

Evolution of newspaper coverage of water issues in Australia during 1843–2011

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Abstract News accounts both reflect and influence public opinion through their noted ‘agenda-setting’ capability. We examined newspaper articles in Australia’s *The Sydney Morning Herald* from 1843 to 2011 to observe the evolution of media coverage on water issues related to water resources management. The results showed that water supply-related articles have dominated the reporting of water issues since 1843. This emphasis is reflected in the institutions involved and their related policy/management initiatives, as well as the themes of the articles. Extreme events such as flooding and drought have punctuated the historical record of reports on water issues. An economic development-driven tone was overwhelmingly predominant in newspaper articles (85 % of the total); however, there has been a marked decline in the importance of development-driven tone relative to environmental-sustainability oriented tone of articles since 1994. People from academia and NGOs were rarely quoted. Inclusion of wider range stakeholders should be considered as a strategic break-through and natural events should be considered as an “opportunity” to change public opinion on water issues for environmental sustainability.

Keywords Water catchment management · Murray–Darling Basin · Media content analysis · Newspaper coverage

INTRODUCTION

European settlers brought with them an ambition to control Australia’s water resources and make the vast inland productive (Lines 1991). Extensive river regulation such as dam construction and diversion for irrigation has changed the duration, extent, magnitude, and frequency of small and

medium floods and low flow events in Australian rivers, particularly in the Murray–Darling Basin (Murray Darling Basin Authority 2013). Coupled with climate change, these anthropogenic activities have led to more severe droughts and floods, the long-term drying of ephemeral wetlands, and substantially reduced outflows to sea (Skinner and Langford 2013). The stress on freshwater resources in Australia, exacerbated by climate change and social concern, has raised significant awareness of the need to better manage water systems now as well as in the future.

Conventional water resources management has been dominated historically by engineers and the ‘hard-path’ approach focusing on infrastructure as the dominant solution (Milly et al. 2007; Brouwer and Hofkes 2008; Savenije and Van der Zaag 2008). While useful in many regards, this approach addresses the physical water sector in isolation and social factors are generally considered as exogenous inputs, thus neglecting the dynamic interaction and feedback between physical and social processes (Giacomoni et al. 2013). As a result, it is argued that current water management is insensitive to social values and hence social drivers were not incorporated into management decision in a systematic way (Rammel et al. 2007; Pahl-Wostl et al. 2008).

News accounts are geared to write an immediate first draft of history, and both reflect and influence public opinion through their noted ‘agenda-setting’ capability (Bengston et al. 1999; Neuendorf 2002; Hurlimann and Dolnicar 2012). News media signals the importance of an issue by increasing the frequency and detail of coverage and by ensuring the issue receives a prominent position (Roznowski 2003). It both influences and indicates public opinion on certain issues by reflecting and deliberately framing the stakeholders (people and organizations with a stake in the policy), the situations (the situations in which

the stakeholders interact) and the perspectives (the various viewpoints of these stakeholders) (Howland et al. 2006). In doing so, the media can influence the perception, attitude, and behavior of the wider public (Bonfadelli 2010).

Dynamic examination of media representation of water issues over an extended timeframe permits observation of the evolution of media coverage on water issues. It can assist water policy practitioners' understanding of the media coverage and attitudes to water issues and the level of support for government policy directions. This analysis of news reports will support an understanding of the dynamic interaction and feedback between physical and social processes related to water catchments. To our knowledge only a few studies have been conducted on the influence of social dimensions on water management practices (Hale 2010; Altaweel and Bone 2012; Hurlimann and Dolnicar 2012; Murphy et al. 2014). All these studies were restricted to data collected over months and did not permit any observation of the evolution of social processes surrounding water issues over longer time-frames. In addition, the methodologies used were confined to either computer based text mining or content analysis and have not clearly reflected the stakeholders in water issues or the situation in which the stakeholders interact or the perspectives of these stakeholders.

Our study aims to understand the evolution of newspaper coverage of water issues in Australia for an extended time frame starting before major water resources development began and extending across that full period of development to the current era where the focus is much more on environment management. This is achieved using articles reported in *The Sydney Morning Herald* between 1843 and 2011. Specifically, our research will describe the changes in the themes of the articles reported, institutions which were involved in water issues and certain management or policy initiatives mentioned, and natural events (droughts and floods) and artificial events to which these institutions interact.

MATERIALS AND METHODS

Manual coding content analysis was chosen to observe the change of published information about water management issues over time as we believe that important elements of arguments are often implied rather than explicit in statements, and human coders are more alert to those latent content beneath the manifest content (Lombard et al. 2002; Howland et al. 2006). This approach enables data patterns to be determined from unstructured information, and it provides a powerful tool for tracking changes in media coverage (Higuchi 2004; Kirilenko et al. 2012).

Fundamental to this approach is monitoring what appears in the 'news hole'—defined as the essentially fixed amount of space the news media has to fill with reports. Content analysis has been utilized in a variety of fields to mine large quantities of unstructured textual data in order to uncover relevant patterns that could determine public attitudes, media tone or bias, the relevance of an issue, and how an issue is framed (Altaweel and Bone 2012). We adopted three distinct steps to conduct the content analysis. The first and most time-consuming step was the extraction of the text to be analyzed from the source databases. The second step was identification of the main topics of the text being analyzed including coding instrument design, sampling frame design, coding methods and intercoder reliability testing. The third step was tracking the evolution of these topics over time, to develop a longitudinal understanding of media coverage on water issues.

Media selection

Newspapers provide a long, searchable, and in-depth representation of topics reported on by the media. They also provide coverage of emerging social media and other information aggregators. Furthermore, despite rapid developments in electronic media over the last 50 years, people tend to trust print media more than broadcast media, and they tend to absorb its content more carefully (Levinson and Wien 2011). Historical newspaper archives are readily available in libraries and increasingly through online databases such as ProQuest and *Lexis-Nexis*.

It is argued that leading daily 'quality' newspapers with high circulation and different political profiles should be the target for content analysis because these newspapers often represent the major political ideologies and provide a diversity of news coverage as required by their larger potential readership (Kandyla and de Vreese 2011). Our study sought the longest possible timeframe to enable coverage over political and hydrological cycles, policy changes that have influenced water management, the development and degradation of water catchments, and changes in the public's opinion of water issues in Australia. *The Sydney Morning Herald*, published in Sydney, New South Wales, is Australia's oldest continuous newspaper and it is digitally accessible from 1843, just 12 years after it began circulation. It is a daily newspaper that now serves approximately 4 750 000 readers from diverse backgrounds on weekdays (The Sydney Morning Herald 2014). It is considered as the primary source for the conveyance and receipt of information by many researchers, academics, policy makers and the public in that region. The newspaper is not geographically confined in its coverage to New South Wales and is to some extent read by a national audience. Newspaper articles were assembled for 169 year study

period using three online databases [Trove (1843–1954), The Sydney Morning Herald's archives (1955–1986) and Factiva (1987–2011)].

Sampling

To create a manageable dataset, articles from 4 weeks in each year were analyzed using a combination of sub-sampling methods proposed by Lacy et al. (2001). These 4 weeks were made up of two constructed weeks and two consecutive weeks. A constructed week assumes a cyclical nature of the media across different days of the week and so requires that all the different days of the week be represented. In a constructed weekly sample, all Mondays are identified and one is then randomly selected, as is a Tuesday, a Wednesday, etc., until all days of the week are represented. It is widely accepted that one constructed week can represent a six month period for a daily newspaper (Riffe et al. 1993; Lacy et al. 2001; Riffe et al. 2006; Hester and Dougall 2007). By extension, two constructed weeks should reliably represent an entire year's news content. This stratified sampling approach controls for sources of systematic variation, but could possibly miss important short-term events, including extreme weather events or water specific events (e.g., "Australian Water Week"). To accommodate this, two consecutive weeks (starting from the 3rd Sunday in both April and October) were added to our dataset for analysis. For each set of 4 weeks, articles containing the word 'water' were extracted.

Data retrieval

An overview of the data retrieval process is illustrated in Fig. 1. The search generated a total number of 40133 articles. All of the news stories obtained from the search were exported from the database and stored either as word documents or searchable PDF files. Articles chosen at this stage were then reviewed individually by the authors. Items were removed if they only included incidental mentions of the word 'water' but did not pertain to issues of water management. For example, a letter written to the editor of the Herald on 3rd of July 1878 quoted that "the continual dropping of water will wear a hole in the stone" but the letter was opposing the liquor trade. Pieces in which water issues were not the main focus of the article but which nevertheless included even a small amount of significant content about water issues were included. For example, the legislation of water related laws listed by the New South Wales Legislative Assembly were included. We also removed articles that were solely focused on international issues. This resulted in a sample of 3526 relevant articles for analysis.

Coding

The purpose of the coding frame was to efficiently examine the characteristics of the news coverage of water issues to measure elements which enable description of participants, situations, strategies, and perspectives. Each relevant article was individually reviewed and information was extracted into a database. Coding was conducted manually because we believe human coders are more alert to any implied elements of arguments in their context. We designed a group of variables based on the tables proposed in previous studies (Hale 2010; Joshi et al. 2011) to code each newspaper article using the media agenda-setting theory and the social process model (Table 1).

The coding variables were grouped into three categories (Table 1). The first category provided a descriptive account of the information in terms of the location, type and length of the relevant news articles. These variables were used to describe the newspaper's preferential treatment of water issue in the news hole.

The second category aimed to describe in which geographic locations and water bodies the topics were located. The topics of articles of related water issues were categorized into five themes to reflect very common and emerging topics such as water supply and water quality and environmental water use. These three variables in this category are about the background in which an article was presented.

The third category was designed to measure elements, particularly participant, situation, and perspective in order to characterize the biophysical situation, the stakeholders in the policy or initiative whose voices were being reported, and the perspective reported. In particular, the article tone, or perspective, was coded as "environmental sustainability oriented" or "economic development oriented". The tone was considered as economic development oriented if articles focused on topics that were geared to cater for the needs of economic development such as construction of water storage and irrigation delivery infrastructure for consumptive use. Articles focused on issues that addressed ecosystem degradation or water over-allocation were designated as "environmental sustainability oriented". These two tones were coded to reflect two distinct dimensions of opinions on water issues.

At the initial stages of the coding process, the authors of this paper worked together under the guidance of the third author. To achieve consistency and reliability, 50 randomly selected articles were separately assessed by two authors. The inter-coder reliability was tested using the KALPHA macro (Hayes and Krippendorff 2007) to compute Krippendorff's alpha (Krippendorff 2004) reliability estimate. The inter-coder reliability was tested on each variable across 50 articles. The total reliability was 89.6 %. This is well above 80 % as recommended by Poindexter (2000) indicating that the coding in our study was highly reliable. Nevertheless, variability in the

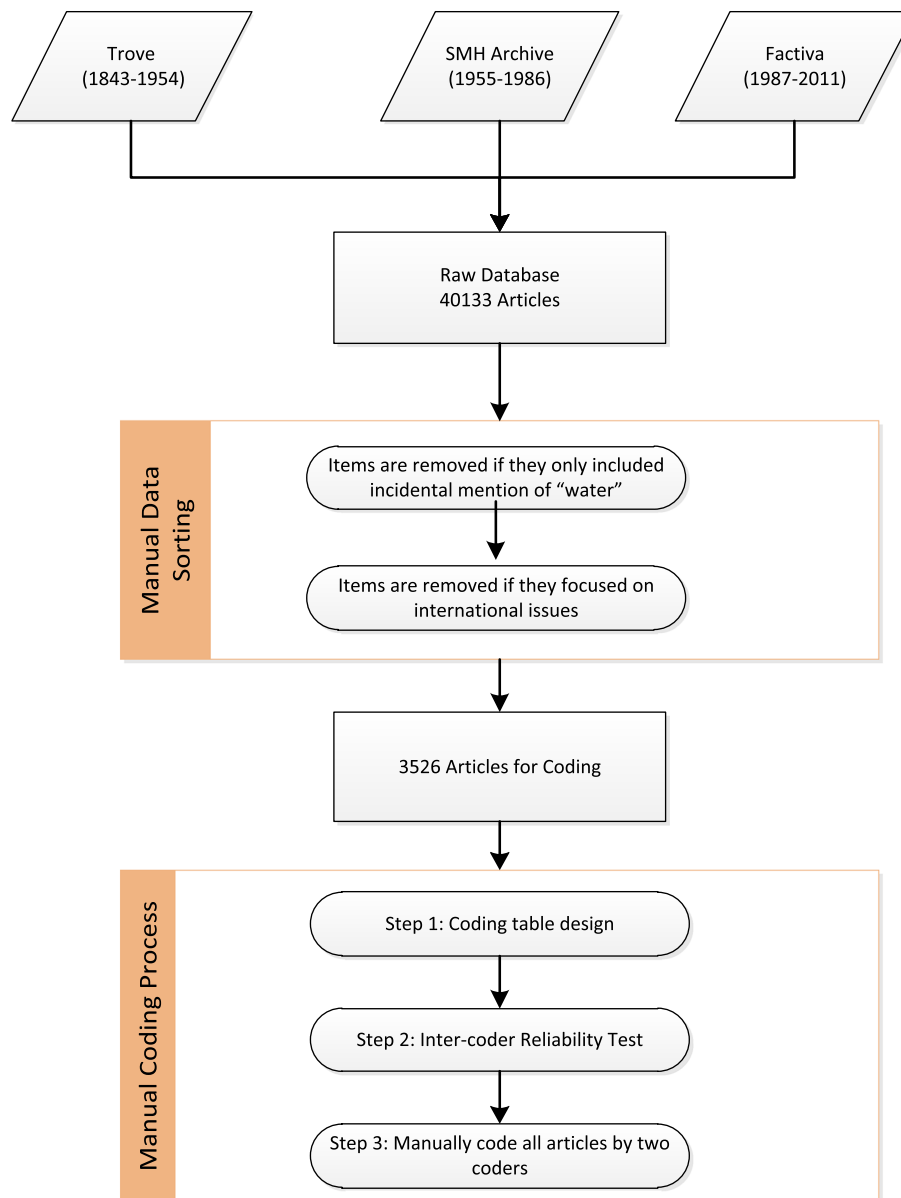


Fig. 1 Data retrieval and coding process

coder's interpretation of articles was discussed. Disagreements about the classifications were discussed and common meanings were set to further improve intercoder reliability. The rest of the articles were then coded by two authors with a third author regularly checking the coding.

RESULTS

Newspaper coverage of water issues in Australia during 1843–2011

Overall, water articles were not prominently positioned by the newspaper, with 85% found in the general news section

(pages 2–14), and only 5 % on the front page. Of these front page stories, about half were about natural events such as flooding and rainfall extremes. The other half of the front page stories were dedicated to river and rural water management (27 %), water supply and sewerage (13 %), and other issues (10 %). These front page articles included, for example, discussion of the Murray Waters Agreement Bill in 1907 and 1908, frequent reporting of the Sydney sewage outfall project in 1982, and Sydney water supply issues before the 1950s. The majority of the articles were news-oriented articles (91.9 %), followed by letters to the editor (8 %). There were only 3 editorials about water over the 169 year study period, all of which appeared after 1986. Most commonly (48 %), coded articles had a word length

Table 1 Description of coding variables

Category	Variables	Description
I: Article information	Publication date	Day, week, month, and year on the newspaper
	Article location	Page on which the article was published. We grouped them into: front page of the newspaper, general news section (Page 2–14), and other sections (Page 15+)
	Article length	Number of words in the article. We divided length into four groups: less than 100, 101–500, 501–2000 and 2001 plus
	Article type	We categorised articles as news story, letter, editorial or others
II: Context information	Administrative area	Specify location of state and town where the issue discussed occurred
	Water body	Water bodies that were referenced in the article
	Article Themes	Five themes: urban water supply and sewerage, water quality and health, water environment, river and rural water management, water research
III: Thematic Information	Institutions	Organizations and individuals which were involved with the issues discussed in the articles. We grouped them into governments, authorities, industries, research organizations and individuals
	Major Events	Major events were divided between natural, i.e., flooding, bushfire, drought and artificial i.e., chemical spills, river pollution and algal bloom
	Policy or management initiatives	List policy/management initiatives which were involved in the issues discussed in the articles, and were classified into five categories: urban water supply and sewerage, river and rural water management, water quality and health, environmental action and water research
	Perspective	Article tone was recorded into two thematic dimensions: “economic development-oriented” or “environmental sustainability-oriented”

between 101 and 500, with 32 % of articles containing between 501 and 2000 words, and a further 7 % of articles with more than 2001 words. The remaining 13 % of articles were written in less than 100 words.

The coverage of water issues in the newspaper was variable over time and reflected the history of economic development, water use development and occurrence of

natural events. For example, there were more water-related articles during the construction of dams for hydro-power and irrigation which included the Murray River Irrigation Scheme (1912), water storage reservoirs and the Snowy Mountains Hydro-electric Scheme (1949–1974), and salinity and waterway pollution in the 1970s.

Themes, geographic locations and water bodies involved in newspaper coverage

Among the distribution of articles for the five themes, the “urban water supply and sewerage” topic, including irrigation, was covered with approximately 2309 times, followed by “river and rural water management” with coverage of 2093 times. “Water quality and health” had 412 mentions. “water environment” and “water research” were covered very occasionally with 27 and 24 mentions respectively.

A clear trend in the dominant themes related to water issues was the declining importance of urban water supply and sewerage, which was replaced by increasing discussions of river and rural water management, as well as of water quality and pollution (Fig. 2). “Water environment” started to attract more attention in 1994 and become relatively prominent in 2007 when water resources were challenged by the “Millennium Drought”. Water research has a very limited share of discussions.

The spatial distribution of obtained water issue articles showed that a majority of the articles (86 %) covered the Greater Sydney region and the remaining coverage was focused on south-eastern Australia (Fig. 3).

Analysis was also conducted on the frequency that specific water bodies were referenced (Table 2). An overwhelming majority of water articles about specific rivers were focused on the Murray Darling Basin, the Murray River and its tributaries, including the Murrumbidgee river and the Lachlan river and were mostly directed toward irrigation issues. Although there was a distribution of articles addressing water issues in other states, the main rivers in New South Wales were much more frequently reported (80 %) than elsewhere as would be expected as this newspaper is published in New South Wales. The Hunter River was prominent for irrigation and river diversions while the Lachlan and Hawkesbury rivers were mostly referenced with regard to water supply issues.

Portrait of newspaper coverage on participants, their perspectives on certain water policies or management initiatives and the situation in which they interact

A total of 439 individual institutions were mentioned in 1843 newspaper articles during the 169 years. Government agencies were estimated as the most frequently covered

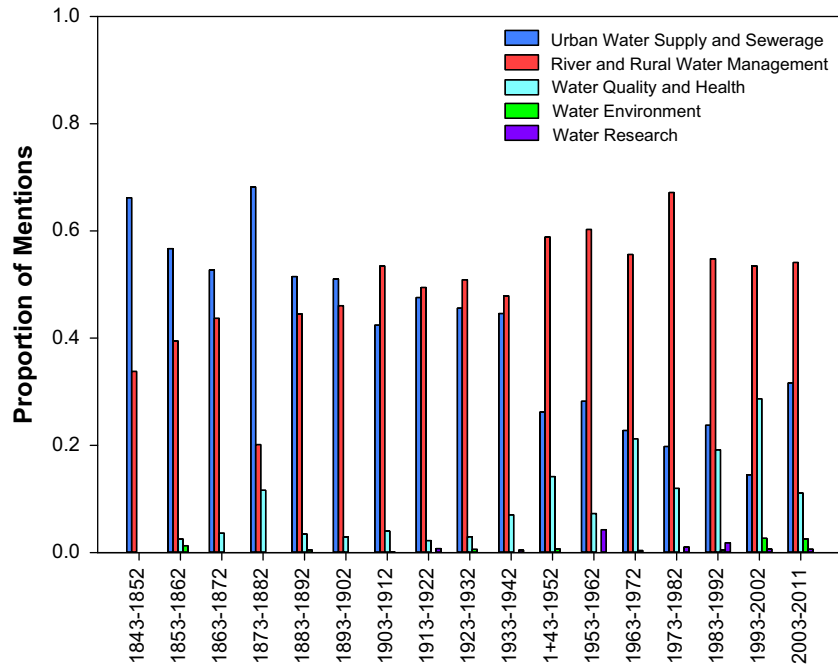


Fig. 2 Themes covered in the articles over year

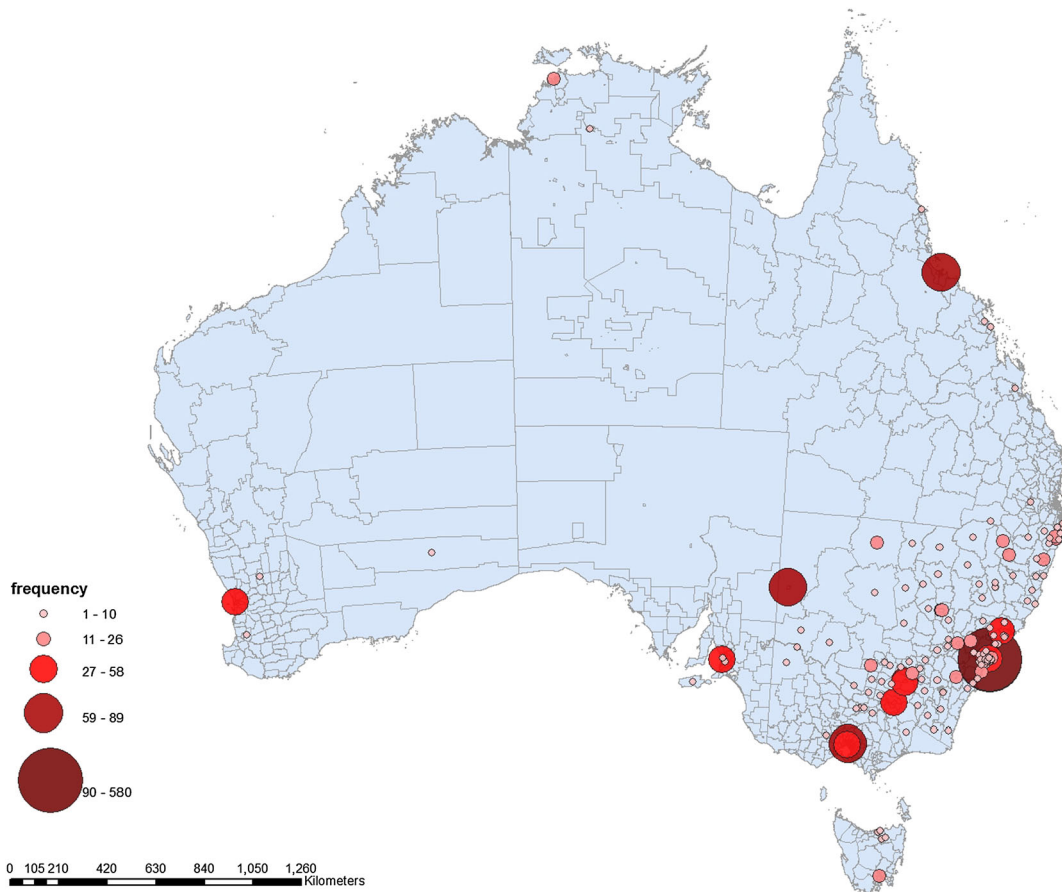


Fig. 3 The geographic location reported in water articles

Table 2 Top water bodies mentioned

Total number of water bodies mentions	1250
Murray–Darling Basin	444
Murray River	165
Murrumbidgee River	64
Lachlan River	41
Darling River	36
Macquarie River	32
Murray–Darling Basin	32
Namoi River	13
Goulburn River	9
Bogan River	9
Barwon River	8
Non Murray–Darling Basin	806
Hunter River	65
Snowy River	68
Hawkesbury River	36
Prospect Reservoir	35
Nepean River	35
Cook’s River	24
Warragamba Dam	22

(Table 3). Of all the government agencies coded, state government agencies were the most frequently referenced institutions, with the NSW State Government and relevant ministries including the Department of Public Works and Legislative Assembly sharing 14 % of the total number of references (Table 3). Federal Government agencies were only cited 23 times. The second largest institution group is governmental authority and 72 % of these related to NSW state authorities. Of the authorities mentioned, the NSW Water and Sewerage Board had 31 % of the total quotes, which were mainly related to urban water use. Industry, research organizations and individuals together were only reported in 5 % of the total number of articles.

The variations in involvement of these institutions in water issues over the assessment period are shown in Fig. 4. The NSW Water and Sewerage Board was heavily referenced over a period of 1843–1986 when water resources development was characterized by a predominance of economic and settlement goals in the early period of Australia’s development. In this stage, growth in water demand and the need for water security was met by extensive water projects funded by governments. The NSW Department of Public Works was active in this period when large water projects were carried out to meet the growing needs of the urban and agricultural sectors. The NSW Legislative Assembly received a considerable number of references during 1843–1900. During that period institutional arrangements were motivated by the rapid settlement of an establishing colony and the political discussions and negotiations in the

Table 3 Top institutions mentioned for each category

Category	Institutions	Frequency
Government		894
	NSW Department of Public Works	120
	New South Wales Government	91
	NSW Legislative Assembly	51
	Sydney City Council	43
	NSW Department of Agriculture	32
	Federal Government	23
	NSW Parliament	20
	Prime Minister	18
	Sydney Municipal council	17
	NSW Department of Lands	16
Authority	NSW Premier	14
	Water and Sewerage Board	864
	NSW Water conservation and irrigation commission	43
	Weather Bureau	13
	NSW Water Committee	11
Research Institute	Murray River Commission	11
		24
	CSIRO	7
	Water Research Foundation of Australia	2
Industry		45
	Broken Hill Proprietary Co., Ltd	3
	Broken Hill water supply company	3
Individual	Water Supply Company	3
		16
	Packaging king Richard Pratt	1

lead up to the establishment of a federal constitution and government in 1901. Under the constitution, states remained responsible for the management of water resources after 1901. New norms and rules were established through the Legislative Assembly. The importance of the Water Conservation and Irrigation Commission between 1914 and 1986 reflects the priority irrigation development had during that period. With increasing environmental concern the NSW Environmental Protection Authority was reported more frequently from 1994 after its establishment in 1991. The federal level of government was involved in management of the Murray Darling Basin in 1903 in discussing the River Murray Agreement, and became more active from mid 1980s with number of institutions arising, notably the Murray–Darling Basin Commission (later Authority). Institutional and policy reform was also encouraged following the Water Reform Agreement signed by the Council of Australian Governments (COAG) in 1994. In 2007, with the passage of the Federal Water Act, some power shifted from the States to

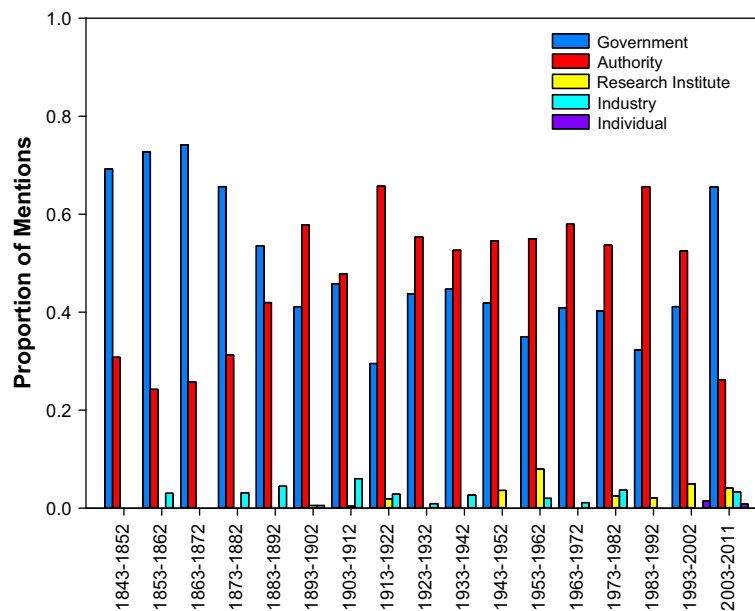


Fig. 4 Management institutions covered by the articles over the study period

Table 4 Top water policies and management initiatives mentioned

Category	Frequency
Urban Water Supply and Sewerage	299
River and Rural Water Management	195
Snowy Mountains hydro-electric scheme	48
River Murray Waters Agreement	32
Murray–Darling Basin Plan	21
Environmental Action	34
Clean Water Act (NSW)	12
Water Quality and Health	11
Water Research	11
Rainmaking experiments	4

the Federal government for planning of the Murray Darling Basin. This was a period when new arrangements were enacted to address national and interstate concerns on water management.

There were 584 policy/management initiatives referenced 782 times in the articles during the 169 years. Urban water supply programs and dam/reservoir projects had the largest share of newspaper references (Table 4). Rural water management practices were the second most frequently mentioned. Of these rural water management practices, attention was given to the Snowy Mountains hydro-electric scheme over the span of almost 30 years from the 1940s to 1970. Also, a considerable number of articles covered topics centered on Murray Darling Basin including River Murray Agreements (32 articles) and Murray Darling Basin Plan (21 articles).

The distribution of references in the newspaper on the major management/policy practices over time showed a

very clear trend over 169 years (Fig. 5). Before the 1970s water supply dominated the articles. Articles on water management and institutional arrangements were frequent during the Federation period until the 1920s corresponding with the Water Supply Bill, Water Rights Act, and joint river management leading to the River Murray Waters Agreement in 1915. River regulation and water management practices start to take the leading role after the 1940s when the large infrastructure initiative of the Snowy Mountains Hydro-electric Scheme was being planned, executed and completed in 1970. Environmental protection focused articles emerged in 1960s and 1970s in response to the issue of water pollution leading to the passage of the NSW Clean Water Act in 1970. Water quality was one of major concerns of the public from 1973 to 1994, particularly fluoridation of drinking water supplies. Stronger concern about water demand and environmental water use arose from 1994 onwards.

Southern Australia, including much of NSW, has a very variable climate with erratic cycles of wet and dry years. Of the major events reported in the newspaper, flooding accounted for 47 % (288/613) and droughts accounted for another 18 % (110/613) of the articles. Floods appeared in the newspaper with greater frequency before the 1950s, which may reflect a decreased risk of unpredictable flood damage from a more regulated river system following a period of post war dam building. Droughts appeared throughout the study period, but discussion of drought has been most prevalent in recent years (Fig. 6). Concern over the quality of Sydney's water supply known as the "Sydney Water Crisis" before the 2000 Olympic Games showed up as a sharp spike in news coverage in the 2 years prior to the Games.

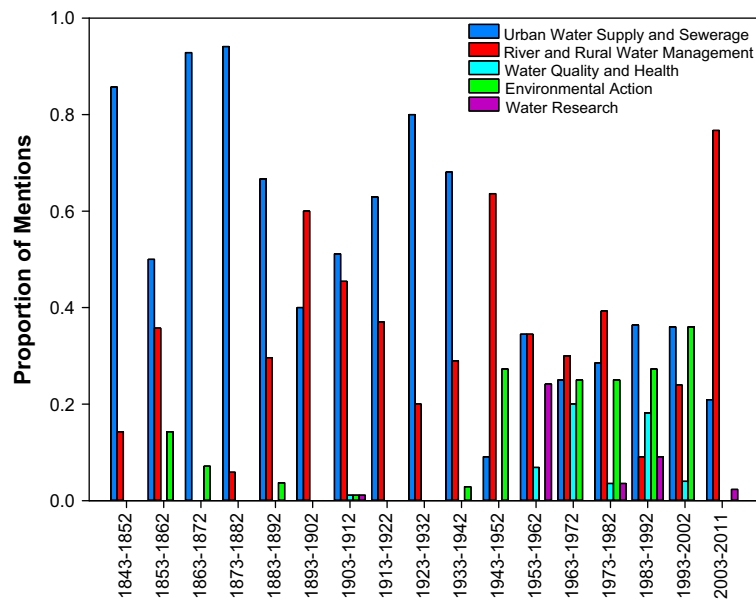


Fig. 5 Policy/management initiatives covered by the articles over the study period

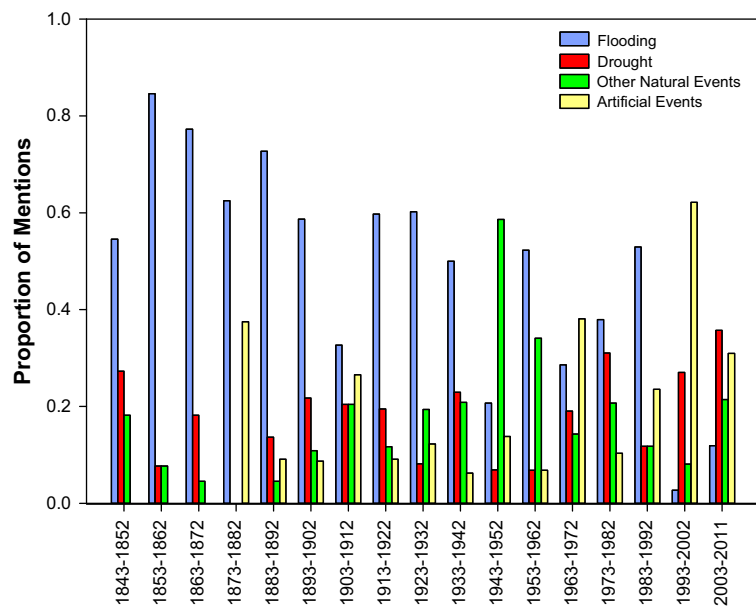


Fig. 6 Distribution of major events over the study period

Overall, economic development was predominant in newspaper articles, comprising 85 % of the total, with environmental sustainability-oriented articles at 15 %. Coverage of issues such as water supply, irrigation and waterworks was emphasized in 85 % of articles as economic development oriented. In comparison, articles that expressed an environmental sustainability oriented tone concerned issues of river and water management, water quality, water use restriction and aquatic ecosystem health.

As can be seen in Fig. 7, environmental sustainability did not appear as a more significant subject in the

newspaper articles until the 1990s, although it has existed at a low level throughout the whole study period. Economic development was overwhelmingly the main issue and media focus until 1990. Environmental sustainability became generally dominant after 1994, and a peak was reached in 2010. A small increase in environmentally driven articles occurred in 1940s, when there was reporting of water restrictions. By 1970, environmental sustainability driven articles were mainly about unsustainable agricultural and water use practices, with recognition of water issues related to the environment, especially land and water

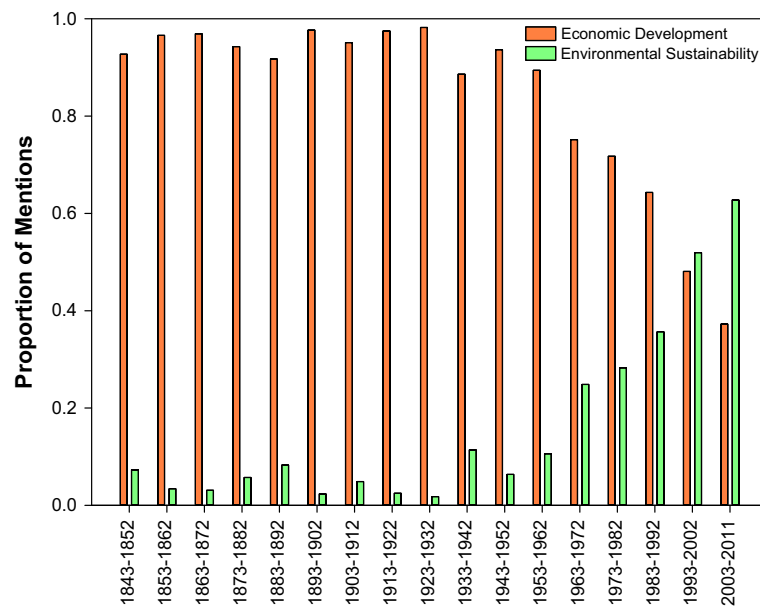


Fig. 7 Economic development-driven and environment-sustainability driven tone distribution over the study period

salinity. The 1994 COAG water reform corresponded to a major turning point and an increase in water-related articles. Water allocation to the environment emerged and sustainability became the dominant voice in the newspaper from then on. Another two key points were around 2007 (Federal Water Act and the millennium drought) and 2010 with the proposed Murray Darling Basin Plan and the continued millennium drought.

DISCUSSION

This is the first study to develop an understanding of the evolution of newspaper coverage of water issues in Australia using a longitudinal empirical study of a newspaper, *The Sydney Morning Herald*, which has extended long 169 year time frame. Major research findings and their implication for practices and future research are as follows.

News media, through their noted ‘agenda-setting’ role, signal the importance of an issue to the wider readership by increasing the frequency and detail of coverage and ensuring the issue receives a prominent position in the essentially fixed amount of space of the newspaper. Only 5 % of the articles here were on the front page, the most prominent and influential location indicating that water articles have generally not been prominently positioned in the newspaper, which likely reflects editorial perceptions of public interest in the topic. Our sample only generated 285 articles (8 % of all water articles) written in letters to the editors. This implies that either the public voice was hidden or the public had a

relatively low interest in water issues. Furthermore, the frequency of coverage of the public voice did not show an increasing trend with time, although the stress on freshwater resources in Australia has been rising in recent decades. ‘Urban water supply and sewerage’ was covered most frequently with approximately 2309 articles, and environmental sustainability became dominant from 1994. Improving media coverage of water issues for environmental sustainability is the first step in using newspapers to influence public opinion toward sustainable water management.

The daily decisions taken by the media set the agenda and influence public opinion on certain issues by reflecting and deliberately framing opinions of stakeholders who have a stake in the policy. Such decisions demonstrate stakeholder interactions and also reflect their perspectives. A total of 439 individual institutions were mentioned in newspaper articles, but government agencies and water-related authorities overwhelmingly dominated the voices on water issues in the 169 year reporting time frame (Table 3). Other institutions including industry, research organizations and individuals together were only reported in 5 % of the total number of articles. The results show that the newspaper overwhelmingly reflected government (48.5 % of overall mentions) and government authority (46.9 %) views on water. Several factors could explain this finding. It is recognised that politicians try to influence the media agenda or the way controversial issues are framed, which in turn can affect political power and government decisions (Bennett et al. 2008; Entman 2010). The battle for media attention has been an integral

part of political conflict (Tresch 2009). In addition there might be a structural bias of journalistic routines which considers powerful actors in the news as the priority. This can be explained largely by ‘news value theory’ according to which important values such as the impact on the nation, and relevance and importance to society raise the interest of political actors (Lance 1996; Cook 1998; Lawrence 2000). Tàbara and Ilhan (2008) argue that the transition of social values and public opinion in Spain was triggered by a coalition of people from academia and NGOs who were capable of articulating and integrating new identities and new values. However, our results indicated that research institutes and NGOs were mentioned 24 times out of 1843. The findings were also in line with Hurlimann and Dolnicar (2012) Australian newspaper study which found that academic and scientists were rarely quoted in water-related articles. This may indicate that independent evidence is not being heard in public debate. Therefore, there is a need to improve academic specialist and NGO’s voice in newspaper to improve significantly dissemination of evidenced-based research findings on water sustainability issues in order to create a better informed public and to stimulate behavior toward sustainable water management,

The longitudinal analysis of the major variables discussed above gave a very clear picture that major government reforms and major natural events together influenced changes in these variables. Specifically, 1901–1915 corresponded to the establishment of the Federation, the River Murray Agreement and the federation drought; 1939–1945 corresponded to the planning for the Snowy Mountains scheme and drought during the second world war; the 1970s–1980s saw increased environmental consciousness, EPAs, and the establishment of the Murray Darling Basin Commission; 1994 corresponded to the COAG comprehensive water reform policies; 2007 corresponded to the national Water Act and millennium drought (2002–2011), and 2010, the millennium drought and Murray–Darling basin plan. These were major turning points for the evolution of water themes (Fig. 1), evolution of involved institutions (Fig. 3), and relevant policy/management initiatives (Fig. 4), although each had their own change patterns. Thus, for water policy practitioners, it was important to not only change the importance of these interactive variables reported in the newspapers but also choose appropriate timing to effectively influence public opinion toward sustainable water management and thereby promote the implementation of their positions.

From a long-term point of view, natural disasters such as flooding and drought are constant themes throughout the history of Australia, although their episodic nature is clear when considered over shorter periods, such as within a decade. Their occurrence and significance is manifest in

Fig. 6. They are critical elements which influence public opinion and attitudes to water issues and are associated with the significant policy and institutional changes described above. While flooding was reported more often than drought, it was less linked to management activities. This suggests flooding in Australia has not been as significant in driving policy and institutional change as drought has been. This is likely to be because flooding is more easily alleviated by e.g., building dams, than drought. Drought however is exacerbated by the water use decisions taken by governments when water availability is more normal or plentiful and governments can take actions to redress these normal water sharing arrangements to reduce the impacts of drought. In the view of news framing, this case suggests that subjective perception of objective reality could be more powerful than the reality itself as the problem was not as severe as it was projected or believed to be (McKay 2005). This demonstrates that extreme/unusual natural events are seen as an important “opportunity” of good timing to influence public opinion about water and sustainable water management.

The economic development tone was overwhelmingly predominant in newspaper articles overall (85 % of the total), and environmental sustainability did not appear as a dominant subject in newspaper articles until 1994 (Fig. 6). This shows the influence of the newspaper on public opinion through its agenda-setting function. The media can ‘create a reality’ and set the public agenda, thereby directly influencing and reflecting public opinion on water management policy. The newspaper can influence public opinions toward sustainable water management by directly increasing the number of articles with an environmental sustainability topic and tone. However, it should be noted that to change the media’s tone may be difficult because it is influenced by many factors such as corporate ownership, profit orientation, and dependence on government, corporations, and other elite sources of information (Bagdikian 2004; Alterman 2010). In particular, in western countries, it is driven by strong commercial competition among media entities (Esser 1999; Hallin and Mancini 2004). One insight into influencing the media is given by political parties where a press release can be highly influential in raising the visibility of issues.

A majority of the articles (86 %) covered the Sydney region where the *Sydney Morning Herald* is published (Fig. 2). Beyond Sydney, the overwhelming majority of water articles are related to the River Murray, or Darling River or Murray Darling Basin and its branches which are extensive in NSW (Table 2). This implies that our study only reflects the evolution of newspaper coverage of water issues in the Sydney region and, to a lesser extent, the regional areas of NSW including its part of the Murray Darling Basin. This shows some geographical bias;

however, this is inevitable as the vast majority of the newspaper's readership is in Sydney. There could also be a reporting bias as most reporters and editors are would be located in Sydney. To get a better picture of the coverage of water issues across the State and in other parts of Australia, regional newspapers would need to be analyzed in subsequent studies to include different cultural and geographical contexts. It would be informative to compare regional newspaper coverage of water issues with that of capital city coverage as regional coverage would better reflect local issues, needs and economies, whereas the (state) capital city news is more likely to reflect metropolitan and national issues, sentiment and changes. Furthermore, comparing capital city newspapers from upstream and downstream states would also be informative in terms of how subjects are reported. For a better national picture, or picture relating to the MDB, further research should be conducted in other geographical areas, should cover several politically representative newspapers, and should include both capital city and regional.

Australia shares similar water problems with many other countries, including water scarcity, salinity, lack of environmental flow, degradation of ecological systems, water sharing across jurisdictional boundaries and uncertainty regarding future climate change. It provides a learning laboratory for understanding the interactions between public opinion on water issues, biophysical conditions and policy changes, knowledge of which is useful when embarking on new trajectories toward water resource sustainability.

CONCLUSIONS

In this paper, we examined water-related articles from *The Sydney Morning Herald* over a period of 169 years. Water as a topic was not prominently positioned in newspaper with only 5 % of the articles found on front page. The most frequent topics are related to urban water supply and sewerage and only a small proportion of articles were letters from the public, suggesting that the public had a relatively small voice in the news debate. The most commonly mentioned organisations were government institutions, reflecting the major role of government in water services and management. There were very few mentions of NGOs and research organisations.

Longitudinal examination of the data showed the major reforms in water management very clearly. Major natural events (droughts, floods, water quality crises, etc.) occurred episodically over the whole study period and were catalysts for increased coverage and interest in water reform. There was a long-term shift in the tone of articles with the economic development perspective being dominant for much

of the study period but a shift to emphasise environmental sustainability since 1994.

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