Valuation of Grazing Benefits from Overland Flow in the Macquarie Valley

Rod McInnes B.Ag.Ec

13 April 2018

Background

Macquarie River Food & Fibre (MFF) was formed in 1996 to provide a unified voice for irrigated agricultural producers in the Macquarie Valley, from Burrendong Dam down to the Macquarie Marshes. MRFF represents over 500 irrigation producers. It is also supported by local businesses through sponsorship and associate membership.

MFF has a range of aims that it pursues on behalf of its members, but a critical one is:

- Promoting sustainable irrigation in the Macquarie Valley

It is understood that MFF has concerns about the sustainable use of water in the Macquarie Marshes area. In its submission to the NSW Parliamentary Inquiry into Water Augmentation in August 2016 MFF stated that:

"Opportunity exists to review the current operating rules to maximise the potential of the existing storage infrastructure and improve the reliability of access for downstream towns, stock and domestic users, irrigators and environmental water users, while still providing the important flood mitigation role."

In this context, it's important to have an understanding of the value of water for these different users in the valley, and how that value can be maximised across the different uses in the valley. This report was commission by MFF to provide an initial valuation based on publicly available information and to provide some initial ideas on moving towards an optimisation of water use by better understanding and signaling its value to the community.

Objective

The aim of the proposed study is to survey and identify gaps in existing information on the value of water in its different uses in the Macquarie Valley including, irrigation, environmental flows, flood irrigated grazing, stock and domestic uses, and any other uses identified in the course of research.

Rationale

The value of water in each use is a key requirement to better understanding the allocation and management of water and associated resources (eg. Native vegetation, soils, etc) in the Macquarie Valley.

The valley has unique environmental resources with the Macquarie Marshes which have particular management requirements of which water is the key, but not the only, input to. In particular, MFF in recent years has identified complementary measures that could enhance environmental values in the Macquarie Marshes with little or no change in water allocation . The study will be an opportunity to investigate the likely impacts of these measures on water values. For instance, effective complementary measures may reduce the value of water in environmental use, better allowing water infrastructure potential to be optimised within the valley, as MFF proposed in its submission, as noted above.

These complementary measures include:

- Managing more marsh land to achieve specific conservation outcomes;
- Removal of diversion structures that impact significant wetlands;
- Erosion control;
- Revegetation; and
- Better management of environmental flows.

Methodology

The primary task is to gather available water value information, and to augment that where it is unavailable or out of date.

A range of techniques are available for valuing water in each use[1]. Conceptually, they all focus on measuring economic surplus, as gained by producers and consumers. In practice, most rural water use value can be captured from market price and production information, such as summarised in enterprise gross margins or whole farm budgets. Such information is readily available, or can be derived from existing models by up-to-date commodity prices and input costs.

Slightly more complex analysis was required for environmental values, where the stated preferences of consumers, the value of land (hedonic pricing) or other techniques are employed because direct market prices are not available for environmental attributes. However, this analysis was simplified by using benefit transfer techniques – that is, using values for similar environmental attributes in other marsh environments. There is also implicit environmental values in the trading undertaken by the Commonwealth Environmental Water Holder[2] and state water holders.

Marsh productivity values will be required to scope values with different flow regimes. Aerial photography is available to show inundation extent, and there is one trial site where grazing has been withheld and marsh productivity changes can be elicited. In this report, this analysis has not been sourced, but it is an important next step to link the . Use has been made of related studies including Natural Resource Assessment of the the Burmah Forest[3]

Overall, the scope of the study has been to assess water use value for the following enterprise groups:

- Irrigation cropping: cotton & grains;

---

[1] Young, R.A. & Loomis J.B. (2014) Determining the Economic Value of Water: Concepts and Methods, Second Edition, Resources for the Future & Routledge,

[2] http://www.environment.gov.au/water/cewo/trade (Accessed 22nd February 2018)

[3] Natural Resources Commission (2010) Riverina Bioregion Regional Forest Assessment River Red Gums and Woodland Forests

- Wetland: Beef cattle floodplain grazing;
- Wetland: native vegetation and fauna;

Beef Gross Margin per ML for valuation was derived from the data provided in the Macquarie Marshes Environmental Landholders' submission attachment, "Beef Productivity of the Macquarie Marshes".

It would be useful to refine this in future work, by calculating gross value of output under different flow regimes estimated using the inundation area and benchmarked productivity.

Analysis

Two substantial tasks comprise the bulk of the analysis, a Gross Margins analysis which focused on deriving cropping and beef grass margins under different water use scenarios, and environmental analysis.

We start with an analysis of the value from the grazing regime in the Macquarie Marshes.

Wetland: Beef cattle floodplain grazing;

Table 1: Beef production from the Macquarie Marshes in Different Flow Events

Flow past Marebone (ML)	Area Flooded ha	Cattle Produced	Kilograms of beef
700,000	145,000	35,802	7,446,816
400,000	81,000	20,000	4,160,000
250,000	50,000	12,345	2,567,901
100,000	19,000	4,691	975,802
58,000	9,000	2,222	462,221
30,000	4,000	987	205,431

Source: Submission to NSW Parliamentary Inquiry.

These tables assume that production of a 208kg beast (dressed weight ie. between weaner-vealer weight) will be yielded from 4 ha of watered marsh land (0.25 of a beast per ha).

Taking the cattle produced at the different flow levels, we can apply a standardised GM per Dry Sheep Equivalent (DSE)[4] to derive a value added per ML for these enterprises and total values.

Table 2: Value Per ML

DSE/ha	Water Use	Value (GM)/DSE	Value GM Per ML
	ML/ha		
4	5	$41	$30

Source: Grazier Submission and Calculations in Appendix A.

These are then compared to the other enterprises in the valley.

Table 3: Gross Margin Per ML

Gross Margin per ML		$/ML	$/DSE	DSE per animal
App. B	Irrigation cropping: cotton & grains;			
	Cotton	278		
	Grain	206		
App. A	Wetland: Beef cattle floodplain grazing;	30	41	17
App. C	Wetland: native vegetation and fauna;	120		

Source: NSW DPI and calculations. See Appendices A, B, and C.

[4] Dry Sheep Equivalent is a standardised measure of pasture demand that can be used to benchmark different enterprises (eg. Sheep for wool, fat lambs, beef breeding, weaner calves, steers etc). Each type of enterprise can have it's pasure demand measured compared to a dry (non-breeding) sheep enterprise. For example, the Beef weaner enterprise assessed in Appendix A, is rated as 16DSE, that is that the average pasture demand per head in this beef enterprise is equivalent to the pasture demand of 16 dry sheep.

The results indicate that the grazing activity has a very low value of water use compared to alternatives, and yet a substantial aggregate value in the grazing enterprise because of the volume used.

In the submission, the total increased production of beef because of water flows was between 205 tonnes and 5.5 thousand tonnes, depending on water flows, which has a gross value of between $1M and $36M at current prices . The Gross Margin analysis shows that a gross revenue increase of say, $1.2M delivers a profit increase of around $0.7M.

This strong profit with low value water use is possible because of the low efficiency of the watering and the fact that market prices are not paid for the water. Graziers would argue that this large volume is delivering extra environmental benefits which cover the costs of its use. Although this is plausible, there needs to be more rigour around the analysis of what amounts to joint production of beef and environmental outcomes. It may be that the environmental benefits associated with beef grazing are lower than in non-grazed areas. This needs further assessment.

Conclusion

In conclusion, the initial valuation suggests that:

- Beef grazing is a relatively low value use of water on a per ML basis in the Macquarie Marshes compared to other agricultural enterprises and environmental uses.
- The gross value of beef production is substantial because of the high volumes of water consumed.
- There is uncertainty as to exactly what environmental benefits are associated with beef enterprise water use. This needs further measurement.

Appendix A: Valuation of Water for Grazing

The Submission by the Macquarie Marshes Environmental Landholders Association on 20 March 2017 (G. Hole, 2017) to a NSW Parliamentary Inquiry into Water Augmentation included data on flow rates through the marshes, the extent of water coverage and the resultant beef production (see Table 1 in report above).

The numbers provided equate to an average beef production per animal of 208 kg. Assuming that this is dressed weight, this equates to a heavy vealer or light steer enterprise. A Gross Margin budget has been prepared, based on NSW Department of Primary Industry proformas (NSW DPI, 2017) consistent with the submission. The Gross Margins are based on the scale of a 100 cow production unit. The production regime assumes improved pasture, but the floodplain grazing of the Macquarie Marshes would match improved pasture in other other environments, but with a much lower maintenance cost. The budget is provided with and without pasture maintenance costs. Floodplain grazing will have low to negligible pasture maintenance costs through use of self-sustaining marsh pasture species. Some attention will need to be taken to weed control.

Enterprise:			Butcher Vealers		
Enterprise Unit			100	Cows	
Pasture:	Floodplain grazing		16.68	DSE/COW	

INCOME:				**Budget**
	32	steer vealers @	$1,008 /hd	$32,256
\	13	store steers @	$1,202 /hd	$15,632
	32	heifer vealers @	$945 /hd	$30,240
	13	store heifers @	$1,031.90	$13,415
	1	CFA Bull @	$1,665 /hd	$1,665
	9	CFA cows @	$1,302 /hd	$11,718
	9	Other culls @	$1,302 /hd	$11,718
	A. Total Income:			$116,643
VARIABLE COSTS:				
Replacements	1	Bull @ $6,000 /hd	$6,000 /hd	$6,000
	18	Replacement heifers @ $1,400 /hd	$1,400 /hd	$25,200
Livestock and vet costs				$1,222
Fodder crops / hay / grain				$0
Drought feeding costs.				$0
Pasture maintenence	209	ha per 100 cows		$20,900
Livestock selling cost (see assumptions on next page)				$7,781
	B. Total Variable Costs			**$61,103**

	GM Including Pasture Cost	**GM Excluding Pasture Cost**
GROSS MARGIN (A-B)	**$55,540**	**$69,175**
GROSS MARGIN/COW	$555.40	$691.75
GROSS MARGIN/DSE*	$33.30	$41.47
GROSS MARGIN/HA	$265.74	$330.98

- DSE = Dry Sheep Equivalent. This is a productivity metric used for comparing different livestock enterprises by benchmarking, in this case, a cattle enterprise to a non-breeding sheep enterprise.

The budget assumes 2017 costs which are those provided by NSW Department of Primary Industries but the income forecast has been updated to current prices, which are slightly down on 2017 values.

References:

Hole G. 2017 Submission to the Inquiry into Water Augmentation

Macquarie Marshes Environmental Landholders Association 20 March

NSW Department of Primary Industries 2017 Livestock Gross Margin Budgets https://www.dpi.nsw.gov.au/agriculture/budgets/livestock

Appendix B Valuation of Water for Cropping

The values of cropping gross margins per ML have just been taken directly from the DPI standardized tables for Cotton and Grains enterprises.

These give values of $278 per ML for Cotton (furrow irrigated) and $206/ ML for other grain.

Appendix C: Valuation of Environmental Water

The valuation of water allocated within the Macquarie River system to environmental purposes is more difficult than the other valuations in this study.

It is clear that there are valuable environmental outputs of the Macquarie Marshes such as bird breeding and unique flora. These are attributes which the community is known to value.

In a free market situation there is not normally a market for environmental services such as the wildlife ecology or clean water that enable these benefits. There are fundamental reasons for this such as the inability to define property rights for these services, as opposed to say, normal agricultural products such as food (beef cattle) or fibre (cotton). The benefits of these services are insufficiently concentrated to be worth someone's while to "fence off" and so "own" the sources of these services such as swamps and streams. There are policy developments which may change this situation, such as pollution discharge rights but these are not imminent.

In the interim, there are a number of non-market valuation techniques that can be employed. These can be classified into two broad categories (Baker and Ruting, 2014) :

- Revealed preference valuation: : deducing the value of environmental services from data on the value of closely connected commodities. For example, finding the value of clean lake water from an analysis of lakeside dwelling prices where water quality varies using the technique called hedonic pricing.
- Stated preference valuation: asking community members what they would be willing to pay for these environmental services.

Stated preference Valuation

There have been a number of primary stated preference studies of the Macquarie Marshes (Morrison et al, 1999 and 2002) and there is some current work in progress at Charles Sturt University and University of Canberra. There has also been a study of the Murray-Darling Basin as a whole which includes valuations

for the Macquarie Marshes, using the earlier primary studies, but modified according to the principles of benefit-transfer to create values for wetlands across the basin (Morrison et al, 2010). Benefit-transfer is a technique, as the name suggests, to transfer valuations from primary stated choice or revealed preference studies to a different location or time by breaking down the values into environmental attributes that can be measured at each location, and then modelling the likely value in the secondary location if the values hold true across both.

What do the stated preference values give? Morrison summarized the willingness to pay for the Gwydir Wetlands and Macquarie Marshes as from $14-34 per household per year for increased frequency of waterbird breeding by one year. (Morrison et al, 2010, Pg. 10), with the Macquarie Marshes at the top of that range. Colonial bird breeding frequency was presented to respondents in the primary surveys at different levels from four yearly, three yearly, two yearly and annually. The measured attribute is an increase in frequency by one year (eg. Moving bird breeding from four yearly to two yearly, or from two yearly to annually) (Morrison et al, 2002, Pg. 163). Water flows have a substantial impact on the frequency of bird breeding as the birds require standing water in the marshes for safety and food. The total values (for all households in the likely payment pool) amounted to $58.8 M (*ibid*. Page 32) for the same attribute improvement.

Unfortunately, although these values are clearly substantial, they can't be easily linked to the water resources inputs to the Macquarie system. Morrison et al do not make clear what environmental water allocations would achieve the valued outcome, and indeed as economists that is not their expertise. This is a matter of scientific analysis and policy development. Other studies such as

It therefore makes more sense in this study, to use revealed preference valuation. The water resource in question is traded on open markets, and the market includes participants who are buying for environmental attributes. Although we do not have values specific for the Macquarie Marshes, we can

obtain values across the northern basin of the Murray-Darling that are full substitutes for the water that flows through the marshes.

Revealed Preference Valuation

Although there is no private market for environmental services in the Macquarie Marshes, there is purchasing of environmental water by Governments in the irrigation water market. These purchases have the objective of improving the ecology in the Murray Darling Basin by providing more water to the ecosystems that underpin that ecology. Economic theory would suggest that if the purchases are made thoughtfully, that the preferences of the buyers for environmental services can be revealed from the prices that they are prepared to pay in that market.

There are two main buyers of environmental water in the Northern Basin of the Murray Darling where the Macquarie Marshes are located:

- The NSW RiverBank project, where water is bought by NSW Government from licence holders and provided to the environment . Over 80,000 megalitres of water have been bought in the Macquarie, Gwydir, Lachlan and Murrumbidgee valleys from a program worth $105 million.
- The Commonwealth Restoring the Balance program worth $3.1 billion for the direct purchase of water licences for the environment in the Murray-Darling Basin (Department of Agriculture, 2018).

NSW Government claims, that, "in general, RiverBank purchases licences at a price consistent with recent or historic market activity or benchmarks, initially derived from an independent assessment of water markets undertaken for RiverBank". The program also places a price cap, where offers of 15% or more above "price benchmarks" are subject to Review. On this basis, and the size of the program relative to the Restoring the Balance program, indicative prices for water purchases are best sourced from the later program.

Table A - 2 Environmental Water Purchase Values contains the list of water purchases by the Commonwealth Government in the Northern Basin.

Table A - 2 Environmental Water Purchase Values

Program of Purchases	Year	Catchment	Entitlement class	Average price of offers accepted ($/ML)
Northern Basin tenders 2010–11	2010	Lower Balonne, QLD	Unsupplemented	$1,433.33
Northern Basin tenders 2010–11	2010	Lower Balonne, QLD	Unsupplemented	$1,433.30
Northern Basin tenders 2010–11	2011	Border Rivers, QLD	Unsupplemented	$1,500.00
Northern Basin tenders 2010–11	2011	Lower Balonne, QLD	Unsupplemented	$1,650.00
Northern Basin tenders 2010–11	2011	Lower Balonne, QLD	Unsupplemented	$1,500.00
Northern Basin tenders 2010–11	2011	Lower Balonne, QLD	Unsupplemented	$1,470.00
Queensland Lower Balonne tenders 2012–15	2012	Lower Balonne, QLD	Unsupplemented	$1,795.00
Queensland Lower Balonne tenders 2012–14	2013	Lower Balonne, QLD	Unsupplemented	$1,500.00
Queensland Lower Balonne tenders 2012–15	2013	Lower Balonne, QLD	Overland Flow	$1,150.00
Queensland Lower Balonne tenders 2012–15	2013	Lower Balonne, QLD	Unsupplemented	$1,750.00
Queensland Upper Condamine Alluvium Groundwater Purchase Tender - 2015-2016	2016	Upper Condamine Alluvium, QLD	Groundwater	$1,736.13
New South Wales Barwon-Darling Tender - June–July 2015		Barwon-Darling Unregulated, NSW	Class B	$1,009.24
Nominal average				$1,493.92
Amortised (ie. per year) value of Average @ 7%				$120.39

Source: Prices of offers accepted in open water purchase tenders http://www.agriculture.gov.au/water/markets/commonwealth-water-mdb/average-prices Accessed 16th April 2018

Volumes of purchases are not provided but a nominal average price was calculated to indicate the value of water to the purchaser. Then this average value was amortised into an annual payment, equivalent to a gross margin for environmental water, assuming that operating cost per ML is small. This gives a value of $120 per ML for environmental services from the marshes. This value is assumed to reflect the worth of the environmental outcomes that the program administrators are targeting.

References:

Baker, R. and Ruting, B. 2014, Environmental Policy Analysis: A Guide to Non-Market Valuation, Productivity Commission Staff Working Paper, Canberra.

Department of Agriculture 2018 Commonwealth water purchasing in Murray-Darling Basin http://www.agriculture.gov.au/water/markets/commonwealth-water-mdb Accessed 16 April 2018

Morrison, Mark, Jeff Bennett, and Russell Blamey. 1999. Valuing improved wetland quality using choice modeling. Water Resources Research 35 (9):2805-2814.

Morrison, Mark, Jeff Bennett, Russell Blamey, and Jordan Louviere. 2002. Choice modeling and tests of benefit transfer. American Journal of Agricultural Economics 84 (1):161-170.

Morrison, Mark, and Hatton MacDonald, D. 2010, *Economic Valuation of Environmental Benefits in the Murray–Darling Basin*, report to the Murray–Darling Basin Authority, Canberra.