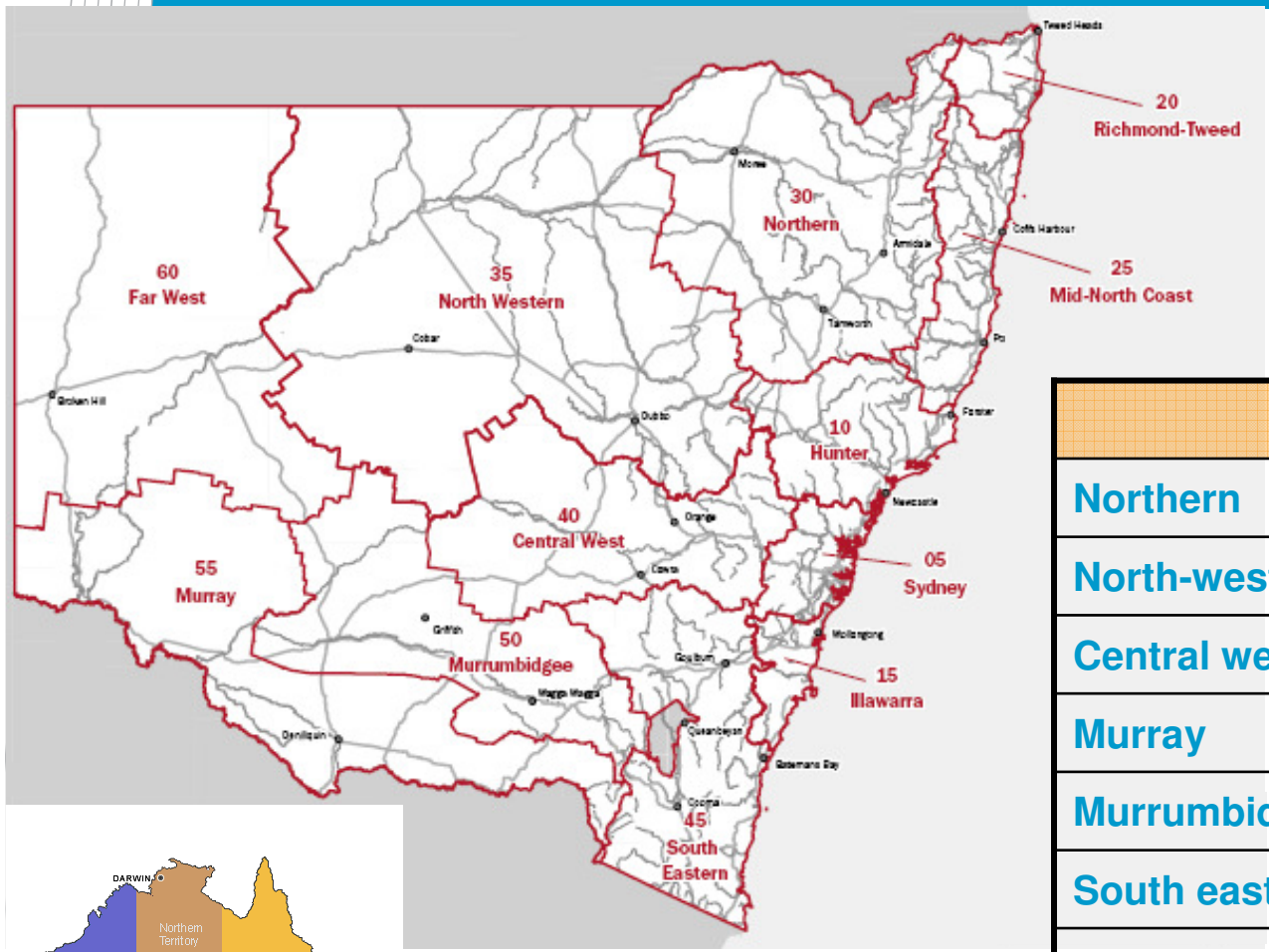
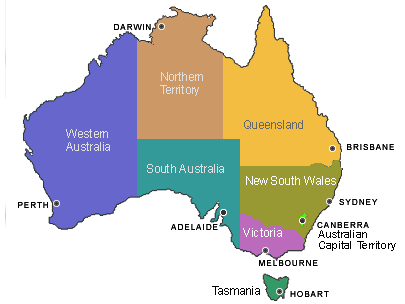
SAI Platform pilot project: NSW grains





Production 2005/06 ('000 t)

	Wheat	Barley	Oats
Northern	1,391	475	34
North-western	1,653	377	139
Central west	1,555	547	204
Murray	1,269	376	66
Murrumbidgee	1,890	527	145
South eastern	273	18	42
TOTAL NSW	8,049	2,336	633
%	>99	>99	>99

Source: ABS

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Estimated irrigation water use

Irrigation volume 2005/06 ('000 ML)

	Total	Maize	Wheat	Barley	Oats	Triticale	Sorghum
Northern	47.9	12.3	31.5	3.7	0.5	-	-
North-western	18.9	4.2	13.9	1.0	0.6	-	-
Central west	9.4	0.4	7.7	0.8	0.5	-	-
Murray	148.6	12.6	99.0	30.5	5.9	0.6	<0.1
Murrumbidgee	287.3	47.1	181.1	47.0	10.5	1.5	<0.1
South eastern	0.1	0.1	0	0	0	-	-

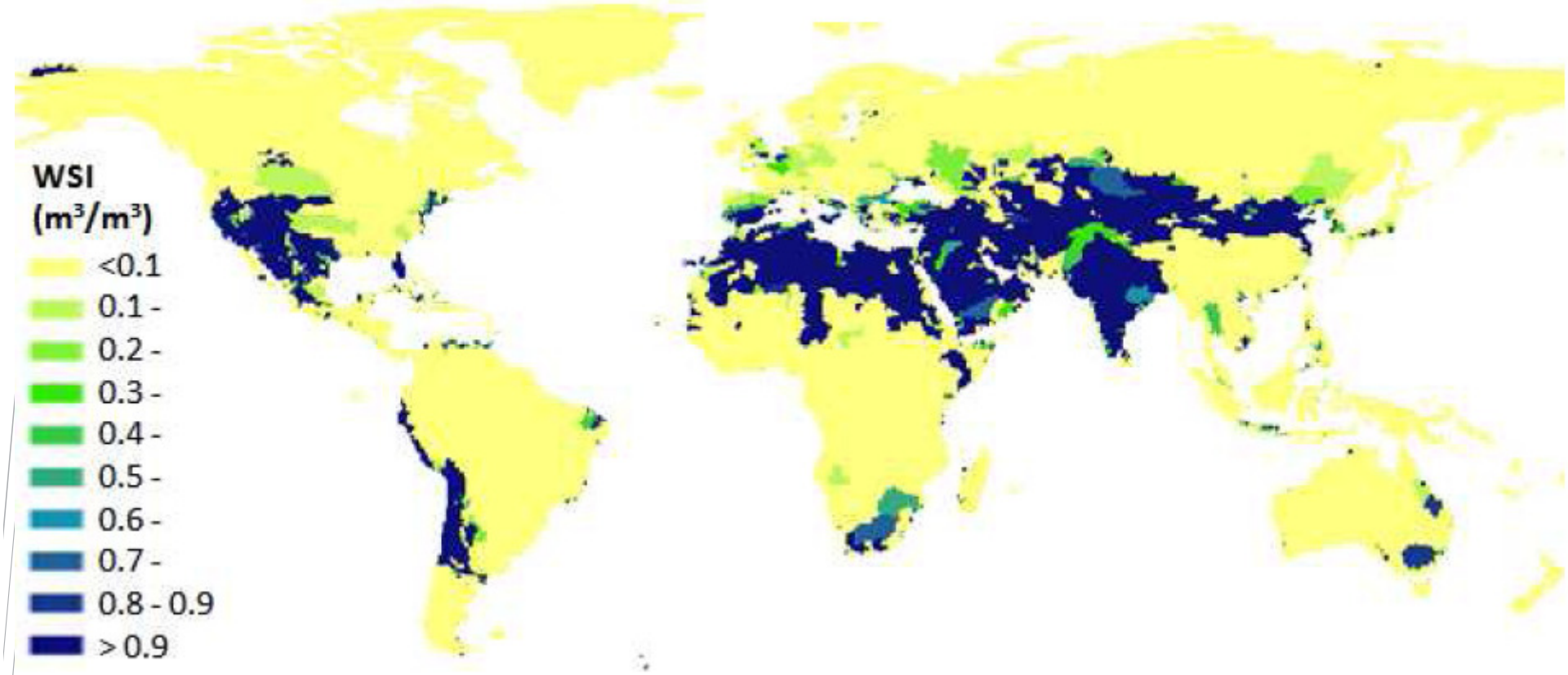
Source: CSIRO modelling using APSIM, www.apsim.info

Calculations

- Virtual water content (L / kg)
  - (Evaporation + Transpiration) / yield
- LCA-based water footprint (L H2Oe / kg)
  - Ridoutt and Pfister, Global Environmental Change 20:113-120

$$\text{Change in blue water availability (L / Kg)} \times \frac{\text{Local WSI (Pfister et al 2009)}}{\text{Australian average WSI}}$$

Water Stress Index (WSI) of Pfister et al.



(Pfister et al., 2009 ES&T)

- Monthy & annual variability in precipitation
- Watersheds with strongly regulated flows
- WSI of 0.5 = WTA of 0.4 = threshold b/n mod and severe water stress

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Results: VWC Australian Wheat

Reference	Total VWC L per kg	Green %	Blue %
Oki and Kanae (2004)	2966	-	-
Mekonnen and Hoekstra (2010)	2256	-	-
Chapagain and Hoekstra (2004)	1588	-	-
Aldaya et al (2010)	1502	73	27
Hanasaki et al (2010)	1339	96	4
This study (NSW)	1234	97	3

Water footprint: NSW grains

Aust-eq litres per kg

	Wheat	Barley	Oats
Northern	3.15	2.19	3.70
North-western	2.73	2.16	3.05
Central west	12.26	4.56	7.82
Murray	182	190	210
Murrumbidgee	230	211	173
South eastern	1.50	1.42	2.87
NSW-average	**86.5**	**80.7**	**65.4**
Components (%)			
➢Irrigation	**96.4**	**97.1**	**94.3**
➢Grey water	**2.2**	**1.1**	**2.0**
➢Land use change	**0**	**0**	**0**
➢Farm inputs	**1.5**	**1.8**	**3.7**

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Old-style single flush – 12 litres

3-star toilet, full flush – 6 litres

3-star toilet, half flush – 3 litres

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Conclusions

1. Many VWC estimates are unreliable
2. VWC-based WF and LCA-based WF: Uncorrelated
3. Impact assessment critical in almost all cases
4. LCA-based WF for NSW wheat: 150x difference
   - Local water stress
   - Supplemental irrigation
5. For communication: H_2Oe units are helpful

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Thank you

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