Discipline-Informed Approaches to Water Accounting

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During recent decades, managers globally have experienced increasing demands for greater transparency and the adoption of more clearly defined lines of responsibility and accountability in the management of natural resources (COAG 2004; IIRC 2010). As a consequence, systematic approaches to recording and reporting diverse data relating to such resources, and the reporting of that data in relevant, reliable, understandable and comparable ways, have gained prominence (Power 1994, 1997). This is particularly the case in the recording and reporting of water.

One of the most pressing global issues of the 21st century is the scarcity of water of a quality appropriate to ensure nations' economic, environmental and social sustainability. In addressing effective water management through policy and management reforms, the critical importance of high-quality water-related information to inform decision making is gaining recognition. However, there is no natural technical domain in which the development of a water accounting system resides, given the range of professions involved in managing water, assessing economic, environmental and social aspects related to water, and reporting on water. Thus, it is not surprising that several approaches have developed internationally for recording and reporting water. Although all are variously labelled 'water accounting', the systems have different origins and objectives, and they report different information, which is arguably influenced by their creators' discipline skills and knowledge.

The development internationally of various water accounting systems provides the focus for our study, which provides an overview of the current status of the emerging discipline. We explore the nature of water accounting, describing the various systems labelled 'water accounting' that have emerged over the last decade. In doing so, we outline the systems' origins and disciplinary influences. We particularly focus on recent water accounting developments in Australia with the aim of drawing out their potential implications for accounting regulators and for professionals in accounting and business. Finally, we raise awareness and

Recent decades have witnessed demands for greater transparency and more clearly defined lines of responsibility and accountability in the management of natural resources. Consequently, various approaches to recording and reporting data relating to such resources have emerged, particularly in relation to water. We explore international water accounting developments where different water accounting systems are being developed in different settings, with different origins, and influenced by different disciplines. Australia is developing a general-purpose water accounting system with its genealogy in financial reporting. We explore its development and implications for regulators and professionals in accounting and water-related business. We also contemplate the potential for a global water accounting system.

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conjecture regarding the likelihood and nature of global water accounting standard setting.

Our overview contributes to the broader research literature on accounting in two ways. First, we build on the growing literature that examines accounting as a social and institutional practice (see, e.g., Miller 1994). Studies in this area take as given that the application of accounting techniques and practices in specific settings can have persuasive and enabling characteristics, with potential to shape the behaviour of individuals as well as the functioning of organisations and societies (Power 1994). A direct implication of viewing accounting in this way is that the diverse processes by which accounting change can occur in specific contexts, particularly where 'new' accounting approaches are developed and applied for the first time, remain deserving of our most careful attention (Potter 2005).

Second, we contribute to the literature that explores the boundaries of the accounting discipline and how those boundaries change over time. We focus on the development of general-purpose water accounting. This is a new field in Australia in which several professional groups are involved internationally through new applications of approaches and practices that are germane to their core disciplines. In recent decades, the economic success of the accounting profession has been driven by the capacity and willingness to expand into new and financially rewarding areas of business, even where such initiatives depart from the traditional accounting base of financial reporting, auditing and taxation (O'Dwyer 2010).¹ This expansion has been partly enabled by the ability of accountants to translate and communicate the concepts and terminology underpinning traditional core functions into new areas, such that the new applications of those techniques and approaches is made appropriate, if not self evident (Free et al. 2009; Miller 1991; Power 1997; Young 1994, 1996). The accounting solution for water is developing in different ways internationally, with Australia adopting a system that aligns with general-purpose financial reporting. We explore how this approach has been facilitated and consider the implications for accounting regulators and professionals in the field.

Water Accounting Significance in the Context of Accounting

Accounting as a social and institutional practice

Studies that view accounting as a social and institutional practice focus on exploring accounting as a device for intervening in the functioning of organisations and societies (see, e.g., Hines 1992; Miller 1994). Inherent in this perspective of accounting is a focus on the ways in which measuring activities and processes in quantifiable

terms creates a means of managing organisations and societies. The application of measurement practices, such as those within accounting, enables adoption of a particular lens for understanding an individual's activities and organisational outcomes. Such practices can, in turn, offer a basis for governing people, processes, organisations and societies. As a consequence of its ability to create possibilities for action in organisations and societies, accounting is broadly recognised as influential in managing organisational and social arrangements (Burchell et al. 1980; Hopwood 1990; McSweeney 1994; Miller 1994).

The domain of accounting

Viewing accounting as a social and institutional practice also creates the need to understand how the domain in which accounting practices are applied is constituted and reconstituted over time (Miller 1994). In turn, an appreciation of the accounting domain has given rise to research that examines both the processes through which changes to the domain take place and the implications of the changes for organisations and individuals. The field of general-purpose water accounting, following principles and practices aligned with financial reporting, is new and evolving as our research is being undertaken. Hence, any consideration of the real and potential implications of its development is necessarily exploratory in nature.

Researchers focusing on the processes of accounting change generally assert the processes to be dynamic and complex, and rarely, if ever, the result of the actions of any single individual or group. A common finding of research in this field is that changes to the accounting domain can occur in a largely discursive fashion and are not necessarily driven by claims to discipline-specific expertise in the area concerned (Miller 1991; O'Dwyer 2010; Power 1991, 1996; Young 1994, 1996).

Significant transformations of the accounting domain, which involve the development of new accounting practices (e.g., discounted cash flow analysis, standard costing and budgeting) can occur from time to time. At the same time, most changes to the accounting domain seem to occur more incrementally, wherein the existing body of accounting practices or component practices and approaches are applied to new areas, where they were previously absent (Young 1994).²

This study explores an example of this incremental form of accounting change, where important recording and reporting structures germane to financial accounting have been advocated, adopted and applied for water accounting in Australia. In order to understand this, it is important to know how Australia's general-purpose water accounting resembles, or differs from, other water accounting systems.

Water Accounting Systems

When water information needs are perceived in different ways, different discipline-based solutions become possible. Internationally, various water accounting systems for measuring and reporting water are in a range of stages of development. The systems we discuss are: General Purpose Water Accounting (GPWA); the System of Environmental-Economic Accounting for Water (SEEA-W); Water Footprint Accounting (WFA); and IWMI WA, a system implemented by the International Water Management Institute.

General-purpose water accounting

GPWA draws upon the internationally accepted approach to general-purpose financial reporting. It is a water accounting system that sets as its primary objective the provision of information useful to users, both external and internal, for making and evaluating decisions about the allocation of resources (WASB 2009). The genesis of the system is the National Water Initiative (COAG 2004) initiation of a range of reforms in the Australian water industry. An intergovernmental agreement on the plan for the management of Australia's water, the National Water Initiative (NWI) established the basis for water accounting standard setting in Australia. A key assumption underpinning the NWI is that high-quality information is crucial to enable sound decision making relating to water management. Consistent with this assumption, an important recommendation in the NWI is to develop water accounting to 'ensure that adequate measurement, monitoring and reporting systems are in place in all jurisdictions, to support public and investor confidence in the amount of water being traded, extracted for consumptive use, and recovered and managed for environmental and other public benefit outcomes'. (COAG 2004, para. 80).

As part of the reform process, the Australian Commonwealth Department of Agriculture, Forestry and Fisheries engaged Sinclair Knight Merz (SKM),³ to perform a stock take of Australia's water accounting practices (SKM 2006). The report's recommendations included establishing water accounting as a *discipline* and came at a time when the conditions were conducive to its acceptance. More specifically:

- there was growing unrest that current and potential users of water accounting information were unable to command information directly from the providers;
- policymakers at federal and state levels were publicly recognising the importance of water accounting information being assembled and reported according to consistent standards in order to facilitate compar-

bility of water data and efficient functioning of water markets;

- there was increasing recognition of the need to develop a water accounting system in which the public could develop confidence – particularly given that the availability of the resource has broad social, economic and environmental consequences as policymakers and water markets react to water accounting information (COAG 2004).

The SKM report explicitly acknowledged the need for intellectual infrastructure in developing the discipline and recognised the role that accountants could play in developing a water accounting system and building capacity to continue its development and application. As noted in the SKM report: '... In particular an infusion of qualified accountants and the integration of their skills and perspectives with water industry practitioners and policy formulators is to be encouraged' (SKM 2006: 5).

It appears that the recommendations in the report were influential – not only for asserting the need for change, but also for creating the conditions for the involvement of professional accountants. Actioning SKM's recommendations, the National Water Commission established a Water Accounting Development Committee (WADC) to develop water accounting standards. At inception, the committee comprised expertise from academic, industry and government sectors and across disciplines related to financial accounting, water management and water policy.

As such, water accounting standard setting in Australia commenced formally in 2007, with the establishment of the WADC. Early on, the WADC commissioned or otherwise participated in a number of related projects, which included a study of the information requirements of present and potential users of water accounting reports.⁴ Several contributors to, and members of, the original WADC also recognised similarities between the NWI objective and the decision-usefulness objective underpinning various versions of financial reporting conceptual frameworks. Accordingly, the National Water Commission also commissioned financial accounting academics to draft a conceptual framework for GPWA.⁵ That conceptual framework was approved by the Water Accounting Standards Board (WASB), which succeeded the WADC in 2009.⁶ The financial accounting-aligned water accounting conceptual framework now forms the architecture for the development of Australian water accounting standards.

The WASB that was formed in 2009 comprises experts representing disciplines such as hydrology, engineering and accounting. It has responsibility for developing Australian Water Accounting Standards that underpin the preparation and presentation of GPWA reports by water report entities. To date, work on GPWA

has resulted in (a) the 2010 release of the first water accounting standard exposure draft for public comment: Exposure Draft of Australian Water Accounting Standard 1 (ED AWAS 1) and (b) the 2011 release of a consultation paper concerning assurance of GPWA reports. These documents are the basis for Australia's first water accounting standards that are likely to be issued from 2012.

GPWA reports include a Statement of Physical Flows, similar in nature to the cash flow statement of financial accounting, which shows how holdings of water moved during the reporting period (WASB 2009). They also include accruals-based statements corresponding to the conventional balance sheet and statements of comprehensive income: the Statement of Water Assets and Water Liabilities, and the Statement of Changes in Water Assets and Water Liabilities, respectively (WASB 2009). The Statement of Water Assets and Water Liabilities reports water rights and other entitlements to water as water assets. It also reports water liabilities, which are obligations to provide either water or water rights or other water entitlements to other parties. The Statement of Changes in Water Assets and Water Liabilities shows movements in water assets and water liabilities during the reporting period. Other important aspects of GPWA reports include a context statement, segment reporting, extensive notes to the accounts and an assurance statement (WASB 2009).⁷

Relative to other methods of water accounting that have emerged over the last decade, the distinguishing feature of GPWA is its general purpose nature – the focus on providing information that is useful to stakeholders, who otherwise could not command the information, for making decisions about the allocation of resources. These resource allocation decisions include, but are not limited to, assessments of accountability for water management and the consequent allocation of economic, environmental or social resources (WASB 2009).

At a time when there was a perceived need for a more rigorous water accounting approach providing a solid information base for water-related decisions by diverse stakeholders as well as policymakers and water markets, GPWA provided a seemingly obvious solution. After all, at its most basic level, accounting is an information system – a rigorous means of capturing large numbers of transactions involving scarce resources and reporting those transactions in meaningful ways. Building on the accounting system, GPWA is designed to be a rigorous means of capturing many water-related transactions (e.g., sales of water), transformations (e.g., evaporation) and events (e.g., flooding) and reporting them in meaningful ways.

It should be noted that GPWA developments to date focus on recording and reporting in units of volume

(e.g., mega-litres), rather than in dollar terms. This is a clear indication that the WASB is mindful of enhancing the recording and reporting of information about water, while at the same time avoiding the potential adverse consequences that can arise when accountability and performance is redefined in financial terms for the first time (Young 1996). Notwithstanding, with widespread support for the development of a general-purpose approach, much work has since centred on implementation issues – including the development and a shared understanding of definitions and concepts to enable the asserted objectives of the framework to be achieved.

System of environmental-economic accounting for water

The United Nations (UN) Statistics Division, in collaboration with the London Group on Environmental Accounting, is developing a System of Environmental-Economic Accounting for Water (SEEAW). This system is described as 'a conceptual framework' for the organisation of physical and economic information related to water using concepts, definitions and classifications consistent to those of the System of National Accounts 1993 (UN 2007: 1). It is an extension of the UN's System of Environmental-Economic Accounting, recording information about environmental and related socioeconomic indicators in a manner similar to the way in which many countries' national accounts record information about economic transactions.

SEEAW reports include physical supply and use tables, showing flows from the environment to the economy and within the economy, and water emission accounts. Asset accounts record water stocks in physical terms (the volume of water) and report their volume at the beginning and end of a period as well as their changes during a reporting period. Water stocks are classified by the SEEAW as surface water, groundwater and soil water.⁸ Surface water is further disaggregated and includes artificial reservoirs, lakes, rivers, snow, ice and glaciers.

SEEAW facilitates the preparation of information at many geographic levels, from local, to river basin, to national and multinational levels. The choice of the spatial reference for the compilation of water accounts ultimately depends on the data needed by users (e.g., decision makers, analysts and researchers) and the resources available to data producers. The framework can in principle be compiled at any level of geographical disaggregation of a territory. At sub-national level, the compilation of the accounts most commonly occurs for: (a) physical boundaries (e.g., river basins and other surface water boundaries such as sub-basins, drainage basins, water catchments; aquifers and other sub-surface boundaries including aquifer

beds, complex aquifer-aquitard systems, groundwater provinces, groundwater regions); (b) administrative regions (e.g., local, state/provincial and national governments); and (c) accounting catchments – those regions defined for the purpose of compiling water accounts for which both economic and physical data are more easily available (e.g., an accounting catchment may be composed of several administrative regions to cover a whole river basin) (UN 2007).

A key basis for understanding how different water accounting systems may be compared and contrasted is to consider the different audiences for which information is produced. The SEEAW, economic accounting for water, is based on the information needs of an assumed audience of policy analysts and informed researchers, as opposed to adopting a general-purpose approach and providing information for use by policymakers more generally or constituents or stakeholders related to water report entities such as ratepayers (water utility water report entities), or shareholders (corporate water report entities such as pulp and paper or mining companies). This partly reflects the purpose of the creator of the system, the UN Statistics Division, being the compilation and dissemination of global statistical information, development of standards and norms for statistical activities, and supporting countries' efforts to strengthen their national statistical systems (UN 2007). In contrast to GPWA reports and notes, the presentation of which is determined by a need to communicate information to users of GPWA reports, SEEAW tables yield cross-sectional or time-series data that can be extracted by informed users for statistical and research purposes or to prepare reports at national, industry or organisational level.

At the time of the *Global Assessment* (UN 2009), SEEAW was being implemented, or planned to be implemented in 44 countries in various guises.⁹ While the institution with responsibility for compiling SEEAW accounts varies internationally (UN 2009), responsibility resides with the national statistical office in most countries. Similarly, the spatial level at which the water accounts are produced varies between countries, with some produced at the national level and others at the administrative regional level.

SEEAW accounts are used to provide data for policymaking, water resource management, reporting to international agencies, and research and modelling (UN 2009). They are used primarily at a macro-level in various ways, including as input to the development of national water policies; water pricing; water allocation; improving water use efficiency; budgeting and designing of water projects; predicting future demands for water; input–output analyses; predicting implications of water reforms for the national economy; flood forecasting; and modelling for climate change scenarios (UN 2007: 17–18).

Water footprint accounting

The aim of WFA is to quantify and communicate the water footprint of a process, product, producer or consumer or to quantify in space and time the water footprint in a specified geographic area. WFA is a system indicating water use and is akin to the accounting for carbon footprints of an organisation, product or process. The water footprint concept was introduced in 2002 by Arjen Hoekstra, an engineer with policy analysis qualifications. Prior to this, formalised initiatives in the science and practice of water management to capture water consumption and pollution along whole production and supply chains were limited. As a result, there was limited awareness of the extent that the organisation and characteristics of a production and supply chain strongly influences the volumes (and temporal and spatial distribution) of water consumption and pollution that can be associated with a final consumer product. Visualising the hidden water use behind products can assist in understanding the global character of fresh water and in quantifying the effects of consumption and trade on water use (Hoekstra and Hung 2005; Hoekstra and Chapagain 2008). The improved understanding can form a basis for better management of the globe's freshwater resources.

One of the objectives of WFA is to bring focus on the extent to which the production of particular products is water consuming relative to the production of others. Thus, the system is intended to inform consumption and production decisions based upon assessments of the impact on water consumption. Where final consumers, retailers, food industries and traders in water-intensive products have traditionally been out of the scope of those who studied or were responsible for good water governance, WFA treats them as *direct* and *indirect* water users.

When analysing the water footprint, blue, green and grey water are considered. The blue water footprint refers to consumption of blue water (surface and ground water) along the supply chain. The blue water footprint measures the amount of surface and ground water available in a certain period that is consumed by a process, product, producer or consumer or within a specified geographic area. The remainder is left to sustain the ecosystems that depend on ground and surface water flows. The green water footprint is the volume of green water (rain water) consumed during the production process. This is particularly relevant for agricultural and forestry products (such as those based on crops or wood), where it refers to the total rain water evapotranspiration from fields and plantations as well as the water incorporated into the harvested crop or wood. The grey water footprint of a process step is an indicator of the degree of fresh water pollution that can be associated with the process step. It is defined as

the volume of fresh water that is required to assimilate the load of pollutants based on existing ambient water quality standards. In other words, it refers to the volume of water that is required to dilute pollutants to such an extent that the quality of the ambient water remains above agreed water quality standards.

Measuring and reporting the water footprint of a product, corporation or nation has resulted in intense debate among various professions. Issues debated include: (a) if a choice is between producing a water-consuming product in a region where employment is necessary to generate social, economic, political and cultural benefits that significantly outweigh the environmental impact of using water in the production, WFA can lead to poor decisions; (b) the system does not differentiate between 'good' and 'bad' use of water due to water abundance *versus* scarcity; and (c) the system does not differentiate between water of different quality, the opportunity cost of water, or whether water is recycled through the production process. Again, this can lead to perverse decisions if water that is non-potable is included in the water footprint of products; the water otherwise could not be captured and used for human, environmental or other needs; or the water is used in a system that then collects the water again and recycles it for other uses. Despite these concerns, interest in water footprint accounting has grown and seen the establishment of The Water Footprint Network (www.waterfootprint.org).¹⁰

International Water Management Institute

The IWMI is a not-for-profit international research centre located in Sri Lanka and supported by governments, private foundations and international and regional organisations. Its mission is to improve the management of land and water for food, livelihoods and the environment, with a particular focus on developing countries. To assist with achieving this mission, a multidisciplinary and cross-cultural team lead by hydrologists developed IWMI Water Accounting (IWMI WA) (Molden 1997; Molden et al. 2001). IWMI WA is a tool that helps identify effective strategies for water saving and enhancing the productivity of water, and also to ease the water related dialogue between professionals and non-water professionals.

IWMI WA provides information on the supply and use of water and relates water use to the economy. It is a multi-scale method to account for the amount of water available, how much is used by various sectors and the value derived from water use. It is based on a water balance approach and in the procedure translates water balance components, inflows and outflows, into various water-accounting categories such as net inflow, process consumption, non-process depletions,

committed outflow and uncommitted outflows (see Molden et al. 2001 for detailed definitions).

IWMI WA can be applied at all scales of interest and requires the definition of a domain bounded in three-dimensional space and time. Three main scales identified for analysis are the basin, service level, and field scale. The procedure considers inflows, storage change and depletion of water. Depletion of water is defined as a use of water rendering the water unavailable for further use downstream. Water is depleted by evaporation, flows to sinks, incorporation into products, or degradation of quality. This is different from other approaches (e.g., SEEWA) that account for water withdrawals. The advantage of using depletion over withdrawals is that it is hard to estimate return flows and recycling of water within the system. By focusing on flows across the domain boundaries, withdrawals and recycling are internalised within the IWMI WA.

Better management to gain more value from existing water supplies is vital for coping with water scarcity. However, the ability of policymakers to develop effective strategies in water management depends on understanding the state of water use and productivity in a basin. IWMI WA accounts for the amount of available water in a domain and reports on the volume of water used by various sectors. The framework provides information on the amount of water consumed by various uses and the value that is derived from these uses. Further, it helps to understand future options for water interventions. The framework's output tables and graphs assist water managers and policymakers to develop strategies for improved water allocations and optimising the benefits derived from water.

Since its development, IWMI WA has been applied in several studies and proved to be a promising tool in accounting for water use. To enhance the system, the WA+ methodology has been proposed to update key terminologies and concepts. Consistent with IWMI WA, WA+ examines depletion or consumption rather than withdrawals to assist to address internal water reuses in a basin. It provides information on water use in different land use categories to identify opportunities for interventions resulting in water savings and increased productivity of water. Moreover, WA+ information can be obtained almost solely from remote satellite sensing. Examples of water accounting in the Karkheh Basin and the Nile demonstrate that the approach is valuable in a range of settings, including major transnational river basins, to provide an important view on water availability and its use.

Discussion

The water accounting systems outlined are underpinned by different disciplines and they differ in important

ways. GPWA draws largely from financial accounting. It focuses upon the information needs of external users of GPWA reports about a water report entity that either holds water or water rights, transfers water or water rights, or is obliged to deliver water or water rights. As such, GPWA addresses the accounting for water rights and other (accrual) claims to water as well as water itself. It details matters such as what to report, how to report and what information to disclose about water for it to be useful for a wide range of decision making, including economic, environmental, social and political. In contrast, SEEAW has its origins in economics and statistics. It provides a database of information that is useful for research purposes and for informing reports which guide policy decisions at a macro level, while also facilitating disaggregated analysis at various levels including state, catchment, industry or firm. Its purpose is primarily to inform economic, environmental and social decision making and to understand the links between economic and environmental performance.

Reflecting a process engineering underpinning, WFA's objectives are different again. WFA aims to provide information about products and the amount of water that was consumed in their production, regardless of the source of the water. Underpinned by hydrology as a discipline, the issues addressed by IWMI WA at a catchment scale concern assessments of the productivity of water in production, where water is sometimes recycled within the catchment, but sometimes transferred across them.

Implications for professionals in the field

Notwithstanding the different origins and discipline backgrounds of the various systems, there are clearly implications, both challenges and opportunities, for professionals in the respective fields, none more so than in the case of GPWA. To the extent that its disclosures will potentially be incorporated into, or complementary to, conventional annual reports, its implications for the accounting functions of reporting entities clearly involve the need for alignment of GPWA with an evolving financial reporting system. As IFRS change and integrated reporting develops, there may be implications for GPWA.

Further, building on the existence of a water accounting concept statement on Assurance (SWAC 8) and with the release of the recent Consultation Paper on assuring water reports (WASB et al. 2011), the WASB has sent a clear signal about the importance of having an independent assurance to assist the credibility of water accounting information. What is not so clear is who should provide the assurance opinion, with the Consultation Paper identifying professional accountants and subject matter experts (including

scientists, engineers, hydrologists) being among those who may be suitable (WASB et al. 2011, para 16). Nor is it clear how the assurance function will be monitored and regulated, although the Australian Auditing and Assurance Standards Board (AUASB), working jointly with WASB on this project, signals the perceived importance of developments in the field. Perhaps not surprisingly, professional accounting firms appear to be positioning themselves for the prospect of greater client engagement in preparing and assuring GPWA information. With current mechanisms in place for using the work of experts in the assurance function (e.g., assuring mining companies' reserves, opining on the valuation of complex financial instruments), the case for the financial statement auditor to provide the water report assurance function is well supported.

Likewise, implications for accounting and business professionals abound if integrated reporting continues to gain traction. Integrated reporting is currently being touted as a robust mechanism for reporting aspects of accountability and performance that are not easily captured and communicated through conventional GAAP-based financial reports. With an emphasis on the reporting of financial, manufactured, human, intellectual, natural and social capital,¹¹ integrated reporting could offer an appropriate mechanism for organisations to format future water accounting disclosures in meaningful ways. That said, there is much work to do to understand the nature and implications of integrated reporting and the myriad implementation issues that exist. Accordingly, such changes appear, at least for now, distant.

Moving to one unified global system of water accounting

While the possibility exists for one coherent and consistent system for water accounting, the probability is low for several reasons. First, there is some support for the utility of different systems within specific locales. By way of analogy, several systems are in place to account for money (financial accounting, management accounting, taxation accounting, government finance statistics) – each of which serve information needs of diverse stakeholder groups. Intuition suggests that if one system were to emerge, it would be that which provides the most relevant and faithfully represented information for decision making. Perhaps more likely, however, is that the potential solutions will depend instead on the strength of the claims made by the relevant professional groups with an interest in water accounting and the political and regulatory support that the water accounting system secures (Chalmers et al. 2012).

The water accounting systems described in this study have been implemented, at least partially, in more

than one country and all are suited to multinational application. This raises the possibility that various water accounting systems will be modified in each country and become internationally inconsistent and incompatible if they are not regulated through international standards. Just as global financial reporting is now shaped through International Financial Reporting Standards (IFRS) in order to provide a consistent, high-quality set of financial accounting standards, is there a case for international water accounting standards governing external water accounting? If so, should international water accounting standards deal with only one water accounting system? Who would encourage or enforce their adoption? What institutional framework would be appropriate?

Central rule-makers and key advocates in various countries claim various benefits of global financial accounting standards including increased comparability of financial reports, clearer and more transparent establishment of property rights, kudos from becoming more developed and aligned with Western methods of reporting, transfer of political power, and greater access to capital markets (Godfrey and Chalmers 2007). Nonetheless, researchers are only beginning to understand whether, and to what extent, these claimed benefits are realised.

IFRS adoption or convergence is generally justified on economic or political grounds. The move is often seen as a mechanism for economic transformation, particularly for developing countries where the reporting improves financial practices and expertise. Similar arguments and interventions could apply in relation to water accounting, especially for countries where trans-border flows create issues of property rights and international water law (Godfrey and Chalmers 2012).

To question whether water accounting standards necessarily apply to only one system, we draw upon some of the experience relating to the globalisation of financial accounting standards. This relatively recent phenomenon, which gained momentum during the late 1990s and early 2000s, can be regarded as part of a globalisation movement that includes economic, cultural and corporate governance aspects. Governments and national standard setters believe that embracing global accounting standards will open up capital markets and either attract, or restrict the loss of, foreign investment. Typically, embracing international accounting developments post-dates a country crisis and is a legitimising or reputation enhancing action. This is reflected in the growing acceptance of international accounting standards in China, India, Japan and South Africa to promote economic reform; the US working more closely with the International Accounting Standards Board subsequent to its financial scandals at the start of this century; and Italy eventually embracing harmonisation to enhance its reputation in

the accounting standard-setting community (Godfrey and Chalmers 2007).

The circumstances surrounding the development and implementation of water accounting are similar. Whereas the Asian Financial Crisis and the Global Financial Crisis and several high profile accounting scandals played a role in reforms to financial reporting, severe droughts, other extended periods of water scarcity and water abundance resulting in floods have afflicted many nations and caused water crises. In turn, these water crises have generated economic, social and political hardship, and international and intra-national conflict. The world is seeking solutions to water-related issues. In doing so, there is increasing recognition of the potential for water accounting to contribute to the solution by providing relevant and faithfully represented water information.

However, the financial accounting and water accounting circumstances differ in several significant ways. For example, no system of water accounting has been fully adopted for any extended period by organisations in any country. Hence, there is no history of national standard setting and enforcement to draw upon and no history of international collaboration in the development of national standards as existed with financial accounting. This lack of experience in standard setting and collaboration is a challenge to the development of a global approach to water accounting standard setting. Alternatively, it can be seen as an advantage because the absence of extensive entrenched support for differing approaches and standard-setting cultures might facilitate the development and adoption of a single international approach to water accounting standard setting.

At a more philosophical systems level, key issues relating to the potential development, adoption and enforcement of global water accounting standards, as with global financial accounting standards, could revolve around the adoption of a principles versus a rules approach to standardisation. For example, GPWA standards will be principles-based. They will require water accountants to exercise professional judgement in applying general principles to determine what should be reported and how, within guidelines that are strategically linked to the objective of providing information to assist decision making by external stakeholders. Some countries are more rules-based in their culture, and will no doubt seek more detailed and prescriptive rules for standards. Presumably, these issues could be handled by an international water accounting standard-setting body with an appropriate composition of culturally-sensitive individuals drawn from appropriate disciplines and from around the globe.

Perhaps the approach to standard setting would differ for different water accounting systems if the international water accounting standard setter were to

take responsibility for setting standards across multiple systems, such as GPWA, SEEAW, IWMI WA and WFA, or any combination thereof.

Even drawing upon the vast experience of financial reporting standards globalisation, what cannot be forecast with certainty is whether there is a future role for international water accounting standards. The survival of an international standard setter would depend on it becoming, and then remaining, relevant and respected relative to each country applying its standards. This would require commitment from countries to adopt the standards, with such commitment probably best demonstrated in financial terms by nations at least partially resourcing the standard-setting body and its regulatory mechanisms. It would require diffusion of technical expertise to meter or model water, capture water data, and classify, quantify and report that data in meaningful ways. It would likely require cross-disciplinary collaboration and it would also demand a respected enforcement mechanism that recognises the different levels of skills and need for water accounting in different parts of the globe. It will be interesting to observe, in another decade, how far the world will progress in relation to globalising water accounting practices.

Conclusion

We have provided some background on the development of different systems of water accounting that are underpinned by different discipline bases. Given the real time nature of developments in the field, our consideration of the implications of developments in the field is necessarily exploratory.

The past decade has seen enormous attention and effort focused upon the management of water and its economic, environmental, social and other consequences. Severe droughts, other extended periods of water scarcity, water abundance and fears of global warming and sustainability issues associated with population growth and its demands upon water have all served to focus attention on one of the world's most precious resources. Out of necessity, water accounting systems have developed to inform stakeholders, internal and external, about water and how it has been managed. Interestingly, water accounting systems have developed internationally along dimensions which differ in important ways most likely attributable to their discipline-based origins.

Using water accounting information, stakeholders will make important decisions about matters of local, national and international importance. Whether to invest in an organisation or country will be influenced by a greater understanding of the organisation's or country's exposure to water supply risks. Water allocations and

pricing will be informed by information about the demand and supply of water across various regions and industries. Community infrastructure construction will depend upon knowledge of water quality, distribution and flows. Underpinning all of this knowledge and understanding will be a discipline that marries the best of financial accounting, statistics, hydrology and engineering: water accounting.

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Notes

- 1 See also Free et al. 2009; Gendron and Barrett 2004; Power 1997; Young 1994.
- 2 An example of incremental development in accounting is the implementation of accrual-based accounting and reporting to diverse public sector entities in many countries, including Australia and New Zealand, from the mid-1980s.
- 3 Sinclair Knight Merz (SKM) is an international firm with global capability in strategic consulting, design and delivery. SKM's clients include entities in the Buildings and Infrastructure, Mining and Metals, Power and Energy, and Water and Environment sectors. Its employees include engineers, planners, architects, economists, scientists and project managers.
- 4 This user needs study explicitly set out to test the receptiveness of key stakeholders to the appropriateness of the financial accounting framework as a means of guiding water accounting development in Australia.
- 5 The academics who completed this project are Keryn Chalmers, Jayne Godfrey and Brad Potter. Jayne Godfrey remains on the Water Accounting Standards Board, the national standard setter in the field, and Jayne Godfrey, Keryn Chalmers, Brad Potter, Robyn Moroney and Ken Trotman received Australian Research Council funding to examine the role of water accounting reports and assurance in generating public and investor confidence in users' decisions involving assessments of water policies, management, allocations and delivery. This project also involved a conference of contributors to the book on water accounting that provides important background for this study (Godfrey and Chalmers 2012). Brad Potter and Keryn Chalmers have presented a water accounting course to members of the Bureau of Meteorology, and Barbara Lynch and Wendy Cai are developing experiments to assess the impact of water accounting on investors' and lenders' decision making. Matthew Egan, James Hazelton, Edward Tello and Jane Hamilton have also been involved in various water accounting research and consultancy capacities.
- 6 The WASB is an advisory board to the Bureau of Meteorology (BOM). The *Commonwealth Water Act 2007* identifies BOM's water-related responsibilities to include issuing national water information standards.

- 7 Examples of model general-purpose water accounting reports for fictitious water report entities are available at <http://www.bom.gov.au/water/standards/wasb/wasbawas.shtml>
- 8 Similar classifications can also be applied in reporting water assets in GPWA reports.
- 9 Since the *Global Assessment* an additional four countries have begun compiling environmental accounts bringing the total number of countries currently compiling or planning to compile accounts to 48. The quality of compilation varies internationally and the number of countries with mature water accounting programs is small.
- 10 The Water Footprint Network was founded to promote water footprinting and engagement in activities including: developing standards for water footprint accounting, water footprint impact assessment training in water footprint accounting, impact assessment and water footprint reduction and offsetting; facilitating meetings, publications, education, research and development with regard to the water footprint concept; promoting the exchange, communication and dissemination of knowledge about water footprint; supporting organisations to implement water footprint accounting and developing a sustainable and fair water policy; and advising on the application of the water footprint by checking and certifying the use of the water footprint (<http://www.waterfootprint.org/?page=files/WFN-mission>).
- 11 See <http://www.discussionpaper2011.theiirc.org/> for the discussion paper on integrated reporting issued by the International Integrated Reporting Council (IIRC) in 2011.

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