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CLIMATE CHANGE AND WATER: HOW WATER ACCOUNTS CAN HELP OUR UNDERSTANDING

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Summary: Climate change imposes potentially significant changes on meteorological and hydrological systems. To understand the impacts of climate change, information about changes to these physical systems needs to be linked with information about human/economic activities and the broader environment. This paper explores possible ways that regular, comprehensive water accounts can inform our understanding of the implications of and the responses to changing water availability due to climate change. In particular, it describes some possible changes to water use by industries and sectors, as well as efficiency responses to expected increased scarcity and value of water resources. The paper incorporates results from a series of Water Accounts produced by the Australian Bureau of Statistics.

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Introduction

Michael Coughlan and Rob Vertessy from the Australian Government Bureau of Meteorology referred to the critical role of measurement and data to assess impacts of climate change at the recent Australian Bureau of Agricultural and Resource Economics (ABARE) Outlook Conference in Canberra.[1] They noted:

‘If you don’t measure it you won’t understand it.
If you don’t understand it you can’t model it.
If you can’t model it you can’t predict it.
If you can’t predict it, your ability to manage it will be constrained largely to the application of reactive measures.’

These observations are especially relevant to water and water accounting in Australia, where any changes in the abundance, distribution and availability of water across the continent as a consequence of climate change will pose significant challenges.

The *Integrated Environmental and Economic Accounting for Water Resources* handbook (SEEAW) provides a framework for organising hydrological and economic information in a consistent framework ideal for addressing cross-sectoral issues such as integrated water resource management. SEEAW was developed in support of the *System of Integrated Environmental and Economic Accounting 2003* (SEEA), with special focus on water. Both SEEA and SEEAW are satellite accounts of the *System of National Accounts 1993* (SNA). As such, both SEEA and SEEAW have a similar structure to the SNA and share many common definitions and classifications. SEEAW describes a set of standard tables focusing on hydrological and economic information as well as supplementary tables covering information on social aspects, which permits analysis of the interaction between water and the economy.

The Australian Bureau of Statistics (ABS) has produced water accounts in respect of 1994-95 to 1996-97, 2000-01 and 2004-05. The ABS water accounts were produced in parallel with the development of SEEAW and successive editions reflect the evolution of thought on the role and purpose of accounting for water. The latest, *Water Account Australia 2004-05,* in combination with *An Experimental Monetary Water Account for Australia, 2004-05*, closely follow SEEAW’s recommendations and use the SEEAW framework as much as possible within the constraints of existing data. The observations that follow are drawn mainly from these accounts.

There are qualifications on using water accounts to explain climate change. Climate change is one of several factors thought to affect variability of water in Australia and effects of climate change are difficult to differentiate from other influences on Australia’s weather. For example, Australia's highly variable annual rainfall is dominated by the El Nino-Southern Oscillation pattern, a discrete, cyclical weather event. Australia was particularly affected by an El Nino induced drought in 2004-05, so comparisons between this and earlier years will include effects of both cyclical weather variability and longer term climate change.

Australia’s water accounts are relatively new and have only been compiled in respect of a short time period. Indeed, Australia’s official weather/climate records cover a relatively

[1] Coughlan, M., and Vertessy, R., Australian Government Bureau of Meteorology, 2008

short period of history so that differentiation between variable weather cycles and climate change is difficult to discern from official records.

Industry, sectoral and regional information

Water accounts make an important contribution to our understanding of impacts of climate change through their ability to facilitate comparisons of the effects of changing water use patterns across time, across industries, across sectors and across regions.

Table 1, below, is a hybrid account showing details for 2000–01 and 2004–05 for chain volume measures (CVM) of Australia’s industry gross value added, water consumption and the ratio of industry gross value to industry water consumption. As expected, the relationship between water consumption and value added by industry varies markedly. For example, agriculture generated on average around $2 million in gross value added for every GL of water consumed in 2004-05—the lowest of any industry. Mining generated an average $155 million and manufacturing an average $169 million for each GL of water consumed in the same period. The average gross value added per GL of water consumed across all industries in 2004–05 was $56 million.

Table 1 also indicates changes in overall water consumption by industries over a short time and changes in their apparent efficiency of water use, indicated by changes in value added per GL of water used from 2000-01 to 2004-05. Although agriculture continued to be the lowest water value adding industry, it did increase its average value added per GL used by a third from 2000-01 to 2004-05. On the other hand, the mining industry value added per GL of water consumed decreased by just over 20% in the period while other selected industries value added per GL of water consumed remained largely unchanged. Across all industries, value added per GL of water consumed increased by 34%; however, as industrial use is dominated by agriculture, any changes in agricultural use are echoed in total industry use.

Table 1. Industry gross value added (chain volume measures) and water consumption for water using industries, 2000-01 and 2004-05

Industry	Industry gross value added $m		Water consumption GL		Industry GVA per GL of water consumed $m	
	2000-01	2004-05	2000-01	2004-05	2000-01	2004-05
Agriculture	23 206	24 344	14 989	12 191	1.5	2.0
Mining	63 691	64 223	321	413	198.4	155.5
Manufacturing	94 474	99 688	549	589	172.1	169.2
Electricity and gas	13 870	14 444	255	271	54.4	53.3
Water supply, sewerage and drainage services	7 724	7 407	2 165	2 083	3.6	3.6
Other industries	617 593	729 585	1 146	1 110	538.9	657.3
Total	**820 558**	**939 692**	**19 425**	**16 657**	**42.2**	**56.4**

Reference year for chain volume measures is 2006-06
Sources: Water Account Australia 2004-05 (ABS cat. no. 4610.0)
Australian System of National Accounts 2006-07 (ABS cat. no 5204.0)

The relationship between water consumption and industry gross value added is dependent upon the nature of production processes taking place within each industry and this cannot readily be represented in a simple table format. Nevertheless, it is worth noting the importance of input-output modelling and its potential to present cumulative consumption of water. For example, businesses manufacturing food, beverage and tobacco products generated an average $89 million in industry gross value added (CVM) per GL of water consumed in 2004-05. However, this excludes the embodied water content of the various inputs to these manufacturing processes and therefore does not show, for example, the cumulative water consumption associated with the manufacture of these products.

Agriculture

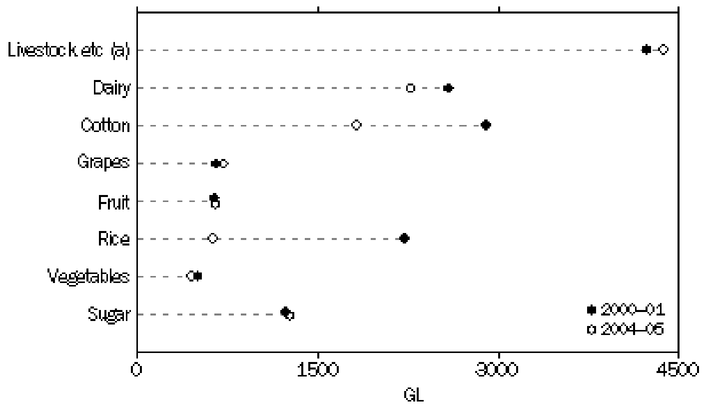
The Australian agriculture industry is considered to be vulnerable to the impacts of climate change, including increases in temperature and atmospheric carbon dioxide, decreases in rainfall over much of temperate Australia, and increased frequency of extreme weather events such as droughts, fires and flooding. Impacts are likely to be complex, both physically and socio-economically, and will vary greatly by production activity and region.[2]

All industries require water to a greater or lesser degree but for agriculture, the availability of water is a key determinant of the output and value added of the industry. The agriculture industry is the single largest consumer of water in Australia, accounting for nearly two-thirds of Australia's total water (including household) consumption.

- Agriculture consumed 14,989 GL in 2000-01, 77% of total industrial (excluding households) water used, while contributing 2.8% to total value added.
- Water consumption by agriculture fell 19% to 12,191 GL in 2004-05, but it still consumed 73% of total industrial water used for 2.6% of total value added.

Water accounts provide a wide range of information about both water uses by agriculture and changing patterns of production. Water usage within the agriculture industry varies widely and is sensitive to both the availability and cost of water. Chart 1 illustrates changes in consumption of water within agriculture between 2000-01 and 2004-05.

Chart 1. Agriculture water consumption, by activity



(a) Includes livestock, pasture, grains and other agriculture (excluding dairy farming).
Source: Water Account Australia, 2004-05 (ABS cat. no. 4610.0).

[2] Australian Government, Department of Climate Change, *Climate Change Impacts and Adaptation*

Some crops such as rice, cotton and grapes are highly dependent on irrigation. For other crops such as grazing pasture and sugar cane, irrigation water supplements natural rainfall or provides moisture at critical periods of plant growth. The area to be irrigated and the volume of water applied depend on the crop type and location. Chart 1 illustrates the sensitivity of certain agricultural production activities to the availability of water. The most significant change in water consumption was for cotton and rice production, both water intensive crops. Water consumption for rice fell from 2,222 GL to 631 GL (-72%) between 2000-01 and 2004-05, while consumption for cotton fell from 2,896 GL to 1,822 GL, (-37%). These decreases were principally due to drought-induced reductions to water allocations and subsequent reductions in irrigated areas for these crops.

Water accounts can help inform decisions about the cost-effectiveness of irrigating different crops. Nevertheless, estimating the value of irrigated agricultural production is difficult because water used by crops comes from a variety of sources. In particular, rainwater is usually a component of the water used by irrigated crops, and the timing and location of rainfall affects the amount of irrigation water required. In addition, water is not the only input into irrigated agricultural production; land, fertiliser, labour, machinery and other inputs are also used. To separate the contribution of each of these factors to total production is extremely difficult, even with ideal data. Therefore, estimates of the gross value of irrigated agricultural production presented in Table 2 attribute all of the gross value of production from irrigated land to irrigated agricultural production.

The estimates of gross value of irrigated agricultural production in Table 2 are not directly comparable with the estimates of industry gross value added presented in Table 1 because gross value of irrigated agricultural production is a measure of output, rather than value added. As such, gross value of irrigated agricultural production should not be used as a proxy for determining the highest value water users—some form of value added measure is instead appropriate for this purpose. At present, the ABS does not produce any value added measure in respect of irrigated agricultural production.

Table 2. Gross value of irrigated agriculture production and water consumption, 2000-01 and 2004-05

Activity	Gross value of irrigated production $m		Water consumption GL		Gross value per GL of water consumed $m	
	2000-01	2004-05	2000-01	2004-05	2000-01	2004-05
Dairy farming	1 499	1 632	2 593	2 276	0.6	0.7
Vegetables	1 817	1 761	507	455	3.6	3.9
Sugar	284	477	1 235	1 269	0.2	0.4
Fruit	1 590	1 777	645	648	2.5	2.7
Grapes	1 355	1 314	655	717	2.1	1.8
Cotton	1 222	908	2 896	1 822	0.4	0.5
Rice	350	102	2 223	631	0.2	0.2
Livestock, pasture, grains & other	1 500	1 104	4 235	4 374	0.4	0.3
Total	**9 618**	**9 076**	**14 989**	**12 191**	**0.6**	**0.7**

Source: An Experimental Monetary Water Account for Australia, 2004-05 (ABS cat. no. 4610.0.55.005)

Mining and Manufacturing

The mining and manufacturing industries use water for cleaning, cooling, product movement, dust suppression and as a raw material. These industries use water from both distributed supply and self-abstracted sources. Distributed water is water supplied to a user, and where an economic transaction has occurred for the exchange of this water. Self-abstracted water is water extracted directly from the environment for use (including rivers, lakes, groundwater and other bodies). There is also a growing use of reuse water in these industries. Reuse water is drainage, waste or storm water that has been used again without being first discharged to the environment.

- Mining consumed 321 GL in 2001-02, 1.7% of total Australian industrial consumption, and 413 GL in 2004-05, 2.5% of Australian industrial consumption.

Most water used in the mining industry is from self-abstracted sources. Water is often obtained from mine dewatering, which occurs when water is collected through the process of mining and mineral extraction, or rainfall, run-off and water infiltration. Mine dewatering is considered to be a self-abstracted water source for the mining industry in the water account. Water extracted from the mine site and discharged without being used in the production process is considered to be in-stream use.

- Manufacturing consumed 549 GL in 2001-02, 2.8% of total Australian industrial consumption, and 589 GL in 2004-05, 3.5% of Australian industrial consumption.

The manufacturing industry in Australia consists of the nine subdivisions shown in Table 3. Water use varies considerably between these subdivisions due to the different nature of the products manufactured.

Table 3. Manufacturing industry gross value added (CVM) and water consumption, 2004-05

Manufacturing subdivision	Gross value added (CVM) $m	Water consumption GL	GVA per GL of water consumed $m
Food, beverage & tobacco	19 195	215	89.3
Textile, clothing, footwear	3 195	15	209.6
Wood & paper products	6 870	99	69.3
Printing & publishing	10 419	6	1628.0
Petroleum, coal & chemical	14 717	70	209.3
Non-metallic mineral products	4 529	20	227.6
Metal products	17 770	146	121.5
Machinery & equipment	18 851	15	1224.1
Other manufacturing	4 283	2	2855.3
Total manufacturing	**99 688**	**589**	**169.2**

Reference year for chain volume measures is 2006-06
Sources: Water Account Australia 2004-05 (ABS cat. no. 4610.0)
Australian System of National Accounts 2006-07 (ABS cat. no 5204.0)

Electricity and Gas

Electricity generators are a significant user of water in Australia. Most of the water is used for hydro-electricity power generation, but coal-fired power stations also use considerable amounts of water in their boilers and cooling towers. Water used for hydro power generation is not considered a consumptive use as the water extracted passes through turbines to generate electricity and is discharged and made available to downstream users; this is called an ‘in-stream’ use. Water consumption by thermal electricity generation is largely due to evaporation from cooling towers.

While it is clear that electricity producers are often significant users of water, it is also true that water availability is an important influence on how electricity is produced. For example, during Australia’s current drought, concerns have been raised about the capacity of some hydro power producers to maintain base load electricity supplies. Water accounts can provide a basis for an informed assessment of whether water flows are sufficient to meet current and expected future needs of power generators. Table 4 shows the amount of water used and electricity generated by different fuel types in Australia in 2004-05.

Table 4. Water use and electricity generation by fuel type, 2004-05

Fuel type	Water use	Electricity generation	Water use per GWh of electricity generated
	ML	GWh	ML/GWh
Hydro	59 867 227	15 991	3 744.0
Black coal	153 021	102 180	1.5
Brown coal	81 887	54 041	1.5
Gas	11 606	20 786	0.6
Other	810	1 473	0.6
Total	**60 114 551**	**194 471**	**309.1**

Source: Water Account Australia 2004-05 (ABS cat. no. 4610.0)

In Australia, any shortfall in the capacity of hydro power producers to meet base load electricity demand will likely need to be met, in the short term at least, by additional electricity production from thermal producers, with consequent increased greenhouse gas emissions. But, as shown in the water account, coal-powered electricity production is also a significant user of water. An increasing scarcity of water may add to existing pressures to explore and adopt less water-intensive energy sources, such as wind, tidal, solar, biomass and geothermal.

There are few options for development of hydro power generation in Australia, especially at prevailing electricity prices. Tasmania, the smallest state, produces most of Australia’s hydro power by utilising its relatively abundant water resources and its suitable terrain. Hydro accounts for around 90% of total power generation in Tasmania. New South Wales (NSW) generates the second highest amount of hydro power, but this accounts for only 8% of total electricity generated in NSW. Most of NSW’s hydro power is generated in the Snowy Mountains, part of the Murray-Darling Basin, which has been severely drought affected in recent rears.

Water accounts can point up some of the regional differences in the mix of fuel types used for electricity generation. Table 5 illustrates the regional breakdown of electricity generation by fuel type in Australia.

Table 5. Electricity generation GWH by fuel type, States, Territories and National, 2004-05

	Hydro	Black coal	Brown coal	Gas	Other	**Total**
New South Wales	4 596	54 231	-	1 182	820	**60 829**
Victoria	794	-	49 341	1 179	-	**51 314**
Queensland	826	38 290	-	4 145	231	**43 492**
South Australia	-	-	4 700	5 401	38	**10 139**
Western Australia	215	9 659	-	6 117	110	**16 101**
Tasmania	9 560	-	-	934	226	**10 720**
Northern Territory	-	-	-	1 828	48	**1 876**
Australian Capital Territory	-	-	-	-	-	-
Australia	**15 991**	**102 180**	**54 041**	**20 786**	**1 473**	**194 471**

Source: Water Account Australia 2004-05 (ABS cat. no. 4610.0)

Water supply, sewerage and drainage

Water accounts have a valuable role to play in assessing potential impacts of climate change on the water supply industry. In a setting of likely increasing water scarcity there will be pressure on this industry to innovate and improve the efficiency of water supply and use. Water supplied by the water supply industry, by water type for 1996-97, 2000-01 and 2004-05 is shown in Table 6.

Table 6. Water supplied by the Water supply industry, by type, 1996-97, 2000-01 and 2004-05

	1996-97		2000-01		2004-05	
	GL	%	GL	%	GL	%
Distributed	11 525	98.9	12 934	96.2	11 337	96.4
Reuse	134	1.1	507	3.8	425	3.6
Total	**11 659**		**13 441**		**11 762**	

Source: Water Account Australia 2004-05 (ABS cat. no. 4610.0)

Reuse or recycled water is considered an important option for securing water supply into the future. There are a variety of water sources that may be supplied as reuse water, including waste water (from sewerage systems), drainage water, storm water or other water providers (i.e. a 'bulk' reuse water supply). There is increasing investment in infrastructure related to the supply of reuse water, and as such there is considerable interest in the volumes of reuse water supplied and used. In addition, water management authorities are interested in whether reuse water is reducing the demand for distributed water or self-abstracted water. Water accounts provide information to assist policy development in this area.

Between 1996–97 and 2000–01, the supply of reuse water increased from around 1% of total supply to nearly 4%. It decreased slightly from 2000–01 to 2004–05, largely due to the decrease in drainage water supplied as reuse water by irrigation/rural water providers (from 423 GL to 280 GL). This decrease was due to lower water availability caused by below average rainfall.

Water accounts also draw attention to distribution losses incurred by the water supply industry (which includes sewerage and drainage services) and provide a basis for assessing improvements in distribution efficiency. For example, the Australian water accounts recorded distribution losses of 2,022 GL (18.1%) of the 11,160 GL self-abstracted by the Water supply, sewerage and drainage services industry in 2004-05. This compares with distribution losses of 2,117 GL in 2000-01, 16.3% of total self-abstracted water (12,915 GL).

Water accounts can also facilitate comparisons of returns on infrastructure assets owned by the Water supply industry with the value of these assets. In a commercial operation, if the price of water supplied does not deliver a competitive return on the value of infrastructure assets used, the water supplier has little incentive to invest in additional infrastructure. Ultimately, investments to improve infrastructure are required to deliver improvements in water supply and use.

Households

Households used 23% of distributed water in Australia in 2004-05, but paid 61% of the total cost of this water.

Water accounts can tell us a great deal about household responses to changing climate patterns. Even in the short period between 2000-01 and 2004-05, Australian households made quite significant changes to their consumption of water, as illustrated in Table 7.

Table 7. Household water consumption, Australia, 2000-01 and 2004-05

	Household water consumption GL		Household water consumption, per capita Kl/capita	
	2001-02	2004-05	2001-02	2004-05
Household consumption	2 278	2 108	120	103
Change over period	-	-7.4%	-	-14.2%

Source: Water Account Australia 2004-05 (ABS cat. no. 4610.0)

The reduction in household water consumption from 2000-01 to 2004-05 was due to a combination of factors. The continuing drought throughout much of Australia saw most of Australia’s capital cities introducing mandatory water use restrictions during this period, generally curtailing use of distributed water on home gardens and lawns. At the same time water providers conducted effective information campaigns to educate users about water conservation practices. Increasing numbers of households installed rainwater tanks to collect water, often supported by government rebates, as well as initiating water conservation practices in and around their dwellings. The proportion of households using recycled or reuse water within and around their dwellings increased from around 11% in 2001 to 16% in 2004. Reuse water used by households increased from 167 ML in 2000-01 to 1,767 ML in 2004-05.

In addition, most of Australia's urban water suppliers have moved to full cost recovery for provision of water supply services, increasing the price of water to households. While the link between increased price and reduced demand (due largely to the effect of mandatory water restrictions) for household water over this period is not entirely clear, increased prices do signal that excessive water consumption will continue to be expensive for households.

The water accounts also provide a regional perspective on water consumption by households. Table 8 illustrates the differences in household water consumption across the Australian states and territories, and changes in water consumption patterns between 2000-01 and 2004-05. Tasmania was the only jurisdiction where household per capita water consumption increased during this period, indicating that the drought affecting most of mainland Australia was not a major concern for households in Tasmania.

Table 8. Household water consumption per capita (Kl/capita) 2000-01 and 2004-05

	2000-01	2004-05	Change over period
New South Wales	97	84	-13%
Victoria	97	81	-16%
Queensland	143	124	-13%
South Australia	110	94	-15%
Western Australia	191	180	-6%
Tasmania	125	143	+14%
Northern Territory	162	153	-6%
Australian Capital Territory	115	95	-17%
Australia	**120**	**103**	**-14%**

Source: Water Account Australia 2004-05 (ABS cat. no. 4610.0)

Regional water accounts

The precise effects of climate change on hydrological systems are difficult to anticipate; therefore statistical agencies need to be flexible in how water accounts are presented.

For example, the Murray-Darling Basin (MDB) is Australia's largest catchment area and is vitally important to Australian agriculture, contributing some 45% of Australia's gross value of irrigated agricultural production in 2004-05. In 2005-06, farmers in the MDB used around 69% of the total water used by Australia's agricultural industry. The MDB spans parts of New South Wales, Victoria, Queensland, and South Australia, as well as the entire Australian Capital Territory. This means that characteristics of water supply and use within the MDB are not apparent from 'standard' Australian water accounts, which are produced in respect of the nation and for each of the states and territory. The Murray-Darling Basin Commission (a government authority with responsibility for the MDB) notes that several studies[3] claim the future climate of the MDB will be characterised by higher temperatures and reduced rainfall, resulting in reduced inflows to reservoirs and increased evaporation.

[3] http://www.mdbc.gov.au/nrm/risks_to_shared_water_resources#Climate_Change

Given the importance of the MDB and its expected vulnerability to climate change, the ABS will shortly release a study focussing on water supply and use in the MDB. The study will provide a detailed picture of the major users and uses of water, as well as analysis of the relationships between rainfall, water storage and water use in the MDB. This study is a clear example of a flexible and responsive approach to linking water accounting and climate change.

Monetary water accounts

Information on physical water flows and stocks can be combined with relevant monetary information into hybrid water accounts (as in Table 1), creating powerful analytical tools. Where climate change increases water scarcity, water pricing and trading strategies can be used to encourage more efficient water use to ensure that water is allocated where it adds most value. Water accounts can be used to chart changing patterns of water use associated with evolving water pricing and trading policies, particularly when such policies target specific sectors of the economy. For example, the Australian government's recent *National Water Initiative*[4] recommended that water distributed to urban users should be priced to achieve full recovery of all costs associated with its capture, storage, treatment and distribution, while water distributed to rural and regional users should be priced to cover only current costs associated with supplying water. Effects of the progressive adoption of these pricing policies will be captured in national and regional hybrid water accounts.

In the past, water allocation in Australia was largely based on a series of administrative systems anchored in incremental allocation and 'first in' principles. These systems lacked the flexibility and functionality needed to respond to changing climatic conditions and changing markets. Now, trading is the primary means of reallocating available water resources among users. Trading may involve a reallocation of water within or between sectors, regions and communities. The ABS produces statistics on trading in entitlements to access water as well as on trading of water parcels—statistics that can be integrated into water accounts.

Water trade information can be a valuable monitoring and policy tool when incorporated into water accounts. For example, rapidly rising water trade prices provide an early and clear indicator of increasing scarcity of water available for production. In addition, ABS water trade data contain information on 'permanent' trade of water rights (i.e. sale of on-going access to a body of surface or ground water) and 'temporary' trade of water rights (sale of one year of access to a body of surface or ground water). If prices of temporary and permanent access rights to a specific water system converge over time, this would indicate a weakening of confidence in the long term availability of water for that system.

Water trade information can also answer questions about the effectiveness of institutional arrangements. For example, we could ask whether volumes of water traded are increasing as a proportion of total water used within the economy. If not, this would suggest that the existence of water trading is not having a material influence on the allocation of water. This may prompt action to seek and remove remaining obstacles to water trading and to encourage innovation in the design and delivery of water trade products.

[4] National Water Initiative (2004), *Intergovernmental Agreement on a National Water Initiative*

Under ‘normal’ climatic conditions, if water prices move from essentially ‘free’ levels to levels where some producers begin choosing not to purchase water, we would expect to see water increasingly being used by those producers who are able to add greater value to water inputs. In ‘normal’ droughts, we might expect to see farmers purchase water to preserve their valuable long-lived assets, such as grape vines and fruit trees, while water intensive annual crops, such as cotton and rice, may be abandoned until water becomes more plentiful and water prices fall. This behaviour reflects the considerable cost in allowing valuable assets to perish, so farmers will incur relatively greater costs and effort in the short term to preserve these assets for the long term.

However, for extended or permanently dry conditions, which may become the case with climate change; a producer may cease to be economically viable if obliged to pay higher water prices indefinitely. It is quite possible; even likely, that a significant impact of climate change in Australia will be reduced water availability in the MDB. Under these scenarios, if the producer cannot generate an adequate return at higher water prices, their response will be to either: change to a less water-intensive type of production; change to a higher value adding form of production; or cease production. Water accounts can capture such changes in water pricing and their associated impacts on agricultural and other economic production.

Monetary water accounts can also shed light on the cost/benefit of potential alternatives to supplying water harvested from local streams and aquifers. Urban water suppliers in Australia have either commenced or considered sea water desalination to supplement traditional water sources. Water accounting will help to establish the viability of providing desalinated water to meet urban household and industrial demand, and the potential to supply desalinated water for agriculture.

Most of Australia’s population live on the coastal fringes in the south and east of the country, while most rain falls in the north of the country. Proposals have been made to pipe water from where it falls in the north to where it is needed by the population centres of the south and east. Water accounts can help to inform policy response to these proposals.

Conclusion

The late Professor Peter Cullen, National Water Commissioner and Member of the Wentworth Group of Concerned Scientists remarked on the importance of water accounting, ‘Flying blind hasn’t worked and we must know how much water we have, where it is and how it is being used.’[5]

Water accounts will contribute to our understanding of climate change and help inform our response to this challenge, but, as for other impacts of climate change on the environment, more information is vital. Returning to the introductory message of this paper: ‘If you don’t measure it you won’t understand it.’ So it is with water.

[5] Cullen, P., cited in *Droplet No. 11*, The University of Adelaide, March 2008

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