A review of socio-economic neutrality in the context of Murray-Darling Basin Plan implementation

A Final Report prepared for the New South Wales Department of Primary Industries – Water

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AITHER

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The *Water Act 2007* ('the Act') provides for the recovery of an additional 450 gigalitres (GL) of water ('upwater') within the Murray-Darling Basin by 2024, above and beyond the 2750 GL of water to be recovered by 2019 under the Murray-Darling Basin Plan ('the Basin Plan'). This water is intended to be recovered through on-farm water efficiency measures, and, unlike the 2750 GL, can only be recovered if the impacts of recovery are socio-economically neutral.

The Basin Plan sets a higher bar or threshold in relation to socio-economic impacts for the 450 GL of 'upwater' as compared with other elements of water recovery.

This provision for 'socio-economic neutrality' has prompted significant debate in recent times, due in part to its characterisation. Under the Basin Plan provisions, on-farm efficiency measures are considered to have positive or neutral impacts where water users voluntarily participate in an on-farm efficiency program or where Basin States assess that neutrality can be achieved through alternative arrangements.

In principle, this provision for socio-economic neutrality in the Act and the Basin Plan (i.e. individual participation equals socio-economic neutrality) is inconsistent with accepted definitions of socio-economic impacts, which state that these impacts are not only felt directly, but also indirectly through flow-on effects on other individuals and groups. The provision is also inconsistent with Commonwealth guidelines on socio-economic impact assessment (see, for example, Bureau of Rural Services, 2005), and does not meet the overarching intent of the Basin Plan to consider the socio-economic impacts of 'upwater' programs.

Specifically, the Basin Plan provisions do not account for:

1. impacts on people who are not directly participating in the program
2. impacts that are a result of the cumulative or aggregate implementation of entire programs
3. the distribution of impacts across stakeholders.

The current provision in the Basin Plan, that voluntary individual participation equals neutrality, does not meet the overarching intent of the Basin Plan to consider the socio-economic impacts of 'upwater' programs.

Socio-economic impacts of water recovery

Figure 1 provides a conceptual framework outlining the potential socio-economic impacts related to water recovery and highlights that impacts are likely to be distributed across multiple groups. The distribution of socio-economic impacts will rarely be even, with some groups usually being impacted more than others, either positively or negatively.

Group	Description of impacts
General public	• Government funding of water recovery projects at expense of funding for other social, environmental, and economic policy priorities • Nation-wide outcomes and impacts from efficiency measures on the general public, including economic, environmental and social impacts from environmental water
Individual participants	• Reduced water entitlement • Grant funding and other capital cost contributions • Impacts on operating costs (including labour and energy) • Impacts on water demand • Changes to risk profile • Impacts on land value • Impacts on productivity
Program delivery partners	• Impacts on demand for water use efficiency services and equipment • Employment for suppliers of water use efficiency equipment and services, program managers and staff
Water market participants	• Cumulative changes in water demand from participants result in potential water allocation and entitlement market impacts • These have financial impacts on other market participants, both positive and negative
Irrigation infrastructure operators	• Changes in distribution of water use may have an impact on revenue and cost base • Could be a need to increase prices for remaining water users
Industry	• Direct production impacts from recipients • Indirect production impacts from other water market participants • Financial impacts on upstream suppliers • Financial impacts on producers / processors / distributors • Impacts on employment by industry
Regional communities	• Cumulative employment and financial impacts could affect community services, housing prices, wages, and local economic activity

Note: Developed by Aither; this is a typology only and does not include all possible links and impacts of water recovery.

Figure 1 A conceptual framework of the socio-economic impacts of water recovery

The framework aligns with several previous studies that show that individual program participants are not the only groups that may be affected by a water recovery or water efficiency program. Typically, there can be flow-on effects on irrigators and irrigation infrastructure operators (IIO) as a result of cumulative or aggregate changes in irrigation water demand and water use. These can be positive or negative, and there may be socio-economic benefits to water users associated with water recovery and environmental water use.

Across multiple irrigation districts, stakeholders consulted in the preparation of this report asserted that water recovery has contributed to (positive and negative) material indirect impacts on community members other than those directly participating in water efficiency programs. These impacts were reported as being, in part, a result of the upward pressure of water recovery on water allocation prices and the recovery of fixed costs of water services provided by IIOs from a smaller base of total water use.

Stakeholders suggested that there is now less opportunity for additional cost-effective investment (i.e. the most cost-effective opportunities have been exhausted), and that individuals, irrigation districts, industries and communities now have reduced capacity to absorb further change, in the immediate future, without adverse impacts.

Water market effects

There is potential for efficiency programs like the Commonwealth On-Farm Further Irrigation Efficiency program (COFFIE) to have an impact on irrigators across the southern Murray-Darling Basin as a result of water market effects. Several recent reports point to the potential for such programs to have other impacts on water allocation market prices, although there is currently a lack of

empirical evidence on the demand responses and cumulative effects. Stakeholders consulted for this project have suggested to Aither that program participants often:

- maintain or increase their overall water requirement after investing in efficiency works
- have a higher willingness to pay for water in the allocation market as a result of the infrastructure that has been installed.

Murray Irrigation has provided evidence that recipients of on-farm water use efficiency grants are more likely to increase their reliance on water allocation markets, compared with other customers. One irrigator consulted for this study increased demand for water allocations on the temporary market by over 1,000 megalitres (ML) per annum, following participation in an on-farm efficiency program.

Some water market effects are likely to be unavoidable, and there will be positive impacts for some people. Program participants have also reported that they are individually better off. The concern is that increased demand and willingness to pay makes irrigation unviable in more years for some irrigation enterprises that are highly sensitive to allocation prices (e.g. rice growers, cotton growers, dairy farmers, fodder producers, etc.). This effect may apply to a greater extent on smaller family farms (which are mainly located within irrigation districts)..

IIO effects

Stakeholders have also stated that on-farm water use efficiency programs can impact the commercial viability of IIOs. Despite the fact that some irrigators will increase their demand and use following an on-farm investment, overall water use must decrease across all irrigators given the transfer of water to the environment. By reducing the total volume of water across which IIOs are able to spread the costs of water service provision, there is potential for increases in charges levied to irrigators or a reduction in IIO expenditure, including on labour. The precise effects will vary due to the differing structures of IIO charges and ability to reduce costs in response to reduced volumes being distributed.

Flow-on effects to irrigation industries and communities

These impacts on irrigators and IIOs can flow through to regional irrigated agricultural production, which can further affect irrigation dependent industries, local businesses and communities. For this reason, socio-economic effects need to be considered at the cumulative or aggregate level. Although a single irrigation efficiency measure implemented on a single farm may not have significant negative or positive impacts on a wider regional community, the cumulative impacts from multiple participants or programs may be highly significant.

> ***In principle, there is potential for adverse socio-economic impacts associated with 'upwater' due to flow-on effects associated with cumulative changes in water demand and use.***

Overall, based on a qualitative assessment, there are grounds to suggest that on-farm efficiency measures, including those likely to take place under COFFIE, could have material socio-economic impacts on individuals other than program participants. These impacts are likely to be a result of cumulative or aggregate changes in irrigation water demand and water use and should be considered in implementing the underlying intent of the Basin Plan.

A suggested approach to defining socio-economic neutrality

Aither proposes a definition for socio-economic neutrality that accounts for a broad range of potential costs and benefits and can be applied at scales appropriate to the objectives and intent of the Basin Plan. The definition accounts for individual program participation, broader impacts on irrigators and irrigation infrastructure operators, cumulative and distributional impacts across communities, and the

potential for targeted compensation to offset negative outcomes without eliminating the efficiency benefits of the program as a whole.

The starting point for the proposed definition is a Cost Benefit Analysis test aimed at meeting the objective of the Basin Plan to optimise social, economic and environmental outcomes arising from the use of Basin water resources in the national interest. However, the lack of regard for distributional effects in a standard Cost Benefit Analysis conducted at the national scale does not meet the overarching intent of the Basin Plan to consider the distributional socio-economic impacts of 'upwater' programs.

To address these distributional effects, the definition requires testing of whether there are any IIOs, irrigation industries, regional groups of irrigators (market participants) or local communities that are materially adversely affected. If these impacts are material then the tests should be rerun with consideration of the efficiency, effectiveness and equity implications of potential compensation packages. Aither's definition is summarised in the decision tree diagram in Figure 2.

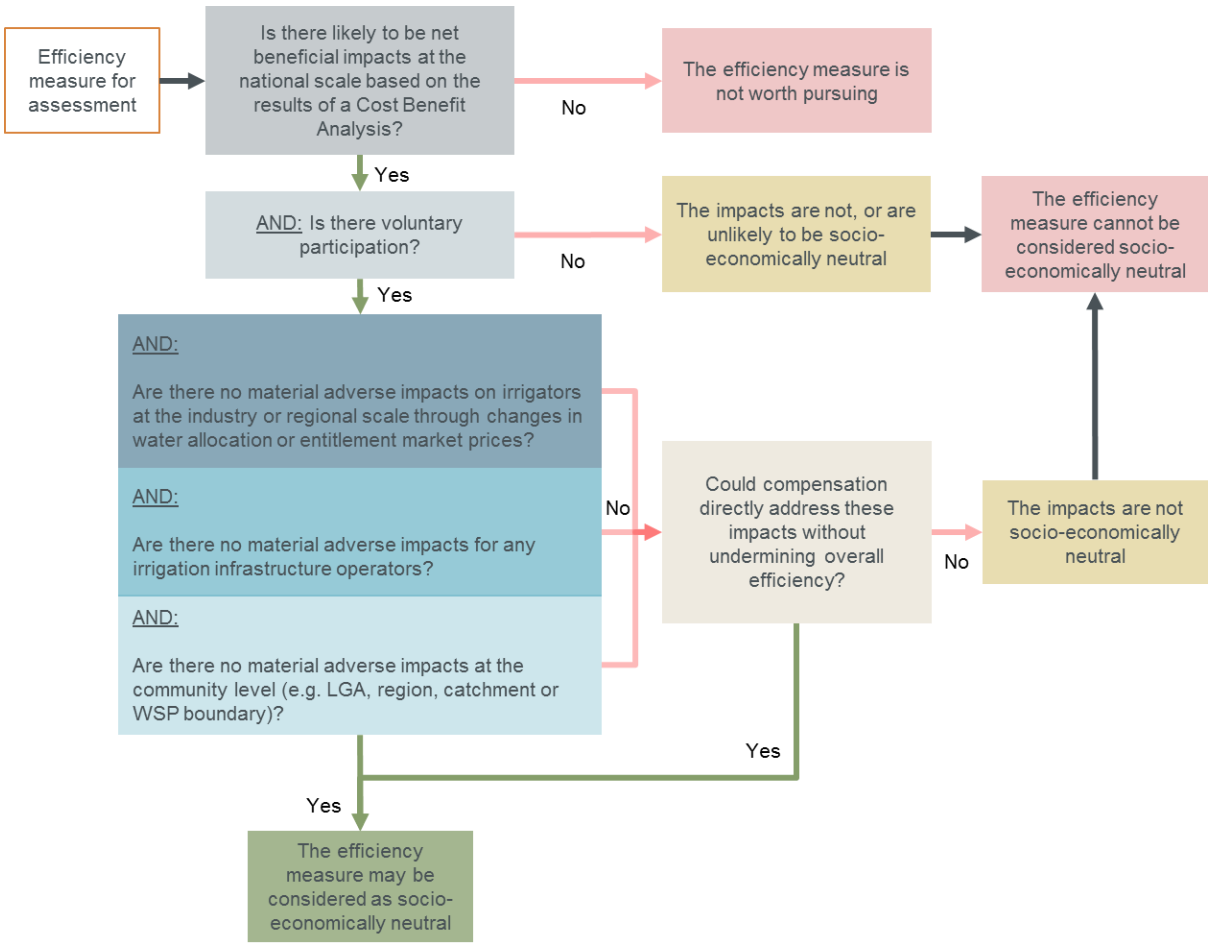

Figure 2 Decision tree outlining the elements of a proposed definition of socio-economic neutrality

In relation to overall economic efficiency, it is noted that the current COFFIE program proposes to pay entitlement holders 1.75 times current market value for entitlements. At current market prices of approximately $3000 per ML of high security entitlement in the southern Murray-Darling Basin (and higher in New South Wales), this implies an indicative total cost of $2.4 billion to achieve the full 450 GL of 'upwater' recovery, without any provision for potential compensation.

Recommendations

1. The New South Wales Government should advocate for an independent Cost Benefit Analysis of the efficiency measures program. If the overall program does not pass this more easily implemented test, then it should not be considered socio-economically neutral at an aggregate level.[1]

2. If the efficiency measures program proceeds on the basis of the Cost Benefit Analysis, the New South Wales Government should advocate for a revised Basin-wide definition and cooperative approach to assessing socio-economic neutrality given the potential for efficiency measures to have flow-on impacts across the Basin.

    a. The definition should be based on that proposed in this report.

    b. Parties should develop appropriate governance arrangements and methods for operationalising an improved provision for socio-economic neutrality, including by agreeing on decision making powers, requiring socio-economic impact assessments, and engaging with key stakeholders.

    c. Quantitative analysis of pilot programs and past on-farm programs should be undertaken and published to fully understand the aggregate impacts of potential 'upwater' programs, with the water demand response of participants under different seasonal conditions as a core focus.

    d. Pilots should be designed to enable quantitative measurement of these impacts.

3. If a Basin-wide approach cannot be achieved, the New South Wales Government should develop its own workable definition based on the definition proposed in this report. Under the second modality set out by the Basin Plan's provision for socio-economic neutrality, the New South Wales Government should use this definition to assess to assess any efficiency measures planned for implementation in that State.

[1] Particular consideration should be given to the potential increased costs of water recovery associated with increases in entitlement prices since 2012 and the incremental environmental benefits of moving from 2750 to 3200 GL of water recovered.

1. Background and scope

Under the water recovery targets established by the Murray-Darling Basin Plan ('the Basin Plan') in 2012, the Commonwealth Government committed to recovering 2750 gigalitres (GL) of water across the Basin by 2019, to meet Basin environmental needs. The *Water Act 2007* ('the Act') and the Basin Plan also allow for the return of a further 450 GL of water through the implementation of efficiency measures – this portion of the recovery target is known as 'upwater' – potentially bringing the total water recovery target to 3200 GL by 2024.

Under the Basin Plan, recovery of 'upwater' may only occur if the socio-economic impacts from this recovery are positive or neutral; a threshold test that does not apply to initial recovery of the 2750 GL. This principle, which has come to be termed 'socio-economic neutrality', has prompted significant debate in recent times, due in part to the way it is characterised. In particular, under the Basin Plan, efficiency measures are considered to have positive or neutral impacts where water users voluntarily participate in a program or where Basin States assess that neutrality can be achieved through alternative arrangements.

The New South Wales Department of Primary Industries – Water (DPI Water) commissioned Aither to review the concept of socio-economic neutrality as it is defined in the Basin Plan in the context of 'upwater'. This report has been prepared in response to the following three objectives set by DPI Water:

- Review the provisions of existing Commonwealth legislation and policy documents relating to socio-economic neutrality requirements for further water recovery under the Basin Plan.
- Consider the potential qualitative socio-economic impacts of water recovery in the Murray-Darling Basin under the Commonwealth On-Farm Further Irrigation Efficiency (COFFIE) program.
- Develop a working definition of socio-economic neutrality that is applicable to the impacts of water recovery under the Basin Plan.

Meeting these objectives is expected to support the New South Wales Government in its engagement with the Commonwealth Government and other Murray-Darling Basin State Governments on enhanced implementation of the Basin Plan.

This report is based on primary and secondary source material. It draws from consultations with relevant stakeholders, a review of policy documents and legislation, and a review of the broader academic literature on the socio-economic impacts of water resource management.

2. Assessment of the provisions for socio-economic neutrality in the Basin Plan

2.1. What are socio-economic impacts?

Socio-economic impacts are outcomes for individuals, communities and economies that are caused by particular trends, drivers or events. Socio-economic impacts can result from the various decisions made by households and businesses as they adapt to change over time, or from more specific responses to triggers such as government programs (or both) (Aither, 2014).

Socio-economic impacts:

- can be direct or indirect, positive or negative
- can be non-linear in response to drivers, e.g. thresholds where businesses or government services (such as health or education) become, or cease to be, viable
- vary according to their desirability, scale, duration, severity, and the extent to which multiple impacts accumulate or counter-balance (Bureau of Rural Services, 2005)
- need to be assessed against a baseline or benchmark scenario (where a specific trigger or event being assessed did not occur)
- should be considered based on the aggregate or cumulative effects of a change, at different scales.

In economic terms, socio-economic impact assessment can be thought of as considering all the benefits and costs of an intervention or event, as well as the distribution of those benefits and costs.

There is no commonly used definition of 'socio-economic neutrality'. As discussed in following sections, adopting a definition of neutrality requires a determination of the scale at which neutrality should be achieved, and the ability to measure and balance positive and negative impacts on different groups, over time.

2.2. The provisions for socio-economic neutrality in the Basin Plan

For recovery of 'upwater', the Basin Plan sets out the requirements for determining whether or not an efficiency measure is considered to have achieved, or be able to achieve, neutral or improved socio-economic outcomes. That requirement is detailed in Basin Plan section 7.17(2)(b), as shown in the box below.

2.2.1. Basin Plan requirements

Murray-Darling Basin Plan section 7.17(2) (b)

"The efficiency contributions to the proposed adjustments achieve neutral or improved socio-economic outcomes compared with the outcomes under benchmark conditions of development as evidenced by:

(i) the participation of consumptive water users in projects that recover water through works to improve irrigation water use efficiency on their farms; or

(ia) the participation of consumptive water users in projects that recover water through works to improve water use efficiency off-farm; or

(ii) alternative arrangements proposed by a Basin State, assessed by that State as achieving water recovery with neutral or improved socio-economic outcomes."

2.2.2. Other legislative arrangements

Further to the provisions above, there are other legislative arrangements which interact with this characterisation of socio-economic neutrality and which may affect its practical application. These include provisions for water recovery programs contained under the Act, which allows for compensation to be paid through the Water for the Environment Special Account (WESA)[2] (from Section 86AD(2)(c)(ii)):

> *Amounts standing to the credit of the Water for the Environment Special Account may be debited…to address any detrimental social or economic impact on the wellbeing of any community in the Murray-Darling Basin that is associated with a project or purchase referred to in paragraph (a) or (b) or subparagraph (c)(i) so as to offset any such impact.*[3]

The implication of this is that compensation is permissible under the current legislative settings. Consequently, this acknowledgement that some additional investment may be required to offset socio-economic impacts has been taken into account in developing the definition of socio-economic neutrality proposed in this report.

2.3. Assessment of the Basin Plan provisions for socio-economic neutrality

While the Basin Plan includes the aforementioned provisions for socio-economic neutrality, it falls short of providing a practical and workable definition for the purpose of implementing associated 'upwater' programs that seems reasonable when considered against accepted definitions of socio-economic impact. Specifically, Parts (i) and (ia) (shown above) do not account for:

1. impacts on people who are not directly participating in the program
2. impacts that are a result of the cumulative or aggregate implementation of entire programs
3. the distribution of impacts across stakeholders.

While voluntary participation in efficiency programs is an important element of their successful implementation, it is worth noting that even this cannot reliably be equated with positive long-term outcomes for that individual. It is feasible that individuals volunteering for efficiency programs may make poor decisions. This may be due to an absence of perfect information, changes in input prices

[2] WESA is the account through which water recovery measures such as the SDL adjustment mechanism and efficiency measures are funded and is established by the *Water Act 2007* (Part 86AB).

[3] Cross referenced paragraphs (a, b and c(i)) refer to water efficiency programs and purchases of water access rights.

(e.g. for electricity), decisions that are excessively driven by short-term cash flow concerns, or other factors.

On this basis, the provision included in the Basin Plan is inconsistent with Commonwealth guidelines on socio-economic impact assessment (see, for example, Bureau of Rural Services, 2005), and does not meet the overarching intent of the Basin Plan to consider the distributional socio-economic impacts of 'upwater' programs.

The provision in the Basin Plan also appears inconsistent with the position adopted by the Commonwealth in other documents. The Department of Agriculture and Water Resources (2016) recently set out proposed due diligence criteria for State-proposed efficiency measure projects. These criteria are intended to provide Basin States with evidence to support their assessment of a measure's socio-economic neutrality. The criteria suggest that State-proposed projects must consider details of the anticipated neutral or positive socio-economic outcomes on irrigators or participants, communities, and 'the region'. This contradicts the provision for socio-economic neutrality in the Basin Plan and indicates that impacts on individuals and groups other than program participants should be considered.

3. Socio-economic impacts of water recovery

3.1. Conceptual framework

Figure 3 provides a conceptual framework outlining the potential socio-economic impacts related to water recovery and highlighting that impacts may be distributed across multiple groups. The distribution of socio-economic impacts will rarely be even, with some groups usually being impacted more than others, both positively and negatively.

Group	Description of impacts
General public	• Government funding of water recovery projects at expense of funding for other social, environmental, and economic policy priorities • Nation-wide outcomes and impacts from efficiency measures on the general public, including economic, environmental and social impacts from environmental water
Individual participants	• Reduced water entitlement • Grant funding and other capital cost contributions • Impacts on operating costs (including labour and energy) • Impacts on water demand • Changes to risk profile • Impacts on land value • Impacts on productivity
Program delivery partners	• Impacts on demand for water use efficiency services and equipment • Employment for suppliers of water use efficiency equipment and services, program managers and staff
Water market participants	• Cumulative changes in water demand from participants result in potential water allocation and entitlement market impacts • These have financial impacts on other market participants, both positive and negative
Irrigation infrastructure operators	• Changes in distribution of water use may have an impact on revenue and cost base • Could be a need to increase prices for remaining water users
Industry	• Direct production impacts from recipients • Indirect production impacts from other water market participants • Financial impacts on upstream suppliers • Financial impacts on producers / processors / distributors • Impacts on employment by industry
Regional communities	• Cumulative employment and financial impacts could affect community services, housing prices, wages, and local economic activity

Note: Developed by Aither; this is a typology only and does not include all possible links and impacts of water recovery.

Figure 3 A conceptual framework of the socio-economic impacts of water recovery

The framework has been compared to recent examples of economic and socio-economic impact assessment of water recovery (see ABARES, 2016; Aither, 2016a, 2016b; Murray-Darling Basin Authority, 2016; RMCG, 2016; TC&A and Frontier Economics, 2017). Based on this comparative review, there is a growing consensus around the nature and type of impacts of water recovery programs, both positive and negative. There are also a number of potential feedback loops in relation to the impacts of water recovery that are not fully illustrated above due to their complexity.

The framework and previous studies show that individual program participants are not the only people that may be impacted by a water recovery or water efficiency program. Typically, there can be flow-on effects via the water market and in relation to the volume of water being used within an irrigation infrastructure operator (IIO) district, which can affect that IIO's financial viability or contribute to increased charges to other users. These impacts can also flow through to irrigated agricultural production, which can further affect irrigation industries, local businesses and communities. There may also be economic and social benefits to water users associated with water recovery and environmental water use.

Indirect impacts vary based on the type of water recovery mechanism (buyback, on-farm water use efficiency, or off-farm modernisation), and across different seasonal conditions. They are sometimes difficult to quantify, and may offset each other (e.g. channel rationalisation may help reduce IIO costs and generate off-farm water recovery).

Socio-economic effects may also be cumulative. Although a single irrigation efficiency measure implemented on a single farm may not have significant negative or positive impacts on a wider regional community, the cumulative impacts from multiple participants or programs may be highly significant. This is relevant to the subject of this report in that the types and magnitudes of socio-economic impacts from recovering 450 GL of 'upwater' through efficiency measures may be quite different from the types and magnitudes of those impacts related to the implementation of a single measure within that broader program.

Input provided by stakeholders consulted during preparation of this report supported the connections demonstrated in Figure 3 and described above. Across multiple irrigation districts, water recovery is said to have contributed to (positive and negative) material indirect impacts on community members other than those directly participating in water efficiency programs. These impacts were reported as being at least in part a result of the upward impact of water recovery on water allocation prices and the recovery of fixed costs of water services provided by IIOs from a smaller base of water use.

Stakeholders also suggested to Aither that the cumulative effects of past water recovery and investments in efficiency measures should be considered. In particular, there is said to be limited opportunity for additional cost-effective investment, and that individuals, irrigation districts, industries and communities now have less capacity to absorb further change without adverse impacts on people and communities. This is relevant to consider in developing any baseline for assessment of socio-economic impacts. Previous investment in on-farm efficiency measures is also important to consider in relation to the likelihood of voluntary participation (i.e. the most efficient opportunities for investment may have already been implemented).

3.2. Application to on-farm water use efficiency measures

3.2.1. What is COFFIE?

When recovery of 'upwater' was included in the Act and the Basin Plan, it was considered that on-farm water use efficiency programs would be the main mechanism for obtaining the additional 450 GL. The Commonwealth On-Farm Further Irrigation Efficiency program (COFFIE) is now the main program under which the Commonwealth Government proposes to achieve recovery of 'upwater'. COFFIE is intended to provide $1.575 billion of funding from the Water for the Environment Special Account for on-farm water use efficiency measures in Basin States. Currently piloting in South Australia, the program will provide funding at a rate of 1.75 times the market value of water entitlements to encourage consumptive water users to voluntarily increase on-farm water efficiency and return entitlements to the Commonwealth for environmental watering purposes.

It is our understanding that 100 per cent of the water savings associated with COFFIE funding would be transferred to the Commonwealth (through an entitlement transfer) (Department of Agriculture and Water Resources, 2015, p. 6). In contrast, some previous programs have typically only required a transfer of 50 per cent of the savings with the remaining 50 per cent retained by the irrigator.

3.2.2. Assessment of COFFIE and other on-farm water use efficiency programs

The intended costs and benefits of COFFIE are relatively straightforward. Funding is provided to irrigators for them to modernise their on-farm irrigation systems, in exchange for water entitlement transferred to the environment.

However, the greatest area of debate and uncertainty around the effects of on-farm water use efficiency programs is their cumulative or aggregate effects on the price of water allocations in connected markets across the Murray-Darling Basin and their impacts on the financial viability of irrigation infrastructure operators. These effects relate to the changed demand from individual participants as well as the overall reduction in water available for use within irrigation districts associated with the recovery of an additional 450 GL for the environment, which would not be used in irrigation delivery systems.

Water allocation market effects on irrigators

Conventionally, it was considered that on-farm programs were simply reducing inefficiencies in irrigation water application resulting in similar levels of production from reduced water extractions. However, anecdotal evidence and emerging data suggests that the effects are more complex.

Aither (2016a) explained that 'the impact of these programs on allocation prices could be negative or positive. This depends on the volume of water transferred to the Commonwealth (on the supply side) and on how the demand for allocations by irrigators responds to on-farm efficiency programs (on the demand side). This balance of supply and demand ultimately determines whether irrigators subsequently enter the allocation market to buy or sell allocations due to their participation in the program, and the impacts on allocation prices'.

Stakeholders consulted for this project have suggested to Aither that program participants often:

- maintain or increase their overall water requirement after investing in efficiency works
- have a higher willingness to pay for water in the allocation market as a result of the infrastructure that has been installed.

The individual case study contained in the text box below describes the experience of one irrigator.

Impacts of on-farm water use efficiency investments on irrigator behaviour

The following example is based on one irrigator's views on, and experience of, participating in an on-farm efficiency program. It is not representative of the experiences of all participants in this or similar schemes, but provides insights into the types of impacts and outcomes from implementing government funded or supported efficiency measures.

Most farmers understand that investing in water efficiency improvements can be good for business and factor this into their decision making; efficiency measures programs may allow progress toward improved efficiency to be accelerated. In this case, participation in an efficiency program (for the individual consulted) led to significant on-farm improvements and allowed the farm to transition from 'a poor one to one of the better ones'. 100 megalitres (ML) of water entitlements were returned to the Commonwealth for environmental watering purposes.

Investment in water use efficiency improved the performance of the farm and allowed for more area to be utilised and at a greater intensity, meaning more water was used per unit area and across a greater area. The participant estimates that water use on their property has increased from 6 ML per hectare per annum to a maximum of 7.5 ML per hectare per annum, equivalent to a net increase in total water use of 1,150 ML per annum. This resulted in improved performance and

greater financial returns for the individual participant, but also increased demand in the water allocation market. The individual now budgets on purchasing around 1250 ML of water per annum on the allocation market.

It was noted by the individual consulted that, in the absence of the government funded program incentive, they had intended to pursue the same or similar efficiency improvements but over a longer time period. This suggests that similar outcomes, both at the individual level and for market participants, would have resulted, but over multiple years and without the return of water to the environment.

This case study highlights that government funded on-farm water use efficiency investments can have beneficial outcomes for participants, but can also drive increased demand for water on the allocation market.

This dynamic is explained by another irrigator as follows (TC&A and Frontier Economics, 2017, p. 167):

> *With all this infrastructure that's gone in it's also created more demand for the water. We're saving water but we're being more intense and more productive. Because we're using it more efficiently and being more profitable that drives us to want more water to do more things. It has that driving effect. We gave water back but we went straight back to the market and bought it again. We were getting two for one really. It is a lot more production but as I say it's made us a lot more intense. A lot of the other people are getting better irrigation systems [and the demand for water is going up].*

An increase in water demand may mean that those who did not or could not participate in the program, as well as those that did, face higher overall prices in the connected allocation market than they otherwise would have. Murray Irrigation has provided evidence that recipients of on-farm water use efficiency grants are more likely to increase their reliance on water allocation markets, compared with other customers. In the three years from 2012/13 to 2014/15, annual water use for participants in on-farm irrigation efficiency programs in the Murray Irrigation region increased from 122 per cent of entitlement to 131 per cent then 140 per cent of entitlement. Among non-participants, annual water use increased from 97 per cent of entitlement to 106 per cent then 123 per cent of entitlement (data supplied, 2017).

In principle, if water demand increases following an on-farm upgrade, then the water allocation price could increase, and this increase could be greater than that for Commonwealth buyback of an equivalent volume of water (Aither, 2016a).

The concern is that this makes irrigation unviable in more years for some irrigation enterprises that are highly sensitive to allocation prices (e.g. rice growers, cotton growers, dairy farmers, fodder producers, etc.). This effect is likely to apply to a greater extent on smaller family farms (which are mainly located within irrigation districts). As a result of higher allocation prices, some irrigators may be better off selling their allocations more regularly as opposed to producing. While stakeholders recognise that some of this type of change is inevitable over time as farms aggregate and become more efficient, there is a concern that this change is happening more rapidly than it otherwise might, due to a combination of factors including water recovery effects and changing demand in the system (e.g. increased nut and cotton development by private diverters).

Numerous recent reports point to the potential for efficiency programs to have these and other impacts on water allocation market prices, although there is a lack of empirical evidence on the demand responses and cumulative effects (see, for example, Aither, 2016a and TC&A and Frontier Economics, 2017). Overall, some water market effects are likely to be unavoidable (and there will be positive impacts for some people).

Price effects on irrigation infrastructure operators

Stakeholders have also stated that on-farm water use efficiency programs can impact the business models of IIOs. Despite the fact that some irrigators will increase their demand and use following an on-farm investment, overall water use must decrease across all irrigators given the transfer of water to the environment. By reducing the total volume of water across which IIOs are able to spread the costs of water service provision, there is potential for increases in charges levied to irrigators. The precise effects will vary due to the differing structures of IIO charges.

According to Murray Irrigation, the result of all environmental water recovery programs to date means that that business presently holds around 450,000 (28 per cent) fewer entitlements than it did in 1995, which represents a reduction of almost $2.5 million in sales revenue (from usage charges) per annum.

Furthermore, the impacts on IIOs may be highly variable as the water market allows for the reallocation of water across different systems. For example, high uptake in on-farm efficiency measures in one system could drive demand for water in that system, taking water away from other systems. This may result in more severe impacts in systems where participation in on-farm efficiency programs is comparatively low.

As a result, some IIOs will either need to recover current costs through increased prices for customers, or reduce their cost base (or do both). Increasing prices will impact farmers, while scaling back could result in job losses and flow-on impacts to the community. IIOs can constitute large employers in some regions and reductions in labour requirements may have significant socio-economic impacts on those communities.

These impacts demonstrate the need for assessment of cumulative impacts. In many regions, water recovery over the course of multiple decades has gradually contributed to modifications in IIO business practices. As with other elements of water reform in the Basin, the resulting socio-economic impacts are often accelerations of existing structural adjustment trends. Nonetheless, there is a need to capture these impacts in a comprehensive assessment of COFFIE's likely contribution to outcomes for IIOs and their customers.

3.2.3. Conclusion

Given that overall efforts to recover 'upwater' will depend on the extent to which irrigator communities support efficiency programs through their voluntary participation, there is a need to assure stakeholders that all relevant socio-economic impacts, direct and indirect, cumulative and distributional, and short-term and long-term, have been adequately considered.

This assessment suggests that, although there is very little publicly available quantitative information on the benefits and costs of on-farm water use efficiency measures to date, there is an 'in principle' case for considering the socio-economic impacts of those measures.

It is clear that efficiency measures such as those proposed under the COFFIE program could have positive impacts on participants and others, and some negative socio-economic impacts on the wider irrigator base. Particular consideration should be given to flow-on impacts on the water market and IIOs resulting from changes in water demand and use.

As identified above, there is enough evidence to suggest that there are likely to be some genuine distributional concerns or other unintended consequences from the 'upwater' program. That is, there are likely to be individuals who will experience net negative impacts as a result of the program's implementation. These impacts can potentially be addressed by compensation through WESA, as described in Section 2.2.2, or by pursuing efficiency initiatives that minimise negative impacts.

However, approaches to reconciliation (such as compensation) must not significantly undermine the efficiency and objectives of the program. The challenge in formulating government responses in this context is to ensure that interventions address genuine equity concerns or other unintended consequences, while enabling necessary change and avoiding perverse incentives that undermine efficiency (Aither, 2014). Where it is conceivable that compensation may increase the costs of COFFIE to the extent that program benefits no longer exceed costs, this possibility should be rigorously assessed through Cost Benefit Analysis.

4. A suggested approach to defining socio-economic neutrality

4.1. Objectives in developing a provision for socio-economic neutrality

Any provision for socio-economic neutrality used to assess water recovery measures under the Basin Plan should be consistent with the intent of the Basin Plan and should make sense as a principle for public policy making.

An acceptable approach to establishing a provision for neutrality also needs to be accompanied by clear implementation and assessment guidelines and methods, and an appropriate governance and decision making framework.

4.2. Theoretical economic definitions and interpretations

4.2.1. Economic definitions of neutrality

As previously stated, there is no single accepted definition of socio-economic neutrality. However, there are two main theoretical economic principles that can be considered in developing a definition of neutrality with regard to socio-economic impacts: the Pareto and Kaldor-Hicks principles.

A Pareto compliant definition can be described as a 'no net negative impacts to anyone' definition. A Kaldor-Hicks compliant definition can be described as a 'net benefit' definition. Suppose that Person A gains $1000 from their participation in an on-farm efficiency program and Person B loses $800, making the net outcome of the program $200. This program would fail a Pareto neutrality test, but would be regarded as neutral (or indeed positive) under a Kaldor-Hicks definition. However, Person B has suffered a loss, raising the question of distributional effects. The Kaldor-Hicks definition can be interpreted as allowing for the potential for everyone to be better off if a redistribution occurs (e.g. Person A gives Person B $900 and both are $100 better off), but Kaldor-Hicks does not require this to happen.

This discussion highlights that compensation could address distributional impacts, but it is important to note that this may be at the expense of the effectiveness and efficiency of the program. Hence it is important that compensation is considered in terms of distributional effects as well as trade-offs in the efficient delivery of the program and associated outcomes. In simple terms, if compensation is too high, it may make the whole investment uneconomic.

4.2.2. Aither's assessment of the intent of the Basin Plan

In our view, a Pareto improvement definition (i.e. making no individual worse off) would be extremely difficult to achieve for any government policy reform. It is impractical to measure individual impacts and to perfectly compensate individuals; this approach is therefore inappropriate.

On the other hand, Kaldor-Hicks is a standard approach to assessing the economic merits of a policy. In our view, it is a necessary, but not sufficient, condition to establish a Kaldor-Hicks socio-economic neutrality test at the national level. This implies that the total benefits must exceed the total costs of

any efficiency measure in order for it to potentially be socio-economically neutral and to meet the objective of the Basin Plan to 'optimise social, economic and environmental outcomes arising from the use of Basin water resources in the national interest' (5.01(c)). In practice, this means that efficiency measures must first pass a standard economic Cost Benefit Analysis test.

However, the lack of regard for distributional effects in an application of Kaldor-Hicks at the national scale does not meet the overarching intent of the Basin Plan to consider the distributional socio-economic impacts of 'upwater' programs. To address these distributional effects, we recommend that Kaldor-Hicks be applied at one or more sub-national scales to consider the distribution of direct and indirect costs and benefits for water users and regional communities. The challenge is then to establish a workable and sensible approach to defining these levels and undertaking the assessment.

4.3. Proposed definition

Based on our interpretation of the intent of the Basin Plan, Aither proposes a definition of socio-economic neutrality that considers all benefits and costs, and can be applied at scales appropriate to the objectives and intent of the Basin Plan. This proposed definition could be viewed as a starting point for discussion at an inter-governmental level in the pursuit of a more workable approach. The proposed definition is shown in the boxed text below.

In summary, the definition first requires that efficiency measures pass a Cost Benefit Analysis at the national scale. If they pass, then the definition requires testing of whether there are any IIOs, irrigation industries, regional groups of irrigators (market participants) or local communities that are materially adversely affected. If these impacts are material then the tests should be rerun with consideration of the efficiency, effectiveness and equity implications of potential compensation packages.

The efficiency contributions to the proposed efficiency measure achieve neutral or improved socio-economic outcomes compared with the outcomes under benchmark conditions of development as evidenced by:

i. the assessment that the efficiency measure is likely to be net beneficial at the national scale based on the results of a Cost Benefit Analysis; and

ii. the voluntary participation of consumptive water users in efficiency measures that recover water through works to improve irrigation water use efficiency on or off their farms; and

iii. the efficiency measure having no material adverse impacts on irrigators at the industry or regional scale through changes in water allocation or entitlement market prices; and

iv. the efficiency measure having no material adverse impacts for any irrigation infrastructure operators with particular regard for price impacts on distribution systems; and

v. the efficiency measure having no material adverse impacts at the community level (as defined by an existing administrative boundary, e.g. LGA, region, catchment, WSP);

Or:

where compensation programs (for example, through the Water for the Environment Special Account) and complementary investments can feasibly address any material adverse impacts in relation to clauses iii., iv. and v. without undermining the overall efficiency of the measure.

Figure 4 shows the proposed definition in the form of a decision tree to aid practical decision making.

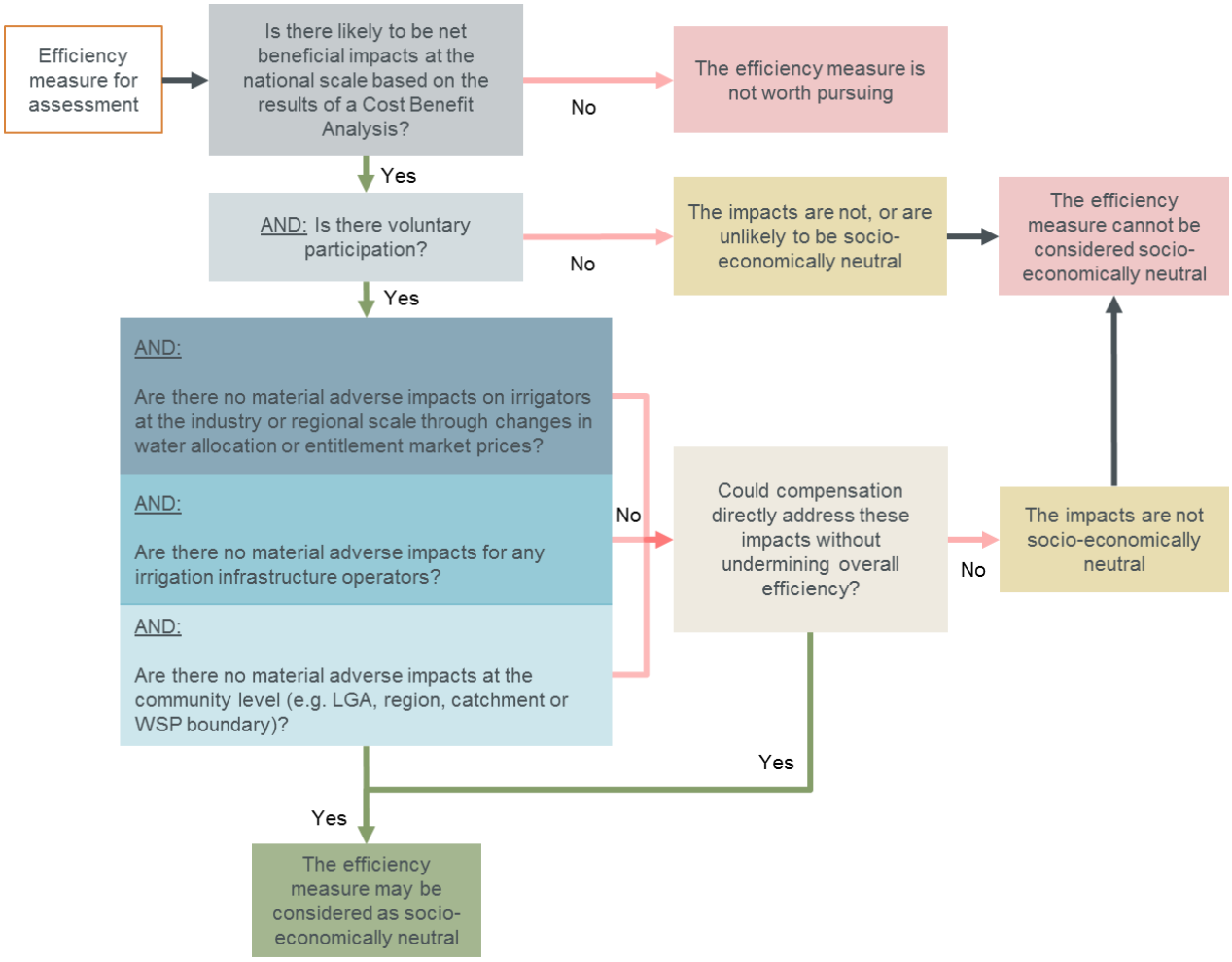

Figure 4 Decision tree outlining the elements of a proposed definition of socio-economic neutrality

4.4. Implementing the proposed definition

The proposed definition seeks to consider the full suite of social and economic impacts and provide a framework for making efficient and equitable decisions. Below are some key considerations that may further clarify or improve the definition:

- The first requirement is that an efficiency measure passes the overall national Cost Benefit Analysis. Undertaking this assessment is a first hurdle and it may be possible to rule out the need for any more complex socio-economic assessment if this test is not passed. This is important as undertaking detailed socio-economic assessment, particularly at a community level, is costly and time consuming, and may be avoided if the overall program is not economically efficient.
    - In this regard, we note that the current COFFIE program proposes to pay entitlement holders 1.75 times current market value for entitlements. At current market prices of approximately $3000 per ML of high security entitlement in the southern Murray-Darling Basin (and higher in New South Wales), this implies a total cost of $2.4 billion to achieve the full 450 GL of 'upwater' recovered, without any additional compensation.

- This means that the benefits of the program, particularly the environmental benefits of moving from 2750 GL to 3200 GL of water recovered, would need to be worth at least this amount, which is equivalent to a one-off cost of approximately $100 per Australian.

- It is proposed that the voluntary nature of the efficiency measures be retained with the view that this forms a necessary but not sufficient condition to support socio-economic neutrality.
- There is significant potential for efficiency programs like COFFIE to have an impact on water markets. Numerous recent reports point to the potential for such programs to have other impacts on water allocation market prices, although there is a lack of empirical evidence on the demand responses and cumulative effects (see, for example, Aither, 2016a and TC&A and Frontier Economics, 2017). Some water market effects are likely to be unavoidable (and there will be positive impacts for some people), and an assessment to consider whether these are material could be undertaken using existing models combined with additional evidence from pilot programs on the water demand response of program participants.
- IIOs have expressed concerns about the financial impacts on their businesses and customers associated with recovering fixed costs across a reduced base of water use within their systems. A test may be developed to help ensure that IIOs and remaining customers are not adversely affected in a material manner. This is beyond the scope of this report, but should be explored further in future.
- Impacts on water markets and IIOs are more direct and likely to be easier to assess as compared with broader flow-on impacts in local irrigation dependent communities. Therefore, if the tests associated with water markets and IIOs are not passed, it may not be necessary to undertake further assessment at the community level. Conversely, if water market and IIO impacts are immaterial for programs like COFFIE, it is likely that the community impacts will also be indistinguishable from other factors driving change. Therefore, the need for detailed assessment at the community level may be limited to instances where efficiency measures do not have material water market or IIO effects, but there remains a case for concern regarding community level impacts (i.e. the proposed efficiency measures have different flow-on effects and change occurs through different mechanisms).
- Where community level assessment is required, defining an appropriate scale based on an existing administrative boundary will help create consistency in application of the definition. This could be further enhanced by adopting boundaries that are similar across jurisdictions, making operationalisation of the definition across multiple Basin States more straightforward.
- As noted in the theoretical discussion, compensation is an important potential component of the definition. It is recommended that compensation is only used where it does not create further inequities, where it effectively addresses the actual distributional impacts of further water recovery, and where it does not undermine the efficiency or intent of the program; this includes cases where compensation may change the incentives and outcomes of the program. Aither (2014) has previously published a report on lessons learnt in dealing with structural adjustment issues, which provides useful insights on the potential downsides associated with compensation.

4.5. Governance framework for assessment and decision making

If an appropriate definition cannot be agreed among the Commonwealth and Basin States, Aither recommends that the New South Wales Government adopt the definition of socio-economic neutrality proposed in this report. Whether acting collectively with other jurisdictions or alone, some accompanying actions will be required to ensure the definition is translated into a workable decision making framework. These should include:

- **Appropriate governance arrangements**: Implementing the proposed definition ultimately requires some judgements to be made. To be effective, any definition needs to be accompanied by a clear and effective governance framework for decision making. Given the interconnectivity across the southern Murray-Darling Basin, a consistent definition and approach to implementation would be beneficial. Injecting clear decision making guidelines into this process is likely to be beneficial for all parties. It will be important to clearly define who ultimately decides whether an efficiency measure passes the proposed definition of socio-economic neutrality (i.e. is it done through the existing Ministerial Committee and Basin Officials Committee, or through an independent body set up for this purpose with advisory or decision making powers?).
- **Credible and robust assessment of programs to determine benefits**: Working through the decision tree presented in Figure 4 will require robust, credible and transparent program assessments that are respected by stakeholders. The definition requires good evidence to make good decisions and may benefit from further development of assessment techniques and guidelines. Decision makers will need to decide how to commission or undertake this work. Options include utilising independent consultants or government staff.
- **Commitment to stakeholder engagement and transparency**: Stakeholder engagement will be critical to acceptance of any definition and to program implementation. Similarly, for the definition and its application through implementation, transparency will be an important ingredient for wider support and adoption. This could be achieved through publication of all definitions, governance arrangements, assessments and decisions.

5. Conclusion

The *Water Act 2007* and Murray-Darling Basin Plan provide for the recovery of an additional 450 GL of water within the Basin ('upwater') by 2024, above and beyond the 2750 GL of water to be recovered by 2019. This water is intended to be recovered through on-farm water efficiency measures, and, unlike the 2750 GL, can only be recovered if the impacts from recovery are socio-economically neutral.

This provision for 'socio-economic neutrality' has prompted significant debate in recent times, due in part to its characterisation. Under the Basin Plan provisions, on-farm efficiency measures are considered to have positive or neutral impacts where water users voluntarily participate in an on-farm efficiency program or where Basin States assess that neutrality can be achieved through alternative arrangements.

In principle, this provision for socio-economic neutrality in the Act and the Basin Plan (i.e. individual participation equals socio-economic neutrality) is inconsistent with accepted definitions of socio-economic impacts, which state that these impacts are not only felt directly but also indirectly through flow-on effects on other individuals and groups. The provision is also inconsistent with Commonwealth guidelines on socio-economic impact assessment and does not meet the overarching intent of the Basin Plan to consider the distributional socio-economic impacts of 'upwater' programs.

Specifically, the Basin Plan provisions do not account for:

1. impacts on people who are not directly participating in the program
2. impacts that are a result of the cumulative or aggregate implementation of entire programs
3. the distribution of impacts across stakeholders.

Individual program participants are not the only groups that may be affected by a water recovery or water efficiency program. Typically, there can be flow-on effects on irrigators and IIOs as a result of cumulative or aggregate changes in irrigation water demand and water use.

Across multiple irrigation districts, stakeholders consulted in the preparation of this report asserted that water recovery has contributed to (positive and negative) material indirect impacts on community members other than those directly participating in water efficiency programs. These impacts were reported as being, in part, a result of the upward impact of water recovery on water allocation prices and the recovery of fixed costs of water services provided by IIOs from a smaller base of water use.

These impacts can flow through to regional irrigated agricultural production, which can further affect irrigation dependent industries, local businesses and communities. For this reason, socio-economic effects need to be considered at the cumulative or aggregate level.

Based on a qualitative assessment, there are grounds to suggest that on-farm efficiency measures, including those likely to take place under COFFIE, could have material socio-economic impacts on individuals other than program participants and so socio-economic impacts should be considered. These impacts are likely to be a result of cumulative or aggregate changes in irrigation water demand and water use.

In this report, Aither proposes a definition for socio-economic neutrality that accounts for a broad range of potential costs and benefits and can be applied at scales appropriate to the objectives and intent of the Basin Plan.

Aither recommends that:

1. The New South Wales Government should advocate for an independent Cost Benefit Analysis of the efficiency measures program. If the overall program does not pass this more easily implemented test, then it should not be considered socio-economically neutral at an aggregate level.

2. If the efficiency measures program proceeds on the basis of the Cost Benefit Analysis, the New South Wales Government should advocate for a revised Basin-wide definition and cooperative approach to assessing socio-economic neutrality given the potential for efficiency measures to have flow-on impacts across the Basin.

    a. The definition should be based on that proposed in this report.

    b. Parties should develop appropriate governance arrangements and methods for operationalising an improved provision for socio-economic neutrality, including by agreeing on decision making powers, requiring socio-economic impact assessments, and engaging with key stakeholders.

    c. Quantitative analysis of pilot programs and past on-farm programs should be undertaken and published to fully understand the aggregate impacts of potential 'upwater' programs, with the water demand response of participants under different seasonal conditions as a core focus.

    d. Pilots should be designed to enable quantitative measurement of these impacts.

3. If a Basin-wide approach cannot be achieved, the New South Wales Government should develop its own workable definition based on the definition proposed in this report. Under the second modality set out by the Basin Plan's provision for socio-economic neutrality, the New South Wales Government should use this definition to assess to assess any efficiency measures planned for implementation in that State.

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