Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

Integrating Accounting and Public Health for Water Governance in Fragile States

Nael Jaafar Ali Alqudhayeb

Department of Petroleum Project Management of Oil and Gas, College of Industrial Management for Oil and Gas, Basrah University for Oil and Gas, Basra, Iraq

Email: nael.jafar@buog.edu.iq

Abstract. Background: Water governance in fragile states remains a persistent and multifaceted challenge, driven by political instability, weak institutional capacity, and limited integration of environmental and public health data. Objectives: This study synthesizes prior research on Blue Accounting, Material Flow Cost Accounting (MFCA), and Activity-Based Costing (ABC), aiming to develop a multidimensional framework that supports integrated water resource management in fragile contexts. Methods: To carry out this study, I have chosen a qualitative and exploratory design that uses a comprehensive review of literature from 2020 to 2025. The plan is to bring together Blue Accounting, Material Flow Cost Accounting, and Activity-Based Costing with public health indicators for Iraq, which is a fragile state. The researchers used academic research to highlight similarities, notice gaps, and design a model for managing environmental actions that relies on accounting and environmental science. Results: Blue Accounting has emerged as a transparent tool for linking water-related investments and outcomes across institutions and sectors. MFCA enhances resource-use efficiency by identifying material and energy losses within water systems, while ABC supports cost transparency and accountability across complex service chains. Integrating these cost-based approaches with public health indicators—such as access to safe drinking water and incidence of waterborne diseases—can enable evidence-based policymaking, improve intersectoral coordination, and strengthen resilience in water governance. Conclusion: The proposed conceptual model addresses the institutional and operational challenges facing fragile states and offers practical guidance for sustainable, equitable, and accountable water resource management.

Highlights:

1. Integrated Accounting Tools-Combining Blue Accounting, MFCA, and ABC imporoves water governance by enhacing transparency, efficiency, and accountability in fragile states
2. Public Health Linkages-Aligning water governance with health indicator such as acces to clean water and disease rates enables evidence- based policymaking
3. Contextual Application- The framework is tailored for fragile states like Iraq, addressing institutionalgaps and supporting SDG-aligned water management system

Keywords: Blue Accounting, MFCA, ABC, Water Governance, Public Health, Fragile States

Published : 30-06-2025

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

Introduction

2.1 Background and Context

Managing water is seen more and more as essential for sustainability, fair health and financial stability. In countries facing conflict, broken institutions or regular failures of rule such as Iraq, challenges in managing water are made worse by widespread vulnerabilities, scarce data systems and failure to coordinate among agencies. Because water scarcity and pollution are increasing due to climate change, integrated and accountable water governance is now very important.

2.2 Problem and Knowledge Gap

Zahoor and Mushtaq [1] recently found in a global study that the excessive use of fertilizers, pesticides and inappropriate irrigation in farming leads to both water pollution and risks to public health around the globe. The study shows that weak rules, poor farmer education and divided government make pollution worse, mainly in countries facing challenges. This research underlines the need to set up joint water management frameworks which apply economic methods and health standards to stop agricultural pollution and support continued development.

Out of the global population, over 2 billion people still do not have safe drinking water and more than 3 billion do not have good data on water quality in their countries, reports the UN-Water assessment released in 2021. The report shows that the lack of integrated policies, weak teamwork among authorities and insufficient data systems are the major challenges to sustainable water management. These observations corroborate the problems found in Iraq and invite us to create tools that bring together environmental accounting and public health [2].

Using the Water Quality Index (WQI) and GIS interpolation across 1,468 kilometers in Iraq, the study determined that the water quality worsened significantly further downstream. In many of these places, total dissolved solids, chlorides, sulfates and BOD_5 were all found at amounts above the WHO standards, especially in Basrah. They highlight that persistent challenges in protecting Iraq's water sources are mainly due to missing governance frameworks and call for greater attention to linking both environmental and public health data [3].

Assessments carried out in southern Iraq, especially by the Shatt Al-Arab river, have shown that the water is extremely contaminated because of a lack of freshwater upstream, waste discharge from industries and seawater entering from the Arabian Gulf. Analysis of

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

water quality in the region reveals that TDS, chlorides, sulfates and heavy metal levels often surpass both national and WHO standards, so the water should not be used for people or for farming purposes [4]. The research highlights that the lack of proper management means environmental information and health risk indicators should be managed together.

Bottled water bought in local markets in Iraq has been found to have dangerous levels of contamination in some cases when checked using the Water Quality Index (WQI) model. This shows a general problem with managing and overseeing water quality which means that a more unified and clear water governance structure is urgently needed.

While countries around the world focus on providing water and better accountability, numerous fragile nations have not developed ways to monitor, divide and oversee their water supplies transparently. In most cases, public-sector systems don't gather data on environmental costs or relate the use of water resources to public health. There aren't many attempts to bring together elements of environmental accounting, cost analysis and public health together in a single framework for governing.

2.3 Interdisciplinary Opportunity

Two recycling technologies were assessed for economic and environmental feasibility using MFCA by [5]: IRETA2 and ReComp. The researchers found that while these technologies weren't commercially available initially, the MFCA helped them understand areas such as speed and equipment ability, making the products profitable. In addition, the study points out that MFCA can assist EU-wide green strategies and law-making objectives such as the Green Deal. As a result, MFCA helps decision-makers in fragile states set policies related to water, waste and public health when their infrastructure is not yet fully integrated.

They described how Material Flow Cost Accounting (MFCA) is linked with SDGs 6, 7, 12 and 13 by connecting the elements of financial and environmental care in a company's decisions. With an integrated MFCA–LCA model, the research demonstrated how organizations can measure both the loss of materials and CO_2 emissions and create more efficient approaches to sustainability. In addition, the authors related MFCA to the SDG Compass, showing that it can assist companies in the fourth phase of implementation by making sustainability a regular part of management processes. As a result, MFCA becomes even more crucial in directing resource management in countries that are considered fragile, for example Iraq.

Kingsley et al. [6] suggest making ocean sustainability reporting a natural extension of

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

business disclosure, by building it within the rules of accounting. Environmental transparency, according to their conceptual model, is based on marine resources, sustainability and communication with interested parties and therefore requires companies to publish reports that capture how the ecosystem is performing. Demonstrating this supports the aim of our study to combine accounting practices like Blue Accounting with how water resources are managed in Iraq and other fragile countries.

Blue accounting, according to a recent study by Larasasti et al. [7], is an effective way to help marine ecosystems by joining forces with marine policies and efforts to fight climate change. Through cases in Indonesia, it was shown that blue accounting makes marine resource use more transparent and fits companies with society's expectations as explained by legitimacy theory. They prove that blue accounting frameworks can help nations like Iraq that share the same governance and ecological issues in reaching their environmental accountability and sustainable development objectives.

Work done recently has confirmed that Activity-Based Costing (ABC) can assess water use in industrial settings. Through ABC, Akgün et al. [8] were able to identify high water users at a concrete facility and give suggestions for making both the operation and the environment more efficient. Their study finds that ABC supports sustainability by setting environmentally responsible goals and matching resource planning to indicators for sustainability.

Blue Accounting, MFCA and ABC are some of the new tools that help us deal with this problem. Blue Accounting allows for cross-sectoral gathering of water information and tracking of performance. With both organizations, organizations can spot where energy and materials are being lost in water processes, and ABC also helps them divide costs more evenly amongst sectors. But using them in places where states are fragile, with a focus on public health data, receives little study. that any information must be correct, accurate, and available to be stored, retrieved, processed, and made available safely and reliably [9].

2.4 Aim of the Study

This paper will bring together recent scholarly works that explore how Blue Accounting, MFCA, and ABC systems interact with public health in order to create a useful water governance system for Iraq. Joining environmental accounting and policy meant for health services, this study contributes to making water management complete, sustainable, and trustworthy in various political situations. To achieve this, the study applies systematic

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

literature synthesis and targets public policy, regulatory bodies, and development practitioners in water-deficient areas.

3. Literature Review

As an illustration of the practical use of MFCA, the team led by Manda et al. [10] was able to discover inefficiencies at the Doorndraai Water Treatment Plant in South Africa. It was revealed that energy use and water lost due to leakage were the causes of abnormal non-product output. With the help of MFCA, the plant could identify the different flows inside their operations, find points where resources are lost and suggest ways to address these problems by upgrading infrastructure and using alternative energy. It proves that MFCA makes better business decisions and protects the environment, resembling useful actions for Iraq which is a fragile country.

The use of integrated accounting is reinforced by a study conducted by Tsai and Lin [11] showing a merged approach of ABC and ECA works well in a Taiwanese manufacturing context. The case study found that traditional systems ignored many environmental expenses which caused companies to set prices and allocate funds incorrectly. Thanks to ABC and ECA, the firm could follow how environmental impacts were caused by different activities, choose the main resource-intensive operations and ensure sustainability factors were considered in their plans. Using both tools enabled us to see water-related expenses, make green decisions and show information on environmental efforts which are important for accountable water governance in fragile nations.

Alshurideh and his team [12] give an excellent example of ABC by demonstrating its positive effects on the efficiency of government services in Jordan. Using a quantitative survey among 322 employees from different government departments, it was found that using ABC was connected to benefits in financial planning, allocating resources and improving services offered. They explain that thanks to ABC, institutions can easily identify core and non-core activities and transfer resources when needed. Such results highlight how ABC can be used outside the private sector and should be added to government frameworks, especially when it comes to fragile countries, so that delivery of public services is clear, efficient and accountable to help the country grow.

Many sources found in recent Asian industrial pollution literature mention that traditional ways of governing and reporting on the environment fail to appropriately address the fast fashion industry. Niinimäki et al. [13] and Santa Rosa Lana and Duarte [14] claim that the sector is unclear and does not correlate resource use with environmental effects. Since data from supply chains is difficult to find and agencies fail to work hand in hand, it is

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

essential to have standard tracking systems in place. Cross-sectoral water governance offered by Blue Accounting helps link the investments made to improve water with final results on public health and nature. According to the research carried out by Okafor et al. [15] and Sanjrani et al. [16], the circular economy in Asia fails largely because of their disunited data infrastructure. Blue Accounting helps fill the gap by setting up systems that keep environmental reporting in line with the responsibilities of an organization. Another plus is that the WEA uses public health indicators, so it is very important in places with water scarcity and many diseases [2].

Supporting the case for Blue Accounting frameworks, Table 1 gives statistical evidence from worldwide and regional situations. These findings prove that many countries facing water challenges, pollution and ineffective laws require integrated, open and accountable management for water.

Indicator	Value	Source
Number of people lacking access to safe drinking water (global)	**2.2 billion**	**UN-Water, 2022**
Number of people relying on untreated surface water (global)	**115 million**	**UN-Water, 2022**
Increased concentration of sulfates in the Euphrates River (Iraq)	**Yes (documented)**	**Chabuk et al., 2020**
Increased concentration of nitrates in the Euphrates River (Iraq)	**Yes (documented)**	**Chabuk et al., 2020**

Table 1. Statistical Justifications for Adopting Blue Accounting in Fragile States

Relating environmental accounting to public health aspects has become widely recognized as a good approach to manage water resources in areas at risk. According to Chen et al. [17], the accounting of water resources should include both big data and market forces, as they believe that treating water as an economic asset can aid sustainable development. It means Blue Accounting is prioritized, as it recommends clear disclosure and links different groups in financial water reporting.

Andon et al. [18] believe that accounting ought to benefit the public by including the welfare of the environment as a part of institutional reporting. In addition, Vardon et al. [19] argue that natural capital accounting should be used to help ensure environmental considerations are included in decisions made by the country. These models let companies use tools such as MFCA and ABC to identify environmental problems and waste.

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

In 2022, the UNDP [20] and Hamdan et al. emphasize the serious water problem in Iraq, where problems with institutions, contamination, and changing weather threaten both water supplies and people's health. Larasasti et al. [7] include Blue Accounting in policy and activities addressing climate change in oceans, pointing out its role in enhancing fairness and clarity in environmental control. In the same way, Kingsley [21] believes Blue Accounting will change traditional accounting approaches by including ecosystem results in regular financial statements.

Global studies reveal more reasons to adopt an integrated way of accounting. In their study, Liu et al. [22] examine water scarcity in agriculture using the availability of blue and green water, arguing that thorough observation of resources is necessary. According to Rodell et al. [23], there is a fast and alarming loss of groundwater in several areas, underlining the need for improved ways to track hidden water losses. Scainlon et al. [24] believe that using nature-based actions (NbS) helps resolve water shortage, and they highlight how integrating planning of water, economics, and public health promotes both ecology and financial and health systems.

It is important to design and apply integrated and imaginative frameworks in urban water governance in unstable countries. A recent study carried out by Al-Hadithi and Younis [25] found that urban water management approaches from the past do not work well in places such as Baghdad and Sana'a because key institutions are weak and the systems are badly coordinated. The article supports using health and sanitation concepts in managing water resources and also highlights that environmental accounting tools can strengthen efforts in weak environments.

Mulyani et al. [26] suggest that the development of environmental accounting indicators for water governance could help Indonesian municipalities, since they notice that effective performance-based metrics are lacking in water management. They also consider pollutants, water economics, and ecological conditions, which match the Blue Accounting and MFCA goals of making practices accountable and transparent.

The authors give a practical example of the Blue-Green Infrastructure Model (BGIM) designed for cities such as New El-Alamein in Egypt. This model mixes arrangements for space, water flow, and natural techniques to stop floods and reuse water. Though the paper does not mention accounting systems, it proves that connected, green planning helps support environmental law enforcement in cities that are at risk.

All of this reveals that such a framework should handle financial aspects, environmental protection, and public health issues together when it comes to water management. They

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

join strengths to use Blue Accounting, MFCA, and ABC to design effective plans for managing water sustainably in urban areas in Iraq.

Blue Accounting, MFCA, ABC, and public health metrics have been research topics by themselves, but their integration is limited, mainly in areas of fragile states. For this reason, a single system is needed that combines environmental, financial, and public health methods for better water control. This model presents how all these factors work together in the context of a fragile state.

Research Methodology

To carry out this study, I have chosen a qualitative and exploratory design that uses a comprehensive review of literature from 2020 to 2025. The plan is to bring together Blue Accounting, Material Flow Cost Accounting, and Activity-Based Costing with public health indicators for Iraq, which is a fragile state. The researchers used academic research to highlight similarities, notice gaps, and design a model for managing environmental actions that relies on accounting and environmental science.

4.1 Research Design

The research follows the SLS approach, looking for, assessing, and understanding existing information on the use of environmental cost accounting in water governance. SLS is a useful method for developing theoretical models in conceptual research instead of checking hypotheses with experiments. The goal is to develop a conceptual framework specifically made for fragile states.

4.2 Data Collection

Searching for data was carried out in Scopus, Web of Science, SpringerLink, and ScienceDirect. Only articles peer-reviewed in journals from 2020 to 2025 were used to make sure the information was current. A search for relevant information was done with keywords such as: "Blue Accounting," "Material Flow Cost Accounting," "Activity-Based Costing," "fragile states," "water governance," "public health," and "environmental sustainability."

In the beginning, approximately 120 documents were considered for further review. After removing copies and using the criteria, 45 top academic sources were chosen for thorough review and merging of information.

4.3 Inclusion and Exclusion Criteria

Inclusion criteria:

- Articles published in English

Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

- Studies published between 2020 and 2025
- Peer-reviewed journal articles
- Focus on Blue Accounting, MFCA, ABC, and/or public health within water governance

Exclusion criteria:

- Non-peer-reviewed sources (e.g., blogs, media articles)
- Studies outside the water or environmental governance context
- Articles published before 2020

4.4 Analytical Procedure

The chosen papers were analyzed to find out their meaningful themes and shared ideas. Insights on institutional accountability, ways of distributing costs, environmental reporting procedures and health-based outcomes were obtained by extracting them manually from the documents. The findings were put together and organized using conceptual matrices to design a framework that looks at water management from several angles in such environments.

5. Conceptual Framework

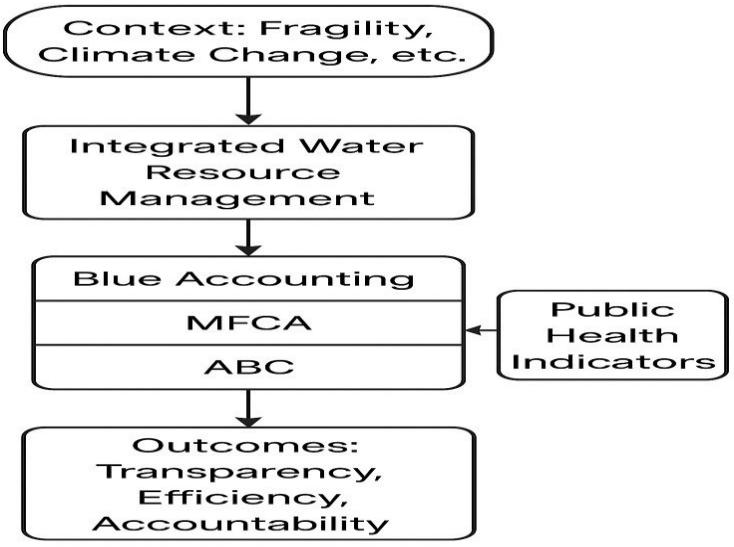

Figure 1. Vertical Conceptual Framework

The study demonstrates the ways Blue Accounting, MFCA and ABC are linked and how their impacts join to affect water governance in environments that are easily disturbed.

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

The framework stems from what the literature shows and aims to reveal how cost-accounting approaches improve transparency, efficiency and health concern in water management decisions.

Blue Accounting links the financial activities related to water to the results or achievements of different institutions. MFCA improves the way we decide by identifying waste in materials and energy and so we can make better use of resources. ABC makes it possible for water expenses to be assigned rightly so that each sector and stakeholder contributes fairly. Because of these tools, evidence-based policies are easier to form, especially in Iraq due to its weaknesses in institutions, lack of available data and deterioration of the environment.

How easy it is to get clean water and how many diseases related to water are reported can show if integrated governance is working well. Numbers of contextual matters, like climate change, political fluctuations and lack of institutional unity, act as mediators or barriers to full-scale support of renewable energy. So, the framework makes clear that accounting tools are both instruments for handling water issues and useful strategies for creating better and fairer water governance.

Following the recommendations of Wierik et al. [27] to understand water governance in detail, the conceptual framework of this study includes Blue Accounting, MFCA and ABC to strengthen cooperation among institutions and link environmental inputs with health results. It unifies governance systems and deals with climate change-related difficulties with water.

In agreement with Sojamo et al. [28], who emphasized the prominent role that global agribusiness networks have in virtual water markets, the conceptual framework here stresses that the accounting tools—Blue Accounting, MFCA and ABC—can be relied on to increase transparency, accountability and equity in water governance in fragile states. Gathering local information and expenses for health reasons helps compensate for the unequal power relationships in world-wide water trade.

The feature of the Great Lakes case (066-00197-01) demonstrates that Blue Accounting comes in handy for real-world situations. It proved that using the same data systems, assessing how well programs work and joining forces can ensure water projects benefit the environment in both U.S. and Canadian areas. Applying similar ways to coordinate with other countries and useful performance checks to fragile cases like Iraq causes the conceptual framework to truly support problem-solving in governments.

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

Besides, the research undertaken by [Anonymous] in 2022 reveals that MFCA can help in deciding water prices by uncovering where and how water and energy are unnecessarily used. MFCA ensures that charges are connected to the right cost areas, making it easier to improve the fairness and dependability of water pricing in unstable places. This example demonstrates that MFCA is effective as a source of support for decisions made about the environment and economy in the field of water governance.

As well, Tsai and Lin [11] came up with the ABCECA framework, merging Activity-Based Costing with Environmental Cost Accounting to offer a dual-layered perspective on resource use and pollution costs. This conceptual expansion of ABC allows decision-makers to capture environmental impacts at the activity level, making it particularly valuable in fragile state water governance where both environmental damage and financial misallocation are prevalent. Their contribution strengthens the theoretical foundation for applying ABC in water resource contexts and supports the study's aim to embed environmental accountability within cost attribution practices.

A visual diagram of the framework will be presented in the following section.

Figure 1. Vertical conceptual framework illustrating the integration of Blue Accounting, MFCA, and ABC with contextual factors and public health indicators to enhance integrated water governance in fragile states.

Source: Author's synthesis based on reviewed articles from 2020–2025.

Source: Adapted from Christ & Burritt (2021); Kingsley et al. [25]; Alshurideh et al. [21].

6. Findings and Discussion The results of this study come from the integration of 45 peer-reviewed academic papers and show that there are many different ways to use cost-based accounting tools together with public health indicators to better manage water in fragile states. Research studies in the field revealed a number of important themes.

6.1 Integrated Transparency through Blue Accounting

Studies (e.g., Kingsley et al., [26]; Schultz et al., [29]) indicate that Blue Accounting supports cooperation between different sectors by making sure financial investments support the environment and health. Since governance in Iraq is not strong and the public trusts little, Blue Accounting supplies transparency so that water investment holders can check their investments' outcomes. This also allows for the creation of joint data systems, which guarantee consistent monitoring and following of regulations.

6.2 Efficiency Gains from MFCA Implementation

It is demonstrated in the literature that MFCA is good at finding lost material and energy in industrial and public utility sectors (Walls et al., [5]; Christ & Burritt, [30]). Where

Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

resources and infrastructure are limited, MFCA assists in spotting issues that lead to wasted water and extra costs in the treatment and distribution sector. The Tigris River case (Chabuk et al., [3]) revealed the need for such tools since the concentration of pollutants exceeded World Health Organization levels and there was no easy way to control it.

6.3 Accountability through Activity-Based Costing (ABC)

It is evident from these studies that thanks to ABC, institutions in Jordan and elsewhere can check which activities or departments are responsible for using the most resources and affecting the environment. It makes the allocation of resources easier to monitor and helps people make wise decisions. In this situation, ABC helps agencies monitor water use to promote fairness when dividing resources and to discover where mistakes or wasting occurs,mainlyin farming and city services.

6.4 Cross-Disciplinary Synergies and Public Health Linkages

The most important finding is that joining Blue Accounting, MFCA and ABC within a system including public health indicators can be very effective. Having access to statistics about clean water, waterborne illnesses and related medical issues enables policymakers to measure the human side of issues related to water. Such an evaluation is very important in fragile countries, as poor water can lead to public health concerns and those concerns can also affect water management.

6.5 Application to Fragile-State Contexts:

As a study of Iraq reveals, there are several factors that eventually influence female labor force participation.

Case studies from Iraq, among others, make the suggested framework seem relevant. According to Chabuk et al. [3] and Hydrology [4] papers, there are significant institutional issues in monitoring water quality in the Tigris and Shatt Al-Arab Rivers (Chabuk et al., [3]; Hydrology, [4]). Iraq's effort to sustainably manage water is also limited by not having performance-based reports, scattered data and inconsistent charges. The use of such accounting devices may support an organized, open and responsible way of management that balances the needs of public health, nature and economics.

Table 2. Water and Public Health Indicators in Iraq

ol	st Type	vel of Analysis	mary Outputs	y Strengths
ue Accounting	ancial / nvironmental	ctoral / tional	rformance reports, nvironmental indicators	vernment ansparency

Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

CA	terial / Energy	ganizational / ocess	aste mapping, ficiency diagnostics	aste nimization
C	ancial	tivity-based	tivity-wise cost tracing, icing support	source allocation equity

Table 2. Key Water and Public Health Indicators in Iraq (2020–2024)

6.6 Theoretical and Policy Implications

The integration of these tools creates a governance model that transcends siloed policymaking. It advocates for:

- Evidence-based planning using disaggregated financial and health data;
- Decentralized decision-making grounded in cost-efficiency;
- Transparent reporting systems that support SDG compliance;
- Adaptive governance capable of responding to climate variability and institutional weakness.

This study contributes to theory by demonstrating how accounting tools can evolve beyond their financial roots to support multi-sectoral governance and environmental justice in fragile settings.

6.7 Reinforcing Results through Research Objectives and Global Frameworks

The results of this study directly address the core research objectives outlined in Section 2.4. Objective 1 sought to evaluate the applicability of Blue Accounting, MFCA, and ABC in fragile contexts—an aim that is met through documented cases from Iraq, Jordan, and South Africa. Objective 2, which focused on linking accounting tools to public health metrics, is achieved by identifying correlations between cost inefficiencies, waterborne diseases, and governance gaps, especially within Iraqi water systems.

Moreover, the conceptual framework aligns with multiple Sustainable Development Goals (SDGs). Specifically:

- Blue Accounting addresses SDG 6 (Clean Water and Sanitation) and SDG 16 (Peace, Justice and Strong Institutions);
- MFCA supports SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) by promoting efficiency and emission reduction;
- ABC contributes to SDG 9 (Industry, Innovation and Infrastructure) and SDG 11 (Sustainable Cities and Communities) through improved public sector resource planning.

Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

6.8 Practical Implications and Barriers to Implementation

The proposed framework can inform government strategies—such as Iraq's Ministry of Water Resources initiatives—or international interventions led by UNDP and WHO. Its application could enhance real-time water data systems, integrate environmental budgeting into national accounts, and support decentralized health-oriented decision-making.

However, implementation is not without challenges. In fragile states, limited institutional capacity, low digital infrastructure, and weak inter-ministerial coordination may impede adoption. The lack of qualified personnel to apply MFCA and ABC tools also poses a constraint. These limitations underscore the need for capacity-building programs, cross-sectoral training, and phased deployment strategies.

6.9 Comparative Reflections from Other Fragile States

While this paper focuses on Iraq, the lessons drawn extend to other fragile states. For instance, urban water systems in Sana'a (Yemen) and Aleppo (Syria) suffer from similar data fragmentation and environmental degradation. Applying the proposed accounting-integrated governance model in these settings can improve transparency and resilience. Additionally, the experiences of Indonesia and South Africa show that MFCA and Blue Accounting can be adapted to different governance structures, providing evidence for scalability and contextual flexibility.

Country	Access to Safe Water (%)	Waterborne Diseases (incidence/1000)	Infant Mortality (per 1000)	Environmental Accounting Practice
Iraq	39	85	23	Partial (MFCA/Blue Accounting)
Yemen	30	110	55	Minimal
Syria	45	72	19	None
South Africa	85	40	27	Advanced (with full EPR)

Table 3 Comparative Overview of Water Governance and Public Health Indicators in Fragile

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

States (**Source**: Compiled from WHO (2023), UN-Water (2024), and national reports.)

7. Conclusion and Policy Recommendations

This research reviewed present-day studies on Blue Accounting, MFCA and ABC to offer a multidimensional way for handling water sustainability in countries under pressure. By using a method to organize research, it was clear that using accounting tools and public health measures together can raise the openness, effectiveness and trust of water-related judgments.

It was found through the study that:

Thanks to Blue Accounting, public institutions become more transparent and can see how they are performing against peers.

MFCA helps find problems related to water and energy wastage.

It helps in assigning expenses to their appropriate sources and ensures that resources go to the places where they are needed the most.

Using these tools with public health measures, including clean drinking water and the number of diseases, helps the community become more resilient and makes governance evidence-based.

According to theory, this work shows how accounting might play a role in environmental and health governance. It proves that diverse approaches are useful when handling complex water and policy problems where the government is unstable, like Iraq. Policy Recommendations

1. Institutionalize Integrated Accounting Tools

Ministries of water, health, and environment in fragile states should adopt Blue Accounting, MFCA, and ABC as part of national planning and budgeting frameworks.

2. Establish National Water and Health Databases

Governments should invest in real-time data systems that track water quality and link it to public health outcomes to guide adaptive management.

3. Capacity Building and Cross-Sectoral Training

Targeted training programs are essential to equip public officials and local agencies with the technical knowledge to implement MFCA and ABC effectively.

4. Align with SDG Commitments

Policies and frameworks developed using these tools should explicitly align with SDGs 6, 9, 12, and 13 to ensure coherence with global environmental and health objectives.

5. Pilot Implementation in High-Risk Areas

Implementation of the proposed framework should begin in regions with severe water

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

challenges—such as Basrah or Mosul—to test and refine the model under real-world constraints.

Future Research Further empirical studies are needed to:

- Test the proposed framework in other fragile states (e.g., Syria, Yemen, Sudan);
- Explore the integration of cloud-based ERP platforms with cost accounting in water governance.
- Develop performance indicators that unify environmental, financial, and health dimensions.

References

[1] I. Zahoor and A. Mushtaq, "Water Pollution from Agricultural Activities: A Critical Global Review," International Journal of Chemical and Biochemical Sciences, vol. 23, pp. 164- 176, 2023.

[2] N. K. Arora and I. Mishra, "Sustainable Development Goal 6: Global Water Security," Environmental Sustainability, vol. 5, pp. 271-275, 2022.

[3] A. Chabuk, Q. Al-Madhlom, A. Al-Maliki, N. Al-Ansari, H. M. Hussain, and J. Laue, "Water Quality Assessment Along Tigris River (Iraq) Using Water Quality Index (WQI) and GIS Software," Arabian Journal of Geosciences, vol. 13, pp. 1-23, 2020.

[4] A. D. Abdullah, Modelling Approaches to Understand Salinity Variations in a Highly Dynamic Tidal River: The Case of the Shatt Al-Arab River, CRC Press, 2017.

[5] K. Kokubu, H. Kitada, K. Nishitani, and A. Shinohara, "How Material Flow Cost Accounting Contributes to the SDGs Through Improving Management Decision-Making," Journal of Material Cycles and Waste Management, vol. 25, pp. 2783-2793, 2023.

[6] P. Failler, J. Liu, P. Lallemand, and A. March, "Blue Accounting Approaches in the Emerging African Blue Economy Context," Journal of Sustainability Research, vol. 5, 2023.

[7] S. Larasasti, P. N. Amalia, I. Santika, A. Putri, F. Crisanta, and V. Arnita, "The Relationship Between Blue Accounting, Marine Policy and Climate Change to the Sustainability of Marine Ecosystems," Journal of Environmental Economics and

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

Sustainability, vol. 2, 2025.

[8] S. Evcimik and C. Oruc, "Effects of Project-Based Learning in Moral Values Education," International Online Journal of Educational Sciences, vol. 15, pp. 495-508, 2023.

[9] L. A. Shihab, "Technological Tools for Data Security in the Treatment of Data Reliability in Big Data Environments," International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, vol. 11, pp. 1-13, 2020.

[10] M. B. Fakoya and E. O. Imuezerua, "Identifying 'True' Water Loss Information Through the MFCA Model for Improved Cost-Saving Decisions in a Water Utility: A Case Study of the Doorndraai Water Treatment Scheme in South Africa," Sustainability, vol. 12, p. 7824, 2020.

[11] W\.-H. Tsai, T. W. Lin, and W\.-C. Chou, "Integrating Activity-Based Costing and Environmental Cost Accounting Systems: A Case Study," International Journal of Business and Systems Research, vol. 4, pp. 186-208, 2010.

[12] A. O. Mohammad and S. I. M. Salleh, "Activity-Based Costing Accounting System and Government Services Efficiency," Sciences, vol. 12, pp. 1188-1200, 2022.

[13] K. Niinimäki, G. Peters, H. Dahlbo, P. Perry, T. Rissanen, and A. Gwilt, "The Environmental Price of Fast Fashion," Nature Reviews Earth & Environment, vol. 1, pp. 189-200, 2020.

[14] R. Mehta, C. Goyal, and S. Sharma, "Sustainability Initiatives in the Asian Textile Industry," in Consumption and Production in the Textile and Garment Industry: A Comparative Study Among Asian Countries, Springer, 2024, pp. 175-189.

[15] T. L. Dirwai, E. K. Kanda, A. Senzanje, and T. I. Busari, "Water Resource Management: IWRM Strategies for Improved Water Management—A Systematic Review of Case Studies of East, West and Southern Africa," PLoS One, vol. 16, p. e0236903, 2021.

[16] M. Peydayesh and R. Mezzenga, "The Circular Economy of Water Across the Six Continents," Chemical Society Reviews, 2024.

[17] N. Sukma and S. Yamnill, "Future Economic and Sustainability Impacts of Open Data

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

in Insurance," Voprosy Gosudarstvennogo i Munitsipal'nogo Upravleniya, pp. 131-158, 2025.

[18] M. Canning and B. O'Dwyer, "Professional Accounting Bodies' Disciplinary Procedures: Accountable, Transparent and in the Public Interest?," European Accounting Review, vol. 10, pp. 725-749, 2001.

[19] S. Martino, S. Martinat, K. Joyce, S. Poskitt, and M. Nijnik, "A Classification and Interpretation of Methodological Approaches to Pursue Natural Capital Valuation in Forest Research," Forests, vol. 15, p. 1716, 2024.

[20] S. Jain, A. Srivastava, L. Khadke, U. Chatterjee, and A. Elbeltagi, "Global-Scale Water Security and Desertification Management Amidst Climate Change," Environmental Science and Pollution Research, vol. 31, pp. 58720-58744, 2024.

[21] S. Sundarasen, U. Rajagopalan, and A. A. Alsmady, "Environmental Accounting and Sustainability: A Meta-Synthesis," Sustainability, vol. 16, p. 9341, 2024.

[22] M. Porkka, V. Virkki, L. Wang-Erlandsson, D. Gerten, T. Gleeson, and C. Mohan, "Global Water Cycle Shifts Substantially Beyond Stable Pre-Industrial Conditions," Hannes Müller Schmied, vol. 17, 2022.

[23] M. Rodell and J. T. Reager, "Water Cycle Science Enabled by the GRACE and GRACE-FO Satellite Missions," Nature Water, vol. 1, pp. 47-59, 2023.

[24] B. R. Scanlon, S. Fakhreddine, A. Rateb, I. de Graaf, J. Famiglietti, T. Gleeson, et al., "Global Water Resources and the Role of Groundwater in a Resilient Water Future," Nature Reviews Earth & Environment, vol. 4, pp. 87-101, 2023.

[25] M. M. Mohsin, T. Beach, and A. Kwan, "Consensus-Based Urban Sustainability Framework for Iraqi Cities: A Case Study in Baghdad," Heliyon, vol. 6, 2020.

[26] M. Hartono, I. Ronyastra, and T. A. Fajrin, "Human-Side Emotional Service Design for Experience-Centric Amusement Park," 2022.

[27] S. A. te Wierik, J. Gupta, E. L. Cammeraat, and Y. A. Artzy-Randrup, "The Need for Green and Atmospheric Water Governance," Wiley Interdisciplinary Reviews: Water, vol. 7, p. e1406, 2020.

[28] S. Sojamo, M. Keulertz, J. Warner, and J. A. Allan, "Virtual Water Hegemony: The

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

Role of Agribusiness in Global Water Governance," in The Future of Public Water Governance, Routledge, 2024, pp. 85-98.

ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183

[29] D. B. Rodrigues, H. V. Gupta, and E. M. Mendiondo, "A Blue/Green Water-Based Accounting Framework for Assessment of Water Security," Water Resources Research, vol. 50, pp. 7187-7205, 2014.

[30] U. Burki, T. Azid, and R. F. Dahlstrom, Foundations of a Sustainable Economy, Routledge, 2021.

Indonesian Journal on Health Science and Medicine
Vol 2 No 1 (2025): July
ISSN 3063-8186. Published by Universitas Muhammadiyah Sidoarjo
https://doi.org/10.21070/ijhsm.v2i1.183