# Unlocking Ethiopia’s Irrigation Potential

## An assessment and action for water security

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## The irrigation opportunity in Ethiopia

Ethiopia has abundant water resources. With 12 river basins and rich groundwater reserves, the country holds an estimated irrigation potential of between 3.7 and 5.3 million hectares[1]. Yet only around 1.8 million hectares, or roughly **one third of its potential**, has been brought into use.

This gap represents an enormous, unrealized opportunity. Closing it would strengthen food security, expand rural livelihoods, and drive local economic development across some of Ethiopia's most productive agricultural regions. It would also build climate resilience: irrigation systems are typically the largest water users within their basins, and managing them well has direct bearing on water availability, local climates, and the health of the broader environment.

***The irrigation landscape of Ethiopia***

*The Ministry of Water and Energy of Ethiopia classifies irrigation schemes by size: small (1–200 ha), medium (201–3,000 ha), and large (over 3,000 ha)[2]. Across more than 790 registered schemes, only about 107,000 of the 115,000 developable hectares are currently irrigated[3]. Key crops include maize, sorghum, wheat, barley, sugar-cane, cotton, vegetables, and tuber - crops that feed millions and can anchor local economies. Figure 1 shows the regional distribution of existing irrigation schemes in Ethiopia:*

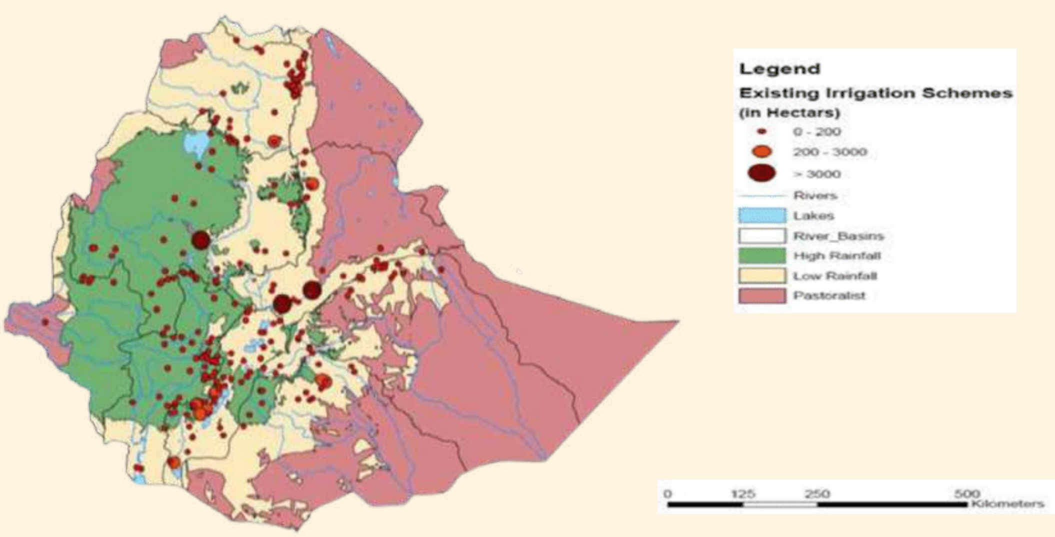


**Figure 1** - *Existing irrigation schemes in various river basins with regional rainfall in Ethiopia[4]*

[1] Teshome, Y., Biazin, B., Wolka, K., Burka, A., (2018). Evaluating performance of traditional surface irrigation techniques in Cheleleka watershed in Central Rift Valley, Ethiopia. Applied Water Science. 8, 1–14. https://doi.org/10.1007/s13201-018-0862-z

[2] Awulachew, S. B.; Yilma, A. D.; Loulseged, M.; Loiskandl, W., Ayana, M.; Alamirew, T. (2007). Water Resources and Irrigation Development in Ethiopia. Colombo, Sri Lanka: International Water Management Institute. 78p. (Working Paper 123)

[3] Water resources and irrigation development in Ethiopia (Report Working Paper 123). (2007). International Water Management Institute.

# Irrigation, a sector operating below potential

## Evidence of underperformance

Despite the scale of investment in irrigation, performance across Ethiopian existing irrigation schemes is often far below expected. A comprehensive assessment[5] of 24 irrigation schemes in the Awash basin found that only three operate at an efficiency above 50%. The remaining schemes, collectively covering nearly 51,000 hectares, fall well short of their intended design capacity. This represents a significant loss for the country: water abstracted but not productively used, infrastructure built but not delivering returns, and food security potential left unrealized.

Surface irrigation, which accounts for roughly 90% of irrigated area in Ethiopia, is the dominant method. Its inherent efficiency is low typically between 30 and 50%, compared to 60-75% for sprinkler systems and 80-90% for drip irrigation. Advanced methods remain limited to a handful of private operators in the floriculture sector. Table 1 illustrates this scale of the efficiency gap.

**Table 1 -** *Irrigation systems area coverage with respective efficiency*

| | Method | Area Coverage (approx.) | Efficiency (%) |
|---|---|---|---|
|  | **Surface Irrigation** | ~90% | 30–50 |
|  | **Sprinkler Irrigation** | <5% | 60–75 |
|  | **Drip Irrigation** | <1% | 80–95 |
|  | **Manual Irrigation** | Small, unquantified | 30–60 |
|  | **Flood Irrigation** | Traditional, included | <30 |

[4] Tadesse, M., & Baihilu, B. (2017). Review on participatory small-scale irrigation schemes and small-scale rainwater harvesting technology development and its contribution to household food security in Ethiopia. International Journal of Water Resources and Environmental Engineering, 9(3), 54–63. https://doi.org/10.5897/ijwree2016.0700
[5] Kedir, Y., Berhanu, B., & Alamirew, T. (2021). Comparative efficiency analysis of irrigation scheme categories of Awash River Basin, Ethiopia. Journal of Resources Development and Management, 79, 21–35. https://doi.org/10.7176/JRDM/79-03
[6] FAO (2016) AQUASTAT Country profile Ethiopia and Irrigation Manual.

The scale of this underperformance is not theoretical. GOPA MetaMeta's work at the Wonji-Shoa sugar estate, one of Ethiopia's better-managed schemes, illustrates how deeply inefficiency is embedded even in relatively well-resourced systems, and how much can be gained through better data and management practice.

***When even the best systems underperform: lessons from Wonji-Shoa***

*The Wonji-Shoa sugar estate is among Ethiopia's better-managed irrigation systems — and it is still grossly underperforming. Declining water productivity, significant abstraction from the Awash River, and a chronic gap between water allocation plans and actual abstraction patterns characterize a system held back by excessive irrigation losses, shallow groundwater tables, electricity shortages, and insufficient maintenance funding. The oldest part of the estate, Wonji Main, relies on furrow irrigation and has consistently underperformed compared to newer schemes.*

*Wonji-Shoa Irrigation Canal*

*Critically, there was no detailed spatial assessment of water consumption, biomass production, and productivity differences across irrigation methods, which restricted evidence-based decision-making.*

*GOPA MetaMeta addressed this gap using WaPOR remote sensing data to assess water consumption, productivity, and distribution uniformity across the estate. The findings revealed significant spatial variations in water use and productivity across different schemes. Generally, centre pivot systems significantly outperformed furrow irrigation* *in both water productivity and consistency, and substantial gaps existed between top-performing and average plots. Critically, the analysis showed that better management and reduced non-beneficial water losses could increase production without using more water - making the case that the productivity potential within Wonji-Shoa, and systems like it, remains largely untapped.*

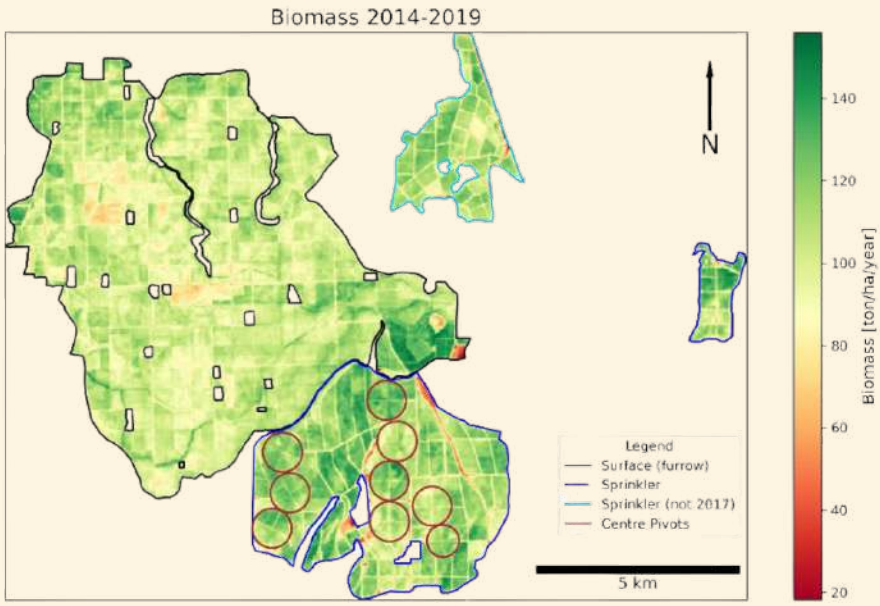


**Figure 2** - *Spatial distribution of the average annual biomass production (ton/ha/year) over the period 2014-2019 for Wonji Sugarcane estate area at 30m resolution*

## Root causes of poor performance

Six interconnected factors drive the underperformance of Ethiopian irrigation schemes. They span design, operations, governance, and policy:

1. **Infrastructure condition and completeness:** Many schemes were never fully built to design, with incomplete minor canal networks limiting distribution reach from the outset. Where infrastructure does exist, deformation, siltation, and deteriorating conveyance systems have progressively altered hydraulic characteristics and reduced capacity and technical performance such as low or fluctuating pressure, power interruptions, high leakage rates, improper equipment configuration (e.g., nozzle sizes), and vulnerability to wind conditions. Flawed design and poor original construction quality compound the challenge of maintenance.

2. **Water supply variability and scheduling failures:** Unpredictable supply, both shortages and excess flows, combined with poor irrigation scheduling and a persistent mismatch between water delivery and crop needs leads to simultaneous over-irrigation in some areas and crop stress in others. Field application efficiency remains low across virtually all schemes.

3. **Weak institutional capacity and governance:** Local management institutions lack authority, resources, and technical depth. Water User Associations are often passive rather than active managers, and experienced technical staff are scarce.

4. **Inadequate water and agronomic management practices:** Poor agronomic and water management practices include improper scheduling, inefficient field application, and a mismatch between delivery and crop needs.

5. **Inadequate operation and maintenance:** Spare parts are unavailable, repairs are delayed, and ownership of infrastructure is unclear. Pressurized systems face additional technical constraints including pressure fluctuations, power interruptions, and improper equipment configuration. The result is a chronic maintenance deficit that compounds over time.

6. **Absence of meaningful water valuation:** Without functioning water measurement instruments or a credible water charging policy, users face no financial signal to use water efficiently. This drives over-abstraction, contributes to soil salinization, and leaves Water User Associations without the revenue base needed to deliver services.

The consequences of poor irrigation performance reach far beyond the farm gate. Excessive water application drives land degradation, nutrient depletion, and soil salinization, while uneven distribution creates moisture stress that damages crops and deepens food insecurity. These pressures generate real conflicts between upstream and downstream users, and between smallholder farmers and private investors who often command larger allocations. **The cumulative effect is a sector consuming scarce water without delivering the food security or economic returns it should.**

## A new way of seeing irrigation

Many of the problems described above stem from a narrow conception of what irrigation systems are for. When schemes are designed purely to deliver water to crops and then handed to under-resourced agencies, the trajectory toward decline is built in from the start.

A more productive starting point is to **recognise irrigation systems as critical infrastructure embedded in a larger water cycle and landscape**. Well-managed schemes do far more than convey water: they regulate groundwater recharge, improve local climates, shape land use, support biodiversity, and determine the economic viability of entire agricultural regions. When managed with this broader purpose in mind, irrigation systems can become drivers of climate adaptation and strong local economies rather than sources of resource waste and conflict.

This reframing has real practical consequences. Managing irrigation as a complete system - coordinating water allocation and scheduling across the full network, combining surface water and groundwater, and aligning daily operations with actual infrastructure capacity - consistently delivers performance gains that no amount of farm-level intervention can achieve in isolation. It also creates the conditions under which institutions can actually sustain improvements: data that is shared rather than siloed, responsibilities that are clear rather than contested, and water users who are engaged because the system is working for them.

Critically, this perspective shifts the investment logic. The question is no longer "how much new area can be brought under irrigation?" but "how much more productive can existing systems become?" A scheme moving from 35% to 60% efficiency effectively doubles its output without additional land, water, or major capital expenditure. Ethiopia has dozens of schemes where gains of this magnitude are achievable within a relatively short timeframe. The action plan that follows is built on this premise. It is deliberately sequenced, beginning with establishing a shared evidence base, moving through targeted technical and governance interventions, and culminating in national policy alignment. The entry point is not another diagnostic study. The data already exists. What is needed now is structured, committed action - beginning with two or three critically underperforming schemes and building toward national-scale change.

Irrigation reservoir in Wererso

# A PHASED ACTION PLAN FOR IMPROVEMENT


## Step 1: Establish a shared performance baseline

The starting point is to organize and activate what is already known. Existing data, supplemented where necessary by remote sensing through WaPOR and IrriWatch, provides a strong foundation for assessing irrigation performance, identifying distribution inefficiencies, and tracking soil moisture trends. Working with irrigation managers, Water User Associations, and government counterparts, a shared baseline should cover:

- Water distribution equity across the network
- Field-level application efficiency
- Crop water productivity
- Infrastructure condition and maintenance status

Establishing this baseline collectively builds the ownership that sustained improvement depends on, and anchors all subsequent interventions in outcomes that can be measured and reported.

## Step 2: Targeted technical and agronomic interventions

With priorities agreed, action focuses on two levels simultaneously.

*At system level:* Improved coordination of water allocation and scheduling across the full network, supported by digital tools (including WaPOR, CropWAT, and DIWASA) for evidence-based scheduling, real-time performance tracking, and remote monitoring of water use and crop stress. GOPA MetaMeta has introduced a GIS-based planning approach in the Gezira scheme in Sudan, where farmers organized in irrigation blocks mapped their irrigation and cropping plans for upcoming seasons, coupled with scheme-level allocation options and visualized in maps showing where and when water would be distributed. This kind of spatial planning, done with farmers rather than for them, is both technically effective and institutionally durable.

*At farm level*: a shift from extractive to regenerative practice through:
- Regulated deficit irrigation and alternate row irrigation to reduce water use without yield loss
- Cover cropping, compost application, and reduced tillage to rebuild soil water retention
- Restoration of soil organic matter depleted by decades of surface flooding

Healthy soil and well-managed fields are as important to water security as the canals themselves.

## Step 3: Governance and institutional strengthening

Technical improvements without governance reform do not hold. Priorities are:

- Transforming Water User Associations into genuine performance drivers with real authority, adequate resources, and the technical capacity to use both.
- Integrating women into decision-making roles at all levels - consistently and demonstrably linked to better governance outcomes and more equitable water distribution.
- Structured horizontal learning through exchange visits, peer workshops, and communities of practice between schemes.
- Developing practical operational guidance that managers can actually use - scheduling tools, maintenance protocols, and reference materials grounded in local conditions.
- Training and capacity building for scheme operators and WUA managers on water allocation, sediment management, and irrigation scheduling, supported by the installation of water measuring and meteorological equipment

## Step 4: Water pricing and financial sustainability

Across Ethiopian irrigation schemes, water is largely unmetered, uncharged, and undervalued. While the current pricing policy is designed around a social tariff structure for cost recovery, it does not generate sufficient funds for operation and maintenance — and without functional water measuring instruments at most schemes, even this limited framework cannot be properly enforced or monitored.

The action priority is therefore threefold:

- **Install water monitoring and measuring instruments** at scheme level so that actual abstraction can be quantified and tariff structures can be applied meaningfully
- **Establish clear tariff regulations that generate sustainable** revenue for operation and maintenance, and over time, for the expansion of additional irrigation infrastructure
- **Introduce digital payment systems** (such as W@tch software) to improve transparency, ensure equitable water allocation, and build the financial reserves that Water User Associations need to deliver higher-quality services to their members

When water carries a fair and enforceable price, farmers facing scarcity have a direct incentive to adopt more efficient practices. Water User Associations with a reliable income base can move beyond basic administration and become genuine service providers. And schemes with functioning cost-recovery mechanisms can sustain themselves - reducing dependence on external rehabilitation funding and supporting long-term inclusive growth. This makes a more comprehensive water pricing policy not a technical detail but a prerequisite for the financial sustainability and lasting effectiveness of Ethiopian irrigation systems.

## Step 5: National scaling and policy alignment

What works at scheme level must shape national policy — not the other way around. This requires:

- National dissemination events giving scheme-level practitioners a direct voice in policy dialogue
- Evidence-based policy briefs translating field findings into actionable recommendations for the Ministry of Water and Energy, Ministry of Irrigation and Lowlands and major development partners
- Investment plans grounded in demonstrated performance rather than theoretical capacity
- A coherent national water management framework that aligns scheme improvements with basin management objectives.

## Step 6: Connecting irrigation to Ethiopia's broader national agenda

Irrigation improvement does not happen in isolation. Linking scheme management with integrated water resource management, watershed restoration, and the Green Legacy Initiative creates compounding returns:

- Reduced soil erosion means less canal siltation and lower maintenance costs
- Restored catchments mean more reliable and predictable water availability
- Better upstream-downstream coordination reduces the allocation conflicts that can undermine trust and cooperation across basins

Addressing Ethiopia's irrigation underperformance is not merely a technical imperative — it is a strategic necessity. The country cannot afford to keep abstract water without delivering returns, building infrastructure without sustaining it, or investing in schemes that operate at a third of their capacity. The integrated approach outlined here offers a practical, sequenced pathway to change that. Ethiopia has everything it needs to make it work.

GOPA MetaMeta is ready to move from assessment to action. We invite development partners and government counterparts to join us in doing so.

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