Reducing water-scarcity impacts through sustainable consumption and production of food

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JC-WISE International Symposium on Water Sustainability

AGRICULTURE AND FOOD
www.csiro.au

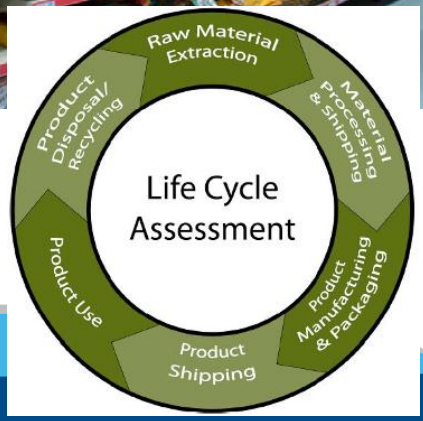
SDG context

ALL forms of malnutrition…ALL people…

increase water-use efficiency….to address water scarcity

sustainable consumption AND production patterns

Water use efficiency labeling makes sense when most water use is in the use phase



It makes no sense to compare or aggregate water use from areas of different water stress

Product	Water use	Local water stress
A	100 L	0.1
B	100 L	0.9

Life cycle stage	Water use	Local water stress
1	50 L	0.1
2	50 L	0.9
Total	100 L	????

International Organization for Standardization

1. World's largest international standard setting body
2. Independent, non-governmental, membership by national standards bodies
3. Founded in 1947 (history dates to 1926)
4. One of the first organizations established by the United Nations Economic and Social Council
5. Works in 163 countries.
6. Headquarters in Geneva
7. Examples ISO 9001, ISO 14001
8. ITCHKSAR: The Innovation and Technology Commission of the Government of the Hong Kong Special Administrative Region

ISO TC207 (Environmental Management) SC5 (Life Cycle Assessment)

Participating

- Brazil, France, United States, Austria, Bulgaria, India, Philippines, United Kingdom, Indonesia, Côte d'Ivoire, Panama, Mexico, Germany, Denmark, Malaysia, Ukraine, Egypt, Morocco, Chile, Costa Rica, Portugal, Argentina, Serbia, Japan, Republic of Korea, Kenya, Lebanon, Mongolia, Malta, Mauritius, Hungary, Belgium, Cuba, Netherlands, New Zealand, Poland, Pakistan, Rwanda, Australia, South Africa**, China**, Armenia, Zimbabwe, Canada, Finland, Sweden, Sri Lanka, Norway, Switzerland, Singapore, United Republic of Tanzania, Thailand, Uganda, Spain, Italy, Uruguay, Czech Republic

Observing

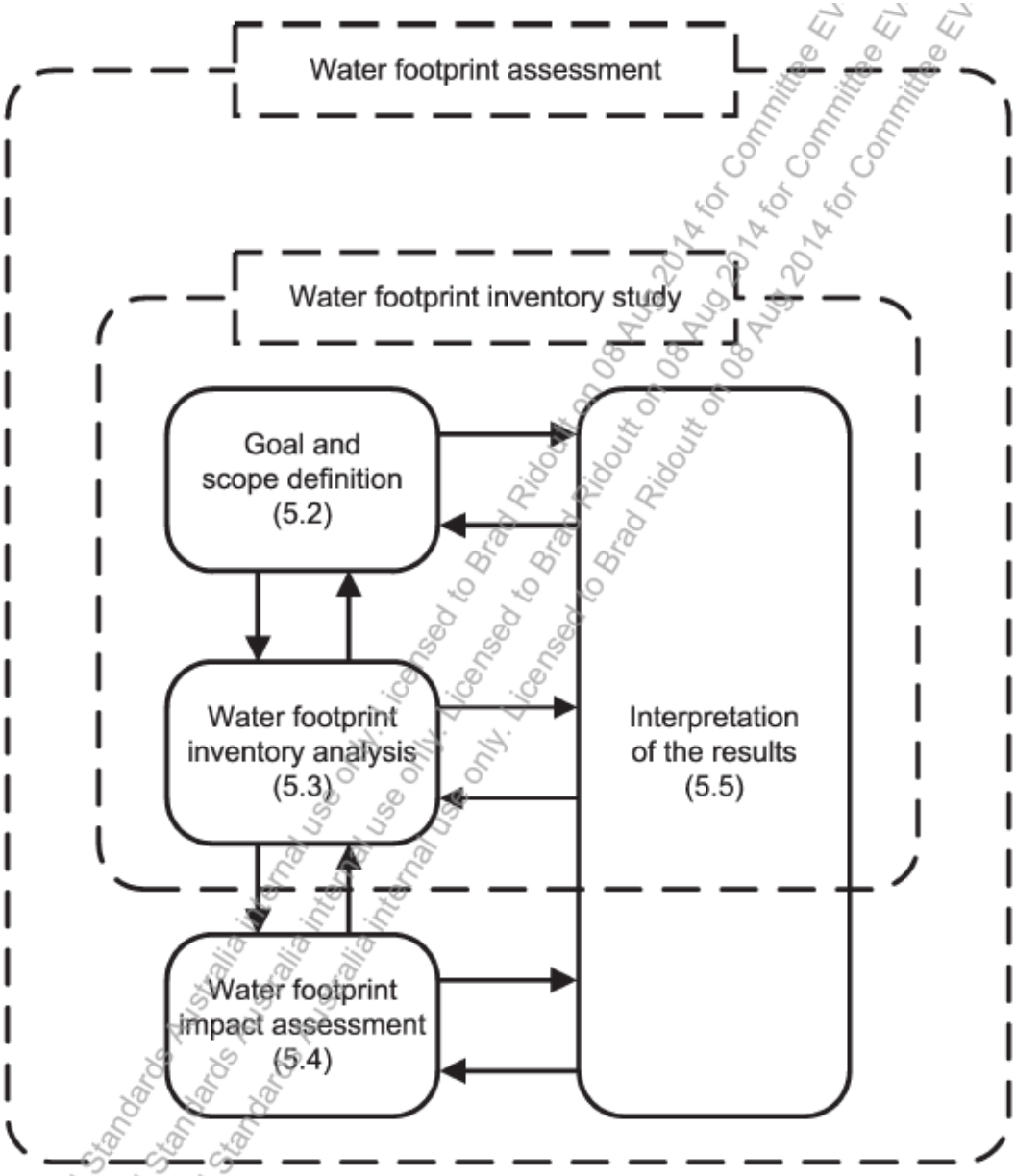
- Romania, Belarus, Iraq, Croatia, Algeria, Colombia, Luxembourg, Islamic Republic of Iran, Montenegro, Iceland, **Hong Kong**, Ireland, Israel, Slovakia, Vietnam, Swaziland, Turkey, Trinidad and Tobago

ISO 14046 Environmental management – Water footprint – Principles, requirements and guidelines

- Five years of international negotiation
- Leading science experts from over 40 countries + liaison organisations: IDF, WBCSD, EC, IAI, World Steel, etc
- The only open, multiparty, international and consensual process to develop an international water footprint standard
- Full ISO standard - Highest possible level of international consensus on the subject
- Published August 1, 2014

ISO 14046 Phases of a water footprint assessment

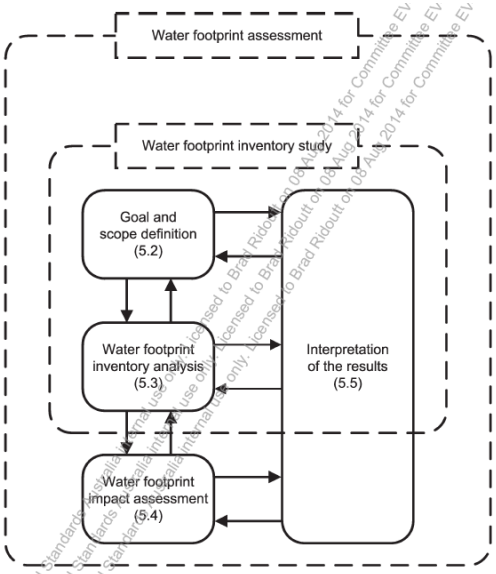
- Figure 1, Clause 5.1
- Based on ISO 14040:2006



ISO14046:2014 important requirements

The results of a water footprint inventory analysis may be reported, but **shall not** be reported as a water footprint (ISO 14046, p.10)

Water inputs or water outputs of different resource types, different quality, different form, different location with different environmental condition indicators, or different timing **shall not** be aggregated in the inventory phase. Aggregation may be performed at the impact assessment phase (ISO 14046, p.17)



Water-scarcity footprint (general approach)

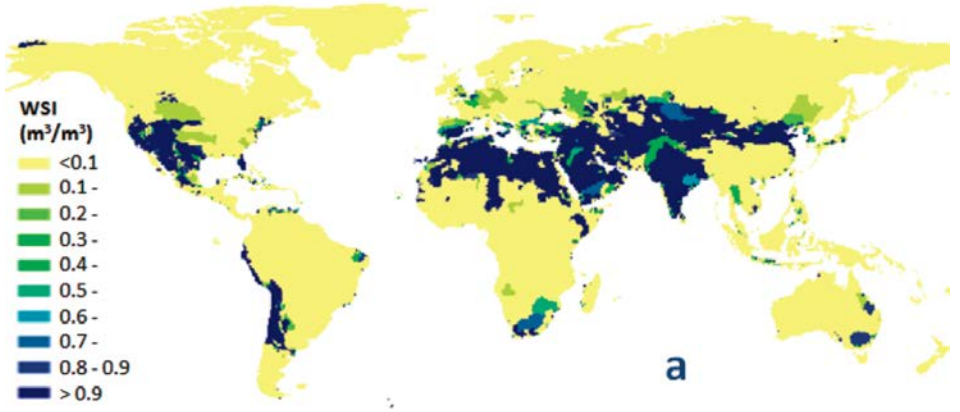
Indicator result for consumptive water use (H_2Oe) =

$$\sum_i \frac{CWU_i \times WSI_i}{WSI_{global}}$$

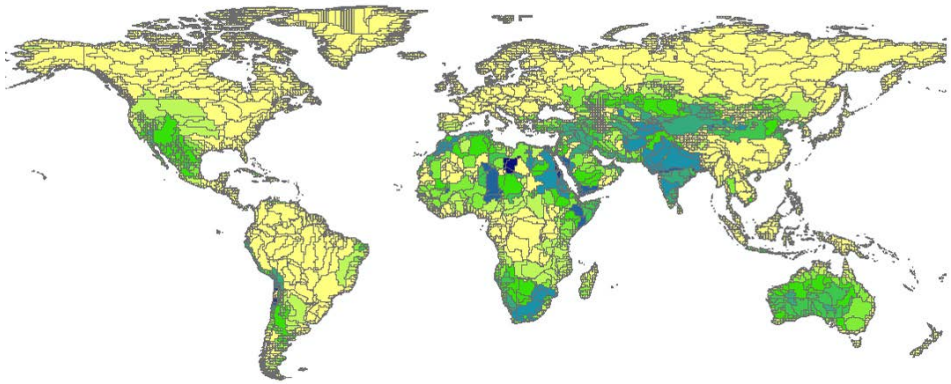
Life cycle stage	1	2	3	4	TOTAL
CWU (L)	10	25	5	20	
WSI_i/WSI_{global}	1.5	0.025	0.33	0.025	
CWU x WSI_i/WSI_{global}	15	0.6	1.7	0.5	**17.8**

Reference: freshwater consumption at global average WSI

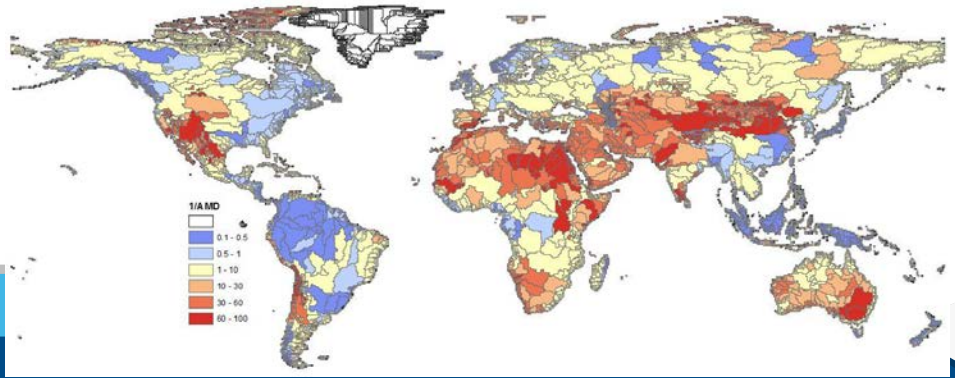
WSI_{WORLD_EQ}



WSI_{HH_EQ}



AWARE



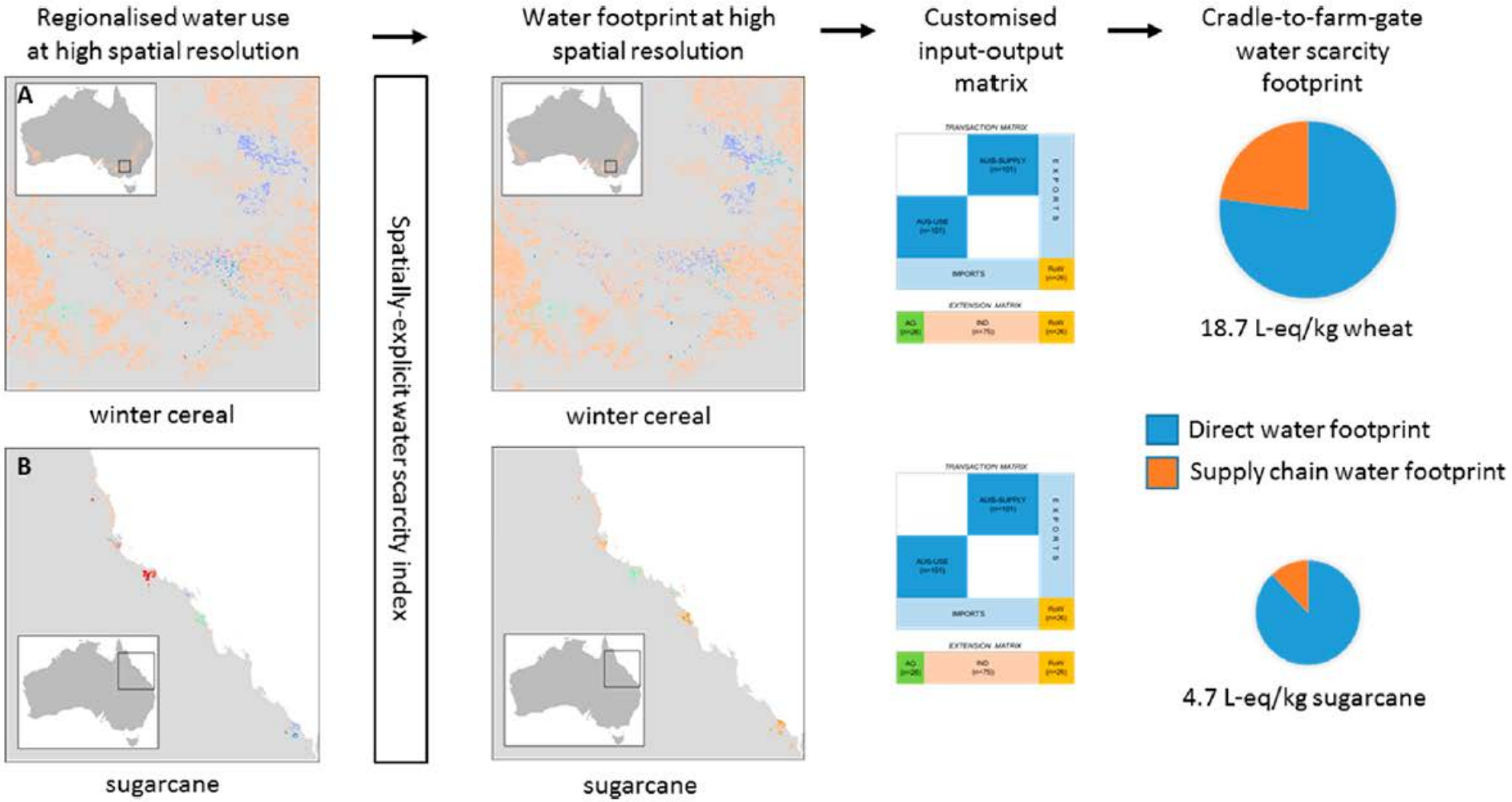
Water footprint of agricultural commodities

Ridoutt BG, et al. Environ. Sci. Technol. 2018, 52(12): 6761-6770.

Water-scarcity footprinting in EEIOA
(Environmentally-extended input-out analysis)

- EEIOA studies are now addressing many different environmental concerns
  - GHG emissions
  - Water and land use
  - Material use
  - Various emissions to air and water
- Many of these impact categories require spatially differentiated impact assessment
- IO tables are produced at the scale of political units which is often not an environmentally relevant scale
- There is a need to integrate best practice impact assessment modelling in EEIOA
- Solution: satellite data sets with LCA impact category indicator results for each industry sector

Method



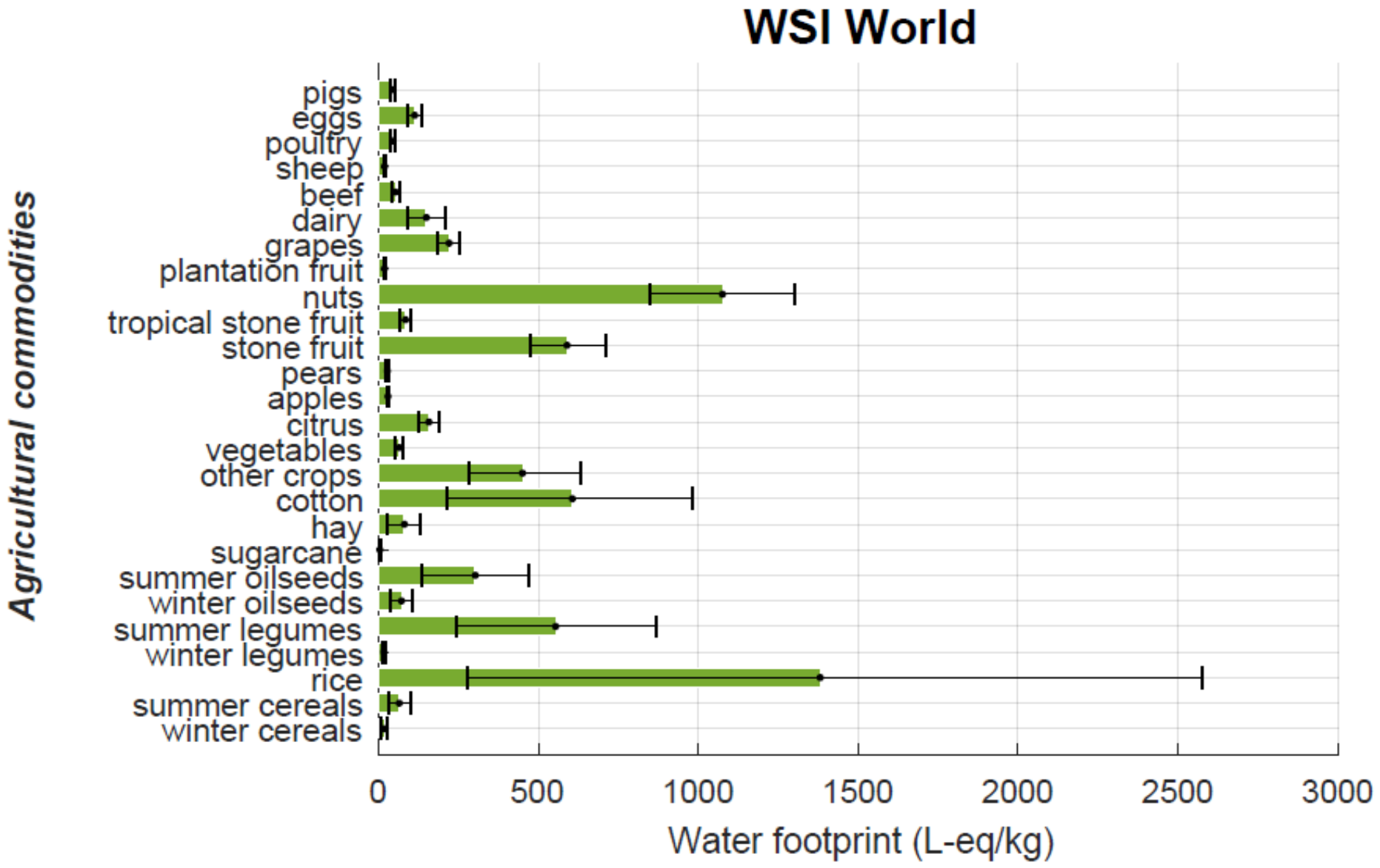
23 ag sectors
1.1 km resolution

3 water scarcity indicators

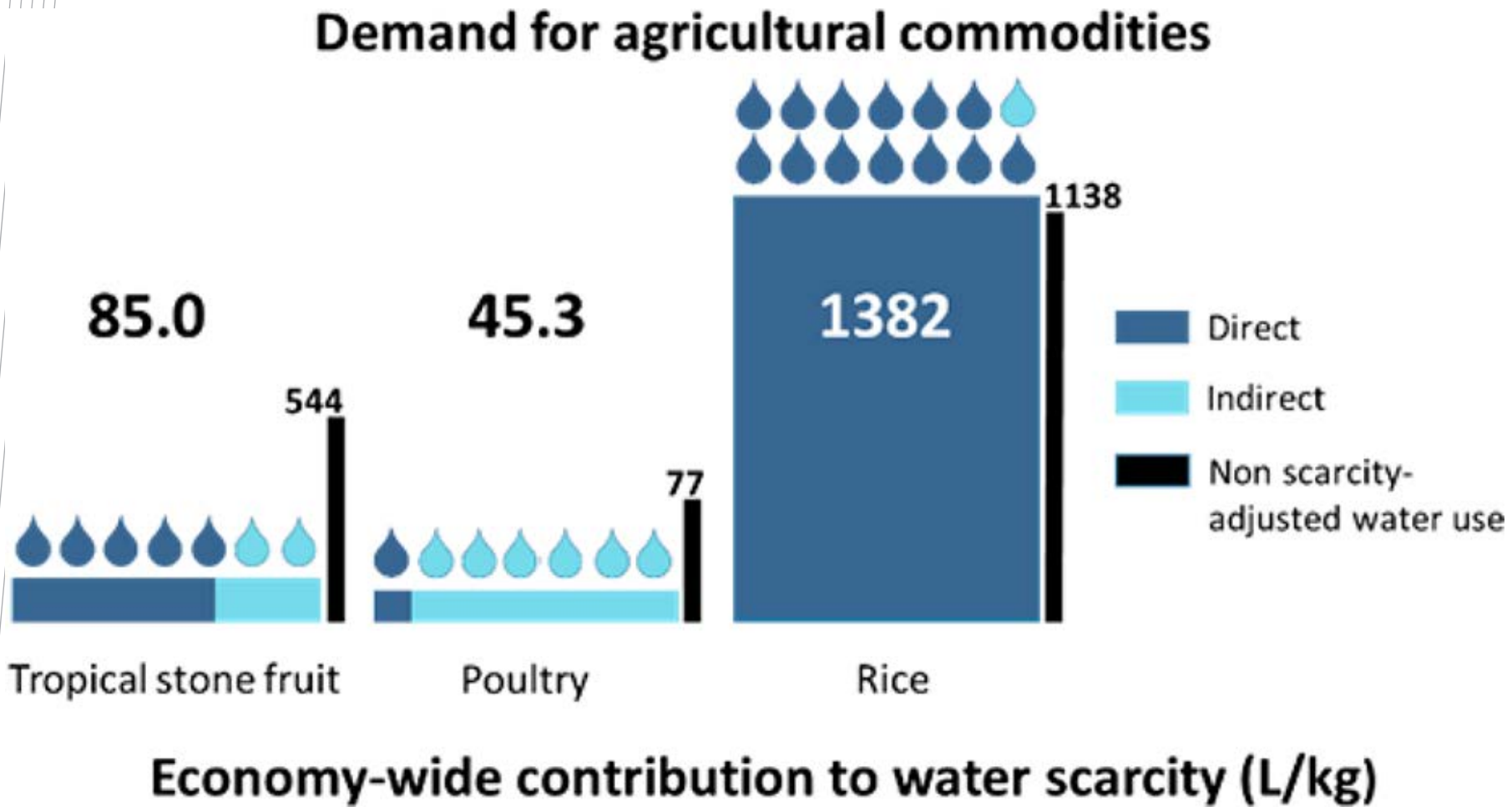
75 industrial sectors

National Research FLAGSHIPS CSIRO

Results


WSI World
Agricultural commodities
pigs
eggs
poultry
sheep
beef
dairy
grapes
plantation fruit
nuts
tropical stone fruit
stone fruit
pears
apples
citrus
vegetables
other crops
cotton
hay
sugarcane
summer oilseeds
winter oilseeds
summer legumes
winter legumes
rice
summer cereals
winter cereals
0
500
1000
1500
2000
2500
3000
Water footprint (L-eq/kg)

Spatially-explicit impact assessment matters



Implications

- Sustainable consumption and production (e.g. sustainable diets)
  - Poultry 45.3 Leq/kgLW >> 70% yield >> 65 Leq/kg retail cuts, well below rice, summer legumes, citrus, stone fruit, tropical stone fruit, nuts, grapes
  - Lamb 19.3 Leq/kg LW >> carcass yield 47% >> prime cuts 86% >> 48 Leq/kg, lower than poultry and even lower than vegetables
- Corporate WF accounting and strategic action
  - Direct and supply chain
  - Water scarcity footprint, not just water use
  - ISO NP14017 Verification and validation of water related information
- Bringing EEIOA into line with best practice LCIA
  - There are limits to the spatial disaggregation of IO tables
  - Without spatially explicit Impact Assessment, many EEIOA studies are simply pointing in the wrong direction

Water footprint of diets

Water-scarcity impacts of diets

- 9,341 individual adult diets obtained by 24-h recall process as part of Australian Health Survey
- Adjustment for under-reporting
- Mixed dishes and processed foods disaggregated into basic components
- Cooking factors (e.g. rice)
- Conversion factors for food processing and edible portions
- Water use in food processing
- Spatial-distribution of food processing sectors
- Imported commodities (tea, coffee, palm oil, etc.
- Aquaculture and wild-caught seafood
- Water-scarcity footprints of around 150 individual foods

Variation in water-scarcity footprint intensity within a food group

- Fruit
  - Medium-sized apple (100g, 92% edible): 3.0 L-eq
  - 250ml fresh orange juice: > 100 L -eq
- Cereals
  - One cup of cooked rice: 124 L-eq
  - 2 slices of wholegrain bread: 0.9 L-eq
- Alcoholic beverages
  - Glass of wine (125ml): 41 L-eq
  - Beer (375ml): 2.9 L-eq
- Meats and alternatives
  - Lamb (65g cooked, 90g raw, boneless): 5.5. L-eq
  - Chicken (80g cooked, 100 g raw, boneless): 8.5 L-eq
  - Eggs (2 large, 120g, 107g without shell): 13.6 L-eq
  - Tofu (170g): 20.0 L-eq

Implications

- Water-scarcity is one of several important environmental aspects
  - Water and carbon footprint not correlated (r = 0.03 to 0.05, N=9,341) after controlling for total energy intake
- Very large reductions in dietary water footprint possible….but not easily achieved through modified dietary guidelines
  - Diversity an important principle in nutrition
  - Highest variation is within a food group
  - Consumers would need labelling to identify low WSF foods
  - Potential unintended consequences
  - Reducing discretionary food a common denominator
- Water-scarcity improvement in food production
  - Technological innovation (tomatoes 5.0 to 52.8 L-eq/kg)
  - Ingredient procurement (milk 0.7 to 262 L-eq per L)
  - Reformulation

Policy framework for water-scarcity footprint reduction in the food industry

- Water pricing
  - Welfare impacts if nutritious food made more expensive
- Technology adoption
  - Investment in research and development
  - Financial incentives for technology adoption
  - Knowledge dissemination and support
- Minimum standards
  - Water licences
  - Planning approvals
- Market transformation
  - Product labelling
  - Corporate reporting

guided by the water footprint to ensure investments reduce water scarcity efficiently

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Thank you