Exploring Future Hybrid Accounting: a review of water accounting and management research

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Abstract

A review of the literature provides empirical evidence that companies use water accounting (WA) to address water shortages and water management issues. Our systematic review suggests two key points: first, phenomena such as water shortages and freshwater scarcity are no longer limited to less developed areas in Asia. Developed economies may also experience a water crisis. Second, in view of the increased pressure from stakeholders, there is a growing tendency amongst firms to manage risks around water as a resource and to implement rigid control of water consumption. [3]

Keywords: water accounting, literature review, isomorphism, hybrid accounting; Sustainable development goals

JEL Classification: Q25, Q56, M40.

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1. Introduction

There is a consensus that water resources are crucial for sustainable development. In addition, WA has emerged as a critical technical tool used by firms in various industries for natural environmental management. However, water accounting and management (WMA) practices are poorly understood. Although there is a growing number of studies on WA, our knowledge about WA remains limited. Thus, the purpose of the paper is to conduct a comprehensive review of existing literature on WA and WMA based on 50 papers published in top-ranked journals between 2015-2021.

Water accounting theory includes the social welfare part, one of the critical accounting theories. Social welfare is also a critical theory this research uses. The role of WA classifies the political power and social classes. By allocating water resources in specific ways via determining water prices, setting urban water consumption to prevent class struggles and environmental disasters is the responsibility of WMA. The definition of the hybrid accounting method is a combination of cash, accrual, and unique accounting methods. This article argues that the peculiar accounting process method is extended based on the reflexive isomorphism from various stakeholders in the WA discipline. That is, various actors shape the accounting process through active engagement internal and external to the accounting process. For different levels of demands, strategic and tacit targets, WMA skills are used in many diverse industries. To achieve business goals, it is essential to consider non-financial factors and financial factors (Soderstrom et al., 2017) and the preferences and pressure from shareholders is one kind of non-financial factors. Ferdous et al. (2019) conclude that environmental management accounting acts as a form of reflexive isomorphism that based on the needs of suppliers, customers, manufacturers, internal managers, and leaders, which are more than the basic demands of obeying the law, that causes pressure from stakeholders, especially in WA realm. The literature reveals the extent of this reflexive isomorphism, which more profound studies the internal causes of how different stakeholders influence water-related decision-making by using P. T. Young's awakening motivation theory.

For example, Wheeler et al. (2013) develop a strategic framework for farmers to adapt to climate change and summaries the gap between strategic plans and actual behaviours. Zhang and Tang (2019) reveal a severe research dead zone of investigating and monitoring related policies and actions previous to the self-disciplinary theory of water disclosure. In addition, the CDP (Carbon Disclosure Project) has preferences for big companies to disclose water information, which causes legal problems of disobeying anti-trust law and riding roughshod over small family firms when people only have chances to check information from top 500 companies via CDP database. He et al. (2021) conclude that many carbon accounting journal articles were based on CDP database. These studies build a protective umbrella for large corporations whose disclosure via CDP builds a better reputation than those who do not disclose carbon data via CDP. We need to highlight the stakeholder pressure and reveal the reflexive isomorphism as this will provide a critical eye on the databases that investors and consumers use, either directly or indirectly. Therefore, the primary research questions is 'RQ1: what factors influences decision making based on environmental change?' The following dimensions of the research questions are 'RQ2: How the main stakeholders in different industries impact WMA decision making? RQ3: What are the limited capacities of SMEs compared to giant corporations?'

Since human influences on the global environment are negative and opposite to natural powers, people live in the Anthropocene era (Steffen et al. 2007). Therefore, WMA research aim to provide an interconnected relationship between people and nature. Al-Jawad et al. (2019)

conclude that water resource management is a complex problem that needs interdisciplinary methods to investigate surface and groundwater, supply and demand of water, quantity and quality of water, urban and rural water issues, and political and non-political controls related with water. Zhao et al. (2019) state that water footprint is a concept that describes the human impact on water quality and quantity. The water footprint has three components: blue water footprint, green water footprint, and grey water footprint (Zhao et al., 2019). It is relatively easy to measure the blue water (ground and surface water) footprint and green water (soil water) footprint but challenging to calculate gray water (as a water quality indicator, grey WF (GWF) is a measure of the volume of water necessary to absorb the pollutant load generated as a result of ultimate demand of a given product back to ambient levels (Chapagain et al., 2006)). So, the final dimensional research question is, ‘RQ4: What is the definition and how to measure grey water?’

Our paper identifies important gaps in the current literature and offers recommendations for future studies in this fast growing and promising field. This topic directly aligns with the clean water and sanitation goal of United Nation’s 17 Sustainable Development Goals (SDGs). This can benefit future research as we aim to provide a sophisticated and advanced WA framework and mechanism. This paper also demonstrates the emergence of WA as an interdisciplinary topic. Such a hybrid water accounting system is expected to make a broader contribution which goes beyond water measurement and reporting.

2. Research methodology

2.1 Literature Search

There are four stages in the literature search part. Firstly, the positioning of this literature review is to find the application of WMA in interdisciplinary research. Therefore, the scope of searching articles is more significant than only looking at the business research database. For better constructing a business world for multidisciplinary research, classical management and accounting papers written by high impact factors and citations are selected as this paper's guideline and theoretical foundation.

Secondly, for achieving an innovative target as our paper is for forecasting future accountancy and managerial methods, the water-related papers were selected between 2015-2021 for a total amount of 50. The keywords for searching the 50 essays are water accounting, water management, water disclosure, water calculation, water economy, water trade, and water information. The database for sourcing these resources were Scopus and Web of Science. The ranking and quality of pieces of literature are essential for this research. Based on the trustful ranking scheme, the Australian Business Dean Council (ABDC) journal list is a gathering attitude of all Australian university business schools for the best interests of future Australian business education. Since this article talks about water business in nature, using this ADBC ranking is beneficial for the authors studying and researching within Australia. ADBC ranking ranks A* as the highest quality of research, followed by A, B, and C. To maintain the high quality of this paper, only A*, A and B ranked documents were screened and analyzed.

Thirdly, the authors accepted suggestions from experts in similar areas as WMA is a new research realm. Jones (2010) mentions that interdisciplinary approach needs collaborative team to create. The experts are from top universities worldwide, such as Australia, the UK, Italy, Belgium, China, and Malaysia. Therefore, around ten different theses were accepted by the authors and used in this research. All ten papers were from top-ranked journals for the environmental, social and governance (ESG) aspects.

Fourthly, valuable ideas from worldwide ESG experts, classical and unfailing business research theories, and professional and fair selected top-ranking water were linked. The strength of topic relevance decided the prioritize of the literature used. Jones (2010) summarizes interdisciplinary research is beneficial to improve the curriculum at all levels. Because this research uses a multidisciplinary method, it is harmful to reduce articles in industries far from the research purpose based on the authors' bias. Hence, it is effective to use motivation model to illustrate why the public views are changed by external factors to show the inter-linkage within reflexive isomorphism.

2.2 Bibliographic analysis findings

According to the latest announcement on 14/10/2021 from FSB Task Force on Climate-related Financial Disclosure (TCFD), the supporters for participating in climate change has spanned into 89 countries. However, CDP Global Water Report 2017 only contains 18 countries. Therefore, there are still 71 countries are under investigation for the water disclosure data. In the 50 top-ranked academic articles from recent 6 years, there are 18% of studies use international perspectives, 82% of studies use indigenous perspectives (28% from China, 24% from Australia, 6% from America, 4% from the Netherlands, all other countries occupies 2%, which are Ireland, Japan, Iraq, Italy, India, Brazil, Thailand, Iran, Greece, and Israel).

Figure 1. Segmentation of article pool (n=50) by research perspective (country level or international level).

All answers for research questions are based on the descriptive analysis of the 50 academic articles, 10 other studies that exports recommended with the combination of Chinese indigenous WMA practices to make the analysis more convincing and competitive.

3. Results

It has been found that accounting methods somewhat solved the water allocation issues and water fees issue, but how to motivate a more profound awareness for the public to protect the environment and put public interests in front of private interests are vogue.

WA has been a widely allowable technology used in various industries and natural environments. The most frequent accounting theory applied in top-ranking WA research is stakeholder theory, which combines the demands from citizens to governments, human beings to animals, birth to death, decades to decades. Demands are motivated by the interaction and concerns of different stakeholders, which are discovered by reflexive isomorphism. Ferdous et al. (2019) suggest that the impact of different factors towards water-related business model setting but do not provide deeper reasons. Therefore, this research uses P. T. Young's awakening motivation model to illustrate why decisions are changed with external factors and how environmental awareness is motivated concerning water protection and social resilience.

3.1 Environmental and water decision making

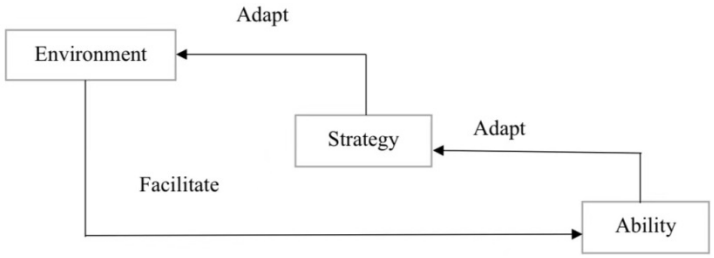

Figure 2. The relationships between ability, resource, and environment.

The capability of individuals adapts to the design of strategy. For example, farmers use advanced technical tools to enhance work effectiveness and fulfil the busy season of food supermarkets. Strategies of companies adapt to the environment. For example, fashion stores sell more raincoats on rainy days. The environment also facilitates personal abilities. For example, studying in Beijing is better than studying in rural regions of China since Beijing creates a better educational environment (1245 universities and 1418 higher vocational colleges in Beijing).

Markides et al. (1999) state that long-term planning guarantees the success of any enterprise strategy, but there is a profound contradiction between enterprise and business environment. Markides (2010) claims that change makes it inevitable for enterprises to adjust their strategies. Therefore, it is arguable that what factors influences decision making based on environmental change. By experiments, P. T. Young (1961) suggests that the affective process differs from the perceptual process in that it produces motivation and influences behaviors. According to the awakening motivation model that P. T. Young concluded in 1961, the research clue of this WMA new study is ensured as below. The awakening motivation has four dimensions: activation-induced behavior, maintain and end behavior, adjustment behavior, and organizational behavior.

Activation-induced behavior: China: (1). Regional water shortage information disclosure and public awareness of recycled water is indirect relative. (2). Health risk concerns influence the acceptance of using recycled water (Hou et al. 2021). This evidence illustrates the importance of awareness of using recycled water in China. Because of the potential health risk that people

are aware of for the health risks that are resulted from recycled water usage, they chose to stop using recycled water. However, the lack of education on using recycled water properly makes most people only focus on the drawbacks of recycled water. Some water-scarce provinces (such as Ningxia, Hebei, and Xinjiang) were still net virtual water exporters, whereas some water-scarce and developed regions (such as Beijing and Tianjin) relied heavily on external water sources (Jiang et al. 2015). The water storage differences between poor provinces and wealthy regions become more significant since China's unequal allocation and internal water trading scheme. Tianjin is a coastal city, which has lots of people and relatively few water resources. However, Xinjiang is an important agricultural province with scarce water resources and export water to other populous provinces. This kind of unequal water trading causes a decline in agricultural output, market prices of food level up, and hunger crisis of poor class. This example proves the importance of using reclaimed water. However, the private interest of healthy life is in contrast with the public interest of fair allocation. Therefore, government needs to let people know the advantages of using reclaimed water to prevent future unfair water allocation.

Maintain and end behavior: Ireland: Before the water service law was enacted in 2014, the majority of the public protested for unfair water billing regulation, successfully maintained the fairness in the social contract and ended the era of high water tax (Jollands & Quinn, 2015). This evidence suggests that future water management and relative regulation are linked with most people directly, which is consistent with the triple bottom line (profit, people, and planet). Deegan (2014) illustrates the Critical Accounting Theory means accounting study that extends beyond determining whether or not specific accounting procedures should be used. In the scenario that Ireland enacted the water service law to end the era of high water tax, the strength of voice from citizens is the trigger to change the tax regulation of Ireland.

Adjustment behavior: The move from present management regimes to more adaptable regimes that take into consideration environmental, technological, economic, institutional, and cultural aspects of river basins requires more attention because of the uncertainties along with climate change (Pahl-Wostl, 2007). For instance, the Qinling and Huaihe River basins are the decisive factor dividing northern and southern China. If the precipitation lines of the regions are lower than 800mm, the regions have belonged to the north. If the precipitation lines of the areas are more considerable than 800mm, the areas have belonged to the south. However, according to the weather data of Beijing, the average precipitation line was 400mm in 2020 and raised to 800mm in 2021. Because of the climate change caused by COVID-19, Beijing was a northern city, but now it is also a southern city. Therefore, uncertainties resulting from climate change are necessary to pay attention to adjust firm-level strategies along with.

Organizational behavior: In many countries, neoliberal reforms in the latter decades of the twentieth century resulted in massive reorganizations of the public sector. (Steger and Roy, 2010). It is feasible to support a holistic portrayal of SEA disclosures by employing silent accounting to pull together information gathered from these different reports emerging from the same business, resulting in an overall account that clarifies a range of issues and is richer in depth. This makes it easier to conduct research that leads to a better understanding of how specific data types were used in official decision-making (McDonald-Kerr, 2017). Accounting behaviors comply with political controls to avoid political attention (Deegan, 2014). Hence, companies and public sectors reorganize their operations under neoliberalism.

Literature evidence for supporting the four parts of P. T. Young’s theoretical framework are showed below in Table 1.

P. T. Young's awakening motivation	Frequencies (n)
Activation-induced behavior	13
Maintain and end behavior	7
Adjustment behavior	16
Organizational behavior	18

Table 1. Sources of water decision making in literature.

From Table 1, it is clear that there is still enough space for conducting research based on maintain and end behavior in the environmental decision making realm, which further studies have a broader perspective to focus on.

3.2 Stakeholders and water disclosure

The decision-making process starts with the perception of stakeholders. Different industries involve various stakeholders when they deal with water relative issues. It is crucial to determine the main stakeholders in different industries that impact WMA quality (RQ1.1). User studies in accounting research have a long history of focusing on stakeholder analysis, specifically whether an entity's stakeholders feel themselves to be "educated and empowered by that entity's reporting" (Tello et al., 2016). In reality, companies make compromised decisions due to the uncertainties of changes that happen among stakeholders. 'Spotlight accounting' is defined as a technique that uses crowdsourcing by independent stakeholders to reveal global organization transparency and sustainability (Perkiss et al., 2019). However, there is no holistic and systematic WA platform for stakeholders to share information and discuss.

The high water-sensitive industries involve thermal power, iron and steel, cement, petrochemical, chemical, and non-ferrous metal smelting. 6 articles emphasize high water-sensitive industries. Therefore, it is essential to figure out the trade-offs that are done within the 6 articles for caring about the demands of stakeholders. Debaere & Kurzendoerfer (2015) conclude that unequal water shares happened in the US because of the rise of service industries. More and more people have been working in service industries instead of water-intensive industries since the 1970s. The water consumption of service industries far outweighs that of other industries (Debaere & Kurzendoerfer, 2015). The other stakeholders are foreign and domestic consumers, investors, governments, and non-trade nature for a certain amount of water (Debaere & Kurzendoerfer, 2015). Zhou et al. (2021) also suggest that agricultural and manufacturing enterprise-level users in China call for enhanced water management and water disclosure. In the finished products of buildings, more than 3/4 of total water use is accounted for by building materials, such as steel, cement, lime, and metal goods, and virtual water consumption is about 1/4 due to the increasing number of buildings in China (Han et al., 2015). Therefore, direct manufacturers (the consumers of visible water) and indirect producers of construction materials (the consumers of virtual water) are water management stakeholders. Okadera et al. (2015) indicate that the energy supply of Liaoning province China is dependent on water resources in surrounding provinces. This opinion corresponds with Debaere & Kurzendoerfer (2015) that the allocation of water resources depends on the interrelationships of different sectors and places.

However, Zhou et al. (2018) and Zhou et al. (2020) illustrate that corporate risk-taking is adversely connected with water disclosure in China. This is because water disclosure by firms has not yet satisfied the demands of investors, and it is difficult for water disclosure to reduce information asymmetry between companies and investors (Zhou et al., 2018, Zhou et al., 2020). This is because different countries have different policies of water resource management. Zhou et al. (2021) divide patterns of international water resources management into three kinds, which are the from top to end model (users such as German and France), the decentralized management model (users such as the USA and Canada), and the decentralized and centralized

management model (users such as China). Hence, further studies are suggested to be conducted according to the comparability of different water resource management models among various nations.

3.3 Water disclosure between large and small sizes of firms

According to institutional theory, the process of "institutionalization" results in organizations becoming increasingly similar to one another to obtain legitimacy and match society's expectations (Baum and Dobbin, 1983). This is because small and medium-sized businesses benefit and gain market share by imitating organizational habits of larger corporations. Therefore, the ranking of the CDP database leads to herding behaviors from small companies to follow the ways of disclosure of top 500 corporations, which increases market convergence and decreases market diversity. Enterprises with more market power are more ready to voluntarily provide water resources information in moderately competitive industries (Zhou et al., 2020). Further experiments suggest that having a state-owned identity substantially influences water information sharing due to product-market rivalry in China (Zhou et al., 2020). The more decisive influence causes herding behaviors that may lead follow blindly. Although small businesses learn managerial and operational experiences from major companies, the financial capability for resistance to climate change that corporations have is difficult to imitate. Extremely high temperatures and humidity increase the volatility of stock markets, whereas shallow temperatures and humidity cause volatility to increase and decrease, respectively (Shim et al., 2017). More giant corporations have a more vital ability to resist weather risks than small and medium-sized firms since larger companies can afford better workplaces, advanced technological tools, and other services to deal with external environmental strikes. As a result, even small businesses disclose water information as large businesses do, the revenue and marketing competition is still lower than large businesses.

3.4 Accounting framework for grey water.

The inefficient and ineffective allocation of water resources results in social conflicts and unrest and gives birth and promotion to grey water. The volume of water required to absorb dirty water is referred to as the grey water footprint. It represents the extent to which water contamination is caused by human activities (Liu et al., 2017). Therefore, it is necessary to calculate the freshwater usage when the procedures generate improvable recycled water (the resultful grey water consumption should be higher than the freshwater supply volume used to generate grey water). More specifically, some small-sized fashion manufacturers do not reckon it is worth using water recycling technology since the volume of freshwater usage for producing gray water is relatively high and the revenue is low. The formula shows here: freshwater (for generating reused water) x water price < revenue (or profit is earned by using grey water).

Zhang & Tang (2019) divide water footprint into two levels: site level and firm level. The overall consideration of grey water consumption cost calculation is at the facility level. Nevertheless, the actual performances and decision making for whether the manager will use grey water purify technology vary from site to site. The adequacy of WA determines the accuracy of grey water accounting since the data and accounting entries are different in different kinds of factories within one company. In Europe, unauthorized discharge of wasted water is unlawful according to the Environmental Management Act, and similar regulations are conducted within the scope of development nations worldwide (Lambooy, 2011). However, in some developed countries and rural areas of development countries, the discharge of wasted water is always happening, because of the non-transparent data and lax supervision due to lack of access to transportation. This is why self-regulation and voluntary disclosure of WA information are ineffective and efficient in some situations. Therefore, the solution for

promoting grey water usage starts with enhancing the popularity of water purifiers and controlling price levels for this kind of technology and freshwater. This is because some corporations are located in rural areas, which are challenging to buy grey water directly from the government, and the managers only care about profits and lack environmental protective awareness. Using water and technological pricing strategies to activate the motivation for farmers and firms to use grey water remit the pressure of freshwater transportation and allocation and promote social harmony.

Conclusion

WMA is a topic based on longitude and historical research. This is because many papers reveal severe water-related social conflicts due to improper governance, unfair water resource allocation, expensive water prices, non-transparent water data, and involuntary entrepreneurs who care more about personal interests than saving water. Recent research is emphasized classical social conflicts, water trades and prices. They are intended to motivate people to save water and create a sustainable society. The tacit knowledge that all the academics who conducted these studies is they believe water resource accounting and management issues can be solved by equitable distribution of the water resource is limited in essential. More and more deserts are emerging, which creates irreversible water depletion for people who live nearby. Rising sea levels threaten people who live near an iceberg, such as Iceland, Canada, and so on.

Natural disasters are difficult to control only by the changing routes of water trades, more equitable water prices, and advanced water treatment technologies. The end of future predictable natural disasters starts with the herding behavior of protecting sources of water. Hence, this study utilizes P. T. Young's awakening motivation model to divide the 50-60 research into four research directions: activation-induced behavior, maintain and end behavior, adjustment behavior, and organizational behavior. The most popular research component is organizational behavior. C suites change operational modes of their corporations is impacted by external environments, such as policies, economics, etc. Maintaining and ending behavior is the least popular research trend, which is vital since educating people to end wasting water is hard and necessary. Therefore, further research is suggested to focus more on practicing maintain and end behavior in WMA. Changing the public's habits naturally and comfortably, deficient educated people is challenging and worth more profound research.

He et al. (2021) expose the carbon accounting works of literature mainly to find solutions to gain profits for developed countries by sacrificing profits of developing nations. A similar inevitable issue happened in WA as well. More and more factories of western brands have been operating in developing countries, such as India, China, and so forth. Water consumption and water pollution are becoming more severe because of the invasion of foreign factories. Although the local job opportunities are boosted due to more factories, the intergenerational effects are adverse and hardly reversible. Developing countries' climate change and water quality issues negatively impact developed countries since Western brands still need to import products made of polluted raw materials. This research provides an entry step for future researchers to walk through to a more complex WMA framework. It shows the importance of mobilization of water protection for the public and provides reference for water management policy making in a social contract perspective.

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