Report

A thirsty future?

Water strategies for Ethiopia's new development era

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Cover photo: © UNICEF Ethiopia: A boy in the Tigray Region of Ethiopia fetches water from the pond.

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All findings, conclusions and errors are the responsibility of the authors.

About the study

This report is the final output of the project 'Building adaptive water resources management in Ethiopia', led by the Overseas Development Institute (ODI), in partnership with the Ethiopian Ministry of Water, Irrigation and Electricity (MoWIE). The project was funded by the Strategic Climate Institutions Programme (SCIP) from September 2013 to December 2015 (see Annex I).

The project was commissioned out of growing concern for the socio-economic consequences of unconstrained water development in Ethiopia. Phase 1 of the project aimed to develop a 'road map' of the actions and institutional investments that are required to build long-term integrated and adaptive water resources management in the face of climate change and other pressures. In phase 2, a basin-scale study highlighted the impact of poor water management on different users and uses, including water pricing for different sectors, and the growing costs of scarcity, competition and pollution. The research focuses on a case study of the Awash River Basin, a 'hotspot' which is experiencing increased tension between downstream and upstream irrigators, and between water for agriculture, energy and domestic use. The report is intended for MoWIE and other water sector stakeholders in Ethiopia, and for those with broader research, development and policy interests in sustainable water resource management.

Abbreviations

AAU	Addis Ababa University
AWRM	Adaptive water resources management
CC-WRMA	Climate change and water resources management assessment
CRGE	Climate-Resilient Green Economy
AfDB	African Development Bank
EIWR	Ethiopian Institute of Water Resources
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross domestic product
GoE	Government of Ethiopia
GTP	Growth and Transformation Plan
IWRM	Integrated water resources management
MDGs	Millennium Development Goals
MoA	Ministry of Agriculture
MoWIE	Ministry of Water, Irrigation and Electricity
ODI	Overseas Development Institute
OWNP	One WASH National Programme
PSNP	Productive Safety Net Programme
RBAs	River Basin Authorities
RWBs	Regional Water Bureaus
SCIP	Strategic Climate Institutions Programme
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
USD	US Dollar
WASH	Water, Sanitation and Hygiene
WEF	World Economic Forum
WLRC	Water and Land Resource Centre
WRM	Water resources management
WRMA	Water resources management assessment

Executive Summary

Key messages

- Public and private investments to develop Ethiopia's water resources have contributed to the country's progress in growth and poverty reduction.
- For sustainable and broad-based growth, policy-makers must address problems of scarcity, competition and pollution as pressure on water resources increases.
- River basin authorities can play a key role, but lack resources and authority to coordinate investments, allocate water, resolve conflicts.
- High-level political leadership is essential to ensure future planning within a comprehensive and integrated framework across projects, sectors and regions.
- With better, sustainable and inclusive water resources management, Ethiopia can continue to harness its water for the new development era.

Ethiopia's double-digit economic growth is the envy of many countries in Africa. Growth has also been broad-based. Ethiopia has made significant progress in human development indicators including education, health and poverty (Lenhardt et al, 2015). However, further gains will be dependent on responsible water management: developing and managing water in ways that balance competing social and economic claims within the frontiers of environmental sustainability.

Water resources help drive development. Water is an essential input for energy, industry and agriculture, while water and electricity for domestic use can catalyse higher incomes and improved welfare for poorer households. The government has therefore outlined ambitious water development plans, including small- and large-scale irrigation schemes, multipurpose dams to provide hydropower, and water infrastructure to serve growing rural and urban populations. The rapid mobilisation of water is central to the second stage of the government's Growth and Transformation Plan (GTP II), which emphasises the importance of increased agricultural production, accelerated industrial growth and poverty reduction. The Grand Ethiopian Renaissance Dam, currently under construction, will be the largest dam in Africa on completion, and is a powerful symbol of the country's ambitions.

Where is the water coming from? Ethiopia has a relatively generous endowment of water. Renewable flows of 1,290 cubic metres per person per year compare favourably with other countries in Africa (World Bank data, 2013). However, Ethiopia's water is distributed unevenly in space and time – across different regions, seasons and years. This variability and unpredictability causes major problems for the economy, with a cost of approximately one third of potential gross domestic product (GDP, see Grey and Sadoff, 2006).

Variability also affects livelihoods, as smallholder farmers rely on rainfed production. The effects of the El Niño related drought, floods and subsequent failed harvests in 2015 and 2016 have created a humanitarian crisis. More than 10 million people require emergency food aid and six million people require emergency water services (Fewsnet, 2016). Climate change will likely amplify risks, since climate models project higher levels of seasonal and inter-annual variability, and more droughts and more floods, over the coming decades (Conway and Schipper, 2011).

Ethiopia's investments in water capture, storage and conveyance can help buffer the effects of rainfall volatility and support growth. But they will not be enough to secure climate-resilient growth without parallel investments in soft infrastructure – the institutional plumbing of water resources management. This was the finding of Phase 1 of the ODI/MoWIE-led project, Building Adaptive Water Resources Management in Ethiopia (Mosello et al, 2015), that went on to develop a 'road map' of the actions and institutional investments that are required to build adaptive water resources management at national and basin level.

Our most recent research under Phase 2 of the project and reported here looked at the financial and economic consequences of intensive water resources development in the Awash river basin. The Awash supports Addis Ababa, Ethiopia's growth hub, and a corridor of increasingly intensive agricultural and industrial development in the Upper Awash. Here, the claims of urban, industrial, energy and irrigation users are beginning to compete with one another as different agencies and actors use, and pollute, the same interconnected resource.

In the Awash Basin, water treatment for domestic use is increasingly expensive. In Adama, for example, roughly 70% of the utility budget is now earmarked for basic water treatment, and chemical use now exceeds international standards. In Awash Town, surface water pollution and low flows have forced the utility to pump groundwater, but shortages mean the supply is intermittent.

Utilities in the Awash struggle to cover production costs, which are higher than average tariffs. As a result, there are limited funds to expand coverage. The majority of people do not have a household connection and cannot benefit from subsidised tariffs. The poorest households in new or informal settlements rely on standpipes, private water vendors and water trucks. Buying water from these sources costs substantially more. In Metehara for example, the poor can pay from 1.5 to 8 times the cost of the lowest public utility tariff. In short, the urban poor are paying the price of supply shortages and basin mismanagement.

Agricultural users in the Awash also face increasing water scarcity, directly impacting crop production. Economic development and improved market links have driven an irrigation boom, from large-scale export crop production of sugar and cotton drawing on surface water, to small-scale groundwater pumping for horticulture targeting the local market. Agriculture is a high-volume withdrawer and consumer of water, and downstream schemes complain that the water they need is being captured by upstream users.

Poorly managed irrigation schemes have other unforeseen impacts on the catchment. Return flows into Lake Beseka have caused salinity and lake expansion, damaging infrastructure and contaminating the downstream water supply for Awash Town.

The economic, social and environmental costs of unconstrained and uncoordinated water development are increasing rapidly. These include the rising costs of domestic supply and treatment, economic losses from inefficient water allocation, pollution and the loss of essential ecosystem services. A key problem is that many of the investment decisions around 'water for growth' are being made by different agencies at different levels, with often conflicting plans to develop the same resources. In intensively used basins such as the Awash, new water developments will inevitably affect the quantity or quality of water available to others, and these spill-over effects incur costs.

The challenges in the Awash Basin illustrate that water strategies for Ethiopia's new development era, marked by publication of the second GTP, need to change. There are lessons from other emerging economies, such as China. Chinese leaders now acknowledge that a narrow focus on water development alone, without parallel investment in management, has incurred unforeseen costs. The costs have become so great they have damaged China's international reputation, act as a drag on growth and threaten the legitimacy of the party-state.

Investing in water infrastructure is an important first step in Ethiopia's sustainable development pathway. However, infrastructure alone is insufficient to capture the potential of water for growth, control supply variability and provide adequate water to meet demands across different sectors.

Complementary investment in management institutions and human and institutional capacity is essential to ensure that water resource plans are implemented, to leverage the potential of water for growth and to manage scarce resources for equitable distribution. The water and energy sector's contribution to the Climate-Resilient Green Economy (CRGE) strategy recognises this in principle, but does not describe how water management policies can resolve issues of 'scarcity' and 'conflict' in practice. These are the daily challenges faced by different water users.

Through a series of consultative workshops and interviews with key stakeholders in Ethiopia's water sector, we have developed the following recommendations for better, more inclusive and more sustainable water resources management:

Recommendations

What are the essential building-blocks of effective water resources management? In essence, they can be distilled down to five core elements – what Perry (2014) terms the 'A, B, C, D, and E' approach. Because our analysis focuses on the institutional dimensions of water resources management, we substitute Perry's 'Engineering' component with an 'Enforcement' one. These elements are found wherever water management is effective, and absent – in whole or part – when it is not:

- **A: Accounting** should result in clear and publically available knowledge of resource conditions in time and space, and systems for 'following the water' – where it is being withdrawn, who is using it, what proportion is returned, and what changes in quality are occurring. This will help decision-makers to understand who benefits and who pays the costs of water resource allocations and infrastructure. GoE, with the support of development partners, must mobilise resources for data systems (a cross-cutting issue in Ethiopia's GTP) to allow for accurate, efficient and adaptive economic and hydro-ecological water accounting. The research sector can support this process by providing socio-economic, climatic and hydrological data and evidence for policy-making.
- **B: Bargaining** is an important part of the political process to determine water use priorities among different users. Ethiopia's outdated Water Strategy states that domestic use is the number one priority, but other priorities are unclear. In practice, different agencies, jurisdictions and sectors follow their own agendas and mistakenly assume there is adequate water to meet them. GoE, RBAs and water sector stakeholders must

consider and discuss the needs of different users at different scales, including the needs of ecosystems and more marginal downstream users such as small scale farmers and pastoralists. There should be mechanisms to transfer and distribute the benefits of economic growth driven by water resource development.

- **C: Codification** is the translation of agreed priorities and allocations into rules, statutes and laws, so that the water service to each sector or user is clear under different hydrological conditions. Crucially, this means defining and allocating shares of available water according to the priorities set above. The water management system should also allow for processes such as social and environmental impacts assessments, vulnerability assessment and identification of mechanisms to compensate affected users and redistribute benefits. GoE should revise, update and reform existing regulations for the water sector to improve data management, permits (for use and waste), tariffs and penalties. Development partners should support human and organisational capacity development for water resource management from federal level to the community.
- **D: Delegation:** Roles and responsibility for water management and provision of water must be clearly defined. Currently, there are overlapping mandates between federal government and river basin authorities, and between basin authorities and regional government. Water institutions require clear and distinct roles and adequate resources and capacity to assess user needs, consider trade-offs and allocate water in a way which is efficient, equitable and environmentally sustainable. GoE should assign distinct roles and responsibilities for each actor in the water sector, and ensure that ministries which manage water-dependent sectors (for example, Ministry of Planning, Industry and Trade, Agriculture, Environment, Natural Resources, Water and Energy) are equipped to establish required institutional structures, share information within and across sectors and implement national water resource management plans.
- **E: Enforcement:** It is essential that water institutions, stakeholders and users understand, respect and comply with the rules, statutes and laws established by the process above. Evidence-based planning, appropriate regulations and delegation, and enforcement procedures (which are utilised as needed) will encourage water sector stakeholders to act cooperatively and effectively, for sustainable water driven growth. The GoE and water sector stakeholder should establish the 'rules of the game', and develop the mechanisms to ensure they are respected through transparent and accountable enforcement procedures, including recourse for when due process is not respected. Other water sector stakeholders must comply with the reformed system, or risk punitive enforcement procedures such as penalties and fines. Donors, private actors and financial institutions can support the process through data collection, information sharing and coordination.

1. Water and growth

1.1 Water for growth: risks and rewards

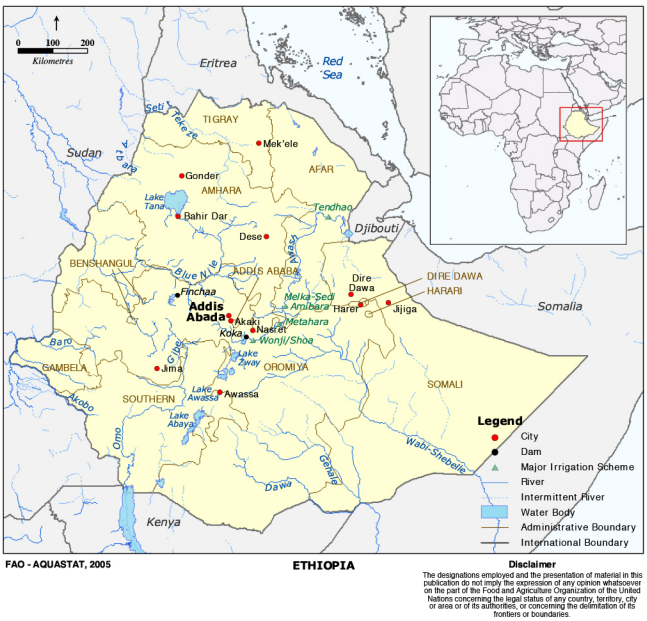
Ethiopia provides important insights into the relationship between water, growth and poverty reduction. Since 2000, the Government of Ethiopia (GoE) has pursued an ambitious development agenda, with impressive results. Ethiopia maintained an average gross domestic product (GDP) growth rate of 10.5% between 2010 and 2014 (World Bank, 2014). Unlike many African countries which rely on commodity exports, Ethiopia's GDP growth is derived from transformational investment, supported by growth of the manufacturing sector at an average rate of 10% from 2006 to 2014 (Economist, 2015).

In development terms, Ethiopia has also achieved rates of poverty reduction far ahead of regional trends, with a 33% reduction between 2000 and 2011 in the number of people living in poverty (World Bank, 2015). Ethiopia stands out as one of the few African countries on track to meet most of the Millennium Development Goals (MDGs), and has made significant improvements in Human Development Indicators (HDI) (United Nations Development Programme (UNDP), 2015). However, in relative terms, Ethiopia is ranked 173rd out of 186 countries according to the UN's Human Development Report, and its people still experience some of the lowest levels of development globally (ibid).

Ethiopia's development progress has been well documented by the Overseas Development Institute (ODI) and others (Lenhardt et al., 2015; Mosello et al., 2015). However, commentators rarely acknowledge the role of water in growth and transformation. Analyses such as those conducted by Grey and Sadoff (2006) focus on water risks. However, water can play both a positive and a negative role in economic and social development.

Ethiopia has a relatively generous endowment of water, which can meet the needs of agriculture, industry and households. Renewable flows of 1,290 cubic metres per capita per year compare favourably with other countries in Africa (World Bank Data, 2013[1]). However, these water resources are distributed unevenly in space and time. Ethiopia's water is spread across 12 river basins and stored in groundwater aquifers, and rainfall levels vary significantly across seasons and years. This variability2affects economic growth and broader development outcomes.

Figure 1: Detailed map of Ethiopia, with major water bodies indicated



Source: FAO/AQUASTAT, 2005[2]

The World Bank (2006), using data from 1986 to 2000, identified that hydrological variability exerted an annual cost of 38% of GDP growth. More recent research suggests this relationship is more complicated. Conway and Schipper (2011) found that the economic growth and variability relationship no longer holds, but that growth is negatively affected in major drought years, and is positively related to average run-off.[3]

The 2015-2016 El Niño related drought has had devastating impacts. Successive failed rains have destroyed

1 This can be compared with Kenya, which has only 474 cubic metres per capita (World Bank Data, 2013).

2 Available online: http://www.fao.org/nr/water/aquastat/countries_regions/ETH/ETH-map_detailed.pdf

3 Economic analysis highlights sensitivities within the economy to large-scale drought. However, while the effects are clear in major drought years, in other years the relationship is weak. See: Conway and Schipper (2011).

harvests and killed livestock. The Government has identified 10 million people who require food assistance, while the UN estimates up to 15 million are at risk (Fewsnet, 2016; IRIN, 2015). There will also be a lagged effect on growth, as agriculture still accounts for 40% of GDP (World Bank, 2015). Further impacts are likely, due to predicted flooding, which could cause disease outbreaks and kill weak livestock (IRIN, 2015).

The record-breaking strength of El Niño is attributed to climate change. In Ethiopia, models project that climate change will also cause higher temperatures, greater hydrological variability and more extreme events, including longer and more frequent dry periods, with negative impacts on agricultural GDP and agricultural livelihoods (You and Ringler, 2011).

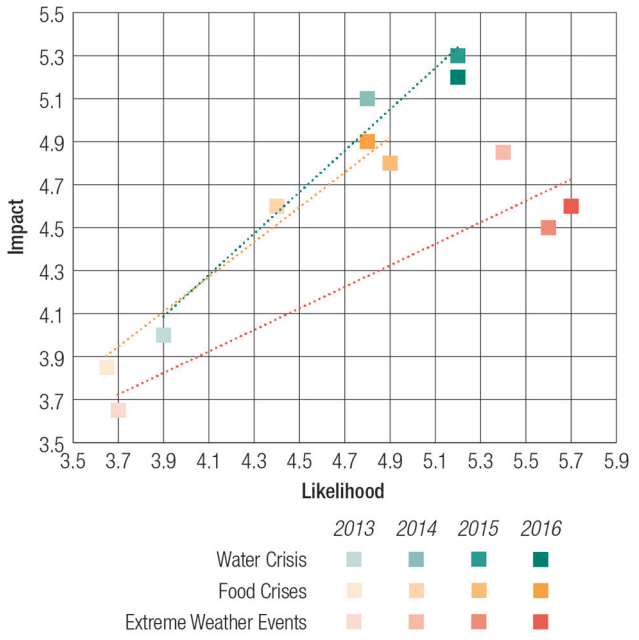
More generally, with climate change impacts and El Niño, the role of water for development and the potential for water-related risks is rising on the global strategic agenda. The African Development Bank (AfDB, 2015) stressed the importance of effective water management for Africa's economic transformation and climate change adaptation.

The costs of poor water management will escalate as demand increases and climate change accelerates. The World Bank (2016) predicts that the combined effect of population growth, economic development and urbanisation will drive up water demand and drive scarcity and water insecurity, with a potential annual cost of 6% of GDP in certain regions. The World Economic Forum (WEF, 2015) recognised 'water crises'[4] as the top global economic risk in 2015 (Box 1). This is exemplified by the effects of El Niño, which have been felt across the world. Droughts in the Horn of Africa, the Caribbean, and Southern Africa have affected agricultural output and growth, and put development gains at risk (Vidal and Carrington, 2015).

Investment in water resource development such as reservoirs for water storage can help 'smooth' the effects of current rainfall variability, manage water risks and mitigate the negative impacts of a changing climate (Grey and Sadoff, 2006). Historically, Ethiopia's investments to reduce the negative impacts of hydrological insecurity and harness its water for power, food production, industry, livestock and improvements in health and livelihoods have been limited (ibid). This situation is now changing, both at the strategic level (in terms of political will and regulations) and across river basins (in terms of management and implementation). The development of water resources to support green growth and poverty reduction is a key element of the government's growth and poverty reduction strategy, the second phase of the Growth and Transformation Plan (GTP II).

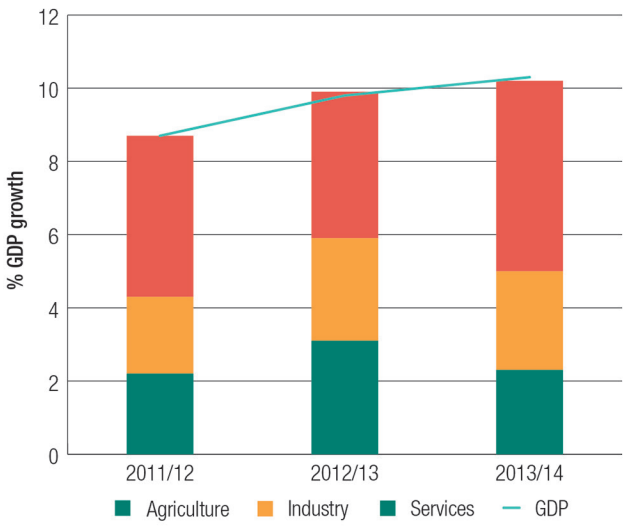
The GoE's vision is to transform Ethiopia into a lower-middle-income country by 2020-2023. To realise this, the first and second phases of Ethiopia's Growth

Figure 2: The rise of water crises as a global risk



Source: WEF, 2012-2016

Figure 3: Ethiopia's GDP growth, 2011-2014



Source: World Bank, 2015.

4 WEF considers water crises to include major droughts in productive farmland which affect food security and growth, low levels of access to clean drinking water which hinder development and interactions between water scarcity and conflict which drive migration and political risk.

Box 1: Water crises: the top threat for economies

In the 21st century, climate change and natural resource degradation pose one of the most urgent and unprecedented risks to the global economy (NCE, 2015). This generation has inherited the historic legacy of environmental degradation and climate change. Patterns of human development including land use change, industrialisation, urbanisation, expansion of commercial agriculture and population growth generate negative feedback effects, which undermine development (Vörösmarty et al., 2005). The poor are often disproportionately affected by environmental change and degradation (Dercon, 2012).[5] Policies and investments that are blind to the impacts of environmental risks embed future insecurity into the economic system.

Water will be the primary channel through which the impacts of climate change and environmental degradation are felt by society. The World Bank (2016) projects that water scarcity, exacerbated by climate change, could drive conflict, migration and damage GDP growth. In recognition of this, the World Economic Forum (WEF) ranked global water crises as the top threat facing global economies over the next decade in 2015, and the third ranked threat in 2016 (WEF 2015 and 2016, see Figure 2[6]).

Water is an essential input for industry, energy production and agriculture, and supports human welfare. 'Water security' is a precondition for sustainable economic growth, wealth, and human well-being (Sadoff et al., 2015). But water also generates risks: droughts, which undermine food security and agricultural production; floods that devastate infrastructure and destroy lives; waterborne diseases, which affect human health; and scarcity and competition which can drive conflict, political instability and migration (see WEF, 2015).

As a result of inherent geographic characteristics related to climate and topography, or economic and social norms around use and allocations, some countries face more water risks than others (Grey and Sadoff, 2006). External drivers can exacerbate these risks. For example, climate change is expected to increase the frequency of extreme weather events such as floods and droughts. Industrialisation, agricultural intensification and urbanisation can cause over-exploitation and pollution of water systems.

It is essential that governments reframe their development agenda to account for the value of water for economic growth, livelihoods and poverty reduction, and to control for water-related risks. Allocation decisions will impact users across the economy (WEF, 2015). Globally, 91% of the population has access to improved drinking water, but there are significant disparities within and across countries – for example, in Ethiopia only 57% of the population have improved water supply, although the rate is 93% for urban dwellers and 49% for rural population (WHO/UNICEF, 2015). In Africa, more than half of the energy from hydropower is directed towards industrial activities and extractive industries, rather than increased access for households (Hogarth and Granoff, 2015).

Decisions around who has water and who benefits from water resource development (depending on geographic location or commercial sector) have economic and social consequences. The macro-objectives around water resource development must be balanced by an inclusive framework that also considers the needs of the poor and the environment. It is important to consider how, and for whom, water security can be realised given trade-offs between uses and users with increasing competition (Mason and Calow, 2012).

and Transformation Plan (GTP I and II) place substantial emphasis on investment in infrastructure, particularly for energy provision. The GTP also identifies main sectoral pillars of growth, including a 'modern and productive agricultural sector' and 'an industrial sector that plays a leading role in the economy' (Federal Democratic Republic of Ethiopia (FDRE), 2011: 21). Water is a critical input to achieve these goals. There are ambitious plans to expand the area under irrigation, encourage the growth of water-dependent industries, increase energy production through hydropower, and ensure near universal access to safe water by 2020.

Recent research indicates that Ethiopia's agricultural development has driven both GDP growth and poverty reduction from 2000 (Lenhardt et al., 2015). Agriculture contributed 42% of value added growth from 2003 to 2012, while smallholder-focused programmes resulted in higher incomes (World Bank, 2013). The public sector has made a concerted effort to invest in rural development, in collaboration with private enterprises, and with support of major multilateral donors. In 2013, the government allocated over 15% of total national expenditure to agriculture, far above the African average of 2.7% (Lenhardt et al., 2015).

5 Environmental change is rarely equity-neutral. The poor are generally considered the main losers from climate change, as well as from the burdens of local environmental damage and natural resource degradation. They are typically more dependent on environmental capital and climate for their economic activities, not least as most of the poor still live in rural areas, dependent on agriculture. See: Dercon, S. (2012: 2).

6 The figure includes both impact and likelihood on a scale of 1 to 7, when 1 represents a risk which is unlikely to occur or have an impact, and 7 represents a risk which is very likely to occur and have massive and devastating impacts.

Box 2: Water and energy use by sector: a global perspective

Water and energy are critical inputs for growth across economic sectors. Agriculture is the highest water user both in terms of extraction and consumption. It is estimated that the sector accounts for 70% of global water withdrawals, although the figure may be much higher in semi-arid areas (Figure 4). This is a result of the expansion of crop production, increased use of irrigation and the growing adoption of water-intensive, horticulture, rice and maize. Industrial and domestic water use is also growing, and will face increasing competition with agriculture for limited freshwater resources. This raises the issue of trade-offs, as the 'value' of alternative uses of the same water may be higher.

Energy is another essential input for economic development, although the profile of users and uses is very different. The primary consumer of energy in the global market is industrial activity, including mining and manufacturing. Energy production is integrally connected with water resources. Hydropower is the most common form of energy production in Africa excluding bio power (USAID, 2014). The energy industry also uses water for cooling. Even though hydropower is not a major 'consumptive' use of water, hydropower infrastructure fundamentally changes river flows and connectivity, which in turn affects the productive potential of fisheries and agriculture downstream.

Industrialisation and population growth will exert increased pressure on water and energy resources. Electricity consumption is expected to increase 50% by 2035, and total water withdrawals for irrigation could grow 10% to meet increased food demands of up to 60% (FAO (Food and Agriculture Organization of the United Nations), 2014). Major water resource development, including dams for hydropower and irrigation, offer 'big solutions' for African economies confronted by growing populations and unprecedented demands for energy and economic growth, but they also generate social, economic and environmental risks which must be managed (Ansar et al., 2014).

However, the agricultural sector is particularly vulnerable to weather-related shocks due to continued dependence on rainfed production in the majority of cultivated areas. In 2015, only 3.3% of cultivated land was under irrigation (FDRE Climate Resilient Strategy, 2015). Water scarcity has become a constraint even for large irrigated schemes. For example, poor upstream planning and successive below average rainfall in the Awash Basin during 2014 and 2015 meant that even large-scale producers of export commodities experienced water shortages, forcing them to cut back irrigation and curtail planned expansion.[7]

After agriculture, services and industry drive Ethiopia's growth. The expansion of services including tourism contributed to 50% of value added growth between 2003 and 2012 (World Bank, 2013). In the 2013/2014 financial year, the service sector overtook agriculture in terms of GDP contribution. The industrial sector is also growing in importance, but remains dominated by construction (Figure 3).

All Ethiopia's key economic sectors are water and energy thirsty. Industry, services (such as hotels) and agriculture all require high volumes of water as an input, although agriculture is the highest global withdrawer and consumer (see Box 2). The majority of Ethiopia's electricity (between 86% and 98%) is generated by hydropower, with the residual provided by renewable sources and geothermal (World Bank, 2013).[8] The results of various surveys cite energy and water shortages as key constraints to the growth of domestic industry and enterprise. In 2011, for example, electricity access was a major constraint for 23% of firms (ibid).[9] In November 2015, after a poor rainy season, the 300-megawatt Tekeze Hydropower Project in the drought-affected Tigray region had to be shut down for two days.[10] Therefore, at the macro level of the Ethiopian economy, water and energy are closely related, and both are essential for production and growth.

1.2 More water for more growth?

The Ethiopian Government recognises that water is an essential input to its economic development and structural transformation. Water for energy, industry and agriculture drive growth, while water and energy for domestic users can enable and catalyse improved welfare for poor households. Figure 5 outlines the eleven strategic priorities for water development, as reported in the water and energy sector's contribution to Ethiopia's Climate-Resilient Green

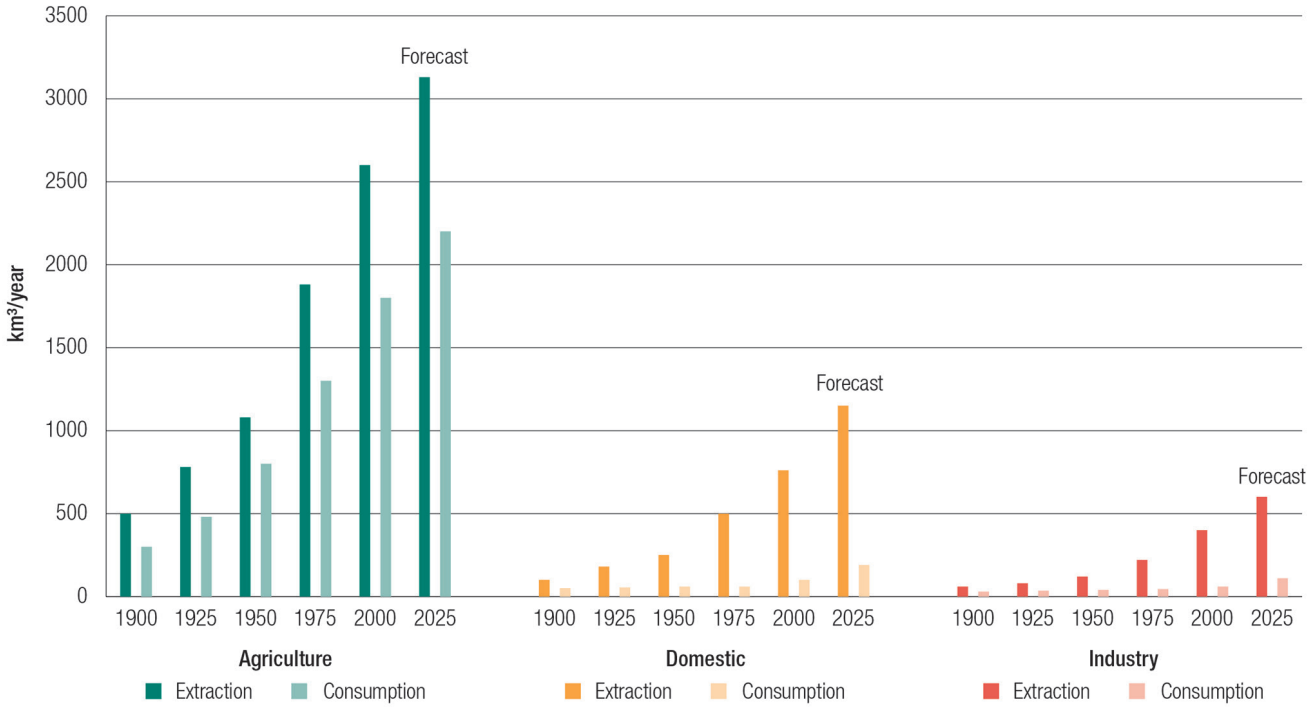
7 Information from interview with representative from Metehara Sugar Plantation, held in Metehara in August, 2015.

8 According to the World Bank (2013), the role of hydropower in Ethiopia's energy mix is about 98%. However, USAID (2015) identifies the contribution of hydropower as only 86%, with 8% renewables and 6% thermal. See: https://www.usaid.gov/powerafrica/partners/african-governments/ethiopia. The discrepancy represents the lack of data regarding rural energy use, for example off-grid generation and biomass for cooking and heating.

9 According to a World Bank study, electricity is a major constraint to business growth. Ethiopia was ranked 98 out of 185 countries for electricity access in the 2013 Doing Business Indicators, and the 2011-2012 Enterprise Survey revealed that electricity was the second top constraint faced by Ethiopian companies, with issues experienced by 23% of all firms, including 38% of exporters. Source: World Bank (2013).

10 See articles in Bloomberg http://www.bloomberg.com/news/articles/2015-12-01/ethiopia-sees-nationwide-power-cuts-while-drought-dries-dams and Mail & Guardian Africa http://mgafrica.com/article/2015-12-01-ethiopia-hit-by-power-cuts-addis-ababa-faces-an-enemy-that-has-defeated-all-africas-big-men

Figure 4: Global water withdrawals and consumptive use by sector in 2000 for agriculture, domestic use and industry



Source: United Nations Environment Programme (UNEP), 2005.

Economy strategy (CRGE, 2015).[11] The Government has ambitious water development plans, including small- and large-scale irrigation schemes, multipurpose dams including for hydropower, and water infrastructure in rural and (especially) urban areas for consumers. This aligns with GTP II goals increased agricultural production and accelerated industrial growth.[12]

As part of an overarching strategy of food security, rural employment and commercialisation of the agricultural sector (including development of agri-industry), GoE has identified 5 million hectares (ha) of land across 176 sites for irrigation feasibility assessment. New irrigation schemes are already under development in the Omo, Awash, Didessa, Tana Beles, Baro Akobo and Tekeze basins to produce sugar cane, cotton and other cash crops. These large-scale schemes are mostly funded by the public sector. Representatives from the Irrigation Directorate of MoWIE noted that 'irrigation development is funded for more than 90% by the government – private investors find irrigation projects too risky, as they provide only long-term returns'.[13]

Groundwater-based irrigation is also growing. As new market opportunities open up for high-value crops, for example through the new highway between Addis Ababa and Adama, smallholder farmers are investing in pumping. Private investment in groundwater extraction has been catalysed by increased access to credit, by infrastructure development and by growing market integration, similar to the catalytic factors that fueled Asia's Green Revolution in the 1970s (Kebede, 2013).

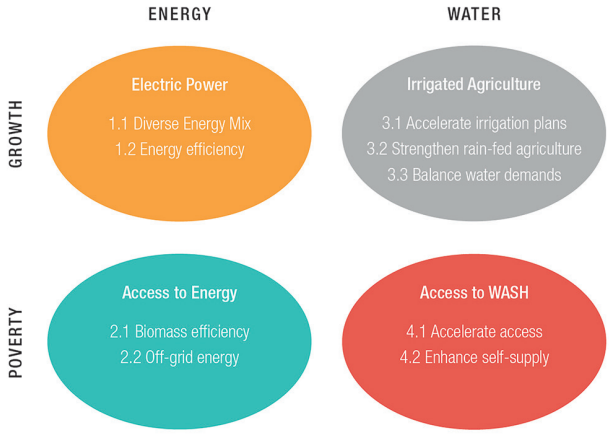
To extend access to the clean energy needed to fuel a growing green economy, Ethiopia is investing more in hydropower. In 2012 Ethiopia was ranked 108th globally for total energy production, and this is a constraint for development and growth (Energy Information Administration (EIA), 2014). However, this is changing rapidly. There are ambitious plans to further increase energy production, focused particularly on hydropower, from 2,200 megawatts (MW) of installed capacity in 2014/15, to 17,300 MW in 2019/20 and 24,000 MW by 2030 (MoWIE, 2015).

11 The GTP II is currently under draft; it will incorporate the strategies set out by the contributions to Ethiopia's Climate-Resilient Green Economy (CRGE) strategy that each sectoral Ministry submitted in 2015.

12 Information from interviews with key informants from the MoWIE, conducted in Addis Ababa in August 2015 (GTP II not yet officially released).

13 Interview with key respondent, conducted in Addis Ababa on 13 August 2015.

Figure 5: Water plays a key role in implementation of the GTP II



Source: MoWIE, 2015.

Power generation capacity increased 230% from 2008 to 2012, 94% of which came from four new hydroelectric dams: Tekeze (2009, 300 MW), Gibe II (2010, 420 MW), Tana Beles (2010, 460 MW) and Amerti Neshe (2011, 97 MW) (REEGLE, 2014). The overall scale of investment is impressive: 13 schemes are currently in the pipeline and five are ready for construction, while the remaining eight await the outcome of feasibility studies. This will enable Ethiopia to meet future domestic peak demand, and increase exports to other countries (MoWIE, 2015). However, commentators note that Ethiopia is overly dependent on hydropower, and therefore vulnerable to falling reservoir levels (Asress et al., 2013).

To meet the basic needs of a rapidly growing population, the One WASH National Programme (OWNP) will support accelerated water resources development to meet coverage targets (FDRE, 2014). According to a senior advisor from the MoWIE, there are plans to construct and rehabilitate a total of 3,870 water supply schemes in rural areas, and to develop 400 new urban water supply projects and 42 wastewater systems.[14] The MoWIE has also committed to bridge the current 32% funding gap of OWNP, with priority given to the most vulnerable people in Tigray, Afar and Somali (MoWIE, 2015:45). While most people still live in rural areas, the level of rural-urban transition envisioned by the GTP will bring new challenges for service provision. Labour mobility drives growth at the junctions of economic systems, but also creates stress for the institutions responsible for delivering services, including water supply and the disposal of liquid and solid wastes.

The GoE is aware that infrastructure alone is insufficient to leverage the potential of water for long-term growth and higher incomes. The policy objectives of the water and energy sector's contribution to the CRGE, for example, include 'avoiding scarcity' by investing in data and information management, and 'avoiding conflict' by establishing fair and accessible processes to resolve disputes over the use of water (MoWIE, 2015:44). These strategic caveats should address the potential competition and conflicts that can result from more intensive water use through more irrigation, more energy and more WASH.

However, there is no description of how water management policies can resolve issues of 'scarcity' and 'conflict' in practice. In addition, the investments required to achieve growth are often different from those needed to achieve poverty reduction. A complementary investment in management institutions and human and institutional capacity is needed to ensure that infrastructure delivers the planned benefits in terms of development and does not cause negative socioeconomic impacts. The relationship between water for domestic use, agriculture, energy and the environment must be considered within a framework of equitable use and explicit trade-offs between sectors.

Box 3: 'Thirsty' energy or 'Energy for all?'

In theory, plans for increased energy production through hydropower development will lead to economic growth and provide electricity for schools, hospitals and households. Increased electricity access is a development priority and the first objective of the UN Sustainable Energy for All initiative. However, in reality almost half of electricity consumption in Africa is used for industrial activities, primarily mining and refining, and plans for increased generation are often focused on further provision for extractive industries, industrialisation and increasing demands of existing users (Hogarth and Granoff, 2015).

Large hydropower projects that feed into the national grid are often well suited to provide energy for industry or high-density urban population. However, rural, remote and dispersed communities characterised by low income and low levels of development may require off-grid solutions (Newborne and Welham, 2014). As such, increased energy generation through hydropower does not always have positive development impacts for the poorest people.

Poorer people are also more reliant on environmental capital (Dercon, 2012). The environmental cost of hydropower development can undermine the resource base of the poor and amplify the loss of livelihoods and social structures caused by relocation and resettlement (Hatfield-Dodds, 2006). Benefit sharing, compensation and preferential tariffs can mitigate this loss but only under certain institutional conditions (Skinner and Haas, 2014).

14 Information from interview conducted in Addis Ababa on 13 January 2015.

2. Growing pains

The Government of Ethiopia (GoE) has adopted a multidimensional planning approach to facilitate economic transformation while improving provision of basic goods and services including health and education (Lenhardt et al., 2015). Agriculture is a focal sector for both growth and poverty reduction, as a primary provider of both GDP and employment. Under GTP I, government policy and donor programmes targeted agricultural productivity and commercialisation while also accounting for marginal groups. Investments in agricultural extension, land management and road construction generated improved yields, higher incomes for smallholder farmers and new opportunities to access markets and jobs (ibid). From 2004 to 2010, the cultivated land area increased 15% and average productivity grew by 40%, to 1.7 tonnes per hectare (Deloitte, 2014).

To support the poorest, the Productive Safety Net Programme (PSNP), the largest social protection programme in Africa, provides cash or food transfers in exchange for labour towards community goods such as land terracing, roads, schools and health clinics (World Food Programme (WFP), 2012). A recent World Bank study estimated that PSNP has reduced poverty by 7% since 2005 (World Bank, 2015). Commentators also highlight the essential role that PSNP will play to help farmers recover from the impacts of the 2015-2016 drought (Mamo, 2016).

The achievements of Ethiopia's agricultural sector illustrate that it is possible to have double-digit growth and improve the welfare of the poorest. However, the agricultural sector requires water for growth, and Ethiopia's water future is uncertain. Furthermore, the new economy of services, industry and manufacturing needs water to grow, and people need water for basic welfare. Therefore, as we enter the new development era under GTP II, the crucial question is: How can Ethiopia manage its water resources for sustainable and inclusive growth?

2.1 A risky water future

The pathway to growth, to date, has focused on large-scale mobilisation of water resources through substantial investments in water infrastructure such as dams and irrigation schemes. Domestic provision has also increased, and the growing services and industrial sector in Addis Ababa are exerting increasing demands on the municipal utility. However, this report argues that increasingly intensive water development cannot continue without incurring major costs.

Where river basins are already over-exploited or approaching 'closure', there will be adjustment pressures as demand increases. These pressures can be addressed through rules that set out the terms and conditions under which different groups can access and use water. Institutional frameworks, combined with effective

Box 4: Water: an economic good

Water may be a gift of nature, but it is also a commodity of sorts. In an economic sense it is a scarce good or service; unlimited amounts are not available at zero cost. Even where water is plentiful, it has to be treated and distributed, and wastewater has to be disposed of. Where water is scarce or getting scarcer, the environmental costs of supply, consumption and disposal begin to mount, and diverting water for one purpose implies a lost opportunity to use water for another – an opportunity cost. As scarcity grows, for both water and the assimilative capacity of water bodies, there is a pressing need to understand the underlying economics of water demand and value in different economic sectors.

Very few countries have accounting systems that capture the full economic costs of water supply, use and disposal. This is partly because basic water accounting is crude or absent. Information on water withdrawals, water users, water consumption, return flows and changes in water quality may be unavailable or unreliable. It is also because the arithmetic of 'value' becomes complex, especially when values are fluid even over short periods of time (e.g. in agriculture). In broad terms, however, we know that people's willingness to pay for domestic and municipal use far exceeds any calculable values in agriculture, even for high value crops. This should come as no surprise, but does raise the question of why irrigation projects are sanctioned in water-scarce basins where domestic users – rural and urban – are going short.

Source: Rogers et al (1998)

enforcement, allow sustainable and 'secure' water resource development. In contrast, weak governance will exacerbate scarcity, competition and conflict. With poor governance, water can be easily captured by powerful interests and the costs will increase, particularly for the poor and the environment.

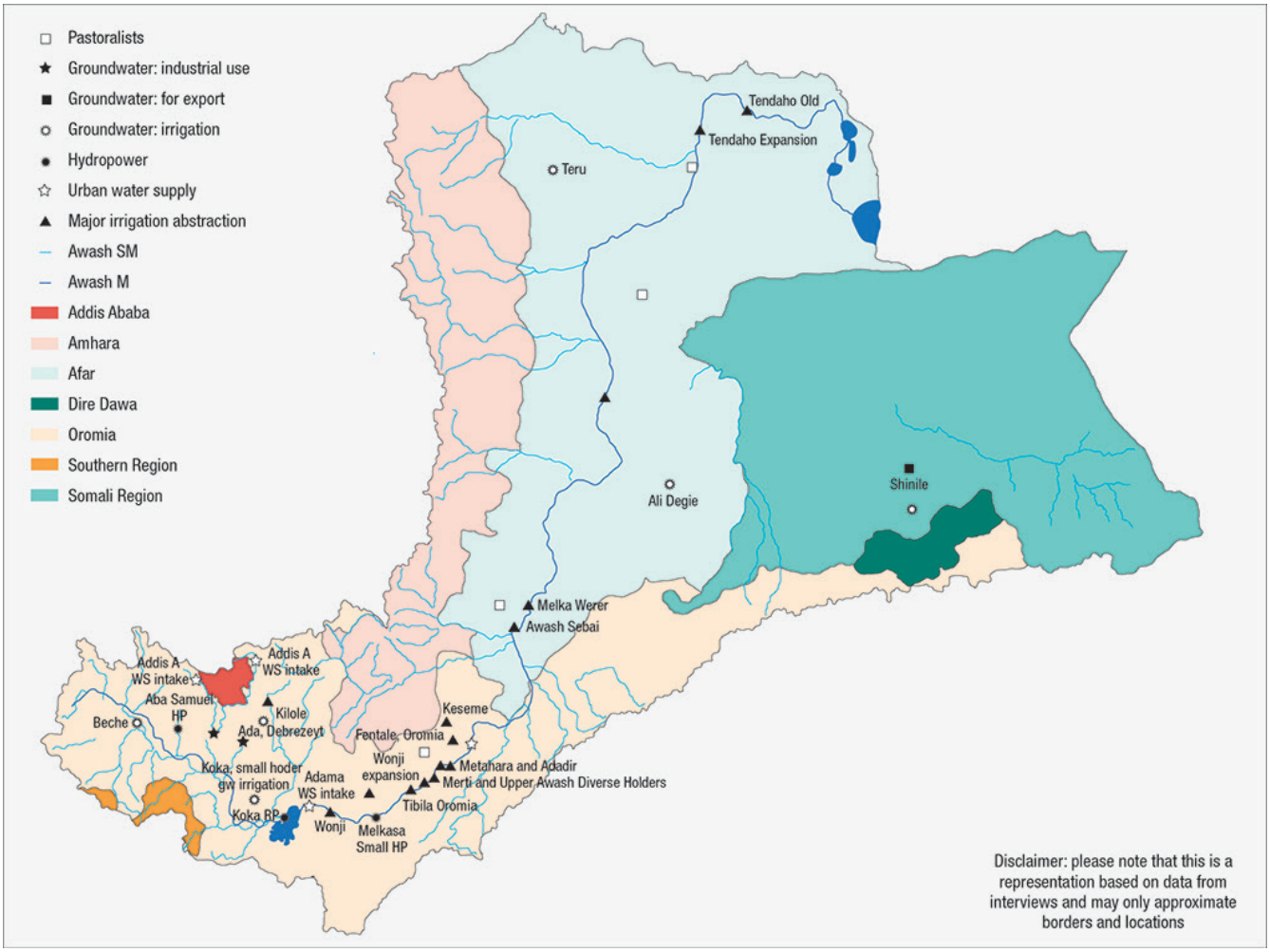
Our case study consultations identified that water scarcity is increasingly prevalent in Ethiopia as demand and competition increase. Inadequate and poorly managed information, coupled with the limited capacity of water authorities to monitor and regulate withdrawals, allocations and waste, can lead to over-exploitation and pollution (salinity, chemical and natural) (Mosello et al., 2015). An interviewee from MoWIE explained that 'as a country we know how much water we have, the problem is that we do not know exactly how much water everybody is using'.[15]

In heavily utilised and developed basins such as the Awash, our case study focus areas, scarcity has generated increased competition between upstream and downstream users within and across sectors – energy, agriculture, pastoralists and domestic providers. Use in one sector can cause direct and indirect (opportunity) costs for others (Box 4).

2.2 Water scarcity: visible impacts, hidden costs

The Awash Basin is a prime example of emerging and increasing competition over water resources. Approximately 15.7 million people live in the Awash, about 17% of Ethiopia's population (FAO, 2013). The majority live in the capital, Addis Ababa, which is also Ethiopia's growth hub. The basin is characterised by a high

Figure 6: Map of the Awash Basin



Source: Authors

15 This statement refers to surface water only. Information is derived from interview with a representative of MOWIE, conducted in Addis Ababa in August 2015.

level of economic development concentrated around use of limited water resources (Figure 6).

It is estimated that the Awash provides only 3.8% of Ethiopia's total renewable water flows, with average annual flows of only 445 cubic metres per capita. The Awash is a 'closing basin' where all the water has been allocated.

Interviews with key respondents identified emerging frictions: large irrigators complain about the lack of secure water in the dry season; small irrigators complain about water capture by large irrigators and promised water which never comes; town planners worry about water pollution from upstream industry and agriculture, about reducing flows and the costs of expanding supply; urban residents wonder how and when they will get a water connection; and pastoralists say their traditional rights to access to water are under threat. Environmental flows amount to what is left – if anything. High levels of development have also led to natural resource degradation more generally, including over-exploitation of forests, loss of vegetation, and soil erosion, damaging fragile watershed ecosystems (FAO, 2013).

Across the Awash Basin, surface water diversions for irrigation reduce flows for other users. Just as the area under irrigation at the (state) Wonji sugar cane scheme is set to triple in size, the (private) agro-industry enterprise in downstream Merti is facing water shortages, threatening 7,000 ha of horticultural production (MoWIE, 2014). An employee of the Metehara sugar plantation, located even further downstream from Merti farm, described how 2015 was a year of 'great conflict' with water shortages from the start of the year.[16] He noted that the situation was deteriorating and called for government intervention to ensure more equitable allocations for upstream and downstream users.

Irrigation also has destructive environmental impacts, with knock-on economic costs (negative externalities). In Metehara, Lake Beseka is expanding rapidly. This is an unforeseen outcome of irrigation expansion in the catchment. Upstream irrigation returns through excess water returned to the groundwater system are increasing lake inflows. The lake has been growing for decades and finally overspilled in 2012. Flooding has damaged infrastructure including clinics, schools and urban water supply system and inundated 900 ha of downstream sugar cane (MoWIE, 2014). Because Lake Beseka is hypersaline, its water cannot be used for agricultural irrigation or freshwater supply.

The adjacent Metehara Sugar Estate has been seriously affected by the Lake Beseka overspill. The rising groundwater table and increasing salinity have reduced yields and forced the estate to abandon large cultivated areas (Olumana et al., 2009). Awash town, downstream, can no longer use the Awash River as a water supply due to saline inflow. As the lake grows, it will cause further damage to infrastructure, agriculture and drinking water supplies. In the medium term (25 years), continued expansion could inundate Metehara town and increase inflow into the Awash River, with worrying implications for all downstream users, including smallholders and pastoralists (ibid).

Meanwhile, the regional government of Oromia is investing in its own irrigation projects in Fentale and Tibila, with no reference to upstream and downstream users. Representatives of large-scale schemes in the Upper Awash Basin, such as Metehara, Wonji and Merti, all expressed concerns about increasing water scarcity. This is partly due to production choices. Wonji and Metehara grow sugar cane, and Merti grows horticulture but focuses on citrus for export. These are water thirsty crops. However, GoE and the National Sugar Corporation continue to plan for further national investment in sugar cane, while regional governments continue to propose and pursue their own projects.

Increasing agricultural use, reduced flows and the problems of irrigation returns including salinity directly affect municipal water suppliers. Water utilities are facing a supply crisis, as reduced surface water flows, pollution and aging infrastructure cannot meet growing population demands and increasing levels of use.

The Adama water treatment plant, built 11 years ago and with expected utility for 20 years, faced a daily supply deficit of 9,000 metres cubed in 2014.[17] This is a consequence of rapid population growth and rising demands. The utility in Awash Town now relies on pumping groundwater as surface water flows are contaminated by saline irrigation returns from Lake Beseka and naturally occurring fluoride.[18] Respondents from water utilities downstream of Addis Ababa also described how pollution from agriculture, upstream tanneries and other industries has resulted in increased treatment costs.[19] In order to produce water of sufficient quality for domestic users, chemical use by the Adama water utility now exceeds international standards.[20] The feasibility of plans to expand irrigation are questionable, given rising urban demands and supply costs.

16 Interview conducted with irrigation engineer for Metehara sugar plantation, conducted at Metehara Plantation in August 2015.

17 Information from interview with staff at Adama water utility, conducted in Adama in August 2015.

18 Notes from interview with Awash Town water utility, conducted in Awash Town in August 2015.

19 Notes from interviews with staff at Addis, Metehara and Awash Town water utilities, conducted in Addis Ababa and Metehara in August 2015.

20 Interview with respondents in the Awash Basin, conducted in August 2015.

Further south in the Rift Valley, there are other examples of the risks of poor water management. Lake Ziway is getting wider but shallower, as a result of siltation, direct water withdrawals, and accelerating ground and surface water abstraction by smallholders, horticultural enterprises and towns in upstream catchments. Pollution from irrigation returns and other sources is also causing eutrophication and habitat destruction, and higher treatment costs have forced the urban utility for Ziway town on the western shores to seek new supplies from 40 kilometres away.[21] At the same time, a reduction in outflows from Lake Ziway is having impacts on hydrologically and ecologically connected systems. Downstream of Lake Ziway, Lake Abijatta is shrinking as inflows diminish. This is affecting the breeding and feeding sites for rare birds.[22]

The Rift Valley lake system is one of East Africa's environmental jewels and a key part of GoE's Nature Based Tourism (NBT) development strategy (World Bank, 2012). This environmental and economic resource is now under threat from uncontrolled water extraction and pollution.

Around 300 miles east of Lake Ziway, Lake Haramaya has dried up completely. Once more than 15 kilometres in circumference and 10 metres deep in places, the lake has been exhausted by the same forces: direct withdrawals, unrestricted surface and groundwater abstraction in upstream catchments, and siltation (Abebe et al., 2014). Today, the town of Harar has had to look elsewhere for its water supply. The town's 150,000 residents now depend on groundwater pumped from Dire Dawa, over 30 kilometres away, at much higher cost (Abebe et al., 2014).

In addition to agriculture, the environment and domestic users, hydropower producers (characterised as 'non-consumptive users) also require water of sufficient quantity and quality to produce energy. In the Awash, there are three hydropower plants: Koka (large scale), Aba Samuel and Awash Melkasa (small scale). Hydropower dams change flow regimes to maximise energy production, and operating procedures impact water availability downstream.

A manager at the Koka Dam downstream of Addis Ababa revealed that water releases are now controlled by irrigation requirements rather than energy generation.[23] At the peak of the dry season, water levels decline significantly to meet irrigation demand. This causes the silt level behind the dam to rise, which decreases storage volume and can damage turbines, resulting in reduced energy production. Our calculations suggest that 65% of downstream irrigation users rely on flows from the dam. However, the 2015-2016 drought has caused low flows which can damage irrigation pumps, exacerbating conflicts downstream.[24]

The problems in the Awash are increasingly visible and affect a growing number of people across all parts of the economy. These issues are a result of poor water management and a lack of rules and regulation around allocations. This is because in Ethiopia (as in many countries) investment decisions around 'water for growth' are made by different agencies and actors, both public and private, with often conflicting plans to develop the *same* water resources (Mosello et al., 2015). River basin authorities have struggled to resolve these conflicts without the political authority to influence investment decisions or the means to assess impacts and trade-offs.

New water developments and existing users with increasing demands affect the quantity or quality of water available to others, and these spillover effects exert a cost on all users and on multiple sectors: agriculture, energy, tourism, domestic users and the environment. Left unchecked, current patterns of water development may undermine rather than support growth and poverty reduction.

21 See more information on Lake Ziway in: Mosello et al. (2015), p.25.

22 Information from interviews with several respondents, including staff at Rift Valley River Basin Authority, conducted in Addis Ababa in September 2014 and August 2015.

23 Interview with manager at Koka Dam, held in Awash in August 2015.

24 Ibid.

3. Economic costs

The costs of water scarcity, misallocation and pollution can be difficult to measure, and they are not always visible. Without regulation, markets cannot account for external costs, and so do not confront polluters or pumpers with the full costs of their actions. Policy-makers and planners do not always appreciate that new investments in irrigation or in polluting industries may affect the quantity or quality of water available to others. A private investor may not care as long as the enterprise makes a profit. However, the costs are real.

Water may be a gift of nature, but it is also a commodity with an economic value. Even where water is plentiful, it has to be stored, treated and distributed, and wastewater has to be disposed of. Where water is scarce or getting scarcer, the costs of supply, consumption and disposal rise rapidly, and diverting water for one purpose exerts an opportunity cost on other users. As scarcity grows, for both water and the assimilative capacity of water bodies, growing risks can only be managed through understanding the underlying economics of water demand and value in different economic sectors.

Few countries have national accounting systems that capture the environmental impacts of economic growth. However, environmental damage such as water and air pollution impose a deadweight loss on many emerging economies approaching 10% of GDP, even before adding the likely impacts from climate change (Losch et al., 2012). Moreover, the costs of resource depletion are not borne equally. The poorest people suffer most from the direct effects, including higher prices for food, water, fuel and fibre, and lower rates of growth and job creation (Steer, 2013).

Economic modelling of water resources risks and the role of water for growth has often focused on the macro-economic links between rainfall variability and GDP rather than the costs of over-exploitation, scarcity and pollution (e.g. see Grey and Sadoff, 2006; Conway and Schipper, 2011). Across sub-Saharan Africa, the abundance or shortage of rainfall has a statistically significant and measurable association with growth (Brown and Lall, 2006). Policy-makers and large donors such as the World Bank have cited this link to advocate for investment in the physical infrastructure of water storage and conveyance – more dams, diversions and drilling to buffer the effects of rainfall variability.

Yet case study consultations in the Awash basin identify significant micro-economic costs as a result of poor water management. Basin-level analysis highlights how increasing scarcity results in lost agricultural production and growing costs for the urban consumer, and it is the poor who are most affected. Our research, building on work by Mosello et al. (2015), suggests that a narrow focus on infrastructure alone is risky, and better water management can generate a range of benefits in terms of avoided costs.

3.1 A thirsty agricultural sector

Agriculture is partly responsible for over-exploitation of water resources, but the sector is also most at risk from water scarcity. Globally, roughly 70% of water withdrawals go to agriculture, although this figure could be much higher in semi-arid regions (UNEP, 2005). Data on water allocations to existing irrigation schemes in Ethiopia are limited. However, the Government, private actors and farmers are investing more in irrigation, and there are GTP II plans for significant expansion of land productivity and irrigation coverage. Given that the Ethiopian economy still relies on agriculture for approximately 40% of growth, it is reasonable to assume that agriculture is the main user, and consumer, of water.

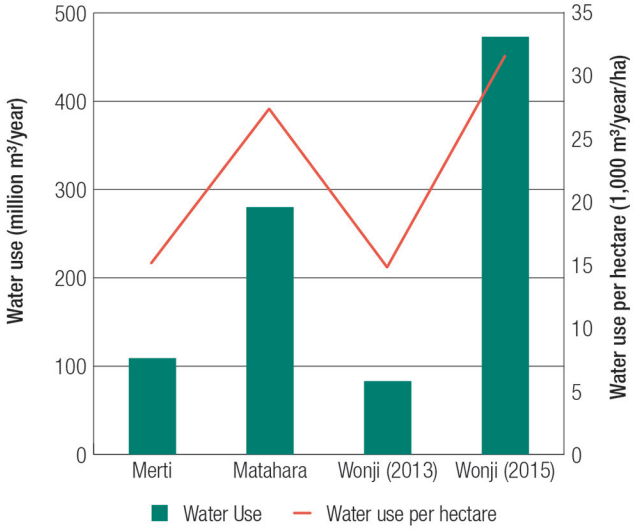
Water scarcity is a growing problem for agricultural users in certain areas. We interviewed key stakeholders in the Awash Basin, at private and public farms of different sizes, from smallholder and tenant farmers, to small and medium farms, and large irrigation schemes of up to 15,000 ha. Many downstream farms already struggle with the costs of water competition, pollution and scarcity. Merti farm, which primarily grows fruit, vegetables and cotton, reported that water scarcity issues were 'common', due to new farms, the expansion of existing large farms, and high upstream demand.[25] Last year, water scarcity contributed to the farm failing to meet production and profit targets.

Downstream, managers of the Metehara sugar plantation discussed serious shortages and said 'the supply issue is getting worse and worse'.[26] Respondents suggested that this was primarily the result of poor decision-making without proper data regarding availability and allocations, and without technical know-how. Irrigation engineers

25 Information in this paragraph from interviews with managers of Merti Farm, conducted in August 2015.

26 Information in this paragraph from interviews with managers and engineers at the Metehara sugar estate, conducted in August 2015.

Figure 7: Water withdrawals for large-scale irrigation schemes in the Awash Basin



Source: Authors

described how the state-run Fentale irrigation scheme upstream had created water scarcity through wasteful water use and returns to the brackish Lake Beseka, at which point the water can no longer be used for further irrigation. It was noted that the expansion of Lake Beseka already flooded 194 ha of fertile land, and that other parts of the plantation are now inaccessible for machinery and require more time-intensive manual harvesting, which is less productive.

Even further downstream, Kesem sugar plantation is less than five years old but poor irrigation management and hydrogeological conditions have created serious salinity issues. Large parts of the Awash are at risk of salinisation and scarcity. Continued short-term planning and profit maximisation will cause adverse and irreversible environmental impacts.

The expansion of existing large-scale schemes, and new ones planned under GTP II in the Awash and other basins, will drive up water diversions and consumption. Our calculations suggest that the combined annual diversions of the Merti, Metehara and Wonji sugar plantations account for over 75% of water releases from the Koka dam upstream, approximately 860 million cubic metres. Figure 7 shows annual water withdrawals by these large-scale irrigators. It is interesting to note that the Wonji expansion of approximately 300% (from 5,600 ha in 2013 to 15,000 ha in 2015) has increased water abstraction by approximately 570%.[27] Scheme expansion has actually reduced efficiency. Respondents from many farms discussed aspirations to upgrade current irrigation technology from furrow systems (about 50% efficient) to sprinklers (about 80% efficient). However, increased efficiency has mixed effects and may not reduce water use.

Small-scale irrigators and smallholder farmers are also affected by water shortages, although the impacts are not evenly distributed. The Awash Basin has experienced significant growth of small-scale irrigators, who get water from pumps or diversions. These irrigators do not pay for the water, although there are costs associated with pumping and transporting. New infrastructure and transport links between the consumer market of Addis Ababa and farmers downstream creates incentives for smallholders to grow food and cash crops, with potential for good returns on their investments in pumps and pipes. One respondent upstream of the river said 'farmers buy bigger and bigger pumps, which leads to increased abstraction. The market is very attractive and the government cannot control it'.[28] A smallholder farmer who leased 0.5 ha to land to grow tomatoes and onions, using surface water irrigation diverted from an Awash tributary, explained that he was now making significant profits. He stated, 'life is changing in the right direction, I am happy'.[29]

Downstream users are paying the cost of profits reaped by farmers upstream. The Fentale land consolidation was meant to provide water for small plots, but planned expansion is unlikely due to declining water levels that mean even existing members do not have water. One interviewee said the community was not happy, noting that 'water does not reach my plot. I grow maize but my yields are poor due to variable rainfall. I have asked the government for irrigation provision for the past five years but there is no solution yet'.[30] During drought, these groups are particularly exposed. The 2015-2016 drought has caused crop production to fall by 50-90% in downstream areas of the Awash (FAO, 2016).

Livestock farmers are also key water users. In the Awash, upstream livestock farmers who own medium to large-scale fattening farms invest in water trucks and pump water for free from irrigation diversions. This provides for herds destined for the growing consumer market in Addis Ababa and the region. In contrast, the pastoralists who have lived in the area for generations are struggling to find water sources for their animals, and are forced to travel

27 Figures from interview with employee conducted in Adama in August 2015.

28 Key respondent interview held in the middle Awash in August 2015.

29 Interview with local smallholder farmer near Adama, held in August 2015.

30 Response from farmer in the Fentale Land Consolidation Scheme, interview conducted in August 2015.

further with weakened herds. They are encroaching on the Awash National Park and causing damage to the sensitive ecological environment. The 2015-2016 drought and floods in early 2016 decimated livestock herds, and pushed entire communities into poverty.

As continued economic development, population growth and increased purchasing power generates more demand for food in the region, there are further incentives for uncoordinated expansion of large scale irrigation, small-scale irrigation and intensive livestock farming to supply new urban and per-urban markets. However, this exerts costs vertically within the agricultural sector, horizontally across different sectors, and on the environment. In the Awash, as in other parts of Ethiopia, major irrigation schemes such as Wonji and Metehara pay a minimal set fee of ETB 0.003 (USD 0.00014) per cubic metre of water. The majority of smaller farms, livestock owners and smallholders pay nothing at all.

3.2 Growing costs for urban consumers

From an urban perspective, the costs of water supply, treatment, distribution and disposal are rising. This is expected as towns and cities expand, and aging infrastructure is replaced. However, in the Awash Basin, water mismanagement in surrounding catchments has resulted in disproportionately high costs for urban utility providers. Water utilities in Adama, Metehara and Awash Town described how deteriorating water quality and low flows drive up treatment and supply costs, particularly in the dry season.[31]

Pollution is a growing problem. In Adama, which is downstream of industrialising Addis Ababa, approximately 70% of the utility budget is earmarked for basic water treatment (e.g. chlorination), and chemical application is above standard regulatory benchmarks.[32] In Awash Town there are high levels of surface water pollution due to the expansion of saline Lake Beseka, runoff and sugar molasses from Metehara sugar estate upstream, and naturally occurring fluoride. This has forced the utility to develop groundwater sources, but shortages still mean that supply is intermittent.

Perhaps more seriously for all towns, the effluents discharged by upstream industries, including tanneries, are likely to contain heavy metals, pesticides and toxins that are unmonitored and untreated.[33] Once these pollutants are discharged into water bodies, they are extremely expensive to remove. Poorly controlled pollution has a direct cost on utilities, and an indirect cost on human health and the environment.

Low flow and water scarcity can also raise the cost of supply. In Awash Town, surface water shortages and pollution have forced the utility to use groundwater supplies, although serious shortages means that water is provided in shifts. The utility does not have the capital to build an improved treatment plant and pay recurrent costs,

Box 5: Water efficiency: myths and realities

Since water use in agriculture usually dwarfs that in other sectors, there is a common assumption that 'efficiency gains' in irrigation can release saved water for other users. Upgrading irrigation technologies, so the argument runs, will reduce leakage and other 'losses', liberating water for high value industrial and domestic users whilst, at the same time, improving agricultural productivity. Everyone wins.

In reality, efficiency savings in irrigation rarely translate into real (wet) water savings. This is because much of the water 'saved' was never lost in the first place.

To understand why this is the case, consider the issue of scale. When irrigation engineers talk about 'losses' at plot or scheme level, they may not be considering where those losses go at a basin scale. Yet in many cases, irrigation returns are captured by downstream users through, for example, base flow to groundwater. Groundwater users then 'recycle' the water. A technical intervention such as channel lining might therefore save water at scheme level, but deprive others of their recycled water downstream. The end result is reallocation, not real saving.

It follows that 'real' water savings can only be achieved through reductions in the consumed fraction of water use: water used up for plant growth (beneficial consumption), or evaporated or transpired from wet soil, unwanted vegetation and so on (non-beneficial consumption). If the objective is to save water at a basin scale and maintain/improve crop production, then clearly non-beneficial consumption is the target, rather than the 'non-consumed' fraction that returns to the hydrological system and is used elsewhere. Context matters though. In cases where irrigation returns are damaging (in terms of volume and/or quality), then minimising the recycling of water (the non-consumed fraction) makes sense.

Source: Perry et al, 2011

31 Information from interviews with utility representative conducted at the utility offices in August 2015.

32 Information from interview with water manager at Adama water utility, conducted in August 2015.

33 Information from interview with water manager at Awash Town water utility, conducted in August 2015.

and there are fears that low flows could also damage the treatment facility.

Rising treatment and supply costs threaten supplies in the longer term. For sustainable provision, water utilities should aim for full cost recovery including capital costs, operation and maintenance. Inadequate cost recovery can generate a downward spiral of deteriorating water services and non-payment by consumers (Rouse, 2007).

In emerging economies such as Ethiopia, government and donors can subsidise high capital costs, as low-income, previously unserved consumers may not be willing to pay for high tariffs, and there is limited credit availability. Therefore, utility cost recovery is focused on operation and maintenance of supply. It is a positive sign that in the Awash Basin, utility revenues in 2014 for Adama, Awash Town and Metehara exceeded operational costs by an average of 9.4%.[34]

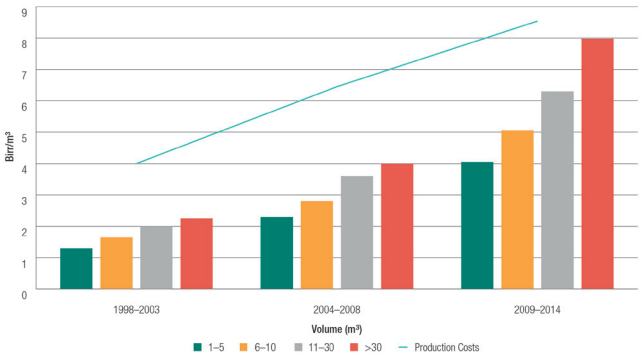
However, given rising treatment costs, cost recovery for water utilities in the Awash is only possible due to increasing tariff rates over time. As providers expand coverage, users with lower consumption patterns may jeopardise revenue collection. Therefore, the running costs deficit (the difference between the average tariff and the average cost of production) could rise significantly.

Figure 8 illustrates rising tariffs, the progressive tariff structure and increasing production costs for Adama water utility. Progressive tariffs were used by all the utilities we consulted, which is positive as it encourages consumers to use water efficiently and means that wealthier households (who often use more water) can subsidise poor households.

High revenues conceal potential threats to supply sustainability. Costs of production are generally far higher than the average tariff rate, as shown in figure 9. This suggests that the majority of consumers are high-volume consumers who pay the top tariff rates for sufficient volumes of water to cover production costs. However, this also illustrates that the majority of consumers with access to household connections are wealthier households with high consumption patterns, or commercial users such as hotels.

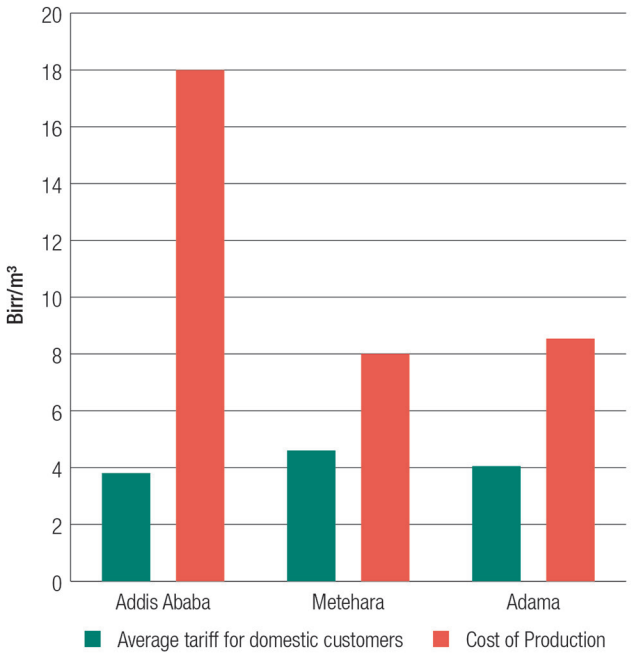
In all the utilities surveyed, connections were provided for a very small minority of the total population of the urban area. Total connection points (including public standpoints) as a proportion of the total population were 12% for Addis Ababa, 13% for Adama, 7% for Metehara and 9% for Awash Town (Figure 10).[35] There are plans to expand coverage and connections as part of the One WASH National Programme (OWNP). However, this will

Figure 8: Adama water utility increasing tariffs over time and rising production costs from 1998 to 2014



Source: Authors

Figure 9: Costs of production compared with average tariff rate for domestic consumers

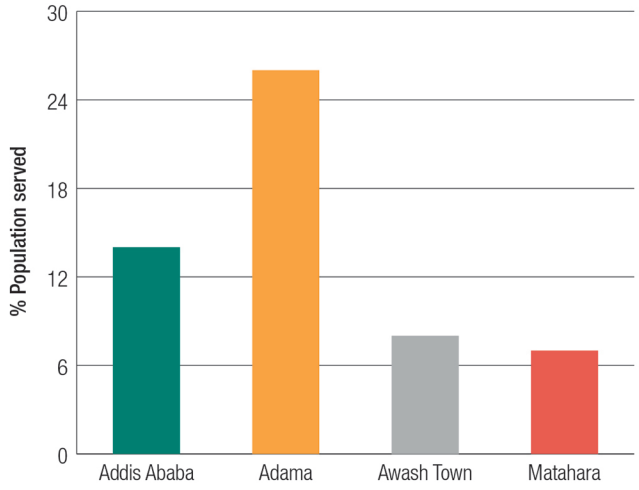


Source: Authors

34 Interviews with respondents at several water utilities in Addis Ababa and in the Awash Basin, conducted in August 2015.

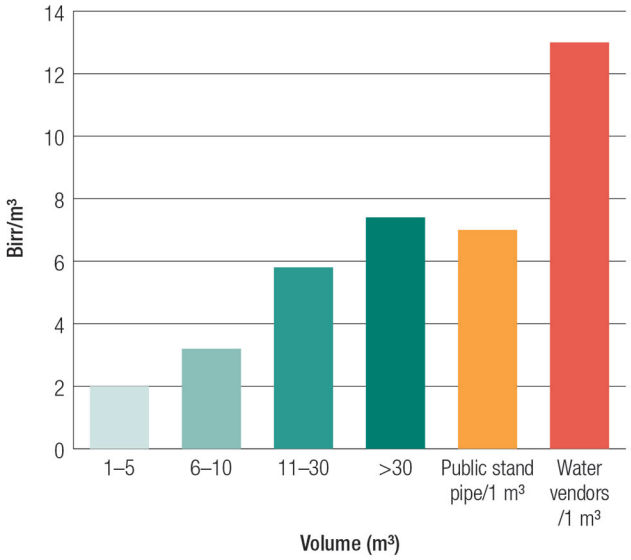
35 Data from interviews with various respondents, conducted in August 2015. According to data from the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation 2015, 57% of Ethiopians have access to improved water sources (12% piped into premises); in urban areas, this percentage goes up to 95% (56% piped into premises). High reported coverage may reflect that the government assumes people in urban areas are able to access public standpipes and water vendors, but there are clear disparities in the household connection data. Data available at: http://www.wssinfo.org/documents/?tx_displaycontroller[type]=country_files

Figure 10: Proportion of population served in major towns in the Awash Basin



Source: Authors

Figure 11: Water tariffs in Awash Town



Source: Authors

result in significantly higher costs, and potentially higher deficits. Expansion is problematic due to high investment costs, which require government subsidies, and fears over supply sustainability.

Consumers who do not have a household connection are often poorer, and live in densely populated informal settlements, often on the outskirts of urban centres. They obtain water from different sources including standpipes, private water vendors, water trucks and other sources. In the Awash Basin, the cost of water is far higher from these sources than from household connections services by the municipal public water utility.

In Awash Town, about 92% of people pay higher costs for water provision through standpipes and private water vendors. Although the standpipes are supplied by the water utility, they are managed by individuals who collect high unit costs tariffs per jerry can, far exceeding the average tariff rate of a household connection, illustrated by figure 11. The cost of a public standpoint is similar to the highest tariff rate for the utility. The cost from water vendors is 6.5 times higher than the lowest utility tariff.
In Metehara, about 93% of the population rely on standpipes and fountains, water vendors and trucks. The poorest groups in new and informal settlements on the city outskirts pay almost 10 times the cost of the cheapest household tariff rate. Those with access to the town centre pay from 2 to 5 times more for water from public standpipes and vendors (Figure 12).

Therefore, although there are progressive tariff rates, only the few low income families with household connections can benefit from this subsidy. Generally, the majority of poorer people are paying a disproportionately high cost for water. In Awash Town, the utility is seeking support from the national government and donors to expand provision, but there must also be coordination with other stakeholders upstream such as Metehara Sugar Plantation and Fentale Irrigation Scheme in order to reduce major supply risks, i.e. pollution and low flows. The high costs of provision of domestic water and the impacts for the poor, who pay more, cannot be addressed only through actions within the utility sector.

3.3 Managing demand, ensuring supply

Today's water development decisions already have high costs, and these costs will rise in the future. International experience indicates that the cost of a unit of water from 'the next project' is typically 3-5 times the cost of a unit of water from the 'current project', i.e. the cost of building a new treatment plant or identifying a new supply source will cost significantly more than the current set up (Losch et al., 2012). This is a result of the 'low hanging fruit' principle – the lowest cost options are often developed first.

In river basins where water is already fully allocated, or close to the limit, like the Awash, new water developments affect the quantity and quality of water available to others. How these effects are realised in both hydrological and economic terms can be difficult to predict, as the contrasting histories of Lake Beseka and Lake Ziway illustrate. Agriculture may not directly pay for its water use, but the external costs for other users within and outside the sector is high.

Costs to develop new supplies for household provision can be funded by utilities, by the responsible government agencies and donors, and/or passed on to consumers in the form of much higher prices. Indirect costs of irrigated agriculture and urban expansion affect people outside the city who see their water rights transferred, or simply taken, and the environment in the form of ecosystem degradation. As the Awash continues to develop rapidly, reallocation

pressures will grow. Other river basins may also experience similar issues, particularly those targeted for irrigation expansion.

If these issues are not addressed in a systematic way, within a clear and agreed regulatory framework, there will be high political, economic, social and environmental costs. In Ethiopia, there are currently few data on resource conditions, and fewer still on what is being used, where and by whom (Mosello et al., 2015).

Good water accounting is needed to find out where water is being withdrawn, where it is being used, what fraction is returned to rivers and groundwater, what changes in quality occur, and who should and who is bearing the costs of water withdrawals, consumption and waste. Sound economics is needed to assess the costs and benefits of water for different sectors and the most efficient water use, which can then be balanced through strategic considerations of equitable economic development.

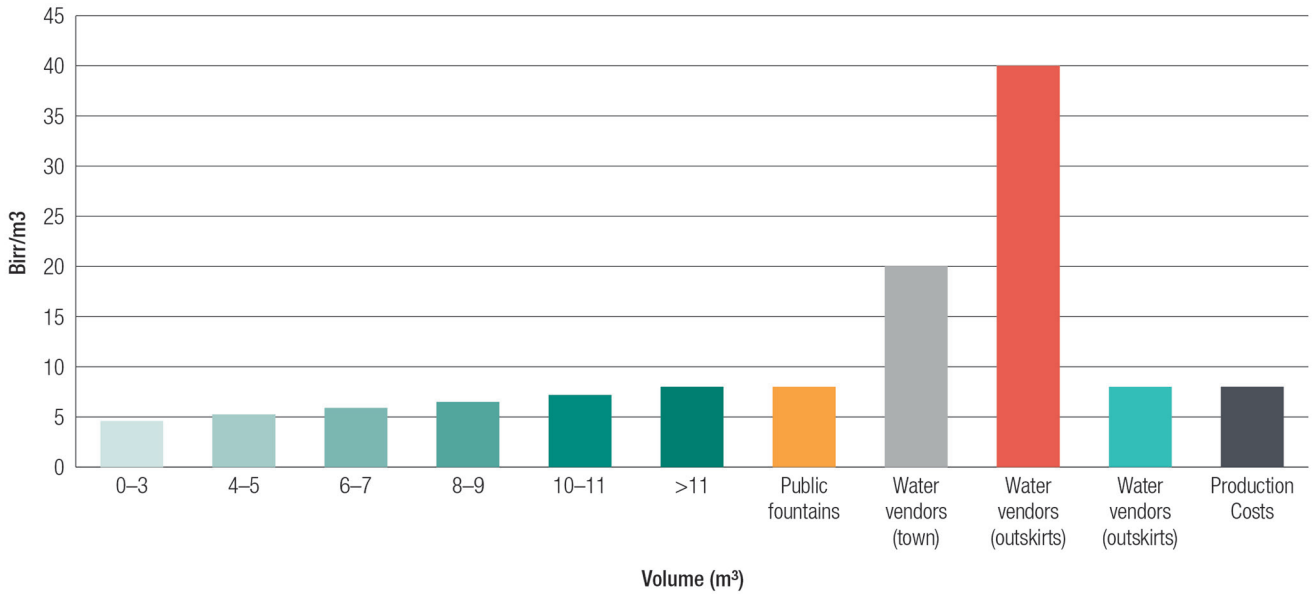
In the Awash Basin, because all water is allocated, high agricultural consumption reduces availability for other users, and pollution affects supply. Domestic and industrial users pay the price through reduced availability and higher treatment costs, which drive up tariffs. Agricultural users pay either nothing or 0.003 Birr (less than USD 0.01) for water. Downstream urban consumers are willing to pay over ETB 10 per cubic metre (around USD 0.50), but are already facing supply shortages. Urban users in Addis pay up to ETB 12 (USD 0.56) per cubic metre, and over 90% of people in Awash Town are paying between ETB 7 (USD 0.33) and ETB 13 (USD 0.61) for water from public standpipes or vendors. Figure 13 shows what different types of consumers pay for water in the Awash Basin.

Box 6: Water for all?

Ethiopia has made significant progress in extending water and sanitation coverage to 57% of the population and achieving the MDG for Water and Sanitation. The new OWNP aims to extend water supply coverage in rural areas to 98% by 2020, and to reduce water point 'non-functionality' rates to less than 10% (FDRE, 2014). However, new research suggests that official statistics for access to WASH services do not provide the full story. When factors such as water point reliability, quality, quantity and accessibility are accounted for, only a minority of 9% of households receive water services which meet the standards of GTP I (Adank et al., forthcoming). The ambitious GTP II sets even higher standards; but meeting them will be difficult given that the performance of water utilities and pumps is also declining due to funding deficits in the sector (ibid).

Furthermore, water supplies are under threat. Reduced water availability as a result of the El Niñ o drought has caused water supplies to fail, and almost 6 million people now need emergency WASH facilities (Reliefweb, 2016). Even before the drought, water scarcity and increased treatment costs in the Awash Basin were driving up tariffs and threatening sustainable supply models. Rapid population growth means large populations will remain unserved without transformative investment in the institutions and infrastructure of water supply services.

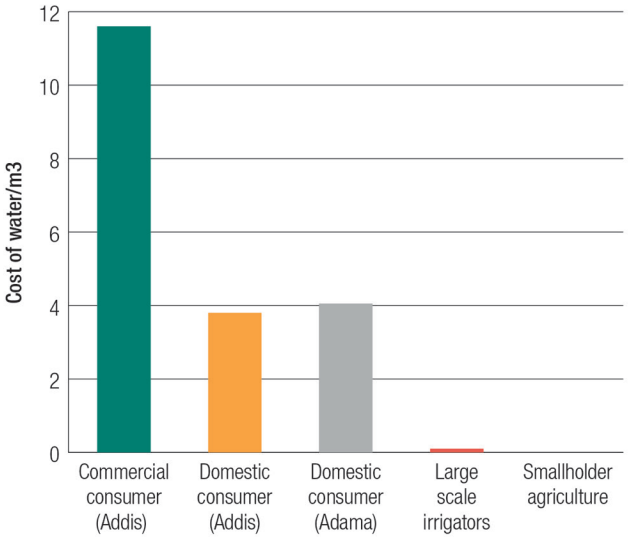
Figure 12: Water tariffs in Metehara



Source: Authors

The agriculture-urban connection is key. As high-value urban demands grow for domestic, commercial and industrial users, so will the opportunity costs associated with diverting water to agriculture – particularly thirsty, low value irrigated crops. Adjustment pressures will be particularly acute when urban residents move from basic levels of service to higher ones, i.e. from standpipes to household connections, and from 'dry' to water-based sewerage systems. Both imply a step-change in water demand. At the same time, the changing food demands of wealthier urban consumers will not be met from big irrigation projects growing non-food crops.

Figure 13: Cost of water for different consumers in the Awash Basin



Source: Authors

Box 7: Water for poverty reduction: water services for the poor

Water for domestic use is strongly correlated with improvements in household welfare (WHO). Providing water of sufficient quantity and quality for households, combined with adequate sanitation and hygiene education, supports improved health outcomes, in turn positively impacting on school attendance and participation in formal and informal employment. Water, sanitation and hygiene (WASH) provision also benefits women and children who are often tasked with water collection. WASH interventions therefore have multiplier effects for the national economy.

A comprehensive assessment by the World Health Organisation (WHO) in 2004 found that WASH generates a total annual economic benefit of USD 84 billion globally, including cost-savings for the public health sector and patients, reduced days lost to illness resulting in improved labour productivity, and productive time gained due to closer proximity of water supplies (WHO, 2004).

4. Emerging changes

The Awash field work confirmed the rising visible impacts and economic costs of poor water management. A recent ODI study concluded that 'on the ground, the fragmented regulation and governance systems for water resources result in pollution, salinity, competition and scarcity, affecting the livelihoods of households' (Mosello et al., 2015). Without the necessary investments in institutions for water management, it is likely that tensions similar to those in the Awash will emerge in other regions with ambitious plans for new water infrastructure. There is also the risk that unsustainable water use in Ethiopia will amplify the impacts of climate variability and change, constrain growth, and negatively affect the poor.

4.1 Institutional change

The Awash Basin illustrates the high costs of inadequate water management combined with intense exploitation and growing pressures from population growth, urbanisation and industrialisation. The pollution and scarcity issues that affect water utilities in the Awash Basin can be mitigated through institutional structures including regulation, permit systems, monitoring and enforcement.

Strong institutions can mitigate the direct and indirect social, economic and environmental costs of water resource development and can ensure benefits are realised across users with explicit and transparent allocation decisions. Ethiopia's existing legal and policy framework for water resources management enshrines the basic principles of Integrated Water Resources Management (IWRM). This must be supported by a realistic assessment of how much water is needed, how much water is available, and what the risks and trade-offs are, as competition for water intensifies.

The new River Basin Authorities (RBAs) must play a key role in improved basin planning through utilising, generating and sharing evidence around resource conditions, patterns of use and drivers of change. Currently, however, only three river basins in Ethiopia have RBAs, and these have capacity and resource constraints (Mosello et al., 2015).

Data management is also a challenge. The MoWIE Hydrology Directorate collects and stores water data at the federal level, but according to a staff member, 'most of the investments in water infrastructure happen without a permit as they are government-led. Private investors need to submit an Environmental Impact Assessment, but because the process is very time-consuming, projects start before the assessment is actually completed'.[36] Measurements of water use and quality only occur at the intake of irrigation canals, and 'nobody knows what happens afterward; farmers can illegally divert water from canals, and industries can release pollutants without being held accountable'.[37]

Plans are underway to set up improved information management, permits and allocation systems, as a representative of the RBA explained: 'Our mandate will soon extend to giving licenses to industries to release (treated) wastewater and for water use. This will give us the possibility to control whether they are polluting the river, and to make them pay if they do so'.[38] At present, monitoring capacity is limited by inadequate technical, financial and human resources, and there is a lack of awareness and clarity regarding provisions and requirements (Mosello et al., 2015).The high costs for utilities and consumers illustrate the urgent need for a more functional and effective system.

The Government of Ethiopia recognises the crucial role that water plays in growth and development, and this strategic commitment is a crucial first step. The MoWIE is working in collaboration with RBAs to take action in vulnerable areas. For example, the Awash RBA has formed a water user committee involving six large irrigated farms to tackle water scarcity issues in the basin. Nevertheless, it excludes all other water users in the basin such as industries and independent irrigators. Farms like Wonji have now agreed to reduce water withdrawals by up to 60%, but it is not certain how this will work in practice as El Niño and climate change cause longer dry periods.[39]

36 Interview with representative of MoWIE, conducted in Addis Ababa in August 2015.

37 Interview with representative of MoWIE, conducted in Addis Ababa in August 2015.

38 Interview with representative of Awash River Basin Authority, held in Adama in August 2015.

24 Interview with farmers in the Awash Basin, conducted in August 2015.

Aziz Ahmed: A woman collects water from a public standpipe near Metehara in the Awash Basin, Ethiopia.

At the federal level, the Government is working to strengthen existing RBAs with the longer-term aim of full cost-recovery.[40] Three new RBAs are planned in the Tekeze, Omo-Gibe and Baro-Akobo basins, which the GTP II has targeted for intense infrastructure development. The MoWIE is facilitating dialogue between the RBAs and Regional Water Bureaus (RWBs) to clarify their respective water management roles, and cooperatively address conflicts between upstream and downstream users. The Awash RBA is also working in collaboration with Addis Ababa University to build a basin allocation model.

However, some basins do not yet have RBAs. As a consequence, each water-using sector makes investment decisions on ad hoc plans, often designed by external consultants, without accounting for other users of the same water resources.

Where RBAs do exist, important stakeholders are missing from discussions around water allocations and use. Investment decisions remain top-down. This means that large irrigators do not have to report on how much water they consume, as investments that are government-led do not require water permits.

Furthermore, consultations often fail to adequately address social and environmental costs of new water resource developments. Key respondents from the MoWIE directorates of irrigation and hydropower noted that consultations are held between governmental authorities and affected water users and communities during the feasibility study phase for potential new irrigations schemes.[41] However, an analysis of the environmental impact assessment process revealed that people rarely receive adequate information (César and Ekbom, 2013).

Can African lions learn from Asian tigers?

Ethiopia's late president Meles Zenawi's vision for the economic transformation of his country was based on the Japanese '*kaizen*' approach, the workplace philosophy that helped Japan recover from the defeat of World War Two.

'Kaizen' (meaning 'livelihood improvement') implies economic growth based on manufacturing, and suggests the simple principles of tidiness and order, innovation and use of local resources. Along these lines, GTP I aimed to expand manufacturing employment and help rural communities diversify their livelihoods.

40 Interview with farmers in the Awash Basin, conducted in August 2015.

41 Interview with MoWIE Basin Directorate, conducted in Addis Ababa in August 2015.

However, this is not the only lesson that fast-growing Asian countries offer to Ethiopia. China provides a prime example of the political, social and environmental costs of economic growth and water resource development that do not consider environmental boundaries.

In 2014, Premier Li Keqiang of China declared a 'war on pollution', announcing that environmental degradation, including water scarcity and pollution, would be treated as national security issues (Reuters, 2014). This was not part of China's green economy strategy but a result of popular concerns with the state of the environment. These concerns pose a threat to the legitimacy of the party-state.

The elevation of environmental concerns into high politics is relatively recent but has been emerging for some time. Over the past four decades, China has built its way to growth, constructing energy and irrigation mega-projects that boosted agricultural production, energy supply and industrial output.

However, the environment has paid a very heavy price. Growing water scarcity and pollution may cost the country 2-3% of GDP – a sizeable sum in an $11 trillion economy. Policy-makers are now faced with a dilemma: how to meet the needs of an increasingly urban population by moving water out of agriculture whilst maintaining food security and rural incomes and cleaning up the environmental damage that has already been done (Doczi et al, 2014).

The problem is particularly acute in the water-scarce north, where major investment in irrigation in the 1970s and 1980s eventually led to the Yellow River drying up near its outlet to the sea. Farmers, dissatisfied with unreliable water from underperforming surface water schemes, began to sink their own groundwater boreholes. Now there is a new problem: groundwater levels are falling rapidly in the North China Plain – threatening both local and regional economies (Calow et al, 2009; Doczi et al, 2014).

Politicians were slow to make the difficult choices. Initially, the assumption was that by increasing efficiencies and scaling up watershed protection programmes, 'saved' water could be used to satisfy urban demands and maintain environmental flows. But this proved to be a myth: much of the 'saved' water was never lost in the first place. For example, channel lining programmes affected the recycling of water, reducing useful groundwater recharge that was recovered by other users. Moreover, more 'efficient' drip and sprinkler systems simply encouraged farmers to expand the irrigated area, or augment the proportion of water withdrawals lost through evaporation and transpiration – increasing rather than decreasing losses (Wu et al, 2014).

Fortunately, Chinese politicians are learning from past mistakes and making the hard choices. At different levels of government, party bosses are now evaluated against environmental criteria – how well they are performing in terms of water quality, availability and other metrics in their areas of jurisdiction (Doczi et al, 2014).

Across China, comprehensive basin plans have been developed setting out 'who gets what water', implemented by basin authorities with the authority and capacity to monitor and enforce rules. Within the regions, politicians are experimenting with new ways of transferring water between sectors and users, using a combination of carrots (positive incentives) and sticks (punitive measures) (Calow et al, 2009).

There is a long way to go. But China has learned some important lessons, not least about the need to balance water development with strong management to build what it terms an 'ecological civilisation'.

4.2 Technological change

Crises often generate incentives for technological change and disruptive innovations. As a result of the water shortages in the Awash Basin, large-scale irrigation users hope to upgrade irrigation technology to more 'efficient' systems. This aligns with GTP plans highlighted by a respondent from the Ministry of Agriculture (MoA): 'GTP is also about transformation from traditional to improved technologies, therefore it will promote technologies to save water like drip or sprinkler irrigation'.[42]

At present, surface (gravity-fed) canal systems are the most common irrigation technology in Ethiopia, followed by temporary or permanent river or stream diversions, spate irrigation, micro-dams, rainwater harvesting and ponds, and pumping systems from groundwater, rivers or lakes (Tiruneh, 2013). Modern pressurised systems are a relatively new phenomenon, with some uptake by the private sector and in new or expanding state schemes (AgWater, 2010).

However, introducing new irrigation techniques will not be enough to ensure that irrigation development meets Ethiopia's ambitious national targets, nor will technology upgrades succeed in releasing large volumes of water for other sectors (see Box 5). Irrigation targets under GTP I were not achieved, according to several respondents in the MoWIE and MoA. A recent report by the Futures Agriculture Consortium concluded that sustained high performance of irrigation schemes in Ethiopia is undermined by institutional fragmentation between the MoWIE (with a mandate to oversee water resources development) and the Irrigation Department and Agriculture Investment Support Directorate in the MoA, as well as regional bureaus and district offices, river basin authorities and para-statals such as the Ethiopian Sugar Corporation (Oates et al, 2015).

The level of attention and resources given to construction and expansion of irrigation schemes is disproportionately high in contrast to expenditure on management, maintenance and supporting services (Oates et al., 2015). Investment decisions must focus on

42 Interview with representative of the Ministry of Agriculture, conducted in Addis Ababa in August 2015.

both medium-term maintenance and longer-term goals. Technological change must be managed by institutional development.

Other water infrastructure projects including large dams are planned in order to address water scarcity issues. For example, in the Awash Basin, two dam proposals are under consideration by government: the first dam will be primarily for flood control but will also store water for downstream farms suffering from water scarcity caused by the large irrigation schemes upstream; the second dam will control flood risks and provide water for irrigation targeted at the Tendaho Farm and small-scale irrigators over 5,000-7,000 ha.[43]

Large-scale infrastructure can provide short-term relief for scarcity issues. However, dams can also encourage increased expansion of irrigation schemes. This exerts an opportunity cost on higher value water users such as services or industry, which can catalyse value-added, high-productivity transformative growth. New technology must therefore be complemented by proper economic accounting of water across users.

43 Information from interview with key respondent in Water Works Design and Supervision Enterprise, held in Addis Ababa on 17th August 2015.

5. Recommendations

Mobilising water for life and livelihoods has played a key role in Ethiopia's economic growth. This is important, given that water insecurity for a large proportion of Ethiopians has been conditioned by a lack of access to water and the benefits that flow from it. Government has responded by seeking to develop supply – for energy, food, industry and people. Its success in doing so, however, has created a different set of challenges. How to realign supply and demand within the frontiers of environmental sustainability, and how to balance the claims of competing users?

The adjustment process is never easy, and there will be those who benefit more and less. Competing demands can be mediated through rules that set out the terms and conditions under which different groups can access and use water. Those who gain ('winners') need to compensate the 'losers', directly or indirectly. Weak governance will lead to present and future claims on available water resources that continue to reflect inequalities in power and money, rather than broader economic, social and environmental interests.

Drawing on the hard lessons learned in Asian economies (Box 9), our core argument is a simple one: water strategies for Ethiopia's new development era, marked by publication of the GTP II, need to change. As Chinese leaders now freely acknowledge, a narrow focus on water development, without parallel investment in management, incurs unforeseen costs, equivalent to percentage points of GDP. Similar costs and tensions are now visible in Ethiopia, particularly in intensively developed areas. Poor water management has led to conflicts between upstream and downstream users, rising costs of supply and water treatment, pollution of water bodies, economic losses arising from the misallocation of water and the loss of precious ecosystem services. The recommendations below outline key steps to address such problems.

5.1 Priorities for the public sector

The government and development partners must realign their priorities around the importance of water management. Within the MoWIE, and across government more broadly, this means elevating the political status of water institutions and regulatory structures and recognising that sound water management lies at the heart of Ethiopia's growth and poverty reduction ambitions. For GoE, this may mean adjusting GDP growth ambitions to ensure resources are invested in institutional development around water and other natural resource management, instead of only in capital-intensive infrastructure projects. For Ethiopia's development partners, this means re-engaging with water resources by recognising, for example, that the gains made on the OWNP and MDGs around WASH access will not be sustained if water resources are degraded or appropriated by other sectors.

Ultimately, however, institutional change requires political pressure. This will emerge over time as different branches of government see their plans and investments underperform because they fail to account for water-related interdependencies. It will also come from development partners that see their own contributions to the poverty reduction 'project' undermined; from the private sector, looking for investment security in increasingly water-insecure industries; and through popular concern with water availability first and foremost, but also with water quality, health and environmental degradation.

From a regulatory perspective, revision of the aging Water Resources Management Policy (1999) and Water Strategy (2002) is long overdue. These strategies were conceived prior to Ethiopia's period of rapid growth, and predate many of the emerging problems of scarcity, competition and pollution. Moreover, these documents are light on many of the core elements of *effective* water management – water accounting, user registration, allocation licensing, the legal framework, pricing, monitoring and enforcement.

The formulation of a new, more comprehensive strategy for water management needs buy-in from across government, and a high-level political push, not least because it must address the problem of coordination between federal and regional government, and the political authority of river basin organisations.

5.2 Taking action

Establishing the agenda for better water management is a gradual process. Decision-makers must understand how climate, demographic and socioeconomic dynamics affect water supplies, users, potential resource development opportunities, management needs, and what strategies are required to protect and empower the poorest and most vulnerable. Investments in water infrastructure or other water development projects need to be considered within a framework of water security and embedded in the Sustainable Development Goals (SDGs) mandate of 'leaving no-one behind'. They also need to be considered in light of the water requirements and demands of neighbouring downstream countries, in order to prevent

(or escalate) conflicts. Ecological limits and needs of ecosystems must be factored into water management strategies as well.

Decision-makers that adopt and embrace the process of improved water management will be able to implement national water strategies and investments that drive shared prosperity. The following plan suggests actions for better, more sustainable and more inclusive water management. We recommend that to translate ambitious water strategies into practical action for the new development era and GTP II, water managers and policy-makers in Ethiopia should focus on the 'A, B, C, D and E' of effective management.[44]

Accounting for water resources

Investment in monitoring, baseline data and publicly available information is crucial. Data must account for resource conditions in time and space, and 'follow the water' - where it is being withdrawn, who is using it, what proportion is returned, and what changes in quality are occurring. This will help decision-makers to understand who benefits and who pays the costs of water resource allocations and infrastructure.

GoE, with the support of development partners, must mobilise resources for data systems (a cross-cutting issue in Ethiopia's GTP) to allow for accurate, efficient and adaptive economic and hydro-ecological water accounting. The research sector can support this process by providing socio-economic, climatic and hydrological data and evidence for policy-making.

Bargaining among water uses and users

Bargaining is an important part of the political process to determine water use priorities among different users. Ethiopia's outdated Water Strategy states that domestic use is the number one priority, but other priorities are unclear. In practice, different agencies, jurisdictions and sectors (from the local to the trans-national scale) follow their own agendas and mistakenly assume there is adequate of appropriate quality water to meet them. At the basin level, our work in the Awash shows that different sectors must consider the impacts of allocation and use. At the national level, the historical tensions with Egypt and Sudan over water sharing show that water allocations in Ethiopia must also consider the interests of neighbouring countries.

GoE, RBAs and water sector stakeholders must consider and discuss the needs of different users at different scales, including the needs of ecosystems and more marginal downstream users such as small scale farmers and pastoralists. There should be mechanisms to transfer and distribute the benefits of economic growth driven by water resource development, for example taxation (and compensation), employment, education, health and migration/settlement patterns.

Codification of the rules for water management

Codification is the translation of agreed priorities and allocations into rules, statutes and laws, so that the water service to each sector or user is clear under different hydrological conditions. Crucially, this means defining and allocating shares of available water according to the priorities set above. The water management system should also allow for processes such as social and environmental impacts assessments, vulnerability assessment and identification of mechanisms to compensate affected users and redistribute benefits.

GoE should revise, update and reform existing regulations for the water sector to improve data management, permits (for use and waste), tariffs and penalties. Development partners should support human and organisational capacity development for water resource management from federal level to the community.

Delegation of roles and responsibilities

Roles and responsibility for water management and provision of water must be clearly defined. Currently, there are overlapping mandates between federal government and river basin authorities, and between basin authorities and regional government. Water institutions require clear and distinct roles and adequate resources and capacity to assess user needs, consider trade-offs and allocate water in a way that respects actual availability, ensures interests and needs are addressed, accounts for socioeconomic and climatic changes, and sustains the resource for future use.

GoE should assign distinct roles and responsibilities for each actor in the water sector, and ensure that ministries which manage water-dependent sectors (for example, Ministry of Planning, Industry and Trade, Agriculture, Environment, Natural Resources, Water and Energy) are equipped to establish required institutional structures, share information within and across sectors and implement national water resource management plans.

Enforcement of use and allocation rules

It is essential that water institutions, stakeholders and users understand, respect and comply with the rules, statutes and laws established by the process above. Use and allocation must give priority to the protection of drinking water supplies in terms of both quality and quantity. This may mean altering plans for big irrigation or industry in areas already struggling to meet urban and rural needs. Evidence-based planning, appropriate regulations and delegation, and enforcement procedures (which are utilised as needed) will encourage water sector stakeholders to act cooperatively and effectively, for sustainable water driven growth.

The GoE and water sector stakeholder should establish the 'rules of the game', and develop the mechanisms to ensure they are respected through transparent and accountable enforcement procedures, including recourse

44 After: Perry (2014). Because our analysis focuses on the institutional dimensions of water resources management, we substitute Perry's 'Engineering' component with an 'Enforcement' one.

for when due process is not respected. Other water sector stakeholders must comply with the reformed system, or risk punitive enforcement procedures such as penalties and fines. Donors, private actors and financial institutions can support the process through data collection, information sharing and coordination.

References

Abebe, S., Haji, J. and Ketema, M. (2014) 'Impact of Disappearance of Lake Haramaya on the Livelihood of the Surrounding Community: The Case of Haramaya District in Oromia National Regional State, Ethiopia'. Journal of Economics and Sustainable Development 5(18): 141-147, available at: http://www.iiste.org/Journals/index.php/JEDS/article/download/16041/16423.

Adank, M., Butterworth, J., Godfrey, S. and Abera, M. (forthcoming) 'Looking beyond the headline indicators: water and sanitation services in small towns in Ethiopia'. Journal of Water, Sanitation and Hygiene for Development, forthcoming.

AfDB (2015) 'Financing water is key to Africa's transformation, experts say'. AfDB News, 7 December 2015, available online at http://www.afdb.org/en/news-and-events/article/financing-water-is-key-to-africas-transformation-experts-say-15152/.

AgWater (2010) 'Ethiopia Situation Analysis. Agricultural Water Management National Situation Analysis Brief, Agricultural Water Management Solutions (AgWater)'. Colombo, Sri Lanka: International Water Management Institute.

Ansar, A., Flyvbjerg, B., Budzier, A., Lunn, D. (2014) 'Should we build more large dams? The actual costs of hydropower megaproject development'. Energy Policy Vol. 69, pp. 43-56.

Asress, M.B. et al. (2013) 'Wind energy resource development in Ethiopia as an alternative energy future beyond the dominant hydropower'. Renewable and Sustainable Energy Reviews 23(2013) 366-378.

Briscoe, E. (1996) 'Water as an economic good: the idea and what it means in practice'. Paper presented at the World Congress of the International Commission of Irrigation and Drainage, Cairo.

Brown, C. and Lall, U. (2006) 'Water and economic development: The role of variability and a framework for resilience', Natural Resources Forum 30(4): 306-317.

Calow, R., Howarth, S., and Wang, J. (2009). *Irrigation development and water rights reform in China. International Journal of Water Resources Development*, 25(2): 227-248.

Calow, R., Ludi, E., and Tucker, J. (2013) 'Achieving Water Security: Lessons from research on water supply, sanitation and hygiene in Ethiopia'. Practical Action, Rugby.

César, E. and Ekbom, A. (2013) 'Ethiopia Environmental and Climate Change policy brief'. SIDA Helpdesk for Environment and Climate Change. Addis Ababa: Swedish International Development Cooperation Agency (SIDA), available at: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2013/05/Ethiopia-Environmental-and-Climate-Change-policy-20130527.pdf.

Conway, D. and Schipper, E. (2011) 'Adaptation to climate change in Africa: challenges and opportunities identified from Ethiopia', Global Environmental Change 21(1): 227-237.

Deloitte (2014) 'Ethiopia. A Growth Miracle'. Deloitte Reports, available at http://www2.deloitte.com/content/dam/Deloitte/za/Documents/strategy/za_ethiopia_growth_miracle_july2014.pdf .

Dercon, S. (2012) 'Is Green Growth Good for the Poor?' World Bank: Washington, available at http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-6231.

Doczi, J., Calow, R. and d'Alcancon (2014). Growing more with less: China's progress in agricultural water management and reallocation. ODI Development Progress, Case Study Report Environment, ODI September 2014

Energy Information Administration (2012) 'Ethiopia: International Energy Data and Analysis' available at http://www.eia.gov/beta/international/country.cfm?iso=ETH"

FAO (2013) 'Awash River Basin Water Audit. Synthesis Report'. FAO Report available at http://www.fao.org/nr/water/docs/awash/AwashSynthesisReport.pdf

FAO (2014) 'The Water-Energy-Food Nexus'. FAO Report available at http://www.fao.org/nr/water/docs/FAO_nexus_concept.pdf.

FAO (2016) 'FAO in Ethiopia – El Niño response plan 2016'. Relief Web Update 15th January 2016, available at http://reliefweb.int/report/ethiopia/fao-ethiopia-el-ni-o-response-plan-2016.

FDRE (2002) 'Ethiopia: Sustainable Development and Poverty Reduction Program'. Federal Democratic Republic of Ethiopia (FDRE), Ministry of Finance and Economic Development (MOFED). Addis Ababa, Ethiopia. https://www.imf.org/External/NP/prsp/2002/eth/01/073102.pdf.

FDRE (2011) 'Climate-Resilient Green Economy Vision (CRGE vision). Ethiopia's vision for a climate resilient green economy'. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia. Available at http://www.preventionweb.net/files/24317_24317crgegevision40pagesforprinting.pdf

FDRE (2014) 'One WASH National Program'. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.
FDRE (2015) 'Ethiopia's Climate-Resilient Green Economy. Climate Resilience Strategy: Water and Energy'. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.
Grey, D. and Sadoff, C. (2006) 'Water for Growth and Development'. 4th World Water Forum Theme Document.
Gross, M., Klasen, S. and Harttgen, K. (2005) 'Measuring Pro-Poor Growth with Non-Income Indicators.' Ibero-America Institute for Economic Research Discussion Paper 132. Göttingen: Ibero-America Institute for Economic Research.
Hagos, F., Makombe, G., Namara, R. and Awulachew, S. (2009) 'Importance of irrigated agriculture to the Ethiopian economy: capturing the direct net benefits of irrigation'. IWMI Research Report 128, available at http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/PUB128/RR128.pdf.
Hatfield-Dodds, S. (2006) 'Water strategies for sustainable development: What is required to ensure 'responsible growth'?' 4th World Water Forum Discussion Paper, available at http://www.sea-user.org/download_pubdoc.php?doc=3332.
HLPE (2015) 'Water for food security and nutrition'. Report by the high level panel of experts on food security and nutrition of the committee on World Food Security, available at http://www.fao.org/3/a-av045e.pdf.
Hogarth, R. and Granoff, I. (2015) 'Speaking truth to power: why energy distribution, more than generation, is Africa's poverty challenge'. ODI and Oxfam, available at: http://policypractice.oxfamamerica.org/static/media/files/FINAL_speakingpowertotruth_SH.pdf.
IRIN (2015) 'How bad is the drought in Ethiopia?' IRIN Humanitarian News, available at http://newirin.irinnews.org/dataviz/2015/11/19/how-bad-is-the-drought-in-ethiopia
Kebede, S. (2013) 'Groundwater in Ethiopia. Features, numbers and opportunities'. Springer Ebook.
Kraay. A. (2004) 'When is growth pro-poor? Cross-country evidence'. IMF Working Paper 04/47.
Lenhardt, A., Rogerson, A., Guadagno, F. and Berliner, T. (2015) 'One foot on the ground, one foot in the air: Ethiopia's delivery on an ambitious development agenda'. London: ODI, available at https://www.odi.org/publications/9884-ethiopia-progress-development-mdgs-millennium-development-goals-employment-agriculture-extreme-poverty-education.
Losch, B., Freguin-Gresh, S. and White, E. (2012) 'Structural Transformation and Rural Change Revisited: Challenges for Late Developing Countries in a Globalizing World'. African Development Forum series. World Bank: Washington.
Mamon, T. (2016) 'We must rebuild farmers' resilience after Ethiopia's catastrophic El Niño', The Guardian Online 18/05/16, available at http://www.theguardian.com/global-development/2016/may/18/we-must-rebuild-farmers-resilience-after-ethiopias-catastrophic-el-nino.
Mason, N. and Calow, R. (2012) 'Water security: from abstract concept to meaningful metrics – An initial overview of options'. ODI Working Paper 357, London: ODI, available at https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7865.pdf.
Mosello, B., Calow, R. Tucker, J., Parker, H., Alamirew, T., Kebede, S., Alemseged, T. and Gudina, A. (2015) 'Building adaptive water resources management in Ethiopia'. ODI Report, London: ODI, available at https://www.odi.org/publications/9568-building-adaptive-water-resources-management-ethiopia.
MoWIE (2014) 'Assessment and Evaluation of Causes for Beseka Lake Level Rise and Design Mitigation Measures. Part II: Study for Medium and Long Term Solutions (Main Report – Final)'. Addis Ababa, Ethiopia: MoWIE.
MoWIE (2015) contribution to the 'Climate Resilient Green Economy Vision'. Addis Ababa, Ethiopia.
NCE (2015) 'Unlocking the Power of Ethiopia's Cities: A report by Ethiopia's New Climate Economy Partnership'. The New Climate Economy (NCE), Ethiopian Development Research Institute (EDRI) and Global Green Growth Initiative (GGGI): Addis Ababa, Ethiopia. Available at: http://2014.newclimateeconomy.report/wp-content/uploads/2015/03/Unlocking-the-Power-of-Cities-in-Ethiopia.pdf .
Newborne, P. and Welham, B. (2014) 'Joining the grid, sustainable energy in Brazil'. ODI Development Progress Case Study Report, London: ODI available at http://www.developmentprogress.org/sites/developmentprogress.org/files/case-study-report/brazil_full_report_-_final_small.pdf.
Oates, N., Jobbins, G., Mosello, B., and Arnold, J. (2015) 'Pathways for irrigation development in Africa – insights from Ethiopia, Morocco and Mozambique'. Futures Agriculture Consortium (FAC), Working Paper 119. http://www.future-agricultures.org/publications/research-and-analysis/working-papers/1956-pathways-for-irrigation-development-in-africa-insights-from-ethiopia-morocco-and-mozambique?path.
Olumana, M., Loiskandl, W. and Furst, J. (2009) 'Effect of the Lake Beseka expansion on the sustainability of Metehara sugar estate in the Awash River basin'. Ethiopia. 34th WEDC International Conference paper, Ethiopia 2009. Water, sanitation and hygiene: sustainable development and multisectoral approaches. Refereed Paper 296. http://wedc.lboro.ac.uk/resources/conference/34/Olumana_M_-_296.pdf.
Perry, C. (2011). Accounting for water use. Terminology and implications for saving water and increasing production. *Agricultural Water Management* 98 (2011) 1840-1846.
Perry (2014) 'ABCDE+F: a framework for thinking about water resources management', Water International, 38:1, 95-107, available at http://www.tandfonline.com/doi/abs/10.1080/02508060.2013.754618.

REEGLE (2014) Ethiopia. Country Data. Renewable Energy Policy Network, data available at http://www.reegle.info/policy-and-regulatory-overviews/ET.
Reliefweb (2016) 'Ethiopia – Drought – 2015-2016'. Disaster Update. Available at http://reliefweb.int/disaster/dr-2015-000109-eth.
Ren 21 (2015) 'Renewable 2015 Global Status Report'. Renewable Energy Policy Network, report available at: http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf.
Reuters (2014). China to declare 'war on pollution', premier says. See: http://www.reuters.com/article/us-china-parliament-pollution-idUSBREA2405W20140305
Rogers, P., Bhatia, R., Huber, A. (1998) Water as a social and economic good: how to put the principle into practice. Global Water Partnership TAC Background Papers No. 2, GWP/SIDA: Sweden.
Rouse, M. (2007) 'Institutional governance and regulation of water services'. IWA Publishing: UK.
Sadoff, C.W., Hall, J.W., Grey, D., Aerts, J.C.J.H., Ait-Kadi, M., Brown, C., Cox, A., Dadson, S., Garrick, D., Kelman, J., McCornick, P., Ringler, C., Rosegrant, M., Whittington, D. and Wiberg, D. (2015) 'Securing Water, Sustaining Growth: Report of the GWP/OECD Task Force on Water Security and Sustainable Growth', University of Oxford, UK, 180pp.
Skinner, J. and Haas, L. (2014) 'Renewed hydropower investment needs social and environmental safeguards'. IIED Briefing, Issue April 2014.
Steer, A. (2013). 'Resource Depletion, Climate Change and Economic Growth'. Global Citizen Foundation, Working Paper 5, June.
The Economist (2015) 'More a marathon than a sprint. Industrialisation in Africa'. The Economist. 7th November 2015, available at http://www.economist.com/news/middle-east-and-africa/21677633-there-long-road-ahead-africa-emulate-east-asia-more-marathon.
Tiruneh, Y. (2013) 'Synthesis Report: Awash River Basin Water Audit', Addis Ababa, Ethiopia: United Nations Food and Agriculture Organization and Federal Democratic Republic of Ethiopia.
UNDP (2015) 'National Human Development Report 2015 Ethiopia'. UNDP Human Development Reports, available at http://hdr.undp.org/en/content/national-human-development-report-2015-ethiopia
UNEP (2005) Vital Water Graphics – An Overview of the State of the World's Fresh and Marine Waters. 1st Edition. UNEP, Nairobi, Kenya.
USAID (2014) 'Africa Energy Outlook: A Focus on Energy Prospects in Sub-Saharan Africa'. OECD/IEA: Paris, France. Available at: https://www.usaid.gov/sites/default/files/documents/1860/IEA-Africa-Energy-Outlook-2014.pdf.
USAID (2015) 'Power Africa in Ethiopia', USAID Briefing for Power Africa, available at https://www.usaid.gov/powerafrica/ethiopia.
Vidal, J. and Carrington, D. (2015) 'El Niño: food shortages, floods, disease and droughts set to put millions at risk'. Guardian online, 16 November 2015, available at http://www.theguardian.com/global-development/2015/nov/16/el-nino-food-shortages-floods-disease-and-droughts-set-to-put-millions-at-risk.
Vörösmarty, C.J., Lévêque, C. and Revenga, C. et al. (2005) 'Fresh water', Chapter 7 in: MEA (2005) Current State & Trends Assessment.
WEF (2015) 'Global Risks 2015'. World Economic Forum: Geneva, Switzerland. http://www3.weforum.org/docs/WEF_Global_Risks_2015_Report15.pdf.
WEF (2016) 'The Global Risks Report 2016'. World Economic Forum: Geneva, Switzerland. http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf.
WFP (2012) 'Ethiopia: Productive Safety Net Programme: Factsheet'. Available at: https://www.wfp.org/sites/default/files/PSNP%20Factsheet.pdf.
WHO (2004) 'Evaluation of the costs and benefits of water and sanitation improvements at the global level'. Executive Summary, available at: http://www.who.int/water_sanitation_health/wsh0404summary/en/.
WHO/UNICEF (2015) '2015 Report and MDG Assessment', WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, available at http://www.wssinfo.org/
World Bank (2013) 'Ethiopia second economic update: laying the foundation for achieving middle income status', World Bank, available at: http://documents.worldbank.org/curated/en/2013/06/18594155/ethiopia-second-economic-update-laying-foundation-achieving-middle-income-status.
World Bank (2014) 'Fourth Ethiopia economic update: overcoming constraints in Ethiopia's manufacturing sector', World Bank Group 97916, World Bank: Washington available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/09/11/090224b0830cfd0f/2_0/Rendered/PDF/Fourth0Ethiopi0manufacturing0sector.pdf.
World Bank (2015) 'Ethiopia Poverty Assessment'. World Bank: Washington, available at https://openknowledge.worldbank.org/handle/10986/21323.

World Bank (2016) 'High and Dry: Climate Change, Water and the Economy', Water Global Practice, World Bank: Washington, available at http://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy.
World Bank and FDRE (2012) 'Ethiopia's tourism sector: strategic paths to competitiveness and job creation'. World Bank Group: Washington, available online at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/04/12/000333037_20130412103216/Rendered/PDF/765760ESW0P1190C00Tourism0ESW0Oct12.pdf.
World Bank Data at http://data.worldbank.org/.
World Bank Group and International Monetary Fund (2015) 'Global Monitoring Report 2014/2015: Ending Poverty and Sharing Prosperity'. World Bank: Washington, available at https://openknowledge.worldbank.org/handle/10986/20330.
Wu, B., Jiang, J., Yan, N., Perry, C. and Zeng, H. (2014). Basin-wide evapotranspiration management: Concpet and practical application in Hai Basin, China. *Agricultural Water Management*, Vol 145, November 2014, pp145-153.
You, G. and Ringler, C. (2011) 'Climate change impacts in Ethiopia'. IFPRI Research Brief 15-19 available at http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/125060.

Annex 1: Project outline

The project 'Building adaptive water resources management in Ethiopia' ran from September 2013 to December 2015 and was funded by the Strategic Climate Institutions Programme. The project was led by the Overseas Development Institute (ODI) and Ethiopia's Ministry of Water, Irrigation and Electricity (MoWIE), in partnership with Addis Ababa University (AAU), the Water and Land Resource Centre (WLRC) and the Ethiopian Institute of Water Resources (EIWR).

Project activities aimed to improve water resource management in Ethiopia. Water in Ethiopia is distributed unevenly between areas, and across seasons and years, which creates challenges for economic development and secure livelihoods. GoE is investing in water resource development to support green growth and poverty reduction. However, without parallel investment in water resource institutions and management, the benefits of this infrastructure will be lost, undermined or 'captured' by the most powerful, while the poorest bear the costs.

To address this challenge, the Ethiopian water sector must embrace a step-change. Institutions and agencies must adopt integrated approaches to coordinate development across sectors and areas. Adaptive management will respond to the growing and sometimes unpredictable pressures of economic development, demographic shifts and climate change. This change will take many years. The work completed by this project was a crucial first step.

Phase 1 of the project ran from September 2013 to May 2015. The project team conducted a climate change and water resources management assessment (CC-WRMA) at federal level (with basin-level case studies), and provided initial training and needs assessment around integrated and adaptive water resources management (AWRM).

Phase 2 ran from June 2015 to October 2015. The project team conducted a basin-scale study in the Awash River Basin to analyse the impact of poor water management on different users and uses, including water pricing for different sectors, and the growing costs of scarcity, competition and pollution.

Phase 1: Building adaptive water resources management in Ethiopia (September 2013-October 2015)

The first phase of this project aimed to develop a 'road map' of the actions and institutional investments that are required to build AWRM at national and basin level, to achieve the long-term goal of promoting sustainable WRM in the face of climate change and other pressures. There was a capacity building programme targeting MoWIE and RBA staff, to support delivery of Ethiopia's green economy objectives through improved WRM. ODI and EIWR organised a five-day introductory training on 'Building Adaptive Water Resources Management in Ethiopia' for MoWIE and RBA staff in September 2015. MoWIE and RBA staff were also involved in all project components and field missions. We interviewed other key stakeholders in water and water-related sectors, including farmers, the private sector, donors and development partners.

This process started a debate at both federal and basin levels on the importance of WRM to prevent water scarcity and competition, especially in the face of rapid socioeconomic and environmental changes. The Water Resources Management Technical Committee (WRM-TC), established in August 2014 as a sub-group of the Water Sector Working Group (WSWG) within the MoWIE, is using our project report to develop a capacity building plan for the water sector.

ODI also organised three stakeholders' meetings to launch the project (December 2013); to validate the preliminary results of the CC-WRMA analysis (December 2014); and to present the final results of the CC-WRMA analysis (January 2015). These events proved an opportunity to introduce to water managers the principles and requirements of an AWRM approach and the challenges related to its implementation in Ethiopia.

Key messages from the final workshop were that WRM should begin with an analysis of emerging problems and potential solutions and that it is a long-term endeavour with no quick returns. Water sector stakeholders also noted that there is a tendency to assume that all new investments in water will simultaneously deliver both economic growth and poverty reduction. However, water managers need a much clearer understanding of 'how' and 'for whom' water resources should be developed. Finally, to make the case for WRM, it is important to start reaching out beyond the water community and engaging with those actors that work in areas directly and indirectly reliant on water resources.

The final report 'Building Adaptive Water Resources Management in Ethiopia', published in May 2015 presents the pressures and opportunities for water resources management and development in Ethiopia, focusing on both climatic and socioeconomic drivers of change and their impacts on water resources availability and demand. The report concluded that GoE must invest more in WRM, to address the increasing pressures that a thriving economy, growing population and

changing climate are placing on its water resources. A long-term integrated and adaptive approach is essential to make water resource management in Ethiopia more efficient, sustainable and equitable.

Phase 2: Making the economic case for water resources management (June 2015-October 2015)

The second phase of the project aimed to make the case for improved water management through adopting economic analysis and a language of costs and benefits. Water sector stakeholders suggested that this would better resonate with key actors outside the water sector. Different agencies make investment decisions around 'water for growth', with often conflicting plans to develop the same water resources. Water-related interdependencies among agencies, jurisdictions and sectors are growing, but the economic consequences of fragmented management or, conversely, the economic benefits of a more integrated approach to planning, have yet to be spelled out.

The second project phase started in July 2015, and aimed to describe and quantify the costs of water scarcity and insecurity on key sectors and users groups, with a particular focus on the Awash River Basin. The analysis highlighted the consequences and costs of a supply-driven, needs-based approach to water resources development that fails to account for resource conditions and trends. The research also identified emerging interdependencies between different water uses and users. Recommendations promote rules-based allocation informed by an understanding of allocative efficiency.

Field research in August 2015 focused on collating data on water use and allocation in the basin, working closely with the MoWIE and RBAs. The research team interviewed stakeholder in the Awash (water utilities, farmers, large irrigation schemes, etc.) to understand their patterns of water consumption, the costs they incur for accessing water resources, the prices they pay and the benefits they derive from their water-dependent economic activities. We compared the data against a map of planned water resource development projects in the Awash Basin, and the potential costs of continued poor water management. We then developed key recommendations to mitigate these risks and improve water resources management.

During the final project event in October 2015 we presented the preliminary results of our study. The event also hosted a photography exhibition titled 'A story of water and growth in Ethiopia', to illustrate the urgent need to invest in institutions to manage water resources in a way that fosters economic growth, protects the poor and preserves the environment, creating a more prosperous Ethiopia for the future.

Outcomes and outputs

Outcome 1: A strengthened evidence base for investing in improved WRM

- Desk review: pressures and opportunities for water resources management and development in Ethiopia (October 2014)
- Climate change and water resources management assessment (CC-WRMA) at federal and basin level (January 2015)
- WRM case studies: Awash and Abay River Basins, Lake Ziway (January 2015)
- Report and executive summary: 'Building Adaptive Water Resources Management in Ethiopia', published by ODI (May 2015)
- Photo story: 'How to avoid conflict over water resources in Ethiopia?' (May 2015)
- Blog: 'Beyond dams and pipes: domestic water politics in Ethiopia' (October 2014)
- Report and executive summary: A thirsty future? Water strategies for Ethiopia's new development era (June 2016)

Outcome 2: Multi-stakeholder engagement at national level

- Interviews with stakeholders in water and related sectors at federal and basin level, including RBA staff, farmers, private sector, etc. (January 2014-August 2015)
- Stakeholders' meetings to launch the project (December 2013); to validate the preliminary results of the CC-WRMA analysis (December 2014); and to present the final results of the CC-WRMA analysis (January 2015)
- Participation in the preliminary phases of the WRM Working Group: the results of this project will help shape the agenda of this group and will shape future activities in the water sector, conducted by MoWIE and government and development partners (January 2015)
- Final project event: 'Water management and economic growth: how and for whom?' A half-day event convening all key stakeholders in the water and water-related sectors to discuss water resources management and development for economic growth and poverty reduction in Ethiopia (October 2015)

- Photo exhibition: 'A story of water and growth in Ethiopia' to illustrate some of the challenges that arise from managing water resources in the context of economic and climate change

Outcome 3: Enhanced capacity for WRM

- Training course: five-day introductory training on 'Building Adaptive Water Resources Management in Ethiopia' for MoWIE and RBA staff (organised by ODI and EIWR, with support from international experts from HR Wallingford) (September 2015)
- Project management and research: active involvement of MoWIE and RBA staff in all project components and field missions (September 2013-October 2015).

List of stakeholders consulted

Phase 1 (January 2014-January 2015)

- Oromia Bureau of Water Resources
- MoWIE Directorate of Hydrology and Water Quality (x2)
- MoWIE Directorate of Hydropower Development and Dam Administration
- MoWIE Directorate of Water, Utilisation and Permitting
- Ministry of Environment and Forestry (MEF), Strategic Planning Directorate (CRGE development strategy)
- Addis Ababa Water and Sewerage Authority (AAWSA)
- MoWIE Water Supply Directorate
- Water Works Design and Supervision Enterprise
- Ministry of Agriculture (MoA), Natural Resources Directorate
- Ethiopian Agricultural Transformation Agency (Household Irrigation Programme)
- MoWIE, Irrigation Directorate
- Ministry of Industry (Environmental Safeguard Directorate)
- Oromia Water Works and Design Enterprise
- World Bank
- Abay Basin
- Abay Basin Authority (x2)
- Abay Basin Authority
- Tana Sub-basin Organisation (x2)
- Integrated Watershed Management Project (World Bank and GIZ)
- Koga Dam and Irrigation Scheme – Koga Water Structure Management and Water Administration Centre
- Ribb Dam and Irrigation Project
- Awash Basin
- Awash Basin Authority (x2)
- Metehara Irrigation Scheme (x2)
- Wonji Plantation (x2)
- Amibara Enterprise (private farm)
- Smallholder farmers in Fentale Irrigation Scheme
- Fentale project
- Merti Farm
- Koka Dam (x2)
- Adama Water Utility
- Smallholder farmers upstream of Koka Dam
- Kebele Office Malem Beri (Bora wereda)
- Strawberry farm plantation Ilan Tot
- Wereda Water Resources and Energy Office (Bishoftu)
- Adama Water Treatment Plant
- Lake Ziway
- Rift Valley Lakes Basin Authority (Directorate)
- Rift Valley Lakes Basin Authority (Planning, Monitoring and Evaluation Expert)

- Natural Resources Development and Protection Program
- Wereda Health Bureau
- Irrigation Authority Office (Extension team leader)
- Nano Wonchi Irrigation Cooperative (x 3)
- Fish Corporation
- Fish Research Centre
- Horn of Africa Research Centre
- Office of Water Resources
- Discussions with local communities (including small farmers)

Phase 2 (August 2015)

- MoWIE, Hydropower Directorate
- MoWIE, Permit Directorate
- MoWIE, Water supply and sanitation program management unit
- MoWIE, Groundwater Directorate
- MoWIE, Irrigation Directorate
- MoWIE, Socio-environmental impact assessment Directorate
- Agricultural Transformation Agency (ATA), Household Irrigation Programme
- MEF, CRGE Technical Unit
- MoA, Small-scale irrigation development directorate
- Water Works Design and Supervision Enterprise
- Food and Agriculture Organization (FAO)
- Participatory small-scale development programme (PASDEP)
- Awash RBA
- Urban water utility in Addis
- Urban water utility in Adama
- Urban water utility in Awash
- Urban water utility in Metehara
- Sugar plantation in Wonji
- Sugar plantation in Metehara
- Merti (horticulture farm)
- Genesis (horticulture farm)
- Farmers (small-scale irrigation users, groundwater users, community scheme users)
- Koka Dam

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