

Blue–Green Water Accounting in the Omo-Gibe Basin, Ethiopia

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September 2026



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Acknowledgments

This work was conducted as part of the CGIAR Multifunctional Landscapes Program. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund (www.cgiar.org/funders/).

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Suggested citation

McCartney, Matthew, Mulugeta Tadesse, and Radheeka Jirasinha. 2026. *Blue–Green Water Accounting in the Omo-Gibe Basin, Ethiopia*. International Water Management Institute (IWMI).

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Executive Summary

This inception report sets out the rationale, conceptual framework and proposed implementation approach for developing spatially and temporally explicit blue–green water accounts for the Omo–Gibe Basin in Ethiopia. The work forms part of IWMI's wider Water System Program, within the Multi-Functional Landscapes portfolio in the basin. It is designed to provide the biophysical evidence base needed to understand water sources and how water is stored, transferred, used and consumed across the landscape, and how these processes support agriculture, ecosystems, livelihoods and economic activities.

The report argues that conventional assessments focused mainly on surface-water availability are insufficient for the Omo–Gibe system. In the upper and middle basin, rainfall, soil moisture and evapotranspiration are central to rainfed and mixed farming systems, while in the lower basin river flows, seasonal flooding, groundwater interactions and floodplain processes sustain flood-recession agriculture, grazing, fisheries, wetlands and the wider Lake Turkana system. A blue–green water accounting approach is therefore required to capture the full continuum of water-dependent functions, from green-water-supported crop production to blue-water-dependent hydropower, irrigation, ecosystems and downstream livelihoods.

The proposed activity will adapt IWMI's water accounting methodology and Water Accounting Plus (WA+) experience to the hydrological, agricultural and social-ecological characteristics of the Omo–Gibe Basin. It will assemble and assess existing observations, remote-sensing products, spatial datasets and institutional knowledge on precipitation, evapotranspiration, soil moisture, land use, surface water, groundwater, reservoirs, irrigation, cropping systems, livestock and other water uses. As far as data permit, the accounts will distinguish between water availability, use, consumption, storage, return flows and depletion at basin and sub-basin scales and at seasonal or, perhaps, monthly time steps.

The workplan is structured around five linked phases running from June 2026 to December 2028. These comprise data assembly, operationalization and stakeholder inception; development of a WA+ baseline and basin hydrological characterization; preparation of blue–green water accounts for the upper, middle and lower basin; integration, validation and uncertainty assessment; and application of the resulting datasets and indicators to linked activities on valuing blue–green water services and assessing hydropower–irrigation–ecosystem trade-offs across the Omo–Gibe–Lake Turkana system.

Stakeholder engagement is central to the proposed approach. The September 2026 inception workshop will provide the first formal opportunity for national and basin stakeholders to validate the conceptual framework and workplan, identify priority datasets and issues, and help refine the accounting protocol. Subsequent technical reviews, basin-level consultations and validation workshops will be used to test assumptions, interpret emerging results, incorporate local and institutional knowledge, and ensure that the accounts are credible, useful and relevant to planning needs.

The expected outputs include an operational blue–green water accounting framework, a basin-wide data inventory, preliminary and final WA+ water balances for the upper, middle and lower basin, an integrated and validated basin-wide accounting package, and datasets to support valuation and trade-off analysis. Together, these outputs will contribute to the Omo–Gibe Multifunctional Living Landscapes (MFLs) Action Plan, which identifies Blue–Green Water Accounting as a priority PoD and MFLs 2030 Outcome OC1.1, under which *Living Landscapes actors apply technological, socio-ecological, policy and/or institutional solutions and innovations that demonstrably improve landscape multifunctionality through sustainable production, restoration, conservation, inclusive livelihoods and healthy diets* by making visible the relationships between land, water, ecosystems and livelihoods and supporting more integrated decision-making on water security, ecosystem services and multifunctional landscape management.

1. Introduction

1.1 Background

The Omo–Gibe Basin is one of Ethiopia’s major river basins, extending from the relatively humid and densely cultivated highlands of southwestern Ethiopia through the middle Omo Valley to the arid lowlands bordering Kenya (Lautze et al., 2022). The basin encompasses a pronounced gradient in climate, topography, land use and livelihood systems. Rainfall is relatively abundant in the upper basin but declines substantially towards the south, where agriculture and pastoralism become increasingly dependent on the Omo River and its seasonal flooding. This strong upstream–downstream connectivity means that water generated and stored in the upper basin supports not only agriculture and other economic activities within Ethiopia, but also ecosystems and livelihoods throughout the Lower Omo and, ultimately, the Lake Turkana system (Avery, 2012).

Agriculture is the dominant land use and livelihood activity across much of the upper and middle basin. Rainfed agriculture is particularly important, with cereals including teff, maize, wheat, sorghum and finger millet forming an important part of production systems, alongside pulses, enset (false banana), coffee and other crops (Mati and Merrey, 2022). For these systems, rainfall and the water stored temporarily in the soil are fundamental productive resources. Soil moisture determines the timing and reliability of crop growth, while evapotranspiration represents a major pathway through which rainfall is converted into agricultural production. Consequently, an assessment focused only on rivers, reservoirs and groundwater would overlook an important component of the water resource base supporting food production and rural livelihoods in the upper basin. Understanding the spatial and seasonal distribution of green water - particularly precipitation, soil-moisture storage and evapotranspiration - is therefore essential for understanding agricultural water use and productivity across the basin.

The lower basin presents a very different relationship between water, ecosystems and livelihoods (Amos, et al., 2021; Carr, 2017). Here, the seasonal flow and flooding of the Omo River are themselves critical ecosystem processes, creating and renewing a mosaic of riverine forests, wetlands, floodplain and riparian grasslands, and seasonally inundated agricultural areas. The annual flood pulse deposits water, sediment and nutrients on river margins and flood-recession areas, supporting agricultural production, regenerating grazing resources and contributing to the productivity of aquatic ecosystems (Kleinschroth et al., 2022). For communities in the Lower Omo, particularly agro-pastoralist and pastoralist populations, these processes underpin a diversified livelihood system that combines livestock production, flood-recession agriculture, rainfed cultivation and fishing. Research indicates that tens of thousands of people depend on flood-recession farming along the Omo, while the river flood also regenerates important grazing areas in the delta and lower river (Kleinschroth et al., 2022).

Flood-recession agriculture is particularly important because it represents a form of water use that is neither conventionally rainfed nor irrigated. Crops are cultivated on land exposed as floodwaters recede, using residual soil moisture and the fertility deposited by the flood. In the lower Omo, sorghum is particularly important, and the availability and extent of suitable land vary with the magnitude and timing of annual flooding. This makes the timing, magnitude and duration of river flows important not only for downstream water availability, but also for agricultural production and food security. Similarly, floodplain and riverine grazing provides critical dry-season and drought-period forage for livestock. The flood pulse therefore has a value that extends well beyond the volume of water delivered downstream: it helps maintain the ecological productivity of landscapes on which pastoral and agro-pastoral livelihoods depend.

Fisheries constitute another important ecosystem service associated with the river and its downstream aquatic environments. The Omo River, its delta and Lake Turkana provide fish habitat and support fishing as both a source of food and income. The seasonal delivery of freshwater, nutrients and sediment from the Omo contributes to the productivity and ecological functioning of the lower river and Lake Turkana, whose fisheries are an important livelihood and food resource for lakeshore communities. The Omo provides more than 80% of Lake Turkana's annual freshwater inflow, making the ecological condition of the lake strongly dependent on the quantity and timing of Omo flows. Thus, the value of maintaining river flows needs to be considered in terms of the ecosystem services generated by those flows, including fisheries, grazing, flood-recession agriculture, soil fertility and broader ecosystem functioning.

These ecosystem services are particularly important because the Lower Omo is a highly water-constrained environment in which communities have historically diversified their livelihoods to manage substantial climatic variability. The combination of riverine agriculture, pastoralism, fishing and use of natural vegetation provides a degree of resilience to drought and other shocks. Recent research also demonstrates that natural land covers - including grasslands, shrublands and riverine forests - provide important provisioning services to different groups in the Lower Omo, and that changes in land cover can affect these services differently for farmers, pastoralists and other resource users.

The Omo–Gibe Basin has also become a major centre of water infrastructure development. The Gibe cascade includes Gibe I, Gibe II and Gibe III, while the Koysha hydropower project represents a further major development downstream. Irrigation development has expanded alongside hydropower, including large-scale agricultural development in the Lower Omo. These investments increase the importance of understanding how water is stored, regulated, withdrawn and consumed across the basin, and how changes in the timing and magnitude of flows may affect downstream ecosystems and livelihoods. Importantly, the effects of infrastructure development cannot be assessed solely in terms of changes in annual water volumes. Changes in the seasonality, magnitude and duration of flows - and particularly in the flood pulse - may affect a range of ecosystem services even where annual water availability remains relatively high.

Against this background, there is a strong rationale for moving beyond conventional accounting of surface-water availability towards an integrated blue–green water accounting approach. In the upper basin, this requires recognising rainfall, soil moisture and evapotranspiration as fundamental components of the water resource supporting rainfed crop production. In the lower basin, it requires recognising the importance of river flows and their seasonal variability in sustaining flood-recession agriculture, grazing, fisheries and other ecosystem services. Bringing these dimensions together provides a more complete picture of how water supports people and ecosystems across the basin, and establishes the biophysical foundation for the complementary activities on valuing blue–green water services and assessing hydropower–irrigation–ecosystem trade-offs across the Omo–Gibe system.

1.2 POD Portfolio

The research reported here, on blue-green water accounting - is one element of a wider portfolio of work being undertaken by IWMI and partners in the Omo-Gibe basin. Under the Multi-Functional Landscapes (MFL) Science Program IWMI is leading nine Water System Programs of Deliverables (PODs) in the Omo Gibe Basin with the overall aim of contributing to enhanced integrated land and water management within the basin. The nine PODs span water accounting, ecosystem valuation, land degradation, soil and water conservation, basin trade-off modelling, environmental flows, landscape multifunctionality planning, and inclusive governance. Individually, these read as a list of independent technical outputs but in combination, and as conceived, they form three interconnected layers of work - foundational science, integration, and solution/governance (Figure 1).

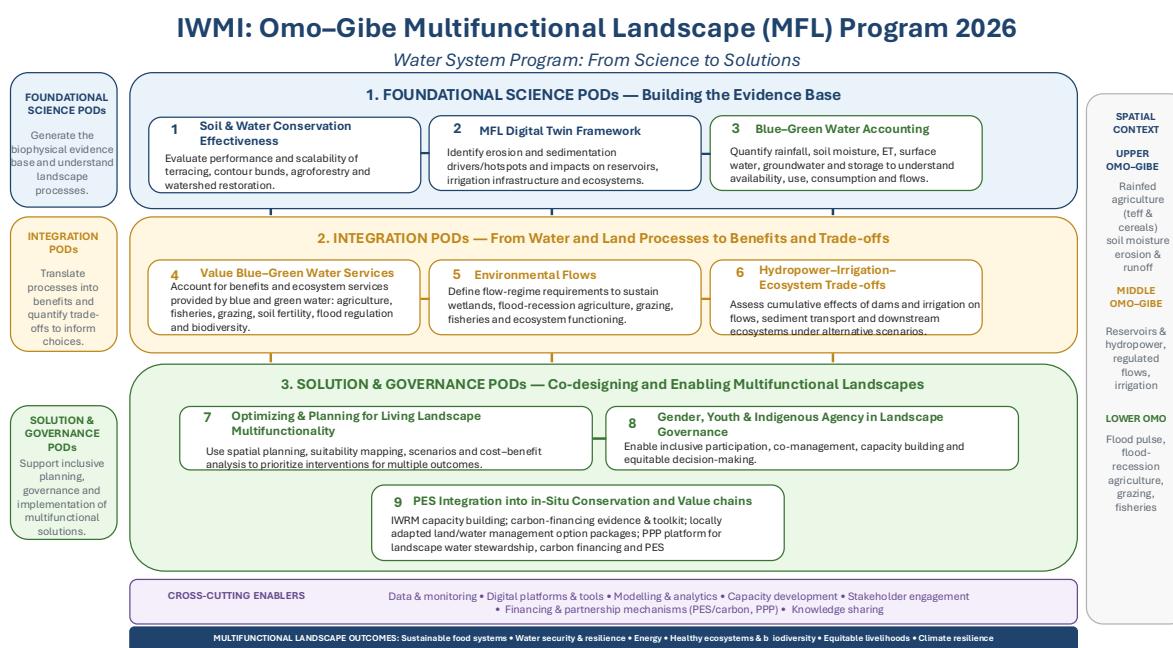


Figure 1. Conceptual framework for IWMI MFL Science Program funded PODs conducted in the Omo–Gibe Basin
Source: Authors' creation

The foundational science PODs will establish the biophysical evidence base for the Omo–Gibe landscape by improving understanding of soil and water conservation, land degradation and erosion, sediment dynamics, and the spatial and temporal distribution of blue and green water. Together, they will provide a common understanding of how land, water and ecosystem processes interact across the basin and from the upper catchment to the Lower Omo.



The integration PODs will translate this evidence into an understanding of benefits, ecological requirements and trade-offs. Blue–green water accounting provides the quantitative basis for identifying where, when and how water is available, used and consumed; the environmental flows work defines the flow characteristics needed to sustain ecosystems and flow-dependent livelihoods; and the hydropower–irrigation–ecosystem assessment brings these dimensions together to examine the consequences of alternative development and water-management choices. The value of blue–green water services provides an additional bridge by translating changes in water and ecosystem processes into benefits for agriculture, fisheries, grazing, livelihoods and ecosystems.

The solution and governance PODs use this integrated evidence to identify and enable multifunctional landscape pathways. Spatial planning and optimization can identify where investments in conservation, restoration, storage, irrigation and other interventions can generate multiple benefits, while the gender, youth and Indigenous agency POD ensures that solutions are grounded in local knowledge, participation and equitable governance. Across all three layers, data and monitoring, modelling and digital tools, capacity development and stakeholder engagement provide the enabling infrastructure, with learning and adaptive management linking implementation back to improved understanding. The overall logic is therefore: understand the system → account for water and ecosystem processes → value benefits → assess trade-offs → co-design and govern multifunctional landscape solutions.

2. Objective, Conceptual, and Methodological Framework

2.1 Objective

The overall objective of this activity is to develop a spatially and temporally explicit blue–green water accounting framework for the Omo–Gibe Basin that provides a consistent biophysical evidence base for understanding how water is generated, stored, transferred, used and consumed across the landscape, and how these processes support ecosystems, livelihoods and economic activities. The framework will extend conventional water accounting beyond its predominant focus on rivers, reservoirs and groundwater to explicitly capture the contribution of precipitation, soil-moisture storage and evapotranspiration, and the interactions between these green-water and blue-water components.

The assessment will adopt a basin-wide perspective that recognizes that dependence on water takes many forms and varies considerably across the landscape. In the upper Omo–Gibe Basin, the assessment will consider the importance of rainfall, soil moisture and seasonal water availability for predominantly rainfed agricultural systems, including teff and other cereals and livestock, recognizing that the upper basin is also the source of the river flow that supports downstream water use and ecosystem services. Here, the focus will be on understanding how precipitation is partitioned and stored in the landscape, how soil-water availability supports crop production and ecosystems and flow generation.

In the middle Omo–Gibe Basin, the assessment will encompass the more diverse mix of rainfed and irrigated agriculture, including home gardens and enset (false banana) production, as well as rivers, wetlands, riparian ecosystems and other water-dependent uses. These systems illustrate the close connections between green and blue water: production depends partly on rainfall and soil moisture and partly on access to groundwater, springs, rivers or irrigation. Understanding these interactions is important for determining how changes in water availability, abstraction and land management affect both agricultural production and ecosystem functioning. The assessment will therefore seek to identify where water requirements overlap, where they are complementary, and where potential competition between agricultural, domestic, livestock and ecological requirements may emerge.

In the Lower Omo, the analysis will extend to riverine, floodplain and wetland ecosystems and the water-dependent livelihoods associated with them, including flood-recession agriculture, floodplain grazing and fisheries. Here, the timing and magnitude of seasonal flows and flood pulses are particularly important, and environmental-flow requirements need to consider the ecological processes and ecosystem services generated by these dynamics. The Lower Omo will consequently represent an important downstream component of the basin-wide assessment, but will be considered as part of the continuum of water-dependent systems extending from rainfall and soil moisture in the upper basin through regulated and unregulated river systems to downstream floodplains and the delta in Lake Turkana.

The water accounts will provide the biophysical foundation for the complementary “Value Blue–Green Water Services” POD, establishing the spatially and temporally explicit water variables needed to identify and quantify the benefits and ecosystem services generated by blue and green water. These will include, for example, soil moisture and evapotranspiration supporting rainfed agriculture; surface water and groundwater supporting irrigation and other uses; river flows supporting fisheries and aquatic ecosystems; and seasonal flood pulses supporting flood-recession agriculture and floodplain grazing. The accounting framework will therefore enable the valuation activity to move from identifying water-dependent services to understanding how the quantity, timing and spatial distribution of water underpin those services and how changes in water availability may affect their benefits.

The activity will also provide a critical contribution to the “Hydropower–Irrigation–Ecosystem Trade-off Assessment POD for the Omo–Gibe–Lake Turkana Basin”. By establishing water requirements and hydrological dependencies across the Basin, it will contribute to identifying how changes in reservoir operation, irrigation development, abstraction, land management and other interventions may affect agricultural systems, ecosystems and downstream flows. The trade-off assessment will therefore be able to consider the full spectrum of water-dependent functions, from green-water-supported rainfed cereals and enset production through irrigated agriculture and hydropower to downstream floodplain agriculture, grazing, fisheries and aquatic ecosystems.

2.2 Contribution to MFL Theory of Change and the MFL Action Plan for the Omo-Gibe Basin

The blue–green water accounting POD will contribute to the Theory of Change (ToC) and impact pathways of the MFL Science Program by providing a spatially and temporally explicit evidence base on the availability, movement, storage, use and consumption of water across the Omo–Gibe Basin. By extending conventional water accounting to include precipitation, soil moisture, evapotranspiration, surface water and groundwater, the activity will make visible the hydrological dependencies of different landscape functions and the connections between them. This will provide a basis for understanding where water availability constrains productive, domestic and environmental needs, where water use is complementary, and where trade-offs may arise across locations, seasons and sectors.

The strongest direct contribution is to *OP 1.1.2: Strategies and bundles of solutions that secure water for productive, domestic and environmental needs under a changing climate*. The accounts will provide the evidence required to identify water-security constraints and opportunities and to inform the design, targeting and assessment of strategies and bundles of land and water management solutions. By considering the full continuum from green water supporting rainfed crops, livestock and ecosystems in the upper and middle basin to blue-water flows supporting irrigation, hydropower, fisheries, floodplain agriculture and downstream ecosystems, the activity will help ensure that strategies to improve water security in one part of the Basin do not inadvertently undermine water-dependent functions elsewhere. The accounts will also contribute to *OP 1.1.3: Strategies and bundles for optimal management and use of common pool resources (e.g., rangelands, forests, fisheries, and water) and protected areas to improve livelihoods and safeguard ecosystem services* by clarifying the hydrological dependencies and trade-offs associated with water and other interconnected common-pool resources, including rangelands, wetlands, fisheries and other ecosystem services.

The blue–green water accounting POD is directly aligned with the Omo–Gibe Multifunctional Living Landscapes (MFLs) Action Plan, which identifies Blue–Green Water Accounting as a priority PoD, providing “foundational water balance evidence” for basin management and serving as a “core reference dataset.” The Action Plan emphasizes strong upstream–downstream linkages among forests, agriculture, rivers, fisheries and hydropower, and calls for integrated planning based on an understanding of basin-wide dynamics. The proposed accounts will provide this hydrological evidence by connecting green-water processes in the upper and middle basin with blue-water flows and downstream floodplain and aquatic systems, thereby helping to identify water dependencies, synergies and trade-offs across the landscape.

The accounts will also support the Action Plan's implementation pathway by providing the baseline and spatial evidence needed for integrated land and water-use planning, trade-off analysis, scenario development and targeting interventions. The Action Plan specifically calls for basin water-balance assessment, analysis of upstream–downstream linkages and coordinated water-management scenarios, while identifying integrated land–water packages and evidence synthesis as priorities for negotiated landscape management. The accounting framework will provide a common biophysical evidence layer for the complementary PODs (e.g. Valuing Blue & Green Water Services, Living Landscape optimization and planning, environmental flows, Landscape Data & Metrics activities and the proposed digital twin) identified in the Action Plan. In this way, it will help translate the MFL approach from landscape diagnosis to action by informing where and how integrated land and water interventions can deliver multiple benefits while managing trade-offs among agricultural production, livelihoods, water security and ecosystem health.

Through these pathways, the activity will contribute most directly to 2030 Outcome OC1.1, under which Living Landscapes actors apply technological, socio-ecological, policy and/or institutional solutions and innovations that demonstrably improve landscape multifunctionality through sustainable production, restoration, conservation, inclusive livelihoods and healthy diets. The overall pathway is therefore from blue–green water accounting, through improved understanding of hydrological dependencies and trade-offs, to better targeted landscape solutions and ultimately improved multifunctionality and water security across the Omo–Gibe Basin.

2.3 Conceptual and Methodological Framework

2.3.1 What is water accounting?

Water accounting is a systematic approach to organizing, quantifying, analysing and reporting information on water resources and their movement through a defined system, such as a field, irrigation scheme, catchment, river basin or country. It brings together information on water stocks and flows, sources and uses, and, where appropriate, their

economic, social and environmental values. Its purpose is to provide a coherent evidence base for understanding how much water is available, where it comes from, how it is used, what happens to it after use, and how water management affects different users and ecosystems. Water accounting is therefore an important tool for water governance and decision-making, particularly in contexts of increasing competition for water, climate variability and change, and the need to maintain ecosystem functions (Efuntade & Efuntade, 2023; Ghorbanpour et al., 2022; Lai et al., 2017).

A fundamental strength of water accounting is that it makes the water balance and the relationships between different components of the water cycle explicit. Depending on the purpose and accounting framework, this can include rainfall, surface water, groundwater, soil moisture, evapotranspiration, runoff, storage changes and transfers between locations. Increasingly, water accounting also needs to recognise both blue and green water. Blue water refers primarily to water stored in rivers, lakes, reservoirs and aquifers and available for abstraction or environmental flows. Green water refers to precipitation that is stored in or passes through the soil–plant system and is returned to the atmosphere through evaporation and transpiration. Accounting for both is particularly important in agricultural landscapes, where rainfed production depends predominantly on green water while irrigated production uses a combination of green and blue water.

Within an accounting framework, it is important to distinguish several related but different concepts:

- Water availability refers to the water accessible to a particular system or user over a specified period, taking account of the relevant stocks, inflows, existing commitments and, where appropriate, environmental requirements. Availability is therefore not synonymous with total water present in a basin. A basin may contain substantial water resources while having limited water available for additional use at a particular location or time.
- Water use describes the appropriation or application of water by people, agriculture, industry, households or ecosystems. In the case of irrigation, for example, water use may refer to water diverted from a river or pumped from an aquifer and applied to a field.
- Water consumption refers to the portion of water use that is not returned to the same water system within the accounting period and location. In agriculture, this is commonly associated with evapotranspiration, although other forms of consumptive use can occur.
- Depletion describes the reduction in water available to other users or ecosystems resulting from water consumption or changes in the timing, location or quality of return flows. Consequently, water consumption and depletion should not automatically be treated as synonymous: water can be consumed from one location or source but may not necessarily constitute depletion of the resource being assessed if equivalent water becomes available elsewhere or at another time.
- Return flows are the portion of water withdrawn or diverted that returns to a river, aquifer or other water body. Return flows may occur as surface runoff, drainage, percolation to groundwater or discharge. They can remain available for downstream or subsequent uses, although their timing, location and quality may differ from the original source.
- Blue-water use and consumption concern water appropriated from surface water and groundwater systems, whereas green-water use and consumption relate primarily to precipitation retained in the land–plant system and subsequently returned to the atmosphere through evaporation and transpiration. These distinctions are particularly important when assessing agriculture because rainfall can support substantial crop production without appearing as an abstraction or withdrawal from a river or aquifer.

These distinctions mean that water withdrawal, water use, water consumption and water depletion should not be used interchangeably. For example, irrigation withdrawals can substantially exceed the amount of water ultimately consumed by a crop because depending on the efficiency of an irrigation system, a significant amount of water may return to rivers or groundwater. Conversely, rainfed agriculture can consume substantial amounts of green water through evapotranspiration without generating a corresponding blue-water withdrawal. A comprehensive basin-scale water account should therefore seek to trace water through the system rather than simply quantify abstractions.

2.3.2 Evolution of water accounting

The concept of water accounting has evolved considerably over the past several decades. It began emerging as a distinct research topic in the 1970s, initially focusing on understanding water resources and their implications for management and policy (Burgia et al., 2017). From the 1990s to around 2007, the field expanded and became more established, alongside the development of related concepts such as water footprints and virtual water (Burgia et al., 2017; Öztürk, 2025). Between approximately 2007 and 2017, water accounting proliferated further and became increasingly connected to wider sustainability and environmental accounting frameworks. Australia and China, among others, made important contributions to the development and application of water accounting approaches during this period (Burgia et al., 2017; Jia et al., 2014; Öztürk, 2025). Water accounting also expanded beyond public water-resource management into the corporate sector, where it has been used to understand water-related risks, improve resource management and support reporting and operational efficiency (Meurer & Bellen, 2024; Panero et al., 2025).

More recently, advances in remote sensing, hydrological modelling and automated monitoring have substantially expanded the possibilities for water accounting. These technologies can improve the spatial and temporal estimation of water flows and uses, including in irrigation systems where conventional measurement approaches may be subject to considerable uncertainty (Abdibayev et al., 2025). At the same time, efforts to link physical water accounts with economic and environmental accounting systems have strengthened their potential to inform national planning and broader environmental-economic decision-making (Jia et al., 2014). Together, these developments have shifted water accounting from a primarily descriptive assessment of water resources towards a more integrated approach for understanding water availability, use, consumption, depletion and the relationships between water resources and economic, social and environmental outcomes.

Despite these advances, however, water accounting remains constrained by data availability, inconsistency and complexity. Comprehensive accounts require information on multiple interconnected components of the water cycle, often held by different institutions and available at different spatial and temporal scales. In many regions, information on groundwater, return flows, soil moisture, evapotranspiration and actual water use remains particularly limited. Gaps or inconsistencies in these data can result in incomplete water balances and reduce the usefulness of accounting for management and decision-making (Ghorbanpour et al., 2022; Castañeda & Uyttendaele, 2019).

A related challenge is the lack of consistency and standardization across accounting approaches. Different frameworks may apply different definitions, system boundaries, spatial and temporal scales, and methods for estimating water use, consumption and return flows. This can make results difficult to compare across basins and countries and can obscure relationships between different components of the water system. Greater standardisation of core concepts, accounting boundaries and reporting principles could therefore improve comparability and credibility, while retaining sufficient flexibility to adapt accounting systems to different hydrological, institutional and data contexts (Hunink et al., 2019; Hazelton, 2015; Panero et al., 2025).

These developments are particularly relevant to the Omo–Gibe Basin. The Basin combines substantial spatial and seasonal hydrological variability with uneven availability of water resource and water-use data. A key requirement is therefore not simply to generate additional estimates, but to bring existing observations, remotely sensed information and modelled data together within a consistent accounting framework that can capture the interactions between blue and green water. This provides the basis for the approach adopted in this POD.

2.3.3 Water accounting frameworks and approaches

Several frameworks have been developed to organise water accounts for different purposes. Water Accounting Plus (WA+) developed by IWMI provides a spatially explicit approach for characterising water resources and their use, drawing on hydrological data and remote sensing to describe water flows and land-use relationships. It has, for example, been applied in northwestern Iran to assess crop water productivity and identify opportunities for improving agricultural water management (Ghorbanpour et al., 2022). Other approaches, including the System of Environmental-Economic Accounting for Water (SEEA-Water), provide internationally recognized frameworks for linking physical water accounts with economic information and national accounting systems (Jia et al., 2014; Lai et al., 2017).

These approaches serve different but complementary purposes. Physical water accounting is primarily concerned with where water comes from, where it goes, how much is available, how much is used and consumed, and what is returned to the system. Environmental-economic accounting extends this by linking physical water information to

economic activities, users and values. Water accounting can therefore provide a bridge between hydrological understanding and decisions about resource allocation, productivity, investment and environmental management.

Water accounting can be applied at multiple spatial and temporal scales, from individual fields and irrigation schemes to entire river basins and national economies. At basin scale, it can help reveal how water is partitioned among rainfed and irrigated agriculture, domestic and industrial uses, groundwater and surface-water systems, and ecosystems. It can also help identify where changes in land use or water management in one part of a basin affect water availability and ecosystem conditions elsewhere.

2.3.4 Application in this POD

This POD will develop spatially and temporally explicit blue–green water accounts for the Omo–Gibe Basin, based on IWMI’s water accounting methodology and drawing on its experience with Water Accounting and WA+ (Karimi et al., 2013). Existing studies and assessments provide important information on individual components of the OMG water system, including rainfall, river flows, irrigation, hydropower, land use and agricultural production. However, these components have often been assessed separately, at different spatial and temporal scales and using different definitions and accounting boundaries. As a result, there is currently limited ability to understand how water moves through the Basin, how it is used and consumed, and how changes in one component of the system affect water availability elsewhere.

The accounts will address this gap by bringing the major components of the Basin’s water balance together within a consistent accounting framework. As far as data permit, they will be developed at basin and sub-basin scales and at monthly or seasonal time steps. The accounts will distinguish between blue and green water, and between water availability, use, consumption, depletion and return flows, providing a clearer picture of where and when water is available, how it is used and consumed, what is returned to the system, and how these processes affect water available to other users and ecosystems. In doing so, the accounting framework will explicitly recognize the interdependence of blue and green water rather than treating rainfall, soil water, river flows and groundwater as independent components of the Basin’s water resources.

WA+ is particularly relevant to the Omo–Gibe context because it was developed to provide spatially distributed information on water resources and their use in situations where conventional hydrological monitoring networks and national water-use statistics are incomplete. This provides a practical basis for integrating available observations, remote sensing and other spatially explicit information to develop a more comprehensive understanding of water resources across the Basin. It also provides an approach for bringing together information generated through different sources and at different scales within a common accounting framework.

The accounts will provide more than a description of the Basin’s hydrology. Water accounting is ultimately a means of making the relationships between water resources, their uses and their consequences visible for decision-making. This requires linking hydrological information with economic, social, institutional and ecological considerations so that the accounts can inform assessment of water productivity, competing demands and trade-offs, and the consequences of alternative water-management strategies (Öztürk, 2025; Efuntade & Efuntade, 2023). In this POD, the blue–green water accounts will therefore provide the evidence base for assessing how water is distributed among different uses and ecosystems, where pressures and potential trade-offs occur, and how changes in land and water management may affect water availability, livelihoods and ecosystem functions across the Omo–Gibe Basin.

3. Workplan

The following workplan is proposed for implementation over 30 months, from June 2026 to December 2028. It provides an initial sequencing of activities, outputs and stakeholder engagement points based on the conceptual and methodological framework presented in section 2. The workplan, including the proposed accounting framework, spatial and temporal scales, priority datasets and stakeholder engagement arrangements, will be reviewed and refined through consultation with national and basin-level stakeholders. It is therefore intended as a living workplan that can be adjusted in response to stakeholder priorities, data availability, emerging findings and linkages with the other Omo–Gibe PODs.

A particular emphasis will be placed on regular stakeholder review and input throughout the 2.5-year implementation period. The first major milestone will be an inception workshop in September 2026, at which national stakeholders will be invited to review and approve/validate the proposed conceptual framework and workplan. Subsequent stakeholder engagements will provide opportunities to review the emerging accounts, validate assumptions and results, identify additional data and knowledge, and ensure that the outputs remain relevant to national and basin-level planning needs. Stakeholder engagement will be coordinated, where appropriate, with the linked Omo–Gibe PODs.

The proposed work will use the IWMI Water Accounting Plus (WA+) approach as the principal accounting framework, adapted to explicitly represent both blue and green water and the contrasting water-use systems found across the Omo–Gibe Basin. The work will develop spatially and temporally explicit blue–green water accounts for the upper, middle and lower basin, while maintaining connectivity between these areas as components of a single hydrological system (basin). The accounts will distinguish, as far as data permit, between water availability, use, consumption, storage and return flows, and will identify the contribution of blue and green water to agricultural production and other major uses.

The following outlines the proposed major phases of the work also presented in the Gantt chart (Figure 2).

3.1 Phase 1: Data Assembly, Operationalization and Stakeholder Inception (June–December 2026)

The first phase will translate the conceptual framework established above into an operational accounting system for the Omo–Gibe Basin. Initial work will focus on refining the accounting boundaries, spatial units, temporal resolution, indicators and datasets required for the WA+ application. The upper, middle and lower basin will provide the principal spatial framework, with further subdivision into appropriate sub-basins or accounting units where data availability and analytical requirements permit.

A comprehensive inventory and compilation of available datasets will be undertaken, covering precipitation, evapotranspiration, soil moisture, land use and land cover, soils, topography, surface-water flows, reservoirs and storage, groundwater, irrigation areas, cropping patterns and agricultural production. Available information on domestic, livestock, hydropower and other water uses will also be assembled. Attention will be given to identifying existing national datasets and monitoring systems that can contribute to the accounts. There will be no new data collection.

The initial work will be presented at the inception workshop planned for September 2026. The workshop will provide a formal opportunity for national stakeholders and other relevant basin stakeholders to review and validate the conceptual framework and approve/refine the proposed workplan. Stakeholders will also be invited to identify priority water uses, datasets, spatial scales, knowledge gaps and issues that should receive particular attention during the subsequent analysis. Feedback from the workshop will be incorporated into the final accounting protocol and workplan.

3.2 Phase 2: WA+ Baseline and Basin Hydrological Characterization (January–June 2027)

Following validation of the framework and workplan, the second phase will develop the initial WA+ water balance for the Basin. Spatially distributed Earth Observation datasets will be combined with available hydrological, meteorological, agricultural and other information to quantify the major components of the water cycle, including precipitation, evapotranspiration, soil moisture, runoff, surface-water storage and groundwater, to the extent that these can be reliably estimated.

A central component will be analysis of the partitioning of precipitation between green- and blue-water pathways. Seasonal and spatial patterns will be assessed, including the extent to which precipitation is retained as soil moisture and consumed through evapotranspiration versus contributing to runoff, groundwater recharge and surface-water storage.

Rainfed and irrigated agriculture will be mapped and characterised, providing the basis for distinguishing green-water consumption in rainfed systems from blue-water withdrawals and consumption in irrigated systems. The analysis will also begin to identify other major blue- and green-water uses, including livestock, domestic uses, evaporation from reservoirs and ecosystems.

Stakeholder engagement: A technical stakeholder review will be undertaken towards the end of this phase to review the emerging baseline, assess the interpretation of major water-use patterns and identify additional data or information required before detailed accounts are developed.

3.3 Phase 3: Development of Blue–Green Water Accounts for the Upper, Middle and Lower Basin (July 2027–March 2028)

The third phase will develop the principal blue–green water accounts for the three major zones of the Omo–Gibe Basin. Although each zone will be analysed according to its distinctive hydrological and socio-economic characteristics, a common accounting methodology and set of definitions will be used so that the accounts can subsequently be integrated.

For the upper basin, the analysis will focus on the importance of rainfall and soil moisture for predominantly rainfed agriculture, particularly teff and other cereals. Green-water availability and consumption will be quantified, alongside blue-water uses associated with irrigation where present, livestock, domestic requirements and ecosystems.

For the middle basin, the analysis will focus on interactions between blue and green water in mixed rainfed and irrigated systems, including enset-based home gardens, other crops, livestock and domestic uses. Where information permits, the analysis will identify the different sources of water supporting these systems, including rainfall and soil moisture, groundwater, springs, rivers and irrigation.

For the lower basin, the accounts will emphasize the relationship between river flows, seasonal inundation, groundwater and water-dependent livelihoods and ecosystems, including flood-recession agriculture, floodplain grazing, fisheries and wetlands, together with other agricultural, domestic and livestock uses.

Stakeholder knowledge will be incorporated throughout this phase to help interpret the spatial patterns emerging from the WA+ analysis and to identify locally important water uses or seasonal dynamics that may not be adequately captured in available datasets.

Stakeholder engagement: At least one basin-level review will be held during this phase, with additional technical consultations as required. Draft accounts for the upper, middle and lower basin will be presented for review before they are integrated into the basin-wide account.

3.4 Phase 4: Integration, Validation and Uncertainty Assessment (April–June 2028)

The fourth phase will integrate the three spatial accounts into a consistent basin-wide blue–green water accounting framework. Particular attention will be given to consistency between upstream and downstream accounting units and to understanding how changes in storage, water use and river flows propagate through the Basin.

The accounts will be compared against available streamflow records, groundwater observations, reservoir information, irrigation statistics, agricultural data and other independent evidence. Stakeholder review will be used alongside technical validation to assess whether the results and their interpretation are consistent with observed conditions and local knowledge.

An uncertainty and sensitivity assessment will focus on key variables such as evapotranspiration, soil moisture, irrigation extent and intensity, crop water consumption and groundwater. Key assumptions and uncertainties will be documented.

Stakeholder engagement: A basin-wide validation workshop will be convened during this phase to review the integrated accounts, discuss key findings and uncertainties, and identify any final revisions required before the results are transferred to the linked PODs.

3.5 Phase 5: Application to Linked PODs and Synthesis (July–December 2028)

The final phase will translate the accounting results into datasets and indicators that can be directly used by the two complementary PODs.

For the Value Blue–Green Water Services activity, the accounting outputs will provide the physical evidence needed to establish the relationship between water dynamics and the benefits generated by different production systems and ecosystems. These will include green-water use by rainfed teff and other cereals; blue–green water use in mixed systems such as enset home gardens; blue-water use in irrigated agriculture; and water dynamics supporting flood-recession agriculture, grazing, fisheries and other ecosystem services.

For the Hydropower–Irrigation–Ecosystem Trade-off Assessment, the accounting outputs will provide the hydrological baseline needed to assess alternative water-management and development scenarios. Relevant inputs will include river flows and seasonal variability, reservoir storage and releases, irrigation withdrawals and consumption, groundwater interactions, downstream water availability and other indicators of changes in the hydrological regime.

The final outputs will be consolidated into an Omo–Gibe Blue–Green Water Accounting Package, comprising the basin and sub-basin accounts, spatial datasets, maps, indicators and methodological documentation. A final stakeholder engagement will be used to present the findings, discuss implications and agree priorities for future updating and application.

Key outputs:

- datasets and indicators for the Value Blue–Green Water Services POD;
- hydrological inputs for the Hydropower–Irrigation–Ecosystem Trade-off Assessment POD;
- final Omo–Gibe Blue–Green Water Accounting Package;
- final stakeholder review and dissemination workshop;
- final technical report and recommendations for future updating.

This schedule is indicative rather than prescriptive. The timing, format and composition of stakeholder engagement will be refined following the September 2026 inception workshop and in coordination with the other Omo–Gibe PODs. This will allow the project to respond to stakeholder priorities and ensure that engagement is substantive—contributing data, knowledge and interpretation to the accounts—rather than being limited to dissemination of results.

Figure 2. Gantt Chart: Omo-Gibe Blue-Green Water Accounting – Workplan (POD commenced July 2026)

Activities and Outputs	2026				2027				2028			
Phase 1 – Data assembly, operationalization and stakeholder inception												
• Preliminary land-use, agricultural and water-use characterization												
• Conceptual framework and inception report												
• National inception workshop (September 2026)			▲									
• Revised and stakeholder-validated conceptual framework and workplan												
• Basin-wide data inventory and data-gap assessment.												
Phase 2: WA+ baseline and basin hydrological characterization												
• Spatial datasets for precipitation, ET, soil moisture, runoff and storage												
• Preliminary blue–green water partitioning												
• Rainfed and irrigated agriculture water-use dataset												
• Stakeholder-reviewed baseline assessment												
Phase 3: Development of blue–green water accounts for the upper, middle and lower basin												
• Draft water accounts for the upper, middle and lower Omo–Gibe basin												
• Spatial maps and seasonal graphs of water consumption												
• Stakeholder-reviewed draft accounts quantifying priority blue and green water-dependent agricultural, livelihood, economic and ecosystem benefits												
Phase 4: Integration, validation and uncertainty assessment												
• Integrated and validated basin-wide blue–green water accounts												
• Validation workshop												
• Uncertainty and sensitivity assessment												
• Revised datasets and accounting assumptions												
Phase 5: Application to linked PODs and synthesis												
• Datasets and indicators for the Value Blue–Green Water Services POD												
• Hydrological inputs for the Hydropower–Irrigation–Ecosystem Trade-off Assessment POD												
• Final Omo–Gibe Blue–Green Water Accounting Package												
• Final stakeholder review and dissemination workshop												
• Final technical report and recommendations for future updating												

Source: authors' creation

Note: ▲ Stakeholder engagement milestone

4. Conclusion

This inception report provides the rationale, conceptual basis and proposed implementation pathway for developing spatially and temporally explicit blue–green water accounts for the Omo–Gibe Basin. It argues that a conventional assessment of surface-water availability alone is insufficient for understanding how water supports agriculture, ecosystems, livelihoods and economic activities across the basin. In the upper and middle basin, rainfall, soil moisture and evapotranspiration are central to rainfed and mixed farming systems, while in the lower basin river flows, seasonal flooding and groundwater interactions sustain flood-recession agriculture, grazing, fisheries, wetlands and the wider Lake Turkana system. Accounting for these blue- and green-water dimensions within a single framework is therefore essential for understanding hydrological dependencies, potential competition and trade-offs across the basin.

The proposed approach will adapt IWMI's water accounting methodology and WA+ experience to the specific hydrological, agricultural and social-ecological characteristics of the Omo–Gibe system. By assembling existing observations, remote-sensing products, spatial datasets and relevant institutional knowledge, the activity will, as far as data permit, establish a consistent account of water availability, use, consumption, storage, return flows and depletion. The workplan recognizes that the accounting framework must be both technically robust and practically useful; it is therefore designed as an iterative process in which national and basin stakeholders help refine priorities, validate assumptions, interpret emerging results and identify the most relevant indicators for planning and future monitoring.

The outputs will provide an important biophysical evidence layer for the wider Omo–Gibe Multi-Functional Landscapes portfolio. In particular, the accounts will supply the physical variables needed to value blue–green water services and the hydrological baseline required for assessing hydropower–irrigation–ecosystem trade-offs across the Omo–Gibe system. More broadly, the activity will help make visible the relationships between land, water, ecosystems and livelihoods, thereby supporting more integrated decision-making on water security, ecosystem services and multifunctional landscape management.

The September 2026 inception workshop will be a critical first step in this process. It will provide the opportunity to validate the proposed framework and workplan, agree priority datasets and issues, and strengthen ownership of the accounting process among national and basin stakeholders. Subject to this validation, the proposed work offers a clear pathway from data assembly and baseline characterization through account development, integration, validation and application. The ultimate value of the activity will lie not only in the production of a technical water account, but in establishing a credible and usable basis for understanding how blue and green water support people and ecosystems across the Omo–Gibe Basin, and for informing future choices about development, conservation and water management.

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