

REACH

Improving water
security for the poor



Country diagnostic report

Ethiopia

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Executive summary

Ethiopia's remarkable progress has been attributed to two factors: the absence of widespread drought over the past decade in the region and a model of development which has driven investment in public infrastructure. Ethiopia's increase in GDP has mirrored its poverty reduction for income, consumption and living standards over the last 15 years. Notably, Ethiopia has reduced its internationally comparable poverty line ($1.25) from 44% to 30% since 2000. Whilst Ethiopia has made considerable gains in income and consumption poverty reduction, indicators of multi-dimensional well-being and poverty, such as access to water and sanitation, education and health, although the latter remain low. Noting the progress Ethiopia has made with these multi-dimensional indicators, amplifying this progress is crucial to ensuing sustainable growth and poverty reduction. Ethiopia's Growth and Transformation Plan (GTP) and GTP-II provide the framework both to drive growth, and to improve multi-dimensional indicators, such as primary education and health. Ethiopia's sustained growth remains linked to better understanding and continued progress in water security balancing economic growth, human development and environmental sustainability.

Risk-based framework: Ethiopia's growth is dependent on balancing population and economic growth with poverty reduction and transformation. The poor and vulnerable groups can be divided into those who are in chronic poverty, who are usually captured in income poverty metrics; and the transitory poor, who move into and out of poverty as the result of shocks occurring at a particular time. Identifying these vulnerable groups is difficult because their poverty is usually transient and they may therefore be missed in surveys. REACH uses a risk-based framework to understand poverty dynamics and transitions, and the role the water-related risks and water security interventions play in influencing poverty outcomes and sustaining growth.

The vulnerability of the Ethiopian economy to shocks, such as the sensitivity of GDP to climatic variability and change, demonstrates the specific risks to growth and transformation posed by water security. REACH has identified three specific areas where water insecurity threatens Ethiopia's efforts to grow and reduce poverty:

Water-related risk to growth: When economic activities do not harness water's productive potential, and do not protect against water's destructive impacts, water can challenge growth and act as a drag on the economy. In Ethiopia, REACH has identified specific water-related risks to growth and the potential for economic drag such as the fragmented decision-making for groundwater management to sustain industry and human development. This fragmentation has been identified as an emerging threat to human development as it potentially reduces water quantity and quality.

A fragile environment: Ethiopia faces threats from land degradation which causes risks to agricultural productivity and growth, and infrastructure development. Soil erosion impedes or reverses efforts in poverty reduction as it threatens household water and livelihood security, through the reduction of arable land and the sedimentation of dams. Implementation of soil and water conservation measures in fragile environments, and the implications for water security for the poor, requires a deeper understanding of how policies such as the Sustainable Land Management Program (SLMP), Productive Safety Net Programme (PSNP) and other initiatives are and can be further targeted

to promote sustainable development for growth, livelihoods and household water security.

Sustaining human development: Fragile environments and fragmentation of water policies intersect to create specific risks to the poor. The rapid progress in Water, Sanitation and Hygiene (WASH) access has been indicative of the potential for Ethiopia to meet the universal action plan, but threats from wider water security need to be addressed for its gains to be sustainable. Inequalities persisting in WASH delivery threaten Ethiopia's provision of water services targeting the poorest. This inequality of access creates risks that further entrench poverty. Issues such as regional inequality, affordability and utility cost recovery threaten sustainable services to meet household water needs. The risks created by inadequate or unequally targeted WASH often affect those more vulnerable to poverty, such as women and children, and can risk creating intergenerational cycles of poverty due to deprivations such as lost education due to water collection duties.

REACH is advancing a Water Security Observatory approach in order to understand the complexity of intersecting water security challenges, and to capture the dynamics of poverty transitions and cycles. The observatories are long-term, interdisciplinary and instrumented sites which can capture complexity and changes over a specific space. This focussed approach enables more frequent and refined data collection, and means REACH can use a nested conceptualisation of water security and poverty beyond simple metrics and single issues. The water security observatories focus on three issues: Small Towns, Fragile Environments, and Sustaining Growth.

The REACH programme has developed a strong science-practitioner partnership with Oxford, Ministry of Water, Irrigation and Electricity, UNICEF and the Water and Land Resources Centre to support development of water security outcomes that specifically meet the needs of the poor. Through our partners, REACH has the opportunity to facilitate innovative evidence-based policy to enable better decision-making and more targeted interventions, develop sustainable and inclusive services in small-towns and build on scientific expertise across the institutions to further water security science in the context of Ethiopia's push to middle income status.



Photo: UNICEF Ethiopia-Getachew

1 Growth and transformation

Ethiopia's remarkable progress has been attributed to two factors: the absence of widespread drought and a model of development which has driven investment in public infrastructure.[1] As a result of these factors, Ethiopia has seen an annual growth rate of 10% per year, and a fall in income-based poverty (less than $1.25 per person per day) of 26% in the last 15 years.[2] These gains provide evidence for optimism for Ethiopia's goal to become a middle income country by 2025. However, achieving this goal is dependent on Ethiopia's ability to manage multiple water security issues at a national, regional, and household scale. There has been a strong link between GDP and rainfall in recent decades.[3] Ethiopia is currently in a major drought following over a decade of above-average rainfall. The coming year will be a big test to Ethiopia's resilience to the water security challenges posed by variable rainfall.[1]

Hydrological variability is one aspect of water insecurity challenging Ethiopia's development ambitions. Other water-related risks, including land degradation and lack of access to water and sanitation, reduce Ethiopia's potential to sustain growth and highlight the need for interventions tackling the multiple dimensions of water security. To understand the occurrence and impacts of these harmful outcomes, REACH employs risk concepts, tracking indicators of hazard, exposure and vulnerability (see box). This definition can be unpacked further to understand how risks can manifest themselves within different water security issues, and that these have different implications for poverty reduction efforts. For instance, household-level water security providing sufficient, affordable, acceptable and accessible water and sanitation access enables people to live productive lives with sufficient levels of health. Similarly, reducing vulnerability to related to climate variability helps to achieve household water security, as well as broader food and nutrition security.[4]

This report aims to highlight the relationship between water insecurity, growth potential and poverty reduction efforts in Ethiopia, and also to highlight where evidence for those relationships

Ethiopia's Growth and Transformation Plan (GTP)

The aim of the GTP policy initiative is to contribute to the 'achievement of Ethiopia's middle income status by 2025'.

The GTP-I, from 2011-2015, aimed to increase agricultural productivity, accelerate agricultural commercialisation and agro-industrial development, reduce degradation and improve productivity of natural resources. The GTP-II updates the strategy for meeting middle income status by 2025, and includes provisional policy initiatives for increasing safe water supply, service level improvements and wastewater management; increasing good governance in rural and urban water supply to enhance sustainability, effectiveness and efficiency; as well as overall capacity building of sub-sectors. The GTP-II is still under consultation.

is lacking. In doing so, it provides a basis for understanding the context for REACH's research in Ethiopia. The report examines the progress made by Ethiopia in reducing poverty and achieving economic growth and considers how current poverty measures may miss the water-related risks that increase poverty, or the depth and severity of poverty.

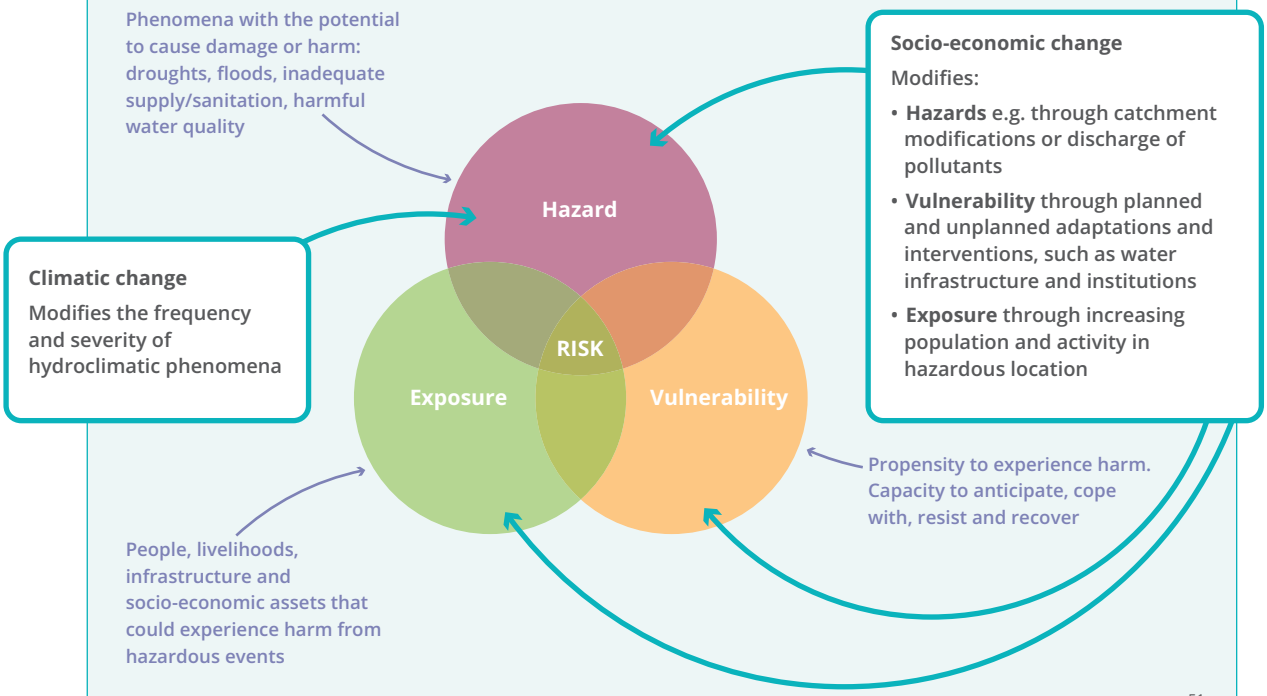
Defining water security

Water security is defined as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies"[3]

Central to this definition is the notion of water-related risks, which can be characterised as a function of hazard, vulnerability and exposure:

- hazard is a phenomenon with the potential to cause damage or harm;
- exposure refers to the people, assets and livelihoods that could experience harm and loss due to the hazard;
- vulnerability captures the propensity to experience harm as a dynamic function of the capacity to anticipate, cope with and recover from harmful events. Poor people have typically higher vulnerability due to lower capacity to anticipate and recover from water-related hazards.

These components can be mapped onto the well-known definition of risk combining probability and consequences, where the probability is that of the hazard materialising and the consequences are determined by exposure and vulnerability.



2 Poverty risks and dynamics in Ethiopia

Ethiopia's poverty indicators show substantial improvement in income, consumption, and broader standards of living over the past 15 years. The internationally comparable income poverty line of $1.25 per person/day has declined from 44% to 30% since 2000.[1] The Ethiopian national poverty line of 3781 Birr, defined by the income needed to cover a bundle of good defined by the value of 2200 kcal per person/day plus essential non-food expenditure, halved in a little over a decade from 44.2% in 2000 to 22% in 2013.[5]

Other poverty indicators tell a different story, reflecting that this progress remains vulnerable. The multi-dimensional poverty index (MPI) includes measures of education, health and living standards. Ethiopia has doubled the percentage of the population with electricity and piped water, and made great reductions in the proportion without education. However, these measures are still low. Only 23% of the population had electricity in 2011. The measure of MPI poverty remains at 87.3% of the population, reflecting the importance of continued investment to ensure the rapid progression with income and growth is sustained through non-monetary advances[1], such as in education, health and access to water and sanitation. These advances are necessary to support sustained poverty reduction.

Subjective measures of welfare often capture aspects of poverty which are not present in poverty

Poverty and welfare

Poverty is a condition of multiple deprivations for vulnerable individuals, households and communities, varying over space and time. Understanding the dynamic nature of poverty has generated an extensive portfolio of metrics and methodologies. Who defines poverty and how poverty is measured influences action and outcomes. Making effective decisions can be challenging if measuring what we value is disputed or disregarded in favour of valuing what we can measure. If measurements are infrequent or inaccurate policy will be less certain in reducing poverty. Poverty is commonly measured in four ways:

- Income poverty, for example the global estimate of USD1.90 per person per day at 2011 purchasing power parity (PPP);
- Consumption poverty in terms of the cost of basic needs such as food, energy, clothing or shelter;
- Multidimensional welfare, which recognises health, education, assets and other social deprivations; i.e. Multidimensional Poverty Index (MPI)
- Subjective welfare which prioritises how people self-assess their individual or household welfare.

measures. The Welfare Monitoring Survey (WMS) contrasts with the income and consumption poverty measures as over half of Ethiopians felt themselves to be worse off than one year ago[1]. Measures such as the WMS highlight where poverty metrics need improvement in order to capture further measures of well-being. Livelihoods, health and well-being depend on skills, knowledge and physical ability of individuals; as these are shaped by multi-dimensional factors, such as education and nutrition, capturing these indicators highlights the risk to human development and livelihood security.

These poverty measures do not capture the reality of the disparities and variations in poverty. Household-level poverty indicators, such as the MPI, fail to reveal the disparity of poverty at the intra-household scale, such as between children and adults, or between women and men, indicating that we do not have a clear understanding of who the poor are. For example, more Ethiopian children are poor than adults due to unequal sharing of money and food within a household, or deprivation of education caused by children engaging in household chores or work.1 Most children in a multi-site study of Ethiopia were not able to access nutritionally balanced diets which included meat, dairy and vegetables.[6] Children who do not have their basic needs met are at risk of leading more 'insecure' lives and being trapped into poverty as adults.[7]

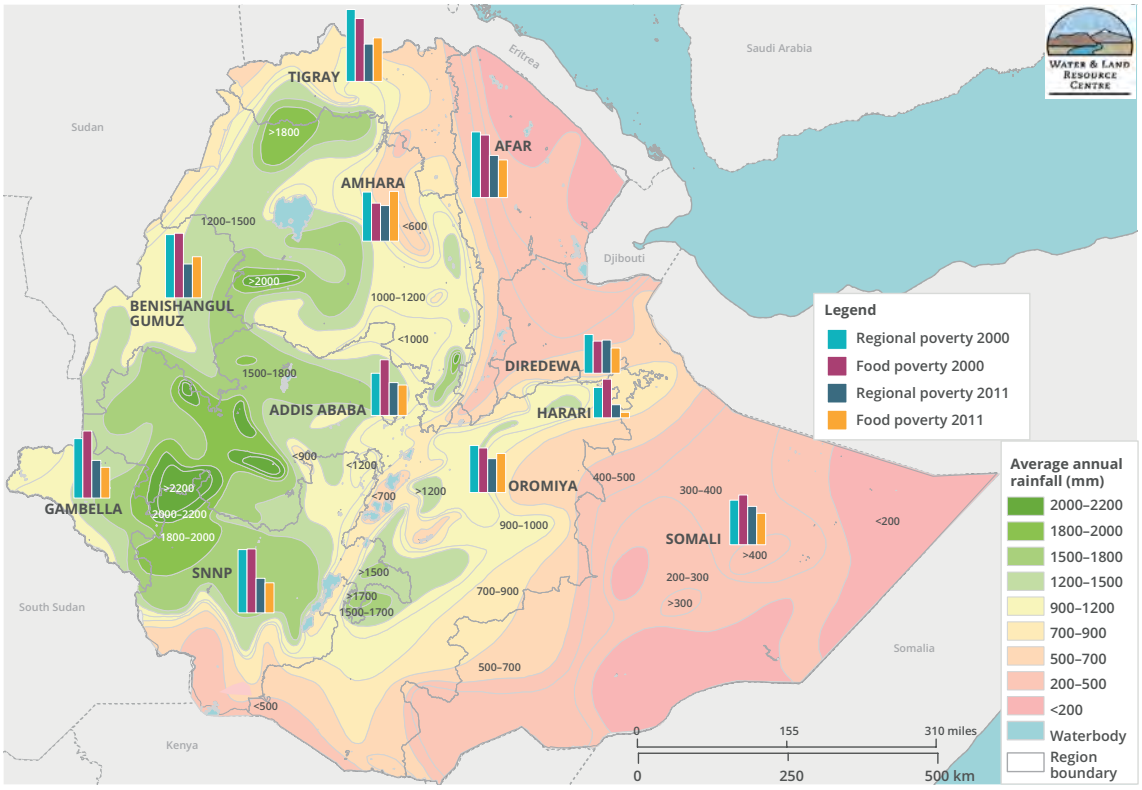
Figure 1: Ethiopia has made sustained progress in reducing poverty in past 15 years, over a period of high population growth (top two panels). Strong improvements in access to water and sanitation have been made, resulting in Ethiopia meeting the Millennium Development Goal for water in 2015 (lower two panels).



Poverty and welfare metrics are commonly focused on a national snapshot and fail to capture changes over specific timescales and areas that are relevant for water-related risks. In Ethiopia, chronic poverty is related to factors which stay constant over time, such as lack of assets, lack of access to education and water and sanitation.[8] Other groups may transition into poverty as a result of one or more shock events occurring at a particular time. In Ethiopia, drought is one such shock known to push households into poverty.[8] These poverty dynamics over time show that households may move through transitions between poverty (below the poverty line) and 'non-poverty' which is only just above the poverty line.[9] In Ethiopia, despite the progress in reducing the population living below the income poverty line, there are a great number of people still who are very vulnerable to these shocks.

Regional disparities exist, although they have been reduced with the recent development progress, as shown in Figure 2. Poverty, and responses to poverty, also varies between urban and rural areas. Poverty has increased in urban areas with 14% of Ethiopia's poor living in cities in 2011, rising from 11% in 2000, and greater disparities between different groups of which the elderly, disabled and female headed households fare worse.[1] Urban poverty is much more closely linked to lack of employment and addressed through subsidies, whereas rural poverty is linked to low agricultural productivity and addressed through cash transfers. These cash transfers may mask poverty levels in some regions. The reliance on subsistence agriculture means malnutrition is greater among rural children than urban,[10] but the urban poor are more vulnerable to food price rises. The location of the affected people might determine the level to which they are at risk.

Figure 2: While Ethiopia has large variation in the annual average rainfall between regions, poverty inequalities between regions have been decreased. Income poverty has reduced in all regions between 2000 and 2011; Food poverty has decreased in all regions except in Amhara, one of the main agricultural areas.



The Productivity Safety Net Programme (PSNP) has been successful at reducing vulnerability of the poor to these shocks, but not reducing exposure to hazards such as droughts.[11] The impact of droughts, such as are currently occurring in many areas of Ethiopia, increases the need for food aid for millions of people while reducing food production and GDP, placing a lot of strain on the safety net system. These social safety nets need to be supported by targeted programmes to reduce the exposure of the poor to shocks, to support the strategic pillar in the GTP II of accelerating human development and to ensure its sustainability. National poverty metrics do not provide the necessary data to target programmes to reduce exposure as they do not provide information on how poverty varies seasonally or with specific shocks; more detailed data sets are required for this. REACH's risk-based framework can be used to understand poverty dynamics and the role that water-related risks and water security interventions play in influencing poverty outcomes and sustaining growth.

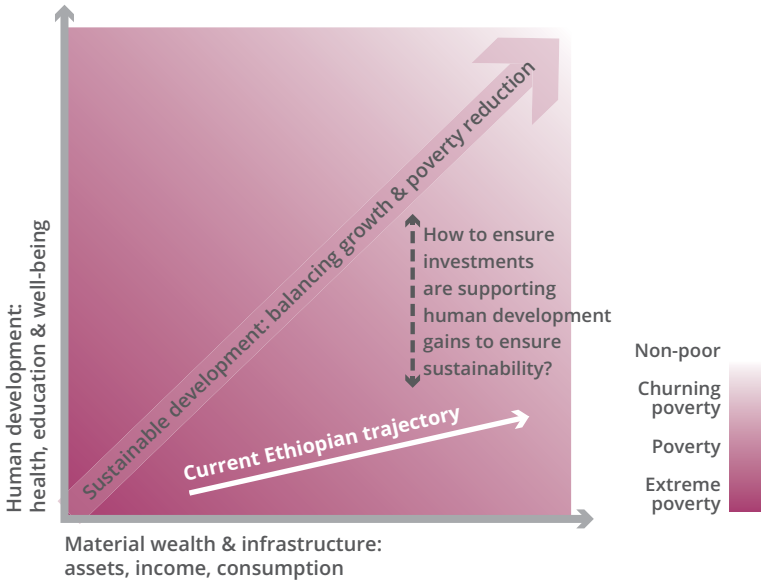


Figure 3: This figure highlights that reductions in poverty require a combination of gains in assets, income and infrastructure, and improvements in education, health and wellbeing to be sustainable. Water security influences and is influenced by both material aspects and human development aspects. The progress in Ethiopia has addressed the material aspects well, as shown by the reductions in consumption poverty, but more work is needed to increase the sustainability in these gains as evidenced by the continuing high level of MPI poverty and the fragility of this progress to rainfall variability.

3 Water security risks to growth and transformation

The Ethiopian economy has also been vulnerable to water related shocks. GDP has been closely linked to climate variability (Figure 4). Ethiopia's reliance on annual rainfall is largely due to remaining a largely rural, agricultural-based society with 82% of the population living in rural areas.[12] Agriculture is the main livelihood, with 78% of households having at least one member engaged in agriculture in 2011, contributing to 42% of Ethiopia's GDP and a significant portion of its exports.[1] Increasing water security at a national, local and household level is necessary to support Ethiopia's continuing growth and poverty reduction efforts.

The agricultural sector is dominated by small-scale famers, cultivating less than two hectares per household accounting for approximately 95% of the country's agricultural output .[13] Historically, rainfall variability and droughts have been major causes of crop failure, mass livestock deaths, and water and food shortage in Ethiopia.[14] A 10% increase in crop loss has been linked to a 3% fall in consumption among drought-prone households.[15] Most poor people rely on subsistence, rain-fed agriculture as their main source of income and nutrition, meaning that rainfall variability is a strong factor which might push small scale farmers into, or further into, poverty or into a pattern of churning poverty.[15]

This variability poses an immediate threat to Ethiopia's remarkable growth and poverty reduction gains. The World Bank predicts that a drought as severe as 2002, when 13.2 million people were affected, could increase the poverty rate from 30% to 52%.[1]

Ethiopia has two main rainy seasons, *belg* (spring) and *kiremt* (summer). In 2015, the failed belg rains has been compounded by El Niño weather conditions weakening the kiremt rains. As the kiremt harvest feeds 80 to 85% of the country, food insecurity and shortages have tested Ethiopia's self-reliance. Currently, an estimated 8.2 million people need food assistance, and 53,400 people have been displaced in the past four months by the drought.[16]

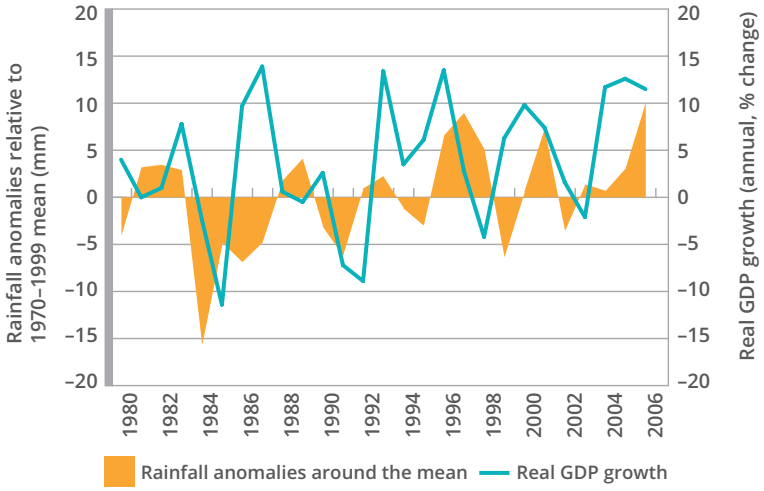


Figure 4: Annual rainfall and GDP growth for Ethiopia between 1980 and 2006 showing how Ethiopia's GDP is tied to rainfall. From 2006 onwards (not shown in the figure) Ethiopia has experienced above average rainfall and a steady rate of GDP growth of around 10%. As of 2015, Ethiopia has entered a drought period.

The impacts of hydrological variability and extremes may be compounded by climate change. Climate projections for rainfall suggest that total annual rainfall over Ethiopia is likely to increase; however, climate change may also bring about an increase in inter-annual variability, risk of multi-year droughts and shifts in seasonality.[17]

This hydrological variability is a defining challenge to Ethiopia's poverty reduction and sustained growth ambitions. A closer look at water-related risks in Ethiopia highlights other dimensions of water insecurity related to inadequate water supply and sanitation, leading to health problems and a large time burden in urban and rural populations to access water supplies, and land degradation, which reduces agricultural incomes and leads to poor nutrition. These water-related risks interact with poverty reduction and growth strategies to push people back into the poverty cycle (Figure 5). Therefore, policy needs to address these multiple dimensions of water security to ensure programmes are effective.

Within water security and poverty interrelations, there are three major areas where water insecurity challenges poverty reduction and economic growth and transformation in Ethiopia:

1. **Water-related risk to growth**: When economic activities do not harness water's productive potential and are not protected against water's destructive impacts, water challenges growth and acts as a drag on the economy. For instance in the Awash basin, fragmented water management institutions and lack of water security investments threaten productivity and poverty reduction goals.

2. **A fragile environment**: Soil erosion is causing problems for both wider growth of agriculture and infrastructure, as well as increasing risks to poverty reduction efforts aimed at both agricultural livelihoods and water supply.

3. **Sustaining human development**: Fragile environments and fragmentation of water policies intersect to create specific risk factors to the poor. Degradation of water resources and infrastructure due to over-abstraction, pollution and sediment threaten drinking water access and water for livelihoods. The rapid progress in WASH access has been indicative of the potential for Ethiopia to meet the universal action plan, but threats from wider water insecurity need to be addressed for its gains to be sustainable.

REACH's approach draws on a substantial body of research around risk and multi-dimensional water security to understand how water-related risks interact to influence growth and poverty reduction outcomes. Water security issues, such as land management and domestic water supply, need to be considered as inter-related with each other in order to drive sustainable growth and poverty reduction.

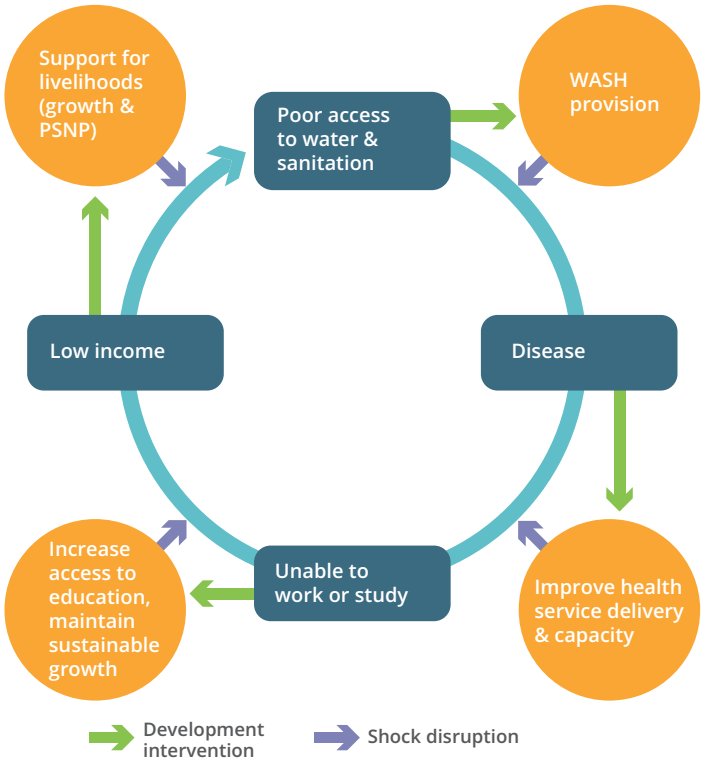


Figure 5: shows how water-related risks (purple arrows) discussed below threaten current policy initiatives' poverty reduction progress (green arrows). This risk is either to perpetuating the poverty cycle or undermining current policy efforts to reduce vulnerability.

3.1 Management of water-related risks to growth

The difficulty of managing water resources to support industrial and agricultural growth, as well as the urgent and growing demand for domestic water supply, presents an institutional challenge to Ethiopia's growth trajectory. The improvements to industry and agricultural production in Ethiopia need to be balanced with competing domestic water quantity and quality. One key example of these challenges is in the Awash River basin in central Ethiopia, where water demands are the highest in the country and where there is strong competition for surface and groundwater resources for multiple users. About 10.5 million people depend on the Awash basin's surface and ground water resources for a diverse range of uses from hydropower generation at the Koka dam, large-scale irrigated agriculture, pastoralism, industrial water use and drinking water for major urban areas.

Groundwater management in the basin is a key resource management challenge. The GTP-I and GTP-II have focussed on additional groundwater for household irrigation as the primary means of enhancing household food security. The aim is to reduce vulnerability to climate variability and enable multiple crops to be grown throughout the year, supporting agricultural transformation. As well as long-term spring discharge decline,[18] Ethiopia faces more immediate alterations to regional groundwater recharge from changing climate and rainfall patterns, and land use activities affecting soil infiltration, runoff and hydrological regimes.

Groundwater policy more broadly has focussed on drinking water supply. Groundwater makes up 60% of water supply for Addis Ababa and 100% for the major urban areas of Mekelle, Bahir Dar, Harar and Diredawa. 70% of the rural population relies on groundwater from springs and wells. Groundwater is also an important source of water for livestock, especially in pastoralist areas. Recently, groundwater development has expanded to include agriculture and industry. The land available for groundwater irrigation in the highlands surrounding Addis Ababa is under-utilised by a factor of [10,19] with similar ratios reported for two-thirds of the country.

Without sustainable management of groundwater, there is the potential for depletion to present a water-related risk to growth for the industries that rely on it; human development is also put at risk as depletion can interrupt water supplies for drinking water and livelihoods. An example is where groundwater near Harar has been exploited for cash crop production (chat and vegetables). This has reduced dependence on rain-fed agriculture, thereby reducing vulnerability of agricultural production to climatic variability. This groundwater abstraction, in addition to abstraction for industrial use, and urban and rural water supply, caused the water table to decline by up to 15 meters,[20] leading to the drying of Lake Alamaya. Harar's water supply had to shift to a more expensive and energy intensive groundwater source, 75 km away and 1,000 meters lower in elevation.

Groundwater development also has consequences for water quality. Expansion of irrigated farming practices at Metahara, Abadir and Fentale has caused the expansion of the hypersaline lake Beseka with saline water from this previously closed lake now polluting the Awash River and impacting on local groundwater quality. Due to natural reasons 35% of groundwater is not of suitable quality for irrigation or drinking water use. Natural fluoride contamination poses significant health risks in the Awash and the Afar region where groundwater is used both for new agricultural irrigation schemes and community drinking water.[21]

Pollution of water sources is increasing costs of supplying, treating and distributing water, with impacts for low income households.[21] In some areas, new water sources have had to be exploited. Those unable to pay have no other option but to use the polluted water for drinking, cooking and bathing. In Adama, a town with 350,000 residents in the Awash basin, 70% of operation costs for municipal drinking water are for removal of pollutants and sediments coming from upstream industrial and urbanisation activities.[21] In Ziway, a town of 50,000 residents, pollution from industries and irrigation return water from small-scale groundwater irrigation water users led to decline in the lake water level and pollution of the lake; the urban water utility was obliged to shift from lake water to a spring water source some 40 km from the town. The scale of impact on the poor is yet to be assessed. As in many places, such as Ziway, there are no major water users from whom to recover costs using progressive tariff structures, so that the increased utility cost means higher charges for the poor. This leads to insufficient cost recovery

which results in both a vicious cycle of unsustainable service and inequitable access. This could result in a cycle in which high costs are passed onto consumers, which may act as a barrier to poorer users.

These water security issues highlight a key gap in identifying water security interventions to balance the water quantity and water quality needs of the expanding industrial sector, increasing agricultural needs and growing domestic demand with sustainable supply to support a climate-resilient economy.

3.2 A fragile environment

Agriculture is a vital part of the economy in Ethiopia, and a source of low-middle income livelihoods. Land degradation reduces agricultural productivity with soil erosion a well-documented concern in the Ethiopian highlands.[22,23] Soil erosion increases vulnerability of small-scale farmers and the wider goals of national growth and transformation. It has a big impact on water security, and the costs of sustaining water security, through impacts on large and small dams, and irrigation and drinking water infrastructure. Erosion has been attributed to deforestation, field ploughing and livestock grazing.[23] Increased pressure on arable land has been influenced by population and agricultural growth.[24] Average soil erosion rates on croplands at a national level are estimated to be 42 tonnes/ha annually,[25] while up to 300 tonnes/ha has been recorded in high risk areas. Such extreme erosion rates have been recorded at the Anjeni Observatory (located in the currently highly productive north-western agricultural region of Ethiopia) where the long term maximum on cultivated lands (1985-2012) is around 225-263 tons/ha annually; the minimum varies between 39.6 and 1.9 tons/ha annually on test plots with varying slope under traditional management practices.[26] Consequential reductions in agricultural GDP have been estimated to range from 2% to 6.7%.[22]

Sedimentation is reducing the effectiveness of infrastructure designed to increase water security. Reservoirs for drinking water and irrigation are losing capacity at a rapid rate: Addis Ababa's main water supply reservoir has reduced by 2.1 million m^3 between 1979 and 2010; the Angereb dam which supplies Gondar's drinking water has had its capacity halved since it was built in 1976; hydropower generation will be reduced at the Koka hydropower dam; and the Borkena II irrigation dam fully silted up in only two years.[24]

At a smaller scale, similar impacts are seen on agricultural micro-dams, which are used to reduce rainfall dependence for crops and associated food insecurity in rural communities. For example, in Tigray, the regional government proposed to construct 500 micro-dams in 1995.[27] Sedimentation threatens the sustainability of these micro-dams by reducing their water-storage capacity and ability to provide agricultural water through periods of drought or delayed rains, thereby placing the surrounding communities at risk.

Sedimentation also increases the operating costs and impacts the operations of drinking water infrastructure. In Metehara (population of 45000), which draws its water from the Awash river, high turbidity levels have caused the water treatment plants to close or face additional costs for water supplies for treatment, increasing the direct production cost.[28] Nearby irrigation schemes are also facing reduced efficiency due to sedimentation, an issue which has transboundary implications, with an estimated 140 million tons[29] of sediment per year carried by the Abbay River from Ethiopia to Sudan resulting in silting up of Sudanese water storage structures and compromising their irrigated agriculture and power generation potential and causing increased costs in terms of dredging.[30]

3.3 Household water security for human development

Household water security refers to more than just drinking water, encompassing water and functioning ecosystems services for livelihoods, basic sanitation, and freedom impacts of from water-related shocks. A lack of household water security is a risk to human development and poverty reduction in three ways: to health, education and livelihoods. In the GTP II, there is a plan to accelerate progress in human development and to ensure its sustainability. Fragile environments and fragmentation of water policies, resulting in degradation of water resources and infrastructure, intersect to create specific risk factors to the poor and their household water security.

Ethiopia has experienced rapid progress in WASH access, which is indicative of the efforts and commitment of Ethiopia to-date as well as its potential to meet its ambitious targets. Gains in access to improved drinking water and sanitation facilities, and reductions in open defaecation, have corresponded to reductions in childhood stunting. However, ensuring water security in the household requires not just increasing access but ensuring sustainability of access.

Despite high functionality of water sources, threats to health and livelihoods are posed by the distances of poor communities from water sources. The time required to collect water in Ethiopia remains high: 17% of the urban population still travel over one hour; in rural areas 44% travel more than one hour, and of those a third travel more than 2.5 hours to collect water. This burden falls disproportionately on women who are solely responsible for collecting water in 70% of urban households and 81% of rural households.[31] With these time demands it is not surprising that per capita water use in Ethiopia is low. In rural highland areas of Ethiopia, per capita day water use for hygiene is estimated at less than 3 litres per capita per day (lpcd) in the dry season, and only a litre more in the wet season, with water use increasing with wealth.[32] This is well below the recommended water use for hygiene requirements in emergencies of 6 lpcd. Estimates for water use for drinking and cooking in the midland zone range from 5 to 10 lpcd in the dry season.

Water insecurity creates significant threats to sustainable human development, in particular to health and livelihoods. For health, diseases resulting from inadequate WASH, or from water resources developments, have implications for human development. Lack of access to adequate WASH is associated with higher rates of diarrhoea[33] and to stunting.[34] For livelihoods, the burden of water collection leads to time poverty which is strongly linked to income poverty as it reduces the time spent in productive, income-generating activities;[35] and the loss of ecosystems results in loss of water and forage for pastoralists communities.

Sustainable human development, poverty reduction that addresses education, health and livelihoods, which enables people to develop resilience to shocks, requires household water security. These relationships form the link between poverty, growth and water security, at the household, regional and national scale. These relationships are complex as they vary across the agro-ecological zones, and between urban and rural areas, making them difficult to understand through national poverty data. Hydrological variability increases the complexity of these relationships, making them difficult to track without dedicated water security

Water insecurity for children and young girls

Inadequate WASH access interrupts children's biological and intellectual development;[34] in turn, this reduction reduces the resources available to them over the course of their life for healthy, productive livelihoods.[36] Poor WASH has significant implications for stunting, malnutrition and educational development.[34] Further to malnutrition, drought and flooding create and amplify poor WASH access. The resultant decrease in access to water of an acceptable quality and quantity for human health, coupled with reduced access to crucial sanitation facilities may result in changes to educational attainment and attendance. For example, drought and precipitation deficiency result in children being removed removal from school and placed in paid employment or in domestic duties such as water collection.[37]

Many Ethiopian girls leave schooling after menstruation due to inadequate sanitation, coupled with poor privacy and lack of water for hygiene practices.[38] As menarche is viewed as sexual maturation, and even activity, in Ethiopia, it represents the beginning of eligibility for marriage.[38] In this case, inadequate WASH services increase the risk of child marriage due to poor menstrual hygiene management. Early marriage usually results in earlier pregnancies; consequently, adolescent women and new-borns are at risk of increased maternal and perinatal mortality respectively.

assessments. This complexity also increases the challenge for addressing the water security to reduce poverty and increase growth. Understanding the regional distribution of poverty in relation to land use and hydrological variability, as well as the poverty dynamics and risks, is important to ensure sustainable provision of drinking water. However it is also important to understand how poverty dynamics and risks relate to water security changes on a short-term and local level.



Photo: UNICEF Ethiopia-Lemma

4 A risk-based focus for water security research

Water insecurity threatens Ethiopia's growth potential and poverty reduction efforts highlight the urgent need to design and appraise alternative water security interventions. For REACH research to inform the design and appraisal of these interventions, water security must be addressed considering the high degree of uncertainty and interlinkages surrounding hydrological, institutional, poverty and economic conditions. In order to reduce poverty, create opportunities and promote sustainable growth, it is crucial to understand water security dynamics. This understanding provides the basis for targeting effective water security investments under uncertainty. A risk-based approach to water security focuses the attention on incorporating the uncertainty surrounding water and poverty dynamics and provides a framework to appraise alternative interventions based on their ability to cost-effectively reduce water-related risks and achieve proposed targets. This focus allows government and donors to transparently assess the level of investment required to achieve a level of water-related risks which is acceptable to society and which does not compromise growth or increase poverty.

This section outlines key areas, shown in Figure 6, for risk-based water security research to support Ethiopia's continuing growth and development. To understand water security and poverty dynamics and inform policy, REACH adopts a place-based approach to research using the concept of a Water Security Observatory. An observatory is a long-term, instrumented and interdisciplinary research location where significant but uncertain trajectories of change are predicted to emerge. Observatories will attempt to harness established research sites and data streams to maximise the research's potential outputs. They will enable the synthesis and interrogation of the challenges and trade-offs for achieving water security for the poor at different scales, leading to in-depth and longitudinal understanding of the challenges within the observatory. The Observatories that REACH will use to address this multiple water security and poverty challenges are outlined below.

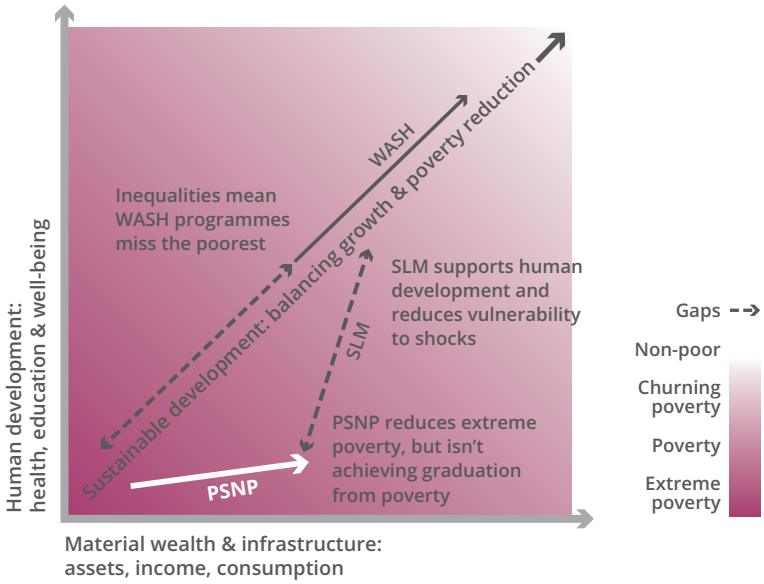
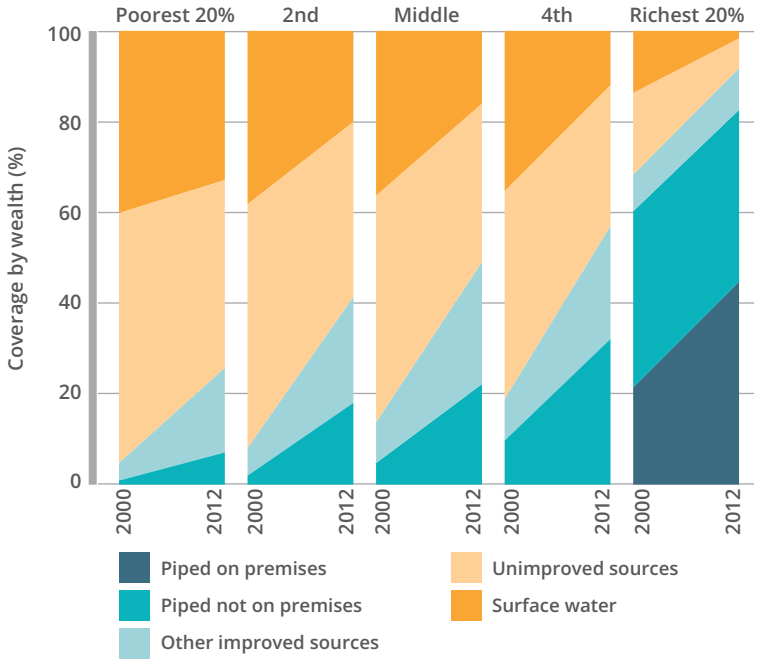


Figure 6: highlights some of the water-related risks to Ethiopia's sustainable growth. WASH services and SLM (Sustainable Land Management) have an important role in supporting sustainable development, balancing growth and poverty reduction, but requiring better targeting to help achieve these outcomes.

4.1 Inclusive WASH services

WASH interventions often miss the poorest. This inequality of access provides risk factors tending to entrench poverty among the most vulnerable.[39] Inequalities of access to 'improved' water services have persisted despite overall gains in water supply provision in Ethiopia.[40] As well as putting poverty reduction at risk, inequality also acts as a threat to growth. As part of Ethiopia's push to middle income status by 2025, it is setting ambitious targets for the next 5 years in the GTP II. Provisional targets for water services are to increase access to improved drinking water from 58% in 2015 to 83% in 2020. With the potential to reduce or amplify inequalities depending on implementation and service delivery, inclusive WASH services are crucial to sustaining and accelerating human development as part of Ethiopia's goal of achieving the status of middle-income country.

As in many countries, access for the poorest quintile lags behind that of the upper quintiles (Figure 7). This difference is less pronounced than in some countries, which may relate to the low Gini coefficient suggesting relatively little inequality of income.[1] However, the low rate of change in the lowest quintile highlights the risk of the poorest being left behind. A similar picture exists for sanitation.



Baseline data from UNICEF's small towns programme suggests that while the access might be present, the water service levels remain of a low standard.[41] Connection costs are commonly a barrier to household service provision for the poor. The cost of household connections for piped water is inaccessible for the poor, with connection costs in one study of 3800 Birr (approx. USD180),[42] nearly eight times the monthly minimum wage of 500 Birr.[41] The prohibitive costs of household connection push households towards public water points where the cost of water per litre can be over ten times the piped price. This pattern is reflected in the wealth disaggregated data (Figure 7) which shows piped water is only accessible to the wealthiest quintile.

The increased price of a water unit coupled with the increased distance to a source away from the household means that the poor consume smaller quantities of water at higher prices, while enduring a greater time burden for collection or depend on unprotected unsafe sources.[43] Pricing water above affordable thresholds might mean that households or individuals might have to trade-off between domestic water and other poverty reduction protections to meet costs, in turn increasing their vulnerability.[39] Baseline studies by UNICEF have found that households are willing to contribute to improved water supplies. However, a significant gap exists to understanding how willingness to pay varies with income, and the implications for cost recovery of the national One WASH programme. Universal access to water requires that these programmes extend to the poorest, to help break the cycle of disease, low educational attainment and low income that traps the poor.

Figure 7: Access to drinking water in Ethiopia between 2000 and 2012, disaggregated by wealth quintile.

Regional inequalities also exist due to the variability of environmental conditions. Pastoralists in the lowland regions, such as the Afar, have specific needs and uses of water, a particular hydrological landscape and a complex socio-cultural legacy.[44] The practice of herding creates specific vulnerabilities, and also a challenge in supplying water access. Many pastoralist communities rely on expensive water trucking to make up deficits in available water supplies, especially during drought; trucking costs about forty times per unit of water that of the planned water supply in Borana.[45]

These inequalities in water reinforce inequalities in human development, and promote inter-generational inequalities and chronic poverty, as stunting, low educational attainment and early marriage continue to make the poorest vulnerable to shocks. Understanding how inequalities in household water security affect the households' poverty or human development can help to target risk-based programmes to break the poverty cycle.

4.2 Fragmentation of WASH and water resources

Domestic water use is very low in many parts of Ethiopia and increasing water availability for water supply and hygiene has many potential benefits in reducing collection times and improving health. With GTP II, the Ethiopian Government has also set a provisional target to increase service levels, providing up to 100 litres per capita per day (lpcd) in urban areas and increasing water provision from 15 lcpd to 25 lpcd in rural areas, which will potentially contribute to improved hygiene and health gains. This increase in service levels is matched by ambitious developments in water resources for agricultural intensification and hydropower which are discussed below. Achieving these targets for water supply will require significant infrastructure development to reach these people and to sustain that infrastructure, but will also require large increases in the abstraction rates. The majority of the population rely on groundwater for drinking

Water Security Observatory: Small towns

Wukro and Maksegnit are two "small towns" that offer a unique opportunity to analyse the challenges to improved access to WASH. Wukro, in drought-prone highlands of Tigray, is a rapidly developing urban area where lack of sustainable water sources and services has the potential to act as a drag on growth. Maksegnit, in the moisture-reliable highlands in Amhara, has 29% of its population below the income poverty line. In both towns, access to adequate WASH is low. Poor service provision, coupled with low water availability, has resulted in the majority of households consuming less than 1000 m^3/month.[41] While households may have access, the water service levels remain of a low standard.[41] This is particularly pronounced for rural services, with Wukro's satellite towns' water services failing at least 3 of 5 indicators of quality, time, distance, quality and reliability. Similarly, Maksegnit showed similar low service standards and they also have over 30% of rural water supplies being classed as unimproved. There is a relationship between the wealth quintiles of Wukro and Maksegnit and the type of water supply used as the main water source within the towns.[46] Due to the low service levels, the wealthiest in these two towns still rely on water vendors.

However, things are changing. Wukro and Maksegnit and their satellite towns are benefitting from the One WASH Plus project, funded by DFID and implemented by UNICEF and Government of Ethiopia. New groundwater sources are being tapped, storage and distribution infrastructure are being upgraded and extended. These towns provide an initial opportunity to work alongside UNICEF during the implementation of the programme to understand how WASH programmes, and the funding models for them, need to adapt to reduce the increasing inequalities in access; there is the potential to expand to further towns in different environments over time. These towns will also be a focus for understanding the longer term implications of increasing groundwater abstractions and demand on infrastructure and water resources.

water, but there is a lack of understanding of groundwater availability to meet the increasing demands from the population, and how changes in surface water management to support growth will impact on groundwater based drinking water supplies.

The case of Wukro, in the Tigray region, highlights this disconnect between water supply and water availability. In Wukro (population 45,925 in 2014), an estimated 95% of households have piped water into their house or yard. Here rainfall is less than 650 mm per year, occurring over 3 months. Despite the high level of access, less than 50% of the urban population has access to 20 lpcd. Groundwater is the only water supply source for Wukro and the surrounding villages. Over the next 15 years, the increase in demand, with the increase in service norms, is expected to almost quadruple, requiring an additional 3,754 m^3 per day to be sourced, treated and distributed. Wukro is one of the eight towns that are benefitting from the One WASH Plus project, funded by DFID and implemented by UNICEF and Government of Ethiopia, including upgrading and expansion of the distribution network and additional boreholes and storage to meet the project increase in demand. Wukro supports a growing hotel industry aiming to develop as a conference venue which places additional needs on the water supplies in terms of quantity, quality and reliability.

The capacity of the groundwater systems to sustainably supply Wukro's needs into the future is poorly understood. Less is understood about how increased abstractions from the deep aquifer might impact local wells or on the environment, or how increasing other abstractions or changing land management practices might impact on Wukro's water supply. Understanding and mitigating the risks of failure for these expanding urban water supplies in times of drought or through competition for resources is necessary to both support growth and sustain human development.

4.3 Managing fragile environments

Sustainable land management has gained increasing attention as a tool to support agricultural productivity, and avoid the negative economic and livelihood impacts of land degradation and erosion. Ethiopia's sustainable land management strategic framework targets two different regions to promote growth and protect vulnerable environmental systems: high rainfall areas ('potential or food secure areas') by the Sustainable Land Management Programme (SLMP); and food insecure areas (mainly moisture stress areas) with the Public Works (PW) component of the Productivity Safety Net Programme (PSNP). This targeted management balances growth objectives in more productive areas whilst protecting the vulnerable by providing social safety nets. External evaluations of the PSNP have shown significant returns on investment; however, they concluded that PSNP has a larger impact when combined with access to services designed to improve agricultural productivity such as improved seeds, credit, and irrigation.[47]

PSNP has achieved impressive results for environmental protection, reducing soil erosion and water losses, stabilising hillsides and using landscape greening to protect communities from flooding. The safety net provided by cash transfers has also enabled changes in risk-avoidance behaviour of the poor, and reductions in negative coping strategies such as 'distress sale' of assets during shocks.[48] 60% of PSNP's public works sub-projects are in soil and water conservation which acts as a social protection for livelihoods. For example, small-scale irrigation developments have helped to buffer shocks and increase incomes by up to 25%.

The SLMP and the PSNP both aim to mitigate poverty and sustain growth. In the case of the PSNP, the aim is to provide a safety net which prevents the poor from going backwards. In the case of SLMP, the stabilisation of income and livelihoods as a result of the improvements to water security results in protecting the transitory poor, who occupy a precarious place just above the poverty line, from slipping into back below it. This also has benefits for growth through the protection of agriculture.

More than 7 million people have benefitted from PSNP.[49] However, this remains a small proportion of Ethiopia's population. Despite all that has been achieved in reducing poverty and improving sustainable land management, approximately a third of the population were considered food insecure in 2011, and graduation from the PSNP programme has been limited; over 8 million people are currently receiving food assistance due to the drought. Soil and water conservation structures are estimated to

be present on only 18% of the country's cropland, while 77% of cropland is on steep slopes of greater than 8%.[24] Hurni et al. highlighted that in many areas soil conservation measures will require subsidies to make them affordable.[24]

Sustainable land management practices improve water security for the poor, increasing infiltration, raising groundwater levels, thereby enhancing spring yields and increasing stream base-flows with the result that, in several communities, springs now last longer into the dry season. There are significant challenges to scaling up sustainable land management in Ethiopia to reduce the vulnerability of the poor to shocks and decrease sedimentation which threatens growth and infrastructure. Using a water security lens enables a risk-based focus that encompasses the hazards posed at these different scales.

4.4 Sustaining growth

For Ethiopia to be successful in achieving its proposed rise to middle-income status there is a need to balance growth objectives with preventing resource depletion or degradation, which is vital considering the consequences for the poor who rely on their immediately surrounding resources for their livelihood and wellbeing. GTP II retains the impetus of irrigation development found in GTP I. Modern implementation of small-scale irrigation

Water Security Observatory: Fragile environments

In 2012, WLRC established six Learning Watersheds (ranging from 220 hectares to 900 hectares) in the Central and North-eastern parts of Ethiopia. The goal was to pilot sustainable land and water management with full participation of communities, extension, researchers and policy makers. In the past three years, rapid rehabilitation of degraded landscapes has been achieved with positive impacts on biophysical and socio-economic aspects: base flow in streams increased and extended through the dry season; biomass production increased; water supplies from shallow hand dug wells are more sustainable; and soil loss was reduced by up to 80%.[26,50]

These established and instrumented research sites, and their counterpart control watersheds, offer an opportunity to study the complex relationships between poverty dynamics and water security, from both natural science and social science perspectives. Over a period of years this can give a broader understanding of how poverty changes in small scale agriculture in the highlands of Ethiopia and the influence SLM and poverty can have on the water and sediment balance within the Abbay basin.





is expected to expand from 1.3 million ha to 1.7 million ha while medium and large-scale irrigation is planned to increase from 0.66 to 0.95 million ha. Expanding small-scale irrigation provides increased agricultural and water security for communities and when designed and implemented correctly, offers enhanced economic benefit from the surrounding environment. Private sector development of medium and large scale irrigation schemes are encouraged to strengthen the economy and reduce Ethiopia's vulnerability to drought.

Investment and policies designed to improve water security have the potential to facilitate economic growth and have a positive impact on livelihoods. These investments benefit communities by providing reliable and adequate water supply and services for a diverse range of water users and by protecting communities and assets from harmful water-related risks (e.g. waterborne diseases). At a macro level, recent work[51] has also shown how lack of investment in water security (including WASH) can act as a drag on economic growth.

In Ethiopia, prioritisation of investments in water security is typically based on appraisals of the number of inhabitants and economic activities within a given administrative unit which will benefit from the proposed investments. This approach to water security investment and policy design generally overlooks distributional aspects of water-related investments and fails to consider the role that uncertain hydrologic and socio-economic characteristics have in influencing outcomes of the proposed policies.

REACH's work in Ethiopia develops a different approach to water security investments based on risk prioritisation. In the risk-based framework, exposure and vulnerability are considered when appraising and prioritising investment decisions, meaning that interventions are not only prioritised in terms of the number of inhabitants benefited, but also in terms of the water-related hazards that these inhabitants experience at present and in the future (e.g., hazards related to lack of aquifer recharge), their ability to cope with these water-related risks

Water Security Observatory: Sustaining growth

The Awash basin is an example of a large-scale observatory where a difficult hydrology influences economic activities and limits the potential for economic growth. Understanding how water insecurity acts as a drag on socio-economic activities in the Awash basin can help the Ethiopian government prioritise interventions that harness water's productive potential and can protect already existing activities from water's destructive impacts. Drawing on a substantial body of research and expertise at the University of Oxford concerning the impacts of water security on economic growth, REACH will initially develop a methodology to assess the economic impacts of hydrological variability in the Awash basin and then appraise alternative interventions based on their ability to mitigate these impacts.

The basin-wide analysis will provide the opportunity to demonstrate that growth without adequate provision of water services and protection from water-related risks will leave economic activities exposed to the destructive impacts of water. Lack of interventions in water security results in regular economic and livelihood losses due to inadequate water supply and sanitation and water-related disasters. This research will explore development opportunities associated with water security interventions and improved water resources management in the Awash basin, particularly focusing on the growth and well-being opportunities linked to reliable and adequate water resources.

A basin-wide observatory will help REACH research in charting a water security pathway for the Awash basin, appraise different combination and sequences of interventions and lay the foundation for informed water resources management in the future. This methodology can then be scaled up to address national water security challenges.

(e.g., vulnerability due to low incomes and lack absence of savings) and their exposure to hazards.

A risk-based approach to water security refines investment and policy design by combining considerations of population density with aspects related to the vulnerability and exposure of the communities to inherent hydrological variability, harmful water quality, lack of access to reliable drinking water supply sources (e.g., aquifers) and other factors. Application of the risk-based framework to WASH related investments would weight the population density in different areas of the country with the water security risk profile for each area. This approach seeks to achieve the greatest improvement in water security for a given dollar spent, thus going from a resource allocation mechanism based on number of inhabitants to a mechanism based on the inhabitants' exposure to and ability to cope with water-related risks.

Water-related risk is different in different parts of the country and so are communities' vulnerability and exposure characteristics, which depend on a range of socio-economic factors including income, gender, and disability. The heterogeneity of the water security conditions implies that investments based on purely demographic considerations may not successfully manage the risks associated with water and, more importantly, may not leverage the opportunities associated with successful water security interventions. Investments in areas with a high population density but with low vulnerability (e.g., people may have diversified incomes) and low water-related hazards (e.g., aquifers may readily recharge) may not be beneficial in achieving water security for the poor. This may not be the best use of that resource, diverting resources away from communities where investments have the greatest potential to harness water's contribution to growth and well-being.

There is a range of inequalities and heterogeneities around water security (different climatic zones, economic, social status, gender and disability) which influence the success of water security investments. A water security investment's success cannot only be measured by counting the number of individuals benefited, but it also has to account for the reduction in water-related risk and the contribution to growth that the investment achieves. Incorporating risk-based concepts in current government policy designs has the potential to better target resources to areas where: (i) water-related risks are higher, (ii) communities are more exposed and less able to cope (iii) there is greatest potential for investments to leverage water security for growth and well-being.

5 Conclusion

Understanding the nexus of water security challenges to Ethiopia's growth and poverty reduction efforts is vital in realising Ethiopia's drive to middle income status by 2025. This intersection of risks provides an explanation for some of the poverty and sustainable growth dynamics, and how they relate to certain water security challenges.

The intersection of fragile environments, fragmentation of WASH and water resources management, and risks to Ethiopia's current economic progress creates significant challenges to poverty reduction efforts. If economic activities are not able to harness the productive potential of water and manage growth objectives with wider human development and sustainability aims, then growth and poverty reduction progress may falter.

Ethiopia's commitment and drive to bring people out of poverty forms the basis of our partnership in Ethiopia between Oxford, MOWIE, UNICEF and WLRC enabling the REACH programme to develop a strong science-practitioner partnership to support development of water security outcomes that specifically meet the needs of the poor. Through MOWIE, REACH has the opportunity to facilitate innovative evidence-based policy to enable better decision-making and more targeted interventions. Through UNICEF, REACH's demand-led research can support UNICEF's work to develop sustainable and inclusive services in small-towns. The collaboration between WLRC and Oxford builds on scientific expertise across the institutions to further water security science in the context of Ethiopia's push to middle income status.

The second phase of Ethiopia's Growth and Transformation Plan, as well as global poverty reduction initiatives, are driving this demand-led research programme to deliver outcomes to support the wave of growth in Ethiopia, and the delivery of improved water security for the poor. This approach creates an enabling environment for practitioners and government to protect Ethiopia's growth and transformation, whilst also having regional implications in Sub-Saharan Africa.

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REACH Improving water security for the poor

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