

What's in it for me – an evidence based approach to improve landholder adoption of riparian works

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Key Points

- In order to increase adoption of riparian works, it is important to provide landholders with factual and reliable information on the on-farm benefits
- There is a large range in the reliability of evidence used to commonly report the benefits of riparian works
- It is important that delivery agencies understand variations in the confidence that can be placed on different intervention outcomes of riparian works and also to understand the factors that influence these outcomes from site to site
- If sound policy is to be developed for riparian management, it must be informed by reliable and up to date evidence that is relevant to scales of management adoption

Abstract

Evidentiary and the Department of Environment, Land, Water and Planning (DELWP) undertook a rapid systematic style review of evidence of the benefits to landholders of undertaking a range of riparian works resulting in direct on farm or individual benefits. The review aimed to increase the confidence of delivery agencies such as Catchments Management Authorities (CMA) in promoting the benefits of riparian works such as combinations of fencing, off-stream water, grazing management, re-vegetation and weed control.

While the benefits of different types of riparian works are commonly reported in CMA, government agency and agricultural organisation's fact sheets, the evidence underpinning this information can be unreliable and based on anecdote rather than being based on studies with transparent and reliable methodologies. While the review confirmed evidence for some relationships such as the stock production benefits from the provision of high quality off stream water and enhanced visual amenity and wellbeing for landholders from riparian re-vegetation, evidence for other commonly reported relationships the evidence was poor or inconclusive.

Keywords

Riparian management, evidence-based, rapid review, landholder adoption, on-farm benefits

Introduction

The Victorian Government provides the state's Catchment Management Authorities (CMAs) with funds to encourage the uptake of riparian works on private land or licensed Crown frontage. While some landholders have embraced the opportunities provided by these investments, others remain resistant to undertaking riparian works for a variety of reasons. One identified barrier to adoption is that while the ecological and broader societal benefits of riparian works are well understood, many landholders want to know 'what's in it for me?' Some landholders are primarily interested in on-farm production gains, cost savings or lifestyle and amenity benefits in order to be convinced to participate in a government funded riparian works program. In addition there are generally high levels of uncertainty surrounding the effectiveness of riparian works (such as off stream water, weed control and revegetation) in delivering individual landholder benefits.

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The reported landholder benefits of riparian works are outlined in many CMA, government agency and agricultural organisation's fact sheets, although the evidence underpinning this information is often not referenced or is anecdotal rather than being based on studies with transparent methodologies. Unless this experiential or opinion based information can be validated against settled science, there are risks in using this information to inform decision making. At worst, landholders will become disillusioned and disengaged by a lack of results based on unsubstantiated recommendations.

The Department of Environment, Land, Water and Planning (DELWP) undertook a pilot study to investigate how an evidence based approach could be used to assist policy development and decision making regarding program investments in riparian management. The question of policy relevance for this particular summary of evidence was "*What are the benefits to landholders of adopting riparian works?*"

In summarising the evidence to answer this question three types of riparian works were addressed:

- Re-vegetation
- Off-stream water
- Weed control (specified species)

NB: It was assumed that riparian fencing was a component of each of these works.

The project focused primarily on the private benefits to landholders involved in dairy, grazing (sheep and cattle) and cropping. Some of the assumed benefits of riparian works to landholders that were investigated included production benefits, ecosystem services, property prices and amenity or aesthetic values. The review did not include evidence regarding longer term environmental benefits that may pass on derived benefits to landholders as the benefits needed to be capable of being seen or experienced by landholders in the short term.

Method

Evidentiary undertook a search and synthesis process using a transparent and systematic approach. A search protocol was first developed and agreed on and then used to guide how the search was undertaken, how evidence items were assessed for relevance and quality and how the evidence was used to inform decision making.

The search method aimed to capture an unbiased representative sample of the literature as comprehensively as the available resources of the study enabled. Published and unpublished literature was used. Search sources were broad including web based grey literature, universities, and government and non-government organisations. Some relationships were able to draw on good quality experimental design papers (for example the influence of increased accessibility of high quality water on increased water and forage intake and increased weight gain). In other cases the best available evidence has been indirect such as the evidence found on the influence of riparian vegetation on property values related to vegetation that was not specific (or not specified) to the riparian land.

An evidence based approach provided an opportunity to determine whether some of the assumed benefits of riparian works were supported by sound evidence, and whether there were any other benefits that are not being communicated to landholders.

The approach used involved:

1. The development of an *a-priori* search protocol
1. Undertaking a systematic search of web based literature using defined search strings such as ("off-stream water*" OR "off-site water*" OR "streamside livestock exclusion" OR "water trough" OR

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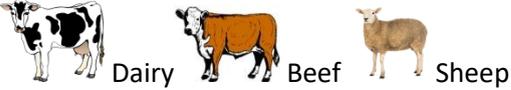
“remote water*”) AND (riparian OR “conservation buffer*” OR “green belt*”OR “watershed restoration” OR “river frontage” OR “streamside zone*”)

2. Assessing all search results for relevance and quality
3. Storing all accepted search result in an electronic evidence library
4. Assessing all full text items and extracting relevant material into evidence tables
5. Developing a set of (42) causal relationships linking specific riparian works to relevant on-farm outcomes for example “Increased accessibility of high quality water >> increased water and forage intake >> increased milk production or weight gain”
6. Summarising findings – text and table summaries
7. Developing recommendations based on findings

As per point 5 above, a key objective of the pilot was to present findings in a succinct and visual format for managers.

Table 1 below show the traffic light indicators that are used in the example results in Table 2 to provide some summary measures of the confidence in the evidence (the quantity and quality) and the consistency of the evidence in confirming that the cause and effect relationship is true. For example, there may be only a few good quality items of evidence but these may provide a high level of consistency in supporting the cause and effect relationship i.e. confirming that it is true. In other cases there may be a higher number of good quality evidence items but there may be inconsistency or little support for the stated cause and effect relationship.

Table 1. Traffic light style descriptions of the confidence and consistency of evidence used.

Production type	 Dairy Beef Sheep
Confidence in evidence quality/quantity	<ul style="list-style-type: none"> • green = a high level of confidence • yellow = some caution should be exercised for the reasons provided • red = a low level of confidence
Consistency in the body of evidence in supporting the relationship	<ul style="list-style-type: none"> • green = a high level of consistency in supporting the relationship • yellow = some inconsistency but overall support for the relationship • red = little consistency and little support for the relationship

Confidence in evidence quality/quantity is denoted as:

- green = a high level of confidence
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Results

The findings from the review revealed that there were different levels of confidence associated with different causal relationships. These levels of confidence were based on the amount, quality and relevance of evidence found.

High confidence causal relationships

From the 42 relationships examined, examples of causal relationships with high confidence included:

A) Stock excluded from heavily vegetated or weedy riparian zone >> increased ease of mustering >> reduced costs

Four independent studies of suitable quality from Australia (AITHER, 2014; Queensland Government, 2013; Sillar Associates, 1998) and the USA (Chamberlain and Doverspike, 2001) on dairy and beef cattle using mixed methods, including cost benefit analysis, provide adequate evidence for a high level of confidence for this cause and effect relationship.

B) Increased accessibility of high quality water >> increased water and forage intake >> increased milk production or weight gain

There were two primary effects here that are evidenced in the literature. The first is direct relationship of high quality water and palatability, hence greater consumption. Evidence suggests that the more water stock consume, the more they eat and hence the more weight gain or milk production. The other effect is the more direct influence of high concentrations of inorganic compounds on the health of stock hence adversely impacting on weight gain or production.

The review found that there is strong evidence (Beede, 2005; Brew et al., 2009; Ensley, 2000; Jaster et al., 1978; Landefeld and Bettinger, 2002; Loneragan et al., 2001; Looper and Waldner, 2007; Maynard, 1992; Morgan, 2011; Pfof et al., 2001; Raisbeck et al., n.d.; Saul and Flinn, 1978; Solomon et al., 1995; Willms et al., 2002) to support both of these effects but the evidence is less clear (less of it and more inconsistent) regarding the influence of lower levels of inorganic compounds on stock production. The relationship between water quality and cattle productivity gains (in the form of weight gain) is widely cited in the literature, but this relationship is primarily through the amount of water consumed and this influence on the type and quantity of forage eaten.

C) Presence of on-farm riparian vegetation >> increased land value

The review found four reliable studies from Australia (Polyakov et al., 2014, 2013; Walpole et al., 1999, 1998) and one study from the USA (Bastian et al., 2002) that examined the influence of the presence of vegetation including riparian vegetation land on property value. It is assumed however that riparian vegetation is included within the assessment of on-farm vegetation in these studies.

The literature reveals that there are many contextual variables that influence the relationship of the presence of riparian land and property value. These include the property size and proportion of native vegetation, the land use (lifestyle or agricultural production), the recreational opportunities of the riparian land (and adjacent water body) and the distance to these recreational opportunities and quality of the riparian habitat.

D) Biodiverse riparian zone >> enhanced visual amenity and wellbeing

Six evidence items (predominantly from landholder surveys) suggested that landholders undertook riparian works because they wanted to improve environmental outcomes (Ede, 2011) create an attractive and aesthetic frontage (AITHER, 2014; Graymore and Schwarz, 2012) and increase wellbeing benefits to their

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families (Land and Water Australia, 2006). Two surveys found that landholders were motivated to be involved in riparian works because of personal pride and a ‘feel good factor’ for their work (AITHER, 2014; Auckland Regional Council, 2001). One evidence item of lower quality discussed the enhanced social capital of weed control if undertaken in a model that was cooperative and community led manner such as that used by the Victorian Blackberry Taskforce (Furze et al., 2008).

Lower confidence causal relationships

Examples of causal relationships with lower confidence included:

A) Increased accessibility of high quality water (impact of inorganic compounds) >> increased milk production (dairy) or weight gain (grazing)

In a literature review on the topic, (Schutz, 2012) noted that “although there seem to be general consensus that the water quality affects the palatability and water consumption of animals, there have been surprisingly few studies investigating the effects of water quality on livestock health and production” (Schutz, 2012). This is supported by earlier research by Looper and Waldner, 2007 who state “Research on water contaminants and their effects on cattle performance are sparse”. This appeared to remain so in 2015, with only three studies of sufficient quality (i.e. with a methods section) located in the search for this evidence.

The review found few reliable studies examining the **direct influence of water quality on cattle production** aside from those studies examining the impact organic or inorganic compounds and water temperature at levels that cause disease or physiological issues.

Generally the literature suggests that the influence of water quality on milk production, weight gain and breeding success is indirectly related to both the amount of water and forage consumption. Both the amount of water and forage consumed is more directly related to production than water quality. The quality of water however can influence the palatability of water and hence the amount consumed.

B) Stock not standing in water >> reduced risk of disease

Caution should be held in the statement that “stock not standing in water reduces the risk of mastitis” as there were few good quality studies to support the oft-cited benefit that excluding dairy cows from waterways through fencing and off-stream watering reduces the incidence of mastitis. While there is a large body of research on the causes and recommended treatment of mastitis, no studies were found that isolated the management practice of excluding dairy cows from streams and tested its validity as a preventative measure. Our search suggests that more research needs to be conducted in this area if reduction of mastitis is to be promoted as a benefit of stock exclusion from riparian land. Two studies gave support for an association between high Somatic Cell Count (SCC) and a number of dairy management practices, including allowing stock to access streams. SCC is an indicator of milk quality and SCC increases when certain bacteria are present, including bacteria that cause mastitis (Barnouin et al., 2004; Schukken et al., 1990). A further study in North Carolina found that samples of mastitis-causing *Prototheca spp* were taken from water, sludge, mud, and vegetation from a creek in the stock lounging area (Anderson and Walker, 1988).

When searching for evidence regarding stock standing in water and stock illnesses due to waterborne disease, the majority of the studies focused on water borne diseases that affect humans caused by stock access to waterways, rather than diseases that affect stock only.

Table 2. Example of the summary of confidence in the evidence (quality and quantity) and consistency of evidence for key causal relationships between riparian works and productivity benefits/disbenefits.

Riparian works	Production type to which benefit applies	Causal impact pathway	Confidence in evidence	Consistency of evidence to support relationship
<i>Production benefits</i>				
Off stream water and fencing		Stock not standing in water >> reduced risk of disease	Few relevant studies found	Too few relevant comparable studies to assess consistency
Off stream water		Increased accessibility of water >> reduced heat stress leading to increased milk production	Only one study of questionable relevance found.	Too few relevant comparable studies to assess consistency
Riparian fencing		Stock excluded from heavily vegetated or weedy riparian zone >> increased ease of mustering >> reduced costs	Few studies found with search strategy used but the study designs used are reliable	Highly consistent
Off stream water		Increased accessibility of high quality water >> increased water and forage intake >> increased milk production (dairy) or weight gain (grazing)	Numerous high quality studies	Highly consistent
Off stream water		Increased accessibility of high quality water (impact of inorganic compounds) >> >> increased milk production (dairy) or weight gain (grazing)	Numerous studies found but few of high quality	Although there is consistency relating to adverse impacts from breaching thresholds, there is some inconsistency regarding other effects at lower levels

Review limitations

There are a number of limitations that are important to consider in understanding the summary of evidence:

- The scope and resources available to conduct the search for evidence in this pilot study was not comparable to those normally available in a full systematic style review which would commonly take anywhere from 6 - 12 months to conduct **for each relationship**. The method used for this project was a rapid systematic style review with over forty different relationships synthesised in just a 12 week period.
- The project was concerned with the benefits to landholders on the property where riparian works are undertaken as opposed to catchment scale, downstream or regional scale benefits. Many benefits of riparian works occur at scales larger than the property scale, and there is a large body of high quality

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evidence available regarding these broader benefits. This body of evidence has been largely excluded because it was not relevant to the project question.

- Cause and effect relationships that were part of broader causal chains but not **directly** relevant to on-farm production were not specifically searched. For example the relationship between riparian buffers and specifically sediment or nutrient inputs to waterways was not searched.

Conclusions

While the ecological and broader societal benefits of riparian works are generally well understood, many landholders want to know ‘what’s in it for me?’ While landholders having knowledge of the direct on-farm benefits of undertaking riparian works alone will not necessarily lead to increased adoption levels if other barriers continue to remain, the provision of fact based reliable information can assist landholders in making favorable decisions to adopt riparian works to achieve on-farm production gains, cost savings or lifestyle and amenity benefits.

The review of evidence conducted across forty-two causal relationships relevant to riparian intervention outcomes, revealed that there is a large range in the quality or reliability of evidence that has been used as the basis of information products for landholders. It is important that delivery agencies and landholders can have confidence in information on the benefits of undertaking riparian works at the farm scale. In order to do this, greater investment needs to be made in the approach used for gathering and assessing evidence for developing information products and an understanding of how this evidence can be used to guide decision making.

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