NSW Floodplain harvesting economic analysis

Economic impacts of NSW Floodplain Harvesting Policy

A Final Report prepared for NSW Department of Planning, Industry and Environment (DPIE)

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AITHER

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Summary

The New South Wales (NSW) Government is implementing the NSW Floodplain Harvesting Policy (the policy) in the NSW Border Rivers, Gwydir, Namoi, Macquarie, and Barwon-Darling valleys. Implementing the policy will establish a licensing and measurement framework for floodplain harvesting within the legal limits set out in NSW water sharing plans. Through this, the NSW Government aims to protect the environment and downstream water users from the impacts of unconstrained growth in floodplain harvesting.

Aither was engaged to:

- Quantify the economic value of agriculture supported by floodplain harvesting in the five valleys where the policy is being implemented.
- Estimate changes in the economic value of irrigated agricultural production as a result of policy implementation.

Scenarios for economic modelling

This report quantifies the economic value of floodplain harvesting for agricultural production under current conditions (base case) and two policy scenarios (Table 1). Expected environmental impacts of the policy changes are discussed qualitatively but were not within the scope of the analysis.

Table 1 Modelled scenarios

Scenario	Description
Base Case (current conditions)	Floodplain harvesting diversions under current conditions (without the NSW Floodplain Harvesting (FPH) Policy
NSW Floodplain Harvesting Policy (Policy Intervention)	Floodplain harvesting diversions under the NSW FPH Policy Intervention to reduce FPH to legal limits
Extreme scenario	No floodplain harvesting (indicative scenario only)

Floodplain harvesting provides significant on-farm agricultural benefits. Implementing the NSW Floodplain Harvesting Policy is expected to decrease on-farm agricultural benefits by 14 per cent

The forecast economic value of floodplain harvesting is highly variable and closely correlated with future rainfall and runoff. The economic results are therefore presented as ranges that reflect three alternative hydrological scenarios; a dry, median and wet future[1].

The total estimated on-farm (profit) economic value of floodplain harvesting across the five valleys under the base case **ranges from $524 million to $1,023 million, with the median value approximately $873 million** (present values over the next 10 years at a 7% discount rate, consistent

[1] The hydrology scenarios are described in Section 1.2.

with NSW Treasury guidelines)[2]. This represents the on-farm economic value that is estimated to be lost if floodplain harvesting was made unavailable to irrigators across the five valleys (i.e. the indicative extreme scenario).

Introducing the Policy Intervention is estimated to reduce the on-farm economic value of floodplain harvesting across the five valleys by between **$19 million and $273 million** (present value over 10 years). The median estimated reduction is approximately **$126 million** (present value over 10 years). The remaining economic value under the median scenario is estimated to be **$747 million** (present value over 10 years) which represents a 14 per cent decrease relative to current conditions. This isolates the impact on floodplain harvesting water by not considering any potential increases in the reliability of other water products3 (i.e. the central case).

Accounting for other water products, introducing the Policy Intervention is estimated to reduce the on-farm economic value of floodplain harvesting by approximately **$100 million under the median scenario** (present value over 10 years). The remaining economic value under the median scenario, accounting for other water products is estimated to be to **$773 million**. This is the total forecast net on-farm impact across the five regions and represents a 10 per cent decrease in economic value relative to current conditions.

These results are presented in Figure 1**.**

Figure 1 Change in agricultural value under the Policy Intervention (present value over 10 years, median hydrology sequence (central case) and with inclusion of other products)

The quantum of the economic impacts is expected to vary across valleys

Under the Policy Intervention, and without considering reliability impacts on other water products, agricultural value is expected to decrease by $93 million in the Gwydir valley and $15 million in the NSW Border Rivers valley (present value over 10 years under the median hydrology scenario). Figure 2 presents a breakdown of the estimated loss of on-farm agricultural value associated with the Policy Intervention for each of the five valleys relative to the base case under the median hydrology scenario. Percentages are in reference to the value generated by floodplain harvesting water only.

[2] A 10 year period was chosen as it assumes irrigators will adapt their irrigation practices in response to the policy change within this time period.

[3] Other water products include High Security (HS) and General Security (GS) entitlements and Supplementary water.

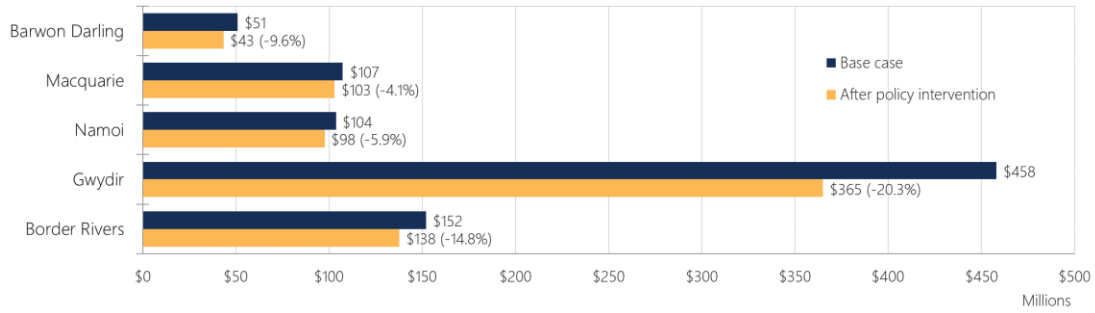

Figure 2 Agricultural disbenefits of the Policy Intervention by region (present value over 10 years, median hydrology sequence (central case))

Floodplain harvesting supports flow-on economic benefits to local communities

In addition to the on-farm impacts (profits), DPIE have estimated the value-added impact of the intervention using REMPLAN[4]. Detailed results, assumptions and limitations are presented in Appendix D. In summary, DPIE's analysis estimate that additional annual average direct and flow-on impacts of introducing the Policy Intervention relative to the base case under the median hydrology scenario for each region are:

- Barwon Darling (- $0.14 million and 3 less jobs per annum)
- Macquarie (-$0.18 million and 1 less job per annum)
- Namoi (-$0.30 million and 3 less jobs per annum)
- Gwydir (-$4.98 million and 41 less jobs per annum)
- Border Rivers (-$1.5 million and 7 less jobs per annum)[5].

Changes to floodplain harvesting extraction limits under the Policy Intervention are expected to have environmental benefits; the economic value of which has not been quantified in this analysis

The Policy Intervention will generate benefits that have not been quantified in this report. The NSW Department of Planning, Industry and Environment (DPIE) modelled the expected hydrology and environmental water availability changes of implementing the Policy Intervention across the Gwydir, Border Rivers and Macquarie Valleys:

- Modelled floodplain water availability in the Gwydir and Border Rivers is expected to significantly improve. Mean annual volume, seasonal volumes, duration of days with flow, and frequency of events are predicted to increase, and inter-event periods are predicted to reduce. The Macquarie valley shows marginal improvements to floodplain hydrology as a result of policy implementation.
- Modelling suggests that in the Gwydir region, environmental water requirements of native vegetation, native fish and waterbirds would be met more often, by an average of 82 per cent, 97 per cent and 142 per cent respectively. Better outcomes for the Gwydir Wetlands would provide

[4] https://www.remplan.com.au/

[5] Impacts include direct and flow on impacts in employment, output, wage and salaries and gross regional product.

greater resilience for the diverse habitats and species it supports in the Gwydir Valley and the northern Murray-Darling Basin (MDB) more broadly.

- Under the proposed Policy Intervention, the Gwydir and Border Rivers valleys are expected to achieve the most environmental benefits, aligning with, and potentially offsetting the expected economic impacts outlined in Figure 2.

Key assumptions and limitations

A detailed list of assumptions used to develop the model and results are presented in Section 2. Appendix B and Appendix C provide a detailed list of inputs and sources used in the economic model. Data limitations are presented in Section 0 and include:

- Reductions to floodplain harvesting do not result in a like-for-like increase to other forms of water take under the legal limits specified in the relevant water sharing plan. This means that the total available water for extraction does not exceed the legal limits in the relevant water sharing plan.
- The results are underpinned by historical hydrology data. The increasing impacts of climate change on water availability in the five regions, and the potential for deviations from historical hydrology data may impact the realisation of these forecasts.
- Hydrological data represents changes to aggregate diversions in ML/annum across each policy option relative to the base case – diversions implicitly reflect water applied to cotton.
- For the purposes of this analysis, all irrigation water is assumed to be applied to cotton.
- All losses associated with the storage and delivery of water (i.e. including on-farm) are accounted for in the outputs of the hydrology modelling.
- Aither did not review or have input to the REMPLAN analysis.

1. Introduction

1.1. Purpose and scope

The New South Wales (NSW) Government is implementing the NSW Floodplain Harvesting Policy (the policy) in the NSW Border Rivers, Gwydir, Namoi, Macquarie, and Barwon-Darling valleys. Implementing the policy will establish a licensing and measurement framework for floodplain harvesting within the legal limits set out in NSW water sharing plans. Aither was engaged to quantify the economic value of agriculture supported by floodplain harvesting in the five valleys and to estimate the changes in economic value from the policy implementation.

The analysis will inform the Select Committee Inquiry into floodplain harvesting and the NSW Government's negotiations on the future implementation of proposed NSW floodplain harvesting reforms.

1.2. Scenarios

Floodplain harvesting policy scenarios

This report quantifies the economic value of floodplain harvesting for agricultural production under current conditions (base case) and two policy scenarios described in Table 2.

Table 2 Base case and project scenarios

Scenario	Description
Base Case (current conditions)	Floodplain harvesting diversions under current conditions (without the NSW Floodplain Harvesting (FPH) Policy
NSW Floodplain Harvesting Policy (Policy Intervention)	Floodplain harvesting diversions under the NSW FPH Policy Intervention to reduce FPH to legal limits
Extreme scenario	No floodplain harvesting (indicative scenario only)

Hydrology scenarios

Changes in the economic value of floodplain harvesting are presented under three hydrology scenarios, each of which represent different modelled futures for how much water would be available for floodplain harvesting diversions.

The central case used a 10-year hydrological sequence that reflected median water availability across the historical record between 1896 and 2013. Three additional scenarios are tested as sensitivities to provide an indication of the upper and lower bound impacts that may arise across the five valleys:

1. Inclusion of other water products (i.e. general, high security entitlements and supplementary water)
2. **90th percentile** diversions (to give an upper bound of water availability)
3. **10th percentile** diversions (to give a lower bound of water availability).

The 10th and 90th percentile hydrological sequences are not linked to a scientific projection that incorporates climate variability and change; they simply represent the upper and lower bounds for historical water availability between 1896 and 2013. A more detailed discussion of these scenarios is provided in Appendix A.

1.3. Limitations

Data limitations

- The results are underpinned by historical hydrology data. The impacts of climate variability and change on water availability in the five regions, and the potential for deviations from historical hydrology data may impact the realisation of these forecasts.
- All water in the five regions is assumed to be applied to cotton. Data on agricultural activity in the regions suggest that a very large proportion of agricultural activity is related to cotton farming. However, there may be other uses that are either higher or lower in value than cotton. These uses are not considered in this analysis. Therefore, depending on these uses and their extent, modelling may over or underestimate the true economic impact.

2. Approach to economic analysis

Aither's approach is designed to best estimate how the Policy Intervention will impact the on-farm value of agricultural production across the five regions over the next 10-years.

Aither's approach integrates hydrological modelling provided by DPIE, with regionally specific agricultural irrigation and production data, to estimate the economic effect of the Policy Intervention. Discrete sensitivity analysis of hydrological inputs is presented briefly in Section 3.1.2 and in greater detail within Appendix A.

Table 3 outlines the costs and benefits that were included in the economic analysis and the approach to quantification.

Table 3 Impacts identified for the Policy Intervention

Impact	Type	Quantify	Approach
On-farm agricultural benefits (profits)	Benefit	✓	Floodplain harvesting supports cotton production across the five valleys. Floodplain harvesting access options are expected to change available irrigation water. This will drive changes to the value of irrigated agricultural production. The approach to quantifying the value of cotton production relies on a net margin model drawing on farm budgets. This is discussed in more detail in Box 1 below.
On-farm establishment cost expenditure	Cost	✗	Establishment costs were not considered as it is assumed irrigation supported by floodplain harvesting is all brownfield.
Variable and overhead costs	Cost	✓	Variable and overhead costs are considered in real terms within the net margin model (Box 1).
Policy development and implementation	Cost	✗	The scope of the analysis is limited to estimating changes in the value of agriculture. Given the scope of the analysis, policy development and implementation costs incurred by government are not considered.
Environmental impacts	Benefit	✗	A reduction in floodplain water harvested for irrigation would result in environmental benefits. Environmental impacts are discussed qualitatively in Environmental benefits.

Agricultural production and the value of agricultural production varies year on year depending on water availability and the value of crops produced. Our approach calculates the value of agriculture underpinned by floodplain harvesting using a net margins approach, as described in Box 1 below.

Box 1: Net margins approach

A net margin is defined as the gross income from an enterprise less the establishment, variable and overhead costs incurred in generating this income. Net margins are calculated in the economic model using the following equation:

$$\textbf{Net margin} = \textbf{Gross income} - \textbf{variable costs} - \textbf{overhead costs}$$

Variable costs are operating costs including harvesting, nutrients and weed control costs. Overhead costs are the fixed costs associated with operating the farm and include administrative costs (e.g. accounting and office costs), permanent labour, rates and land taxes, registration and licensing costs and plant and equipment maintenance costs.

Figure 3 shows a conceptual map of the Policy Intervention and the associated physical and economic impacts (costs and benefits).

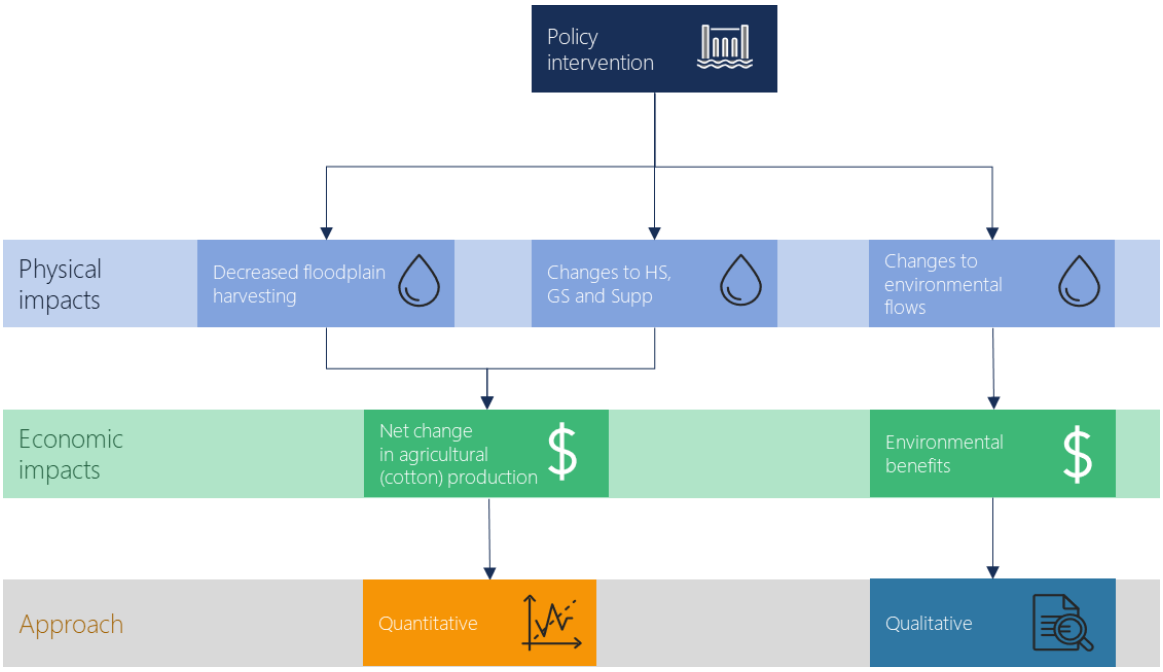

Figure 3 Conceptual methodology model

2.1. Assumptions

The following assumptions were used to develop the model and results, ensuring a practical and fit-for-purpose approach.

General economic parameters

- Inputs are aligned with NSW Treasury guidelines where relevant. For example, NSW Treasury discount rate of 7 per cent is used to calculate the present value of benefits.

- Results are presented as discounted present values over 10 years. The 10-year period, as agreed with DPIE, is a time period where irrigators are assumed to be able to adapt their behaviour to the policy change.
- Results are informed by the timing of the Policy Intervention, and for the purpose of the analysis, the start year for implementation is assumed to be 2022.

Hydrology inputs and assumptions

The historical hydrology data used for the analysis runs from 1896 to 2013. This represents a period of reliable historic data across all valleys[6]. Hydrological data was selected using a 10-year sequence aligned with the median (central case), 10th percentile and 90th percentile (sensitivity analyses) average water availability.

Assumptions that underpin the hydrology and have relevance to the economic results include:

- Any reduction to floodplain harvesting does not result in a like-for-like increase to other forms of water take under the legal limits specified within the relevant water sharing plan. This means that the total available water for extraction does not exceed the legal limits within the relevant water sharing plan.
- Hydrological data represents changes to aggregate floodplain harvesting diversions in ML/annum across each policy option relative to the base case – diversions implicitly reflect water applied to agriculture.
- All losses (i.e. including on-farm) are accounted for in the outputs of the hydrology modelling.
- Potential impacts to available under different entitlement types is not considered under the central case. This is explored as a sensitivity analysis in Appendix A.
- Water available for floodplain harvesting under the Policy Intervention represents the aggregate diversions in ML/year under current flood plain harvesting development conditions with NSW FPH policy implementation.
- The indicative extreme scenario represents zero floodplain harvesting.

Agricultural inputs and assumptions

- Given the valleys in scope and crops produced in these valleys, the model considers the irrigated benefits of cotton production only.
- All agricultural production is assumed to be brownfield cotton (i.e. no establishment costs).
- The model uses regionally specific application rates and yields derived from the NSW DPIE (2020) Regional water value functions.
- Sources for agricultural inputs are outlined in the Appendices.

[6] This analysis uses 10-year sequences from the historical record. To understand the median, 10th and 90th percentile sequences, average volumes are calculated for each 10-year sequence as opposed to the entire historical record. This approach, the time period used, and the expected hydrological outcomes are not comparable to the existing *Rainfall run-off exemption & modelling outcomes* report which reports averages over the entire historical hydrological record.

2.2. Model inputs

2.2.1. General agricultural parameters

Parameter	Value	Unit	Value year	Source(s)
Maximum cotton production area				
Cotton Border Rivers	127,000	ha	2021	Border Rivers Commission (1991)
Cotton Gwydir	154,039	ha	2021	GVIA (2021)
Cotton Namoi	248,889	ha	2021	MDBA (2006)
Cotton Macquarie	126,667	ha	2021	NSW DPIE (2018)
Cotton Barwon-Darling	158,667	ha	2021	NSW DPIE (2018)
Application rates				
Cotton Border Rivers	6.75	ML/ha	2021	NSW DPIE (2020) Regional water value functions
Cotton Gwydir	7.00	ML/ha	2021	NSW DPIE (2020) Regional water value functions
Cotton Namoi	6.88	ML/ha	2021	NSW DPIE (2020) Regional water value functions
Cotton Macquarie	7.75	ML/ha	2021	NSW DPIE (2020) Regional water value functions
Cotton Barwon-Darling	10.5	ML/ha	2021	NSW DPIE (2020) Regional water value functions

2.2.2. Farm budget parameters

Parameter	Value	Unit	Value year	Source(s)
Gross margins – Irrigated annual crops				
Cotton Border Rivers	354	$/ML	2021	NSW DPIE (2020) Regional water value functions
Cotton Gwydir	379	$/ML	2021	NSW DPIE (2020) Regional water value functions
Cotton Namoi	354	$/ML	2021	NSW DPIE (2020) Regional water value functions
Cotton Macquarie	329	$/ML	2021	NSW DPIE (2020) Regional water value functions

Parameter	Value	Unit	Value year	Source(s)
Cotton Barwon-Darling	253	$/ML	2021	NSW DPIE (2020) Regional water value functions
Additional overhead costs – annual crops				
Typical farm overhead costs – including administrative costs (e.g. accounting and office costs), permanent labour, rates and land taxes, registration and licensing costs and plant and equipment maintenance costs.	192	$/ha	2021	Powell. J, Scott, F (2011) A Representative Irrigated Farming System in the Lower Namoi Valley of NSW: An Economic Analysis

3. Results

3.1. Economic value of irrigated agriculture

3.1.1. Quantitative analysis

Under the base case, average water available for floodplain harvesting under the median hydrological sequence equates to 337,686 ML per year across all valleys (noting there are large variations between years). Modelled changes to the average floodplain harvesting extractions per year are shown by region in Table 4.

Table 4 Changes to average floodplain harvesting extractions over the 10-year period (median flows)

	Average FPH extractions (ML / year)		
Region	**Base case**	**Policy intervention**	**Percentage change**
Border Rivers	60,070	57,147	-4.87%
Gwydir	154,290	141,421	-8.34%
Namoi	44,618	41,626	-6.71%
Macquarie	50,468	48,972	-2.97%
Barwon Darling	28,240	25,466	-9.82%

Source DPIE hydrology data

Changes to agricultural benefits in each region arise from implementing extraction limits on floodplain harvesting water available for take and subsequent use as irrigation water. Under the Policy Intervention, the expected reduction in the value of irrigated agricultural production generated by floodplain harvesting ranges between **$19 million and $273 million** (present value over 10 years). The median estimated reduction is approximately **$126 million** (present value over 10 years). This represents a 14 per cent decrease in on-farm agricultural value generated by floodplain harvesting relative to the base case. This would result in a remaining total agricultural benefit of **$747 million** under the Policy Intervention from floodplain harvesting water (present value over 10 years at 7% discount rate) (Figure 4).

Figure 4 Change in agricultural value under the Policy Intervention (central case)

Under the Policy Intervention, the modelled reduction in agricultural benefits predominantly comes from the Gwydir and Border Rivers valleys, representing a reduction of $93 million and $15 million respectively under the median hydrology scenario (present value over 10 years) (Figure 5).

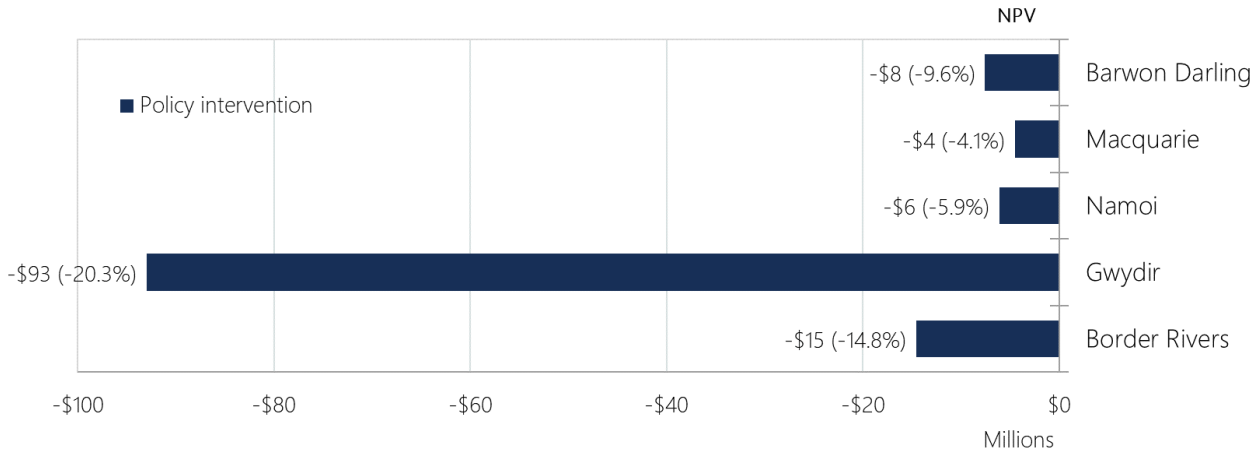

Figure 5 Change in agricultural value under Policy Intervention (central case)

Under the extreme scenario, the expected change in agricultural value from no floodplain harvesting is a reduction of $873 million under the median hydrology scenario (present value over 10 years) (Figure 6). It should be noted that in the extreme case, there will be additional costs associated with business transition. Businesses may no longer be viable, and the human capital and assets would need to be repurposed into other enterprises. While some costs would be considered sunk, there will still be transitional costs and business impacts such that the extreme case estimate of agricultural benefit loss represents a lower end estimate of the impact on irrigation businesses reliant on floodplain

harvesting. The expected loss in agricultural value from no floodplain harvesting may therefore be greater than $873 million.

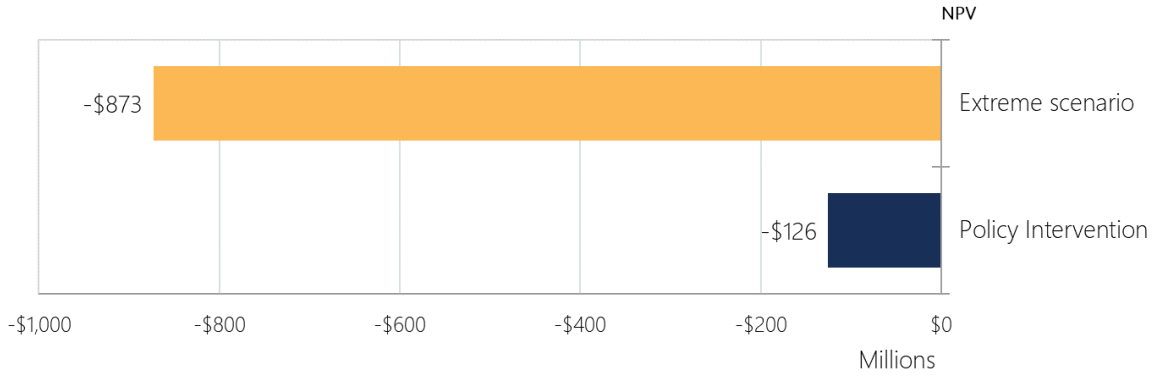

Figure 6 Change in agricultural benefits by scenario (central case)

When changes in total agricultural benefits are separated by region, the Gwydir valley benefits most from the use of floodplain harvesting for agricultural use ($458 million of total present value agricultural benefits over ten years under the median hydrology scenario). This is followed by the Border Rivers ($152 million of total present value agricultural benefits over ten years) (Figure 7).

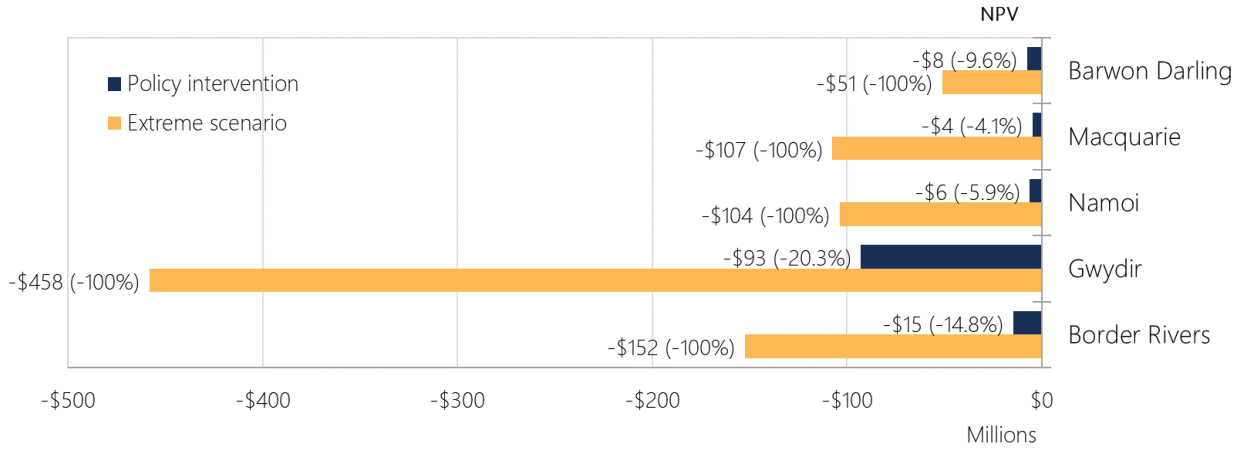

Figure 7 Change in agricultural benefits by region (central case)

3.1.2. Sensitivity analysis

To better understand the hydrological implications of the Policy Intervention, three alternative hydrological scenarios are considered with more detail on these results provided in Appendix A. These scenarios and their results are presented in Figure 8 and discussed briefly below. Scenarios include:

- Inclusion of other water products (i.e. general, high security entitlements and supplementary water)
- Inflows under the 10th percentile sequence
- Inflows under the 90th percentile sequence.

Inclusion of other water products (top-right in Figure 8**):** When the analysis considers impacts on other water products, the decreases to agricultural production under the Policy Intervention are

reduced. This is because some of the decrease in available floodplain harvesting water is offset through increases to other water products (top-right). With these impacts considered, the decrease in agricultural production is reduced from $126 million to $100 million under the median hydrology sequence.

Different hydrological futures (bottom row in Figure 8**):** Generally, when there is higher water availability in the region over the 10-year period, there are greater losses in agricultural production from the Policy Intervention (bottom-right). Conversely, when average inflows and floodplain harvesting water availability is low, the decrease in agricultural value is less (bottom-left). This provides upper and lower bounds for the potential decrease in economic value of the Policy Intervention.

The on-farm economic value of introducing the Policy Intervention varies from approximately -$19 million to -$273 million (present value over 10 years) under a dry and wet hydrological sequence respectively.

The total economic value of floodplain harvesting without the Policy Intervention varies from $524 million to $1,023 million (present value over 10 years) under a dry and wet hydrological sequence respectively. The on-farm economic value of floodplain harvesting is therefore highly correlated with water availability.

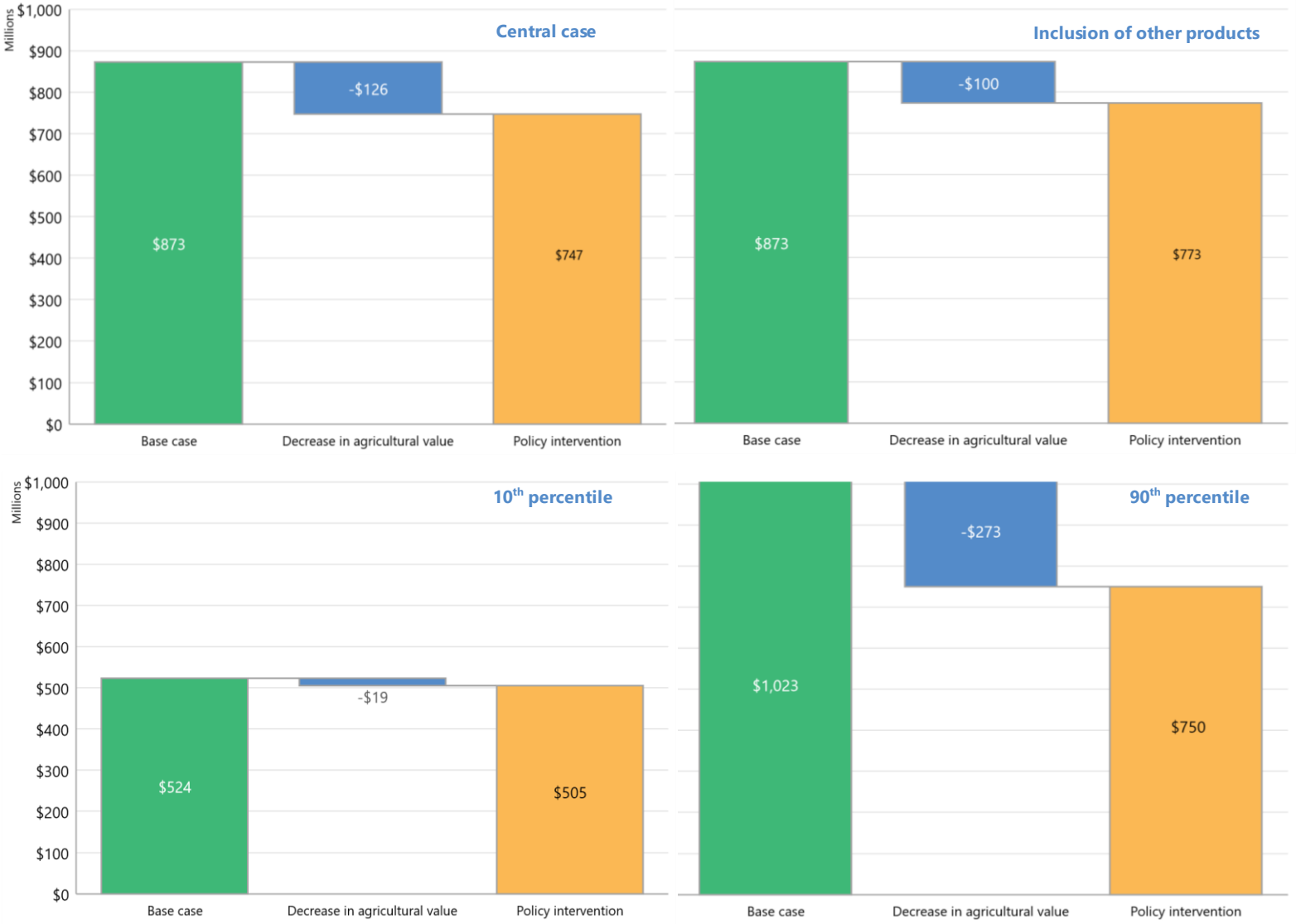

Figure 8 Changes in agricultural production under different hydrology scenarios

3.2. Flow-on economic impacts

In addition to the on-farm impacts (profits), DPIE have estimated the value-added impact of the intervention using REMPLAN[7]. Detailed results, assumptions and limitations are presented in Appendix D.

In summary, DPIE's analysis estimate that additional annual average direct and flow-on impacts of introducing the Policy Intervention relative to the base case for each region under the median hydrology scenario are:

- Barwon Darling (- $0.14 million and 3 less jobs per annum)
- Macquarie (-$0.18 million and 1 less job per annum)
- Namoi (-$0.30 million and 3 less jobs per annum)
- Gwydir (-$4.98 million and 41 less jobs per annum)
- Border Rivers (-$1.5 million and 7 less jobs per annum)[8].

3.3. Environmental benefits

3.3.1. Qualitative analysis

Hydrological and environmental impacts of the Policy Intervention

DPIE has published reports estimating the expected environmental outcomes of implementing the NSW Floodplain Harvesting Policy to inform public consultation on rules for floodplain harvesting licences in water sharing plans. Reports are available for the NSW Border Rivers, Gwydir valley and Macquarie valleys. DPIE will publish environmental outcomes reports for the Barwon-Darling and Namoi valleys as part of public consultation for floodplain harvesting licence rules for those valleys. The environmental outcomes are dependent on future climatic conditions and inflows. The DPIE reports, summarised below, assess outcomes based on median environmental floodplain inflows.

A range of ecologically relevant hydrological metrics, including flood magnitude (volume and flow rate), frequency of events, timing, and duration were modelled. The outcomes of reducing floodplain harvesting to legal limits vary with location on the floodplain; however, in general, mean annual volume, seasonal volumes, duration of days with flow, and frequency of events are predicted to increase, and inter-event periods are predicted to reduce. The largest environmental outcomes are expected in the Gwydir valley, followed by the NSW Border Rivers valley. Only minor changes are expected in the Macquarie valley, primarily at one location near the Wilgara Ramsar site (NSW DPIE; 2021).

DPIE estimates that the NSW Border Rivers and Gwydir valleys will receive an additional 15.5 GL (+18 per cent) and 58.5 GL (+13 per cent) in mean annual flood volumes across the floodplain in years when floods occur. Only limited improvements are expected in the Macquarie valley, with an

[7] https://www.remplan.com.au/

[8] Impacts include direct and flow on impacts in employment, output, wage and salaries and gross regional product.

approximately 4 GL/year improvement (0.2 per cent increase) for mean annual flood volumes across the floodplain in years when floods occur (NSW DPIE; 2021).

The Gwydir/Gingham breakout zone, which supports the internationally important Gwydir Wetlands, is expected to receive the greatest outcomes. NSW DPIE modelling suggests that the environmental water requirements of native vegetation, native fish and waterbirds in this zone would be met more often, by an average of 82 per cent, 97 per cent and 142 per cent respectively. Better outcomes for the Gwydir Wetlands would provide greater resilience for the diverse habitats and species it supports in the Gwydir Valley and the Northern Murray-Darling Basin more broadly. These outcomes are further broken down across the other zones and across key hydrological and environmental outcomes in Table 5 (NSW DPIE; 2021).

In the Border Rivers, most environmental water requirements are predicted to be achieved more frequently under the policy. In addition, the predicted improvements to floodplain hydrology (volumes, durations and timing of floods) suggest that environmental outcomes for the Border Rivers will be primarily beneficial with some negative outcomes at a few breakout zones. (NSW DPIE; 2021).

In the Macquarie valley, implementation of the policy is predicted to result in very little change to the environmental outcomes for key assets and values; very little change in floodplain hydrology (that is volumes, durations and timing of floods); some improvements in hydrological and environmental outcomes at two of the 10 breakout zones with little to no change in the other eight zones.

Publicly available reports outlining the environmental outcomes of implementing the NSW Floodplain Harvesting Policy in the Namoi and Barwon-Darling valleys are not yet available. However, these two regions represent relatively low change in agricultural benefits. In summary, most of the unquantified environmental benefits are expected to occur in the Gwydir valley which explains the higher economic impact of the policy in the Gwydir Valley.

Table 5 Percentage change in key hydrological metrics and the achievement of environmental water requirements after implementing the policy in the NSW Border Rivers, Gwydir and Macquarie valleys

Category	Metric or asset	NSW Border Rivers	Gwydir	Macquarie
Hydrological	Mean of annual volume	18% (15.5 GL)	13% (58.5 GL)	0.2% (4 GL)
Hydrological	Days with flow (total)	30%	13%	1%
Hydrological	Number of flood events	16%	20%	5%
Environmental	Waterbirds	24%	56%	9%
Environmental	Native vegetation	46%	32%	4%
Environmental	Native fish	16%	19%	0%

Note Values represent the average change across multiple floodplain breakout zones in each valley

Source State of New South Wales through Department of Planning, Industry and Environment 2021. The information contained in this publication is based on knowledge and understanding at the time of writing (April 2021).

References

ABARES, 2019. Cotton Farms in the Murray Darling Basin. <https://www.agriculture.gov.au/abares/research-topics/surveys/irrigation/cotton>

ABS, 2021. 6401.0 Consumer Price Index, Australia. <https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/consumer-price-index-australia/latest-release>

CSIRO, 2013. Irrigation costs and benefits. A technical report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment, part of the North Queensland Irrigated Agriculture Strategy. <https://publications.csiro.au/rpr/download?pid=csiro:EP1312979&dsid=DS5>

DPI-Water, 2017. Macquarie-Castlereagh Water Resource Plan, Surface water resource description. Department of Primary Industries-Water. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0009/145395/Macq-Castlereagh.pdf>

DPI-Water, 2018. Barwon-Darling Water Resource Plan, Surface water resource description. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0010/152938/Barwon-Darling.pdf>

GVIA, 2021. Industry profiles: Cotton, Gwydir Valley Irrigators Association. <https://www.gvia.org.au/the-gwydir-valley/industry-profiles/cotton/>

MDBA, 2019. Climate change and the Murray-Darling Basin Plan. MDBA Discussion Paper. < https://www.mdba.gov.au/sites/default/files/pubs/Climate-change-discussion-paper-Feb-19.pdf>

MDBA, 2021. Namoi community profile, Murray Darling Basin Authority. <https://www.mdba.gov.au/sites/default/files/archived/guide_pbp/AppendixC_Namoi_community_profile.pdf>

NSW DPI, 2018. Cotton gross margin budgets, Department of Primary Industries. <https://www.dpi.nsw.gov.au/agriculture/budgets/cotton>

NSW Government, 2021. Environmental outcomes of implementing the Floodplain Harvesting policy in the Gwydir Valley. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0012/350202/environmental-outcomes.pdf>

NSW Government, 2021. Environmental outcomes of implementing the Floodplain Harvesting Policy in the Macquarie Valley. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0007/355930/environmental-outcomes-of-implementing-the-fph-policy-in-the-macquarie.pdf>

NSW Government, 2021. *Environmental outcomes of implementing the Floodplain Harvesting Policy in the Border Rivers Valley*. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0003/326091/environmental-outcomes-report.pdf>

NSW Government, 2021. Summary of predicted environmental outcomes of implementing the NSW Floodplain Harvesting Policy. <https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/368140/summary-of-predicted-environmental-outcomes.pdf>

NSW Treasury, 2021. NSW Treasury discount rate. <https://www.treasury.nsw.gov.au/finance-resource/guidelines-cost-benefit-analysis>

Powell. J, Scott, F., 2011. A Representative Irrigated Farming System in the Lower Namoi Valley of NSW: An Economic Analysis. <https://ageconsearch.umn.edu/record/280788/files/ERR46.pdf>

Appendices

Appendix A – Sensitivity analysis

Impact on other water products

The impacts of reducing floodplain harvesting take on other water including general and high security entitlements and supplementary water is modelled for the median hydrology sequence[9]. From a hydrological perspective, whilst there is some variation depending on the specific year, in most instances, reducing flood plain harvesting under the Policy Intervention increases the volume of water available to other water products. For the base case and Policy Intervention, these effects were modelled and captured directly in DPIE's hydrology data. However, impacts under the extreme scenario were not captured by the hydrology modelling. Results presented below are therefore limited to the base case and Policy Intervention.

These results do not consider the distributional impacts of these changes, only the aggregate changes in water available for irrigation. This essentially means that the cotton farmer who may use floodplain harvesting water may not be the same cotton farmer who benefits from increased general, supplementary or high security entitlements. From a regional economic perspective, this makes no difference to the results. As under the central case, all water available for irrigation is assumed to be applied to cotton. Under this scenario, the impacts to agricultural value are reduced from -$126 million under the central case to -$100 million once increases in other products are accounted for (Figure 9).

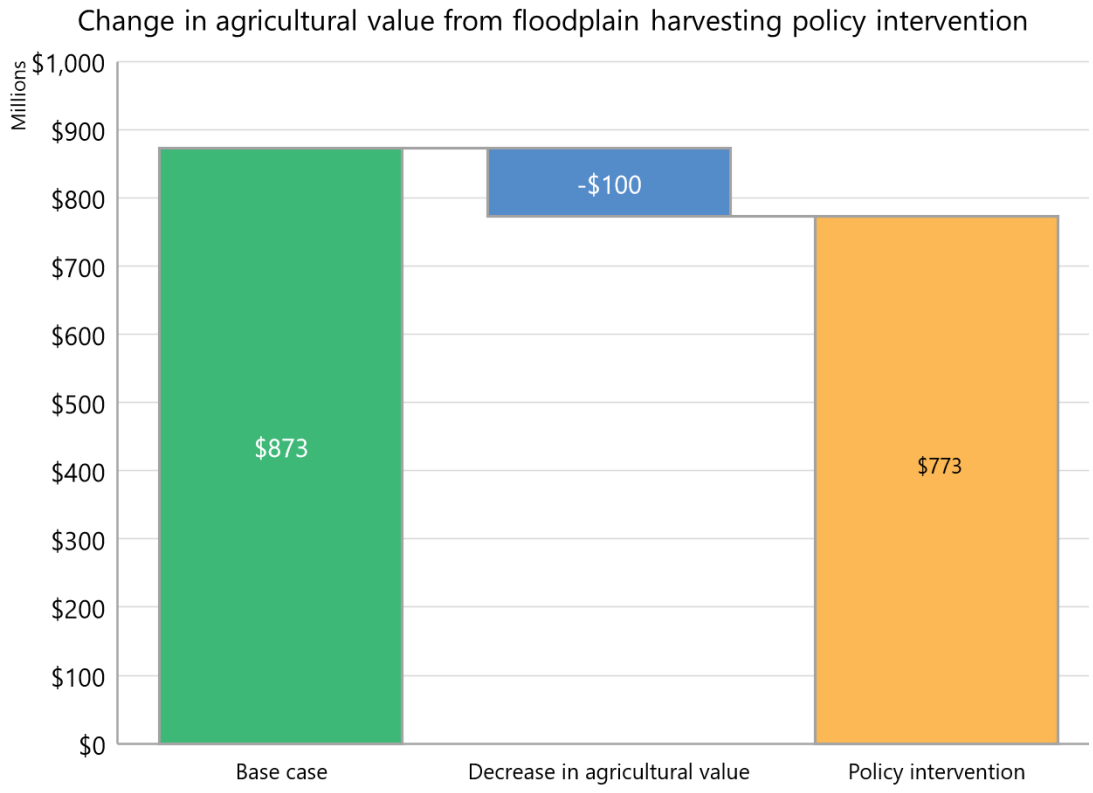

Figure 9 Change in agricultural value under the Policy Intervention (with impacts on other products)

[9] Changes to total metered diversions water in the case of the Barwon-Darling.

10th percentile hydrology sequence (dry future scenario)

Under the base case, average water available for floodplain harvesting under the 10th percentile hydrological sequence equates to 206,126 ML per year across all valleys (noting there are large variations between years). Modelled changes to the average floodplain harvesting extractions per year are shown by region in Table 6.

Table 6 Changes to average floodplain harvesting extractions over the 10-year period (10th percentile hydrological sequence)

	Average FPH extractions (ML / year)		
Region	**Base case**	**Policy intervention**	**Percentage change**
Border Rivers	25,460	25,450	-0.04%
Gwydir	105,680	101,517	-3.94%
Namoi	18,929	18,978	0.26%
Macquarie	41,935	40,543	-3.32%
Barwon Darling	14,123	12,295	-12.95%

Source DPIE hydrology data

Using the 10th percentile hydrological sequence, there is a substantial decrease in the loss of agricultural benefits when compared to the median water availability case (central case). The modelled reduction from the Policy Intervention is $19 million (compared to $126 million under the central case) as shown in Figure 10 below. This represents an approximate 3.5 per cent decrease in on-farm agricultural value. The distribution of this change across the regions is outlined in Figure 11.

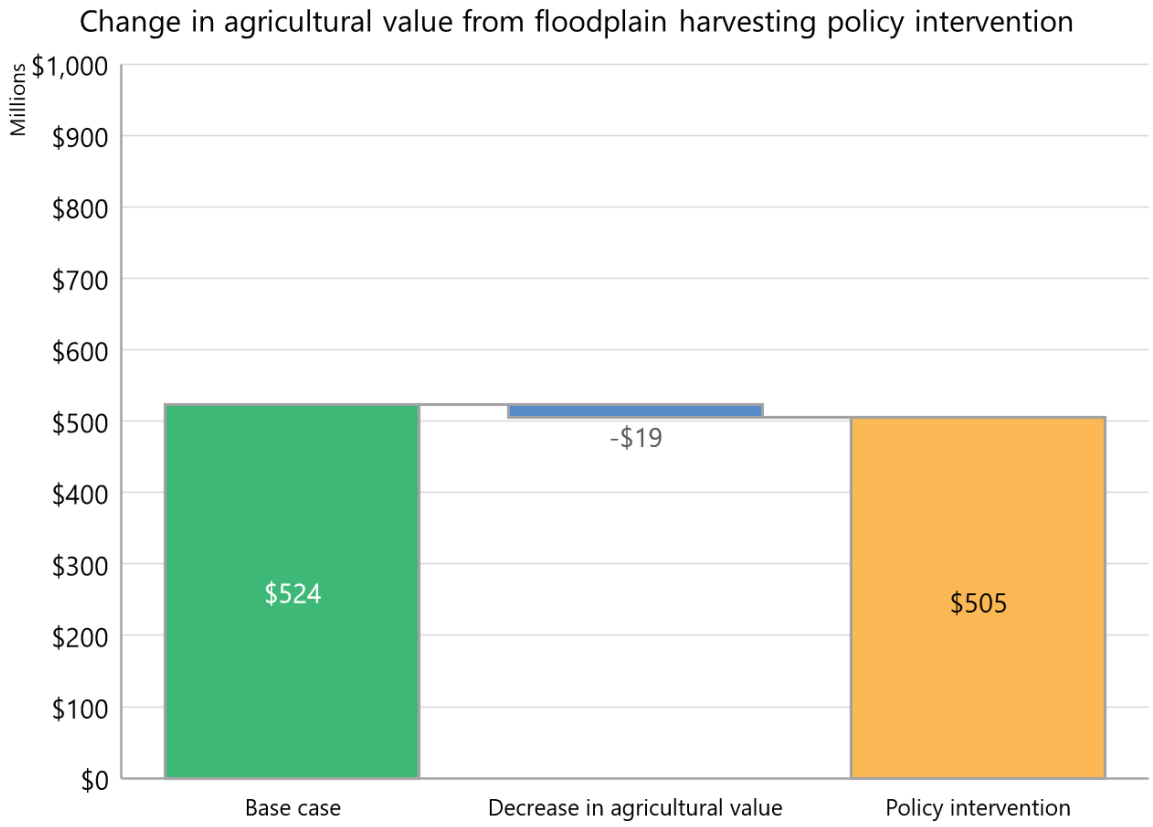

Figure 10 Change in agricultural value from proposed policy change (10th percentile hydrology sequence)

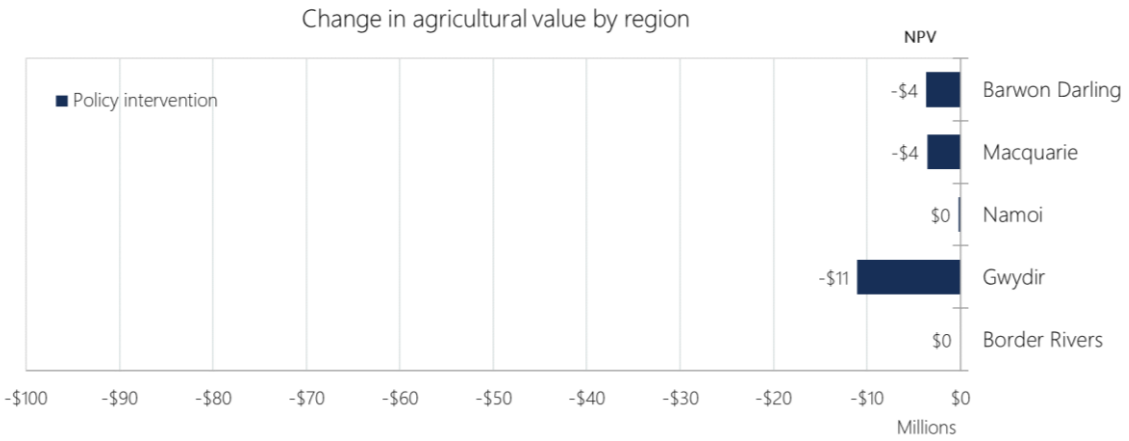

Figure 11 Change in agricultural benefits by region (10th percentile hydrology sequence)

90th percentile hydrology sequence (wet future scenario)

Under the base case, average water available for floodplain harvesting under the 90th percentile hydrological sequence equates to 463,249 ML per year across all valleys (noting there are large variations between years). Modelled changes to the average floodplain harvesting extractions per year are shown by region in Table 7.

Table 7 Changes to average floodplain harvesting extractions over the 10-year period (90th percentile hydrological sequence)

	Average FPH extractions (ML / year)		
Region	**Base case**	**Policy intervention**	**Percentage change**
Border Rivers	72,683	64,726	-10.95%
Gwydir	276,219	176,047	-36.27%
Namoi	49,857	47,606	-4.51%
Macquarie	40,551	39,188	-3.36%
Barwon Darling	23,941	19,327	-19.27%

Source DPIE hydrology data

Using the 90th percentile hydrological sequence, there is a substantial increase in the modelled loss of agricultural benefits when compared to the median water availability case (central case). The modelled reduction from the Policy Intervention is $273 million (compared to $126 million under the central case) as shown in Figure 12 below. This represents an approximate 27 per cent decrease in on-farm agricultural value. The distribution of this change across the regions is outlined in Figure 13.

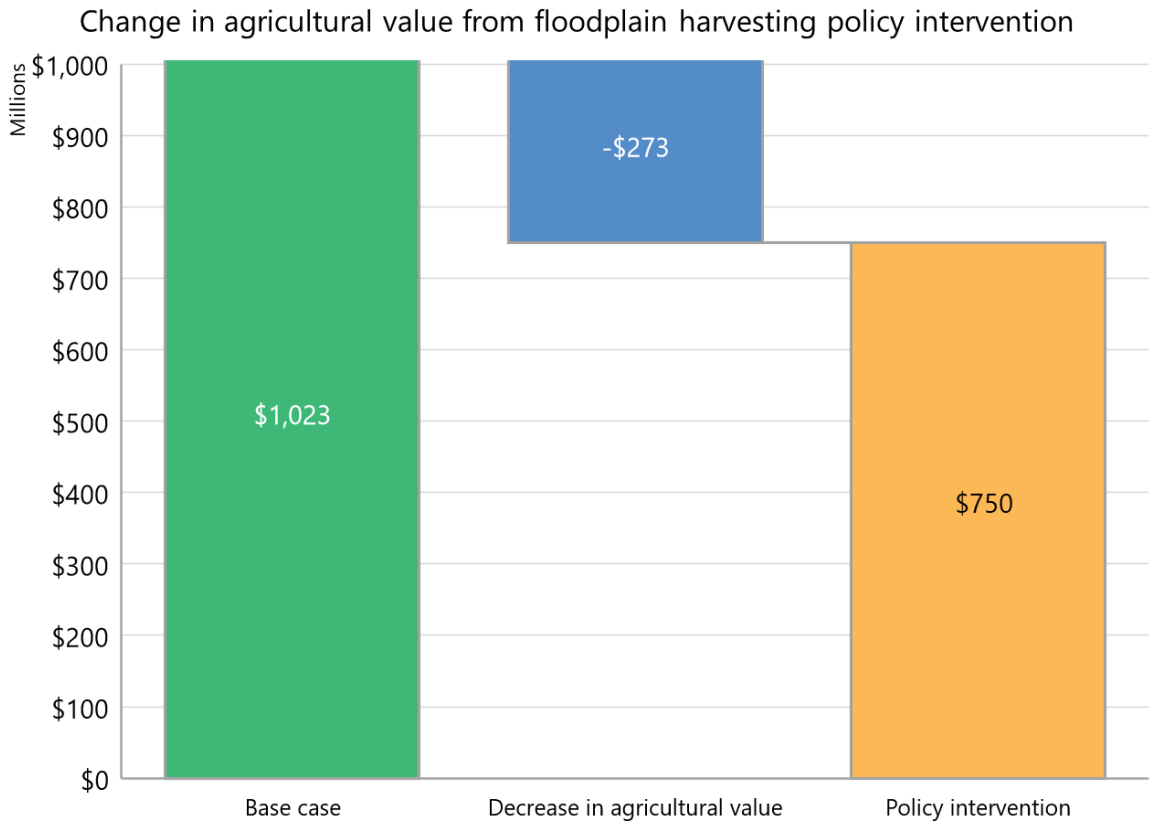

Figure 12 Change in agricultural value from proposed policy change (90th percentile hydrology sequence)

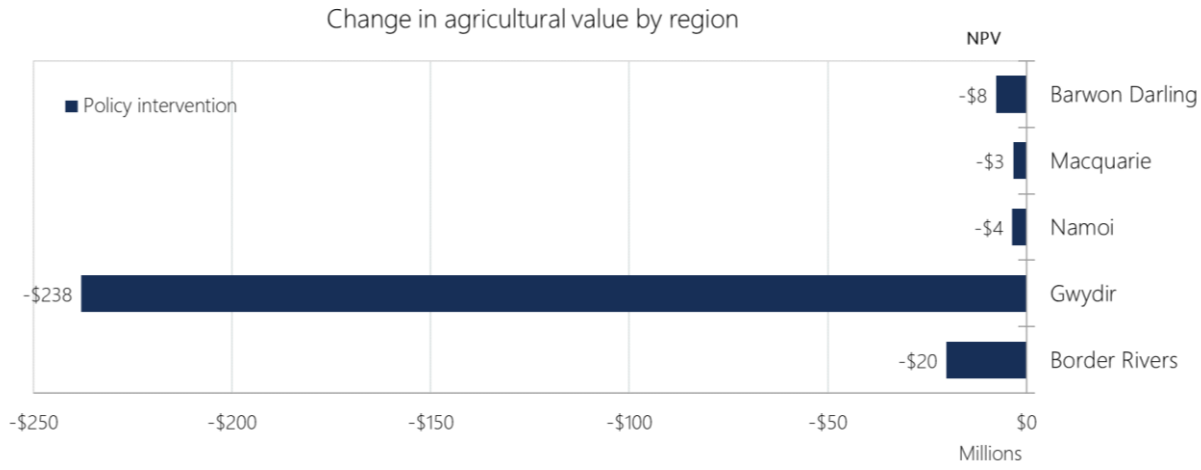

Figure 13 Change in agricultural benefits by region (90th percentile hydrology sequence)

Appendix B – General CBA parameters

Parameter	Value	Unit	Value year	Source
Global parameters				
Appraisal period	10	years	2021	Project team

Parameter	Value	Unit	Value year	Source
Price year	2021	year	2021	Project team
Policy Implementation year	2022	year	2021	Project team
Policy first year of benefits	2022	year	2021	Project team
Policy last year of benefits	2031	year	2021	Project team
Discount factors				
Discount rate	7	Per cent	2021	NSW treasury

Appendix C – General hydrology parameters

Parameter	Start year	End year	Unit	Source(s)
Central case (median) hydrology sequence	1990	1999	Year	DPIE 'Water Supply' sheet - median water supply hydrology
90th percentile hydrology sequence	1996	2005	Year	DPIE 'Water Supply' sheet – P90 water supply hydrology
10th percentile hydrology sequence	1923	1932	Year	DPIE 'Water Supply' sheet – P10 water supply hydrology

Appendix D – Modelling the impact of the change in agriculture benefits from the floodplain harvesting intervention

Overview

To provide an estimate of the economic impact of the floodplain harvesting intervention on the impacted regions, DPIE have estimated the value-added impact of the intervention using REMPLAN[10]. DPIE have modelled the likely direct and flow-on implications for the Regional Water Strategies (RWS) regions of this intervention. DPIE have used the agricultural sector for the shock to the value of the estimated intervention by Aither. The economic impacts are presented in terms of employment, output, wage and salaries and gross regional product across the top six most impacted sectors. To do this, DPIE have used the following assumptions:

- Impacts are annual average impacts, calculated by dividing the 10-year present value estimate (Aither calculations in Section 3.1) by 10 years. E.g. Gwydir -= $93m / 10 years = $9.3m per annum
- For the Barwon Darling: the Central Darling dataset was used as a proxy
- For the Macquarie: Bathurst Regional was used as a proxy
- For the Namoi: Tamworth was used as a proxy
- For the Gwydir: Moree Plains was used as a proxy
- For the Borders Rivers: the entire RWS area was used
- The analysis is based on the 6 most impacted sectors – all values are in $ millions
- Consumption multipliers were excluded as these overstate impacts significantly.

The results should be considered in the context of these assumptions and the limitations outlined in the limitations section below.

Results

	Impact Summary	Direct Impact	Supply Chain
	Barwon Darling ($m)		
1	Agriculture, Forestry & Fishing	-0.8	-0.08
2	Wholesale Trade		-0.01
3	Construction		-0.01
4	Administrative & Support Services		-0.01
5	Electricity, Gas, Water & Waste Services		-0.01
6	Professional, Scientific & Technical Services		0.00
	Total	**-0.8**	**-0.14**
	Macquarie ($m)		
1	Agriculture, Forestry & Fishing	-0.4	-0.06
2	Construction		-0.02
3	Manufacturing		-0.02
4	Professional, Scientific & Technical Services		-0.02
5	Transport, Postal & Warehousing		-0.01

[10] https://www.remplan.com.au/

6	Financial & Insurance Services		-0.01
	Total	**-0.4**	**-0.18**
	Namoi ($m)		
1	Agriculture, Forestry & Fishing	-0.6	-0.07
2	Construction		-0.03
3	Manufacturing		-0.03
4	Professional, Scientific & Technical Services		-0.02
5	Wholesale Trade		-0.02
6	Financial & Insurance Services		-0.02
	Total	**-0.6**	**-0.30**
	Gwydir ($m)		
1	Agriculture, Forestry & Fishing	-9.3	-1.78
2	Construction		-0.46
3	Professional, Scientific & Technical Services		-0.40
4	Transport, Postal & Warehousing		-0.38
5	Wholesale Trade		-0.36
6	Manufacturing		-0.35
	Total	**-9.3**	**-4.98**
	Border Rivers ($m)		
1	Agriculture, Forestry & Fishing	-1.5	-0.27
2	Construction		-0.08
3	Manufacturing		-0.07
4	Professional, Scientific & Technical Services		-0.05
5	Wholesale Trade		-0.04
6	Electricity, Gas, Water & Waste Services		-0.04
	Total	**-1.5**	**-0.75**

Barwon Darling

Impact Summary		**Direct Effect (m)**	**Supply Chain Effect (m)**	**Total Effect (m)**
$0.8 million decrease	Output ($m)	-$0.80	-$0.14	-$0.94
	Employment (Jobs)	- 3.00	-	- 3.00
	Wages and salaries ($m)	-$0.06	-$0.03	-$0.09
	Value-added ($m)	-$0.35	-$0.06	-$0.41

Macquarie

Impact Summary		**Direct Effect (m)**	**Supply Chain Effect (m)**	**Total Effect (m)**
$0.4 million decrease	Output ($m)	-$0.40	-$0.18	-$0.58

	Employment (Jobs)	- 1.00	-	- 1.00
	Wages and salaries ($m)	-$0.04	-$0.04	-$0.08
	Value-added ($m)	-$0.18	-$0.08	-$0.26

Namoi

Impact Summary		**Direct Effect (m)**	**Supply Chain Effect (m)**	**Total Effect (m)**
$0.6 million decrease	Output ($m)	-$0.60	-$0.30	-$0.90
	Employment (Jobs)	- 2.00	- 1.00	- 3.00
	Wages and salaries ($m)	-$0.05	-$0.06	-$0.11
	Value-added ($m)	-$0.28	-$0.13	-$0.41

Gwydir

Impact Summary		**Direct Effect (m)**	**Supply Chain Effect (m)**	**Total Effect (m)**
$9.3 million decrease	Output ($m)	-$9.30	-$4.98	-$14.28
	Employment (Jobs)	- 28.00	- 13.00	- 41.00
	Wages and salaries ($m)	-$0.84	-$0.97	-$1.81
	Value-added ($m)	-$4.03	-$2.23	-$6.26

Border Rivers

Impact Summary		**Direct Effect (m)**	**Supply Chain Effect (m)**	**Total Effect (m)**
$1.5 million decrease	Output ($m)	-$1.50	-$0.75	-$2.25
	Employment (Jobs)	- 5.00	- 2.00	- 7.00

	Wages and salaries ($m)	-$0.12	-$0.15	-$0.27
	Value-added ($m)	-$0.67	-$0.33	-$0.99

Limitations

Aither did not review or have input to the REMPLAN analysis.

While DPIE has used REMPLAN to provide an estimate of the intervention impact, we note that REMPLAN is an Input Output model and has several limitations. These include the potential for:

- **Overstating impacts:** Multipliers assume that resources required for the project such as labour and capital are unlimited and will not be drawn from other activities and sectors of the economy, thereby overstating the economic and employment benefits of the project.
- **Fixed prices:** As resources are considered to be unlimited, multipliers assume that their price is unaffected by changes in demand. Any unintended consequences of a project, such as the crowding out of other activity or price increases for scarce resources, are not captured.
- **Fixed coefficients:** Multipliers assume a fixed input structure in each industry and fixed rations for production. This would imply, for example, that additional consumer expenditure from increased income would be allocated to average consumption patterns and, as such, would assume increased consumption of household necessities, such as food (rather than holidays or savings).
- **Regional distortions:** Multipliers that have been calculated from national IO tables are not considered appropriate for use analysing the impacts of projects in small regions. Interindustry linkages tend to be shallow in small regions since they usually don't have the capacity to produce the wide range of goods used for inputs and consumption, instead importing a large proportion of these goods from other regions.

Nevertheless, DPIE considers REMPLAN to provide a reasonable estimate of the value-added impact of the intervention.

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