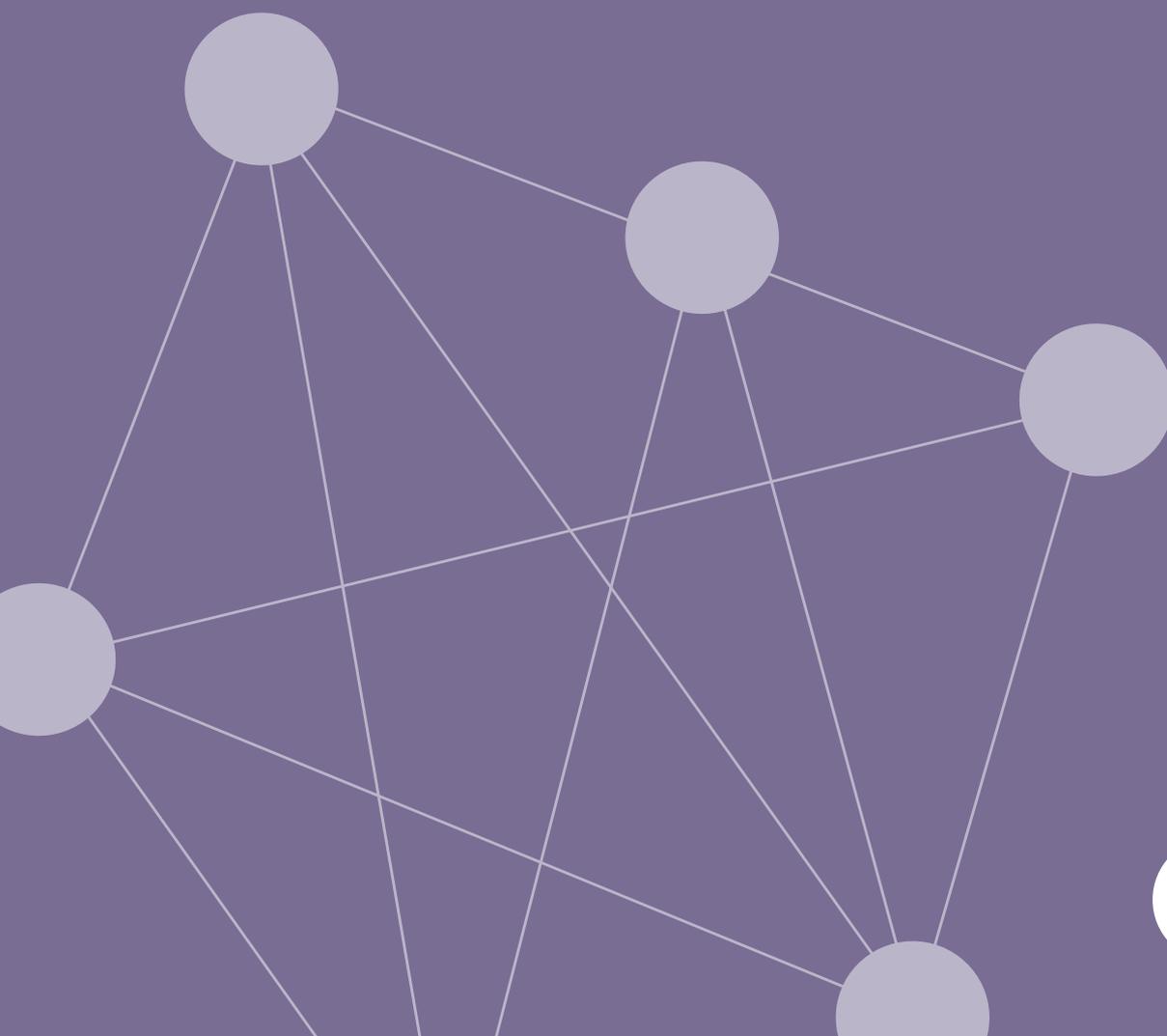


Gender, agriculture and water insecurity



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Insights project introduction

ODI Insights is a series of research papers, policy briefings and outreach activities that address urgent and unresolved development priorities and challenges. As well as reaching new audiences, the aim of Insights is to ensure that ODI's high-quality research and analysis influences policy debates, providing innovative practical solutions to existing and emerging problems.

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Acronyms

AWM	Agricultural water management
DFID	Department for International Development
DRC	Democratic Republic of Congo
PSNP	Productive Safety Net Programme
FAO	Food and Agriculture Organization of the UN
GDP	Gross domestic product
GTP	Growth and Transformation Plan
IFAD	International Fund for Agricultural Development
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JMP	Joint Monitoring Programme
MDG	Millennium Development Goal
MoIWD	Ministry of Irrigation and Water Development
MUS	Multiple use services
NGO	Non-governmental organisation
ODI	Overseas Development Institute
OWNP	One WASH National Programme
PSNP	Productive Safety Net Programme
RIGA	Rural Income Generating Activities database
RiPPLE	Research Inspired Policy and Practice Learning in Ethiopia and the Nile Region
RPP	Rural Poverty Portal
SNNPR	Southern Nations, Nationalities, and Peoples' Region
SSA	sub-Saharan Africa
SDG	Sustainable Development Goal
UAP	Universal Access Plan
UNICEF	UN Children's Emergency Fund
UNOCHA	UN Office for the Coordination of Humanitarian Affairs
USAID	United States Agency for International Development
VSL	Village savings and loans
WASH	Water supply for the home, sanitation and hygiene
WAC	Water users' committee
WAU	Water users' association
WELs	Water, Economy and Livelihoods
WFP	World Food Programme
WSSCC	Water Supply and Sanitation Collaborative Council
WHO	World Health Organization
WWAP	World Water Assessment Programme

1. Introduction

We will not achieve the Sustainable Development Goals (SDGs) for sustainable agriculture (SDG 2) and sustainable water management (SDG 6) without supporting the agency of rural female farmers. And yet, this group is often marginalised and particularly vulnerable to current and future climate variability and water insecurity.

The El Niño phenomenon in 2015-2016 had devastating impacts on countries in Africa that primarily rely on agriculture. In the Horn of Africa, up to 15 million people required food aid in early 2016 as a result of failed spring rains compounded by El Niño weather conditions (UNOCHA, 2016a). In Southern Africa, El Niño droughts have affected up to 40 million people, mostly poor rural populations who rely on rainfed production and subsistence livelihoods (WFP, 2016). The impacts of climate shocks are worse for the poorest, who often bear a disproportionate share of the costs (Scheierling et al., 2014:4). Drought, loss of livestock, and failed or ruined harvests push poor households into food stress and emergency coping strategies, such as reducing household assets, removing children from school, and temporarily or permanently migrating (Jones et al., 2010). Improved water security is central to improving people's resilience to climate variability and extreme weather events (Sadoff et al., 2015).

A growing body of academic and grey literature also addresses the role of water security in development (Mason and Calow, 2012; Grey and Sadoff, 2007) and the effects of water scarcity on agriculture and rural livelihoods (FAO, 2014; Turrall et al., 2008). However, there is still a lack of research around how different markers of vulnerability, beyond poverty, exacerbate or mediate the impacts of water (in)security on an individual or household. In particular, there remains an 'evidence gap' at the intersection of water (in)security in a variable climate and the effects of gender dynamics in the context of increasing climate risks. There is circumstantial evidence that 'at moments of stress, where land and livelihood opportunities are under threat, the most powerful individuals within communities tend to reassert social structures which exclude the less powerful – notably women' (Knapman and Sutz, 2015:2). But the overall picture and pathways for influence between water security and rural women's empowerment are not clearly delineated.

Social norms around gender, alongside other constructs which drive inequality, must be a key part of policy and programme implementation for water security and climate resilience (Le Masson, 2016; Kabeer and Subrahmanian, 1996). When considering gender and development, there are both 'practical gender needs', which relate to responsibilities and tasks assigned according to gender (often to meet an immediate need), and 'strategic gender

interests', which relate to decision-making power and control (Molyneaux, 1985). Interventions can be 'gender sensitive', to compensate for gender imbalances, or 'gender transformative', aiming to explicitly promote women's empowerment and achieve gender equality, disrupting existing power dynamics (Le Masson, 2016). However, in practice, policies and programmes in agricultural water management (AWM) are often 'gender blind' and do not consider women's unique needs and knowledge; unequal rights and responsibilities between men and women in AWM; or limited participation of women in decision-making processes (World Bank, 2009).

In contrast, programmes to improve water supply for the home (alongside sanitation and hygiene, collectively referred to as 'WASH') increasingly adopt gender-sensitive approaches, with some organisations also promoting a more redistributive agenda (Le Masson, 2016; Le Masson et al., 2016). This is a response to an established body of evidence on the positive gendered impacts of providing water supply services (Cairncross et al., 2013). WASH, and water security for the home, is a key part of helping women, and men, gain health and productive opportunities despite climate variability. So, too, is water security 'on the farm', i.e. AWM. This paper explains how and why improved water management on the farm matters for women and girls, and what can be done to better support opportunities for them, as well as for men and boys, in the face of climate variability and change.

This report consolidates existing academic and policy research around climate resilience, water security, and gender (see Box 1), and presents new evidence from Malawi and Ethiopia. We use primary and secondary evidence to explain how women and men in rural areas are differently affected by water insecurity. We analyse how gender and poverty mediate access to and control of water and other resources, and what this means for women's and men's opportunities and livelihoods, particularly in the face of climate variability. We find that in many contexts, women are disproportionately negatively affected by water insecurity associated with climate variability.

We identify three areas where gender focused programming needs to address the unique vulnerabilities of women to water insecurity:

- First, women are often at the pinch point of water-related tasks in the home and on the farm, with pressure intensifying around seasonal periods of scarcity in many developing countries.
- Second, compared to men, women may have less access to or control of assets that can be used to buffer against the effects of rainfall variability (for example, the equipment, land, and access rights

needed for small-scale irrigation). Without access to other productive resources and with limited participation in decision-making processes, women cannot fully benefit from AWM investments.

- Third, women often have fewer opportunities to pursue off-farm work or migrate to urban areas as a temporary coping strategy for seasonal food and income shortages, or for shortages caused by droughts and floods. In rainfed areas, during the lean season or when harvests fail, migration provides an option to find food and employment. However, social norms, limited assets, and fewer marketable skills often mean women are less able than men to exploit off-farm opportunities. Female-headed households are therefore particularly vulnerable to climate shocks.

In the rest of this report we analyse how men and women in rural areas are differently affected by, and adopt different coping strategies to, climate variability and shocks, and we offer recommendations to redress the balance. In Chapter 2 we describe the issue and context in more depth, with a brief literature review and a draft conceptual framework to show the relationship between climate variability, gender dynamics, and welfare for rural women. Chapter 3 explains our methodology, including mapping to inform case study selection, and participatory and gender sensitive approaches used in primary research. Chapter 4 presents key research findings from both the literature and primary evidence, and it outlines recommendations focused on building climate resilience for both men and women. The concluding discussion in Chapter 5 provides a short summary and an urgent call to action for a more integrated approach to water security and differential vulnerabilities to the growing risk of climate shocks.

Box 1: Framing key concepts

Definitions of our core concepts are subject to epistemological debate. The following definitions guide our enquiry and findings:

- Gender refers to ‘the socially constructed differences between women and men’, and relates to cultural ideals of masculinity and femininity, and sexual division of labour across households, organisations and institutions (Scott and Marshall, 2009:276)
- Gender focused programming can address both ‘practical gender needs’ – through improving the ‘condition’ of women, i.e. through access to services – and ‘strategic gender interests’ – through improving people’s ‘position’, i.e. through empowering women to take agricultural water-use decisions (Le Masson, 2016:33; Moser, 1993; Molyneaux, 1985)
- Water security suggests ‘sufficient water, in quantity and quality, for the needs of humans (health, livelihoods and productive economic activities) and ecosystems, matched by the capacity to access and use it, resolve trade-offs, and manage water-related risks, including flood, drought and pollution’ (Mason and Calow, 2012:18)
- Climate resilience is defined as ‘the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation’ (Intergovernmental Panel on Climate Change (IPCC), 2014a:127)
- Climate variability is a term for climate patterns or events (e.g. wet or dry seasons, temperatures, extreme weather events) that vary from the norm of statistical measures (e.g. mean or standard deviation) across spatial and temporal scales, as a result of internal process or external forcing (IPCC, 2014a:121).

2. Issue and context

2.1 Water insecurity is a major risk for the rural poor

The majority of poor people in the developing world rely on agriculture for their livelihoods. In developing regions, rural populations still constitute the majority, at 67% in South Asia and 63% in sub-Saharan Africa (SSA) (World Bank, 2014). Across these regions, people who live in rural areas are generally poorer than urban dwellers, and the depth of poverty (i.e. distance from the poverty line) is greater. The aims of SDG 1 – to eradicate extreme poverty, ensure equal rights to economic resources, and build the resilience of the poor – will only be possible through addressing rural poverty.

Rural poverty in SSA has remained an intractable development challenge: 70% of the continent's poor people live in rural environments and are primarily engaged in subsistence farming activities (RPP, 2015). Agricultural production is a critical component of livelihood strategies, supporting household food security through subsistence production and cash incomes through surplus sold at market and seasonable labour provision (DFID, 2002). The agricultural sector is therefore essential to reducing poverty and achieving the SDGs. High agricultural growth rates can support substantial poverty reductions when driven by investment in smallholder production (DFID, 2002; World Bank, 2008; World Bank, 2013).

However, the sector is also highly exposed to current and future climate risks, particularly rising temperatures and droughts. Regions such as East Africa and South Asia are already subject to high levels of climatic variability within and across years. For example, in Ethiopia, El Niño cycles are associated with heavier rains in the first wet season (March-May) and below average rains in the main planting season (June-September) (FAO, 2014). The 2015-2016 El Niño-related rainfall deficits have resulted in drought warnings, falls in production, and devastating food shortages in the Horn of Africa and across Southern Africa (WFP, 2015). There is a significant negative relationship between rainfall variability and economic growth in SSA – increased extremes in rainfall patterns and surface water run-off appear to have a drag effect on growth due to economic structures that are highly dependent on agriculture (Grey and Sadoff, 2007; Brown et al., 2013; Sadoff et al., 2015).

Certain technologies can mitigate the impacts of climate hazards. Irrigation can compensate for delayed or inadequate seasonal rainfall, and land management practices can reduce the erosion effects of heavy rains and flooding. For example, Brown et al. (2013) found irrigation coverage was positively associated with resilience to hydro-climatic variability. However, many of the rural poor do not have access to these technologies. The World Water Assessment Programme (WWAP) estimates that approximately 80% of agriculture is rainfed (WWAP, 2009). Statistics on irrigation coverage

are often unreliable, but indicate that in parts of Africa such as Uganda, Malawi and Ethiopia irrigation covers less than 1% of total cultivated areas (FAO AQUASTAT, 2015). Therefore, in developing countries in Africa and Asia, water insecurity for the rural poor is driven by a triple burden: high economic dependence on the agricultural sector, a high proportion of rainfed production, and high levels of hydro-climatic variability.

2.2 Water (in)security affects men and women differently

Moreover, the impacts of water (in)security are distributed unevenly across society, and its effects are felt differently (Mason and Calow, 2012). Water scarcity is rooted in 'power, poverty and inequality, not physical availability' (Watkins, 2006). The way in which environmental resources such as water are managed is shaped by social and structural expectations and formal and informal institutions (Knapman and Sutz, 2015; Cleaver, 2000). As a result, men and women have different access to, control over, and rights and responsibilities in relation to land and water for agricultural production as well as assets and opportunities that support adaptive capacity by acting as buffers in times of crisis. Women face unequal access to and control over productive resources and opportunities (World Bank, 2009; FAO, 2012). Rural poverty, food insecurity and agricultural dependence disproportionately affect women (Arun, 2012, citing Devereux, 2010). At the societal level, women are often slower to move out of the agricultural sector into higher-skilled employment than men (Agarwal, 2011). In some regions, urban migration is also leading to a 'feminisation' of agriculture (Arun, 2012).

Negative shocks such as climate variability and hazards have the potential to further entrench inequalities and exacerbate the undesirable outcomes of the marginalisation of women in rural development (Knapman and Sutz, 2015).

Water is a key component of agricultural production and rural livelihoods, yet across the developing world, formal and informal structures, rules and norms mean that while many water-related tasks are assigned to women, most water-related powers and rights are assigned to men (UN, 2013). This represents the dichotomy between women's 'practical needs' in terms of the household care and the 'strategic interests' in terms of control and influence in water management. It means that in periods of stress and reduced resource availability, men may have more capacity to adapt, while women are more vulnerable (Le Masson, 2016; Dankelman, 2010). Effectively supporting the resilience of the agricultural sector and adaptive capacity of rural populations therefore requires a gendered perspective.

2.3 Who you are and what you have: gender and poverty matter for resilience

Access to resources (physical and technological) and opportunities (training, education and markets) can mitigate the negative impacts of climate and other shocks and pressures, through supporting adaptive capacity (Le Masson, 2016; Smit and Wandel, 2006). However, social and structural constraints shape individual access to resources and opportunities (Okali and Keats, 2015, citing Tsikata, 2015). ‘Mechanisms’ mediate access, including formalised institutions, technologies and socially embedded rules (Franks and Cleaver, 2007:9). Through these mechanisms, markers of social exclusion — such as income level, class status, ethnicity, religion, age and gender — limit access to the assets, services and institutions that support adaptive capacity (Adger et al., 2007; Jones et al., 2010).

Different markers of exclusion can interact and compound each other. For example, men and women with high socioeconomic status are equally likely to die during a natural disaster, but poorer women are much more likely to die than poorer men (World Bank, 2012). How these dynamics manifest will vary across countries and communities, and the experience of marginalisation is highly localised (Arun, 2012). Furthermore, social relations are dynamic, and in a constant state of flux and reconstruction (Cleaver, 2000; Arun, 2012; Okali and Keats, 2015), as are gender relations a product of the organisation and renegotiation of institutions through time (Kabeer and Subrahmanian, 1996:4).

This analysis focuses on the interplay of gender and poverty dynamics. It is important to separate these aspects, as although poverty is a gendered experience, gender and poverty are distinct forms of disadvantage (Arora-Jonsson, 2011). The complex relations between men and women and the social norms that define their behaviour are particularly relevant to water (in) security. While men often dominate decision-making regarding water and land management for productive uses (World Bank, 2009), women bear a disproportionate responsibility for water collection and provision, and inadequate access creates a burden in terms of labour and time, which has impacts on health, education and security (Jansz and Wilbur, 2013; UNICEF, 2003).

In many countries, men control access to and use of environmental resources, and are more likely to utilise these resources to contribute to the formal economy (IUCN, 2014). In contrast, the value of many activities carried out by women in relation to water is not often costed or remunerated – for example, provisioning clean water for drinking and hygiene, which supports children’s educational development. This may result in further de-prioritisation in economic planning from household to national levels, despite the evidence that increased involvement of women in decision-making processes and their increased access to resources is strongly associated with more effective resource management and positive development outcomes for the household and community (IUCN, 2014; Meinzen-Dick et al., 1997).



Photo: Beatrice Mosello — Women collect water at a rural community hand pump, often accompanied and helped by their children. Ntcheu, Malawi

Increased incomes for women can also transform household and community welfare, and support national economic growth through differential spending habits, which generate positive multiplier effects (World Bank, 2012). However, it is also important to note that power dynamics are complex. Disrupting traditional roles through gender transformative change can ‘threaten’ accepted behavioural norms and relations between men and women (see Cleaver, 2000; Kabeer and Subrahmanian, 1996). Interventions to empower women are subject to criticism and opposition, which can reduce effectiveness, and it is therefore vital that programmes work with both men and women (Le Masson, 2016:32).

2.3.1 Access to water for agriculture for women and men

Water for agriculture can come directly from rainfall, or be secured through irrigation technologies of different scales, ranging from rainwater harvesting to large-scale schemes with extensive infrastructure. When water is captured and stored for productive uses, women tend to be excluded from formal mechanisms for planning, control and use of that water (World Bank, 2009). Key factors that limit women’s access to water for production include: restricted land ownership, which limits rights to water; farming contexts favouring men’s involvement in large-scale irrigated cash crop production, such as contract farming agreements that require secure tenure; and limited participation in producers’ organisations and water users associations (WUAs) as a result of social or structural constraints such as lower social expectations or levels of education (FAO, 2012; World Bank, 2009).

In the academic literature, Meinzen-Dick et al. (1997) identify key differences in how land and water rights are assigned to men and women, and explain that women face integrated cultural, political and economic constraints that limit and subjugate their participation in the ‘market’ for environmental goods including water. Frank and Cleaver (2007) describe differential access to environmental resources according to gender through their discussions of formal or institutional ‘mechanisms’ which restrict access. Stevenson et al. (2012) begin to adopt an integrated approach to water (in)security for women that considers both domestic and productive uses (the focus of our first Finding). Other works have sought to understand women’s agency in spite of these constraints – for example, how women navigate customary norms and expectations around female behaviour in order to ensure access despite being excluded from formal mechanisms for management (Delgado and Zwarteveen, 2007; Zwarteveen and Neupane, 1996).

Despite well-rehearsed arguments, there is widespread failure to systemically address gendered inequalities in AWM. IFAD (2012) attributes this to lack of understanding of gender issues, lack of commitment in project design and development, limited staff capacity, limited gender disaggregated data, and cultural norms among decision-makers, technicians and project stakeholders. Therefore, although AWM programmes such as irrigation and storage can mitigate the drivers of

water (in)security through providing a constant supply, there is inadequate gender focused programming to provide targeted support for women to access, participate in or control the water resources and associated infrastructure and organisations (World Bank, 2012).

2.3.2 Access to land for women and men

In addition to water, access to land is fundamental for production and rural livelihoods. Different indicators related to control and access of land suggest that women have significantly less ownership and control over land rights across the world (see FAO Gender and Land Rights Database, 2015). In West Africa, for example, less than 10% of agricultural holders are female across Gambia, Senegal, Guinea, Mali and Burkina Faso (FAO Gender and Land Rights Database, 2015). The World Bank (2009) suggests that inheritance rights are a key cause of unequal ownership. Socioeconomic and cultural transfer mechanisms often privilege men, i.e. market purchase, inheritance (and relationship with customary law), labour, use over time, state allocation and community membership (Meinzen-Dick et al., 1997:1307). Land rights are related to water access, which is often defined by ownership of irrigated land or riparian land near rivers (ibid).

However, ownership statistics do not convey the complex factors that determine women’s abilities to manage and utilise land. First, decision-making (for example, regarding planting, seasons, and consumption vs market) is shaped by household and family interactions, informal bargaining, community expectations, and customary practices (Knapman and Sutz, 2015). Cleaver (2000) describes how married men and women differently perceive the use of household land holdings, and how tacit social understandings tied to gendered identities will shape production decisions. While the general picture is that formally reported agricultural holdings are skewed towards men, thus reducing women’s opportunities and security, parts of the holding may be informally allocated for production by women (FAO, 2009).

Second, women’s productive activities are frequently focused on less-marketable crops and home consumption (World Bank, 2009). Women’s and men’s tasks in relation to land management are different, understood as gendered ‘practical needs’. Men are often responsible for heavy physical, seasonal tasks related to large livestock and technology (for example ploughing new fields), while women are assigned more repetitive tasks (such as preparing the ground for planting and weeding) (Cheater, 1999; Cleaver, 2000). Men may plant the crops for market (bananas, sugar cane) while women plant crops for family subsistence (grains and legumes) (Cheater, 1999).

Third, responsibility for land management can change with individual circumstances such as age or marital status (Knapman and Sutz, 2015; Cleaver, 2000). External structural factors, such as increased migration of men to cities and new market opportunities, may

result in women gaining increased control over holdings and planting cash crops (World Bank, 2009). This can threaten men's identities as providers, which has implications for antisocial behaviour and violence perpetuated by men to re-exert their gendered identities (Cleaver, 2000). Therefore, access to and control over land (and with it water) is shaped by dynamic economic, social and structural factors within a given location (Cleaver, 2000).

These overlapping factors complicate the picture, and provide windows of opportunity for women to assert control and agency. They also represent how men and women have both separate and joint interests in relation to the home and farm (Okali and Naess, 2013). Nonetheless, in many contexts, gendered power relations continue to favour men's interests (and perpetuate male privilege through transfer systems) regarding the most essential productive resources.

2.3.3 Access to other resources and opportunities for rural development

Women and men also experience different access to other key factors for rural production and marketing which compound water (in)security and limited access to land and water resources. Issues arise along the agricultural value chain, from inputs to markets.

At the farm level, access to inputs (improved seeds and fertiliser), technology (irrigation and mechanisation) and extension training can increase productivity. Surplus production and appropriate storage can also provide a buffer in case of shocks. However, as with natural and environmental resources, women and men often do not have equal access to these material resources and capacity building opportunities (World Bank, 2009). Agarwal (2011) cites examples of factors in the exclusion and marginalisation of rural women: lower membership of cooperatives that provide training, inputs, storage and market links; lower value of owned farm equipment; lower ownership rates of key farming tools; poor access to extension, which limits adoption of high-yielding varieties and improved practice; and lower input adoption. In Ghana, Doss and Morris (2011) found that women had lower adoption rates for modern maize varieties and chemical fertiliser as a result of gender differentiated access to essential complementary resources, particularly land and extension contracts.

As with other resources, broader markers of marginalisation also affect access to inputs, technology and training. The markets and supply chains for inputs

are undeveloped and uncompetitive in many developing countries. Therefore, access will also be mediated by incomes, poverty indicators such as landlessness or education, and distance from market (or isolation in rural areas). These issues can intersect with gender to affect access and uptake. In Uganda, a case study identified that for male-headed households, extension visits, age and off-farm wages affected fertiliser uptake by male and female-headed households, whereas for female-headed households, education levels and distance to market were key factors (Diirro et al., 2015).

Moving further up the value chain to questions of access to finance, market links and value-addition, we find further gendered differences overlaid on broader challenges for rural poor people. Access to credit and other financial services can help small-scale producers to access capital to finance inputs, machinery and labour for production and insurance against climate hazards (Fletschner and Kenney, 2011). However, financial markets in developing countries are often in early stages with limited products, particularly in relation to rural credit provision, which is seen as high-risk (ibid). On top of these broader structural constraints, the World Bank Findex database (2014) identifies that women are significantly less represented in the use of financial products and were 17% less likely to have secured a loan over the last year. The reasons for this lack of access are multiple, from regulatory restraints (for example, in Pakistan, a woman needs a male relative's permission to open a bank account) to social inequalities such as lower levels of literacy (ibid).

Beyond the farm gate, women continue to face constraints to participation in the rural economy. Women may be subject to mobility constraints (as a result of social rules, limited access to modes of transport or security fears) and are therefore less able to access markets, and this, combined with social norms, means they cannot develop relationships with other actors along the value chain. Thus, women are marginalised in both vertical market linkages (relationships along the chain i.e. buyers and suppliers) and horizontal linkages (relationships within one stage e.g. with a group of producers) (GIZ, 2013). Furthermore, as discussed, women's crops are often less marketable, and productivity is likely to be lower, resulting in less production for market.

2.4 Research objectives: an analysis of water (in)security in a context of increasing risks

As a result of the above intersecting constraints, many rural women do not have the resources and opportunities required to build resilience to the drivers of agricultural water insecurity in a situation characterised by increasing risks. Unfortunately, in practice, gender is still treated as a peripheral concern, or bolted on as a component of design or monitoring for AWM investments (World Bank, 2009). In a context of increasing climate crises and growing water insecurity, it is even more urgent to update the evidence and identify actionable changes to support the resilience of rural women and men.

This research presents a gendered analysis of agricultural water (in)security drivers, mediating factors and outcomes. We locate the analysis in a context of a changing climate and extreme weather events, but the findings are also relevant to contexts characterised by water insecurity associated with hydro-climatic variability and lower-level stress.

Three key research questions guide our analysis:

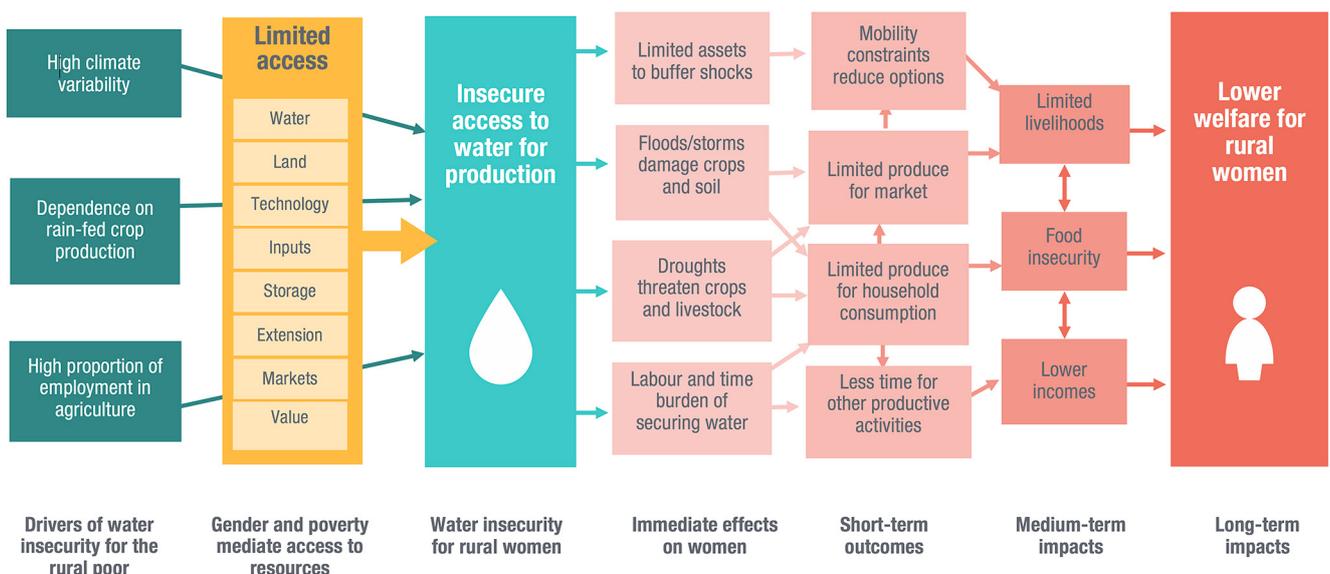
1. How does climate variability and water (in)security affect farm productivity and production across rainfed and irrigated areas?
2. How are rural women and men differently involved in water-dependent tasks and differently impacted by water (in)security?

3. How can institutional and/or technological interventions mediate the impacts of climate variability and water insecurity and support the adaptive capacity of rural women and men?

In order to better understand the relationship between climate variability, access to resources, and the impacts for rural women, we present a conceptual framework. Developed from the above analysis of secondary literature, the framework hypothesises the gendered causal pathways for water (in)security for rural women (Figure 1), and was used to frame the emphasis of our primary research in the case studies.

Our conceptual framework for rural women's water insecurity is characterised by key drivers including climate variability and dependence on rainfed production, and low access to and control over resources and opportunities that could support more resilient livelihoods and mitigate the impacts of these drivers. These limitations are shaped by social relations and power dynamics. The draft framework emphasises the potential negative outcomes that result from the gendered impacts of water insecurity. However, it is important to recognise the agency of rural women to overcome water insecurity and achieve higher welfare for women and girls (Jackson, 1998). This process can be facilitated and supported by gender focused programmes. This implies that the negative picture of insecurity depicted in the framework can also be inverted to achieve water security and higher welfare for rural women. The issues set out in the conceptual framework are further explored in Chapter 4 using evidence from both the literature and primary research.

Figure 1: Conceptual framework of rural women's water insecurity



Source: Authors, 2016

3. Methodology

As with many areas of development research, gender dynamics are highly context specific (Okali and Keats, 2015; Cleaver, 2000; Meinzen-Dick, 1997). Gender norms around access to and control over land and water resources are shaped by local power structures and community-based sociocultural patterns (Knapman and Sutz, 2015). In order to develop a robust analysis that discusses gender issues and guides transformative change, it is necessary to adopt locally focused gender sensitive participatory research methodologies focused on carefully selected case study sites.

Accordingly, the research was conducted through desk analysis of relevant literature to construct a conceptual framework that guided the primary data collection. Primary research was conducted through a case study in Malawi, supplemented with additional, but mainly anecdotal, evidence from Ethiopia. Field research was conducted in January 2016. See Boxes 2 and 3 below for more detail on the country contexts.

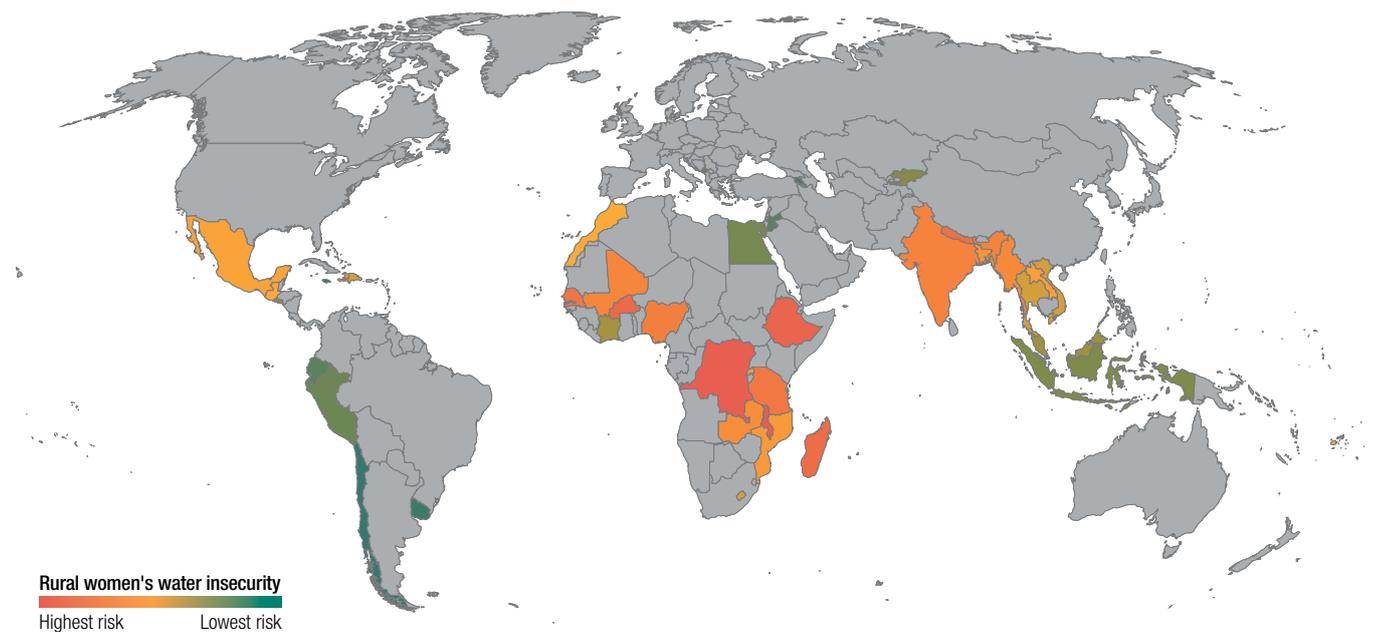
To ensure case studies were representative of the key challenges this research addresses, we constructed an index to represent and rank rural women’s water insecurity. The index includes proxy measures for climate variability, water insecurity in the agricultural sector, and gender inequality, and it ranks countries according to their composite risk rating (more information on composite variables is available in Annex 1).

This generated a list of ten ‘hotspot’ countries where these issues intersect and women are therefore particularly vulnerable. The indicators incorporated are the following:

- Distribution of female agricultural holders by sex (%)
- Rural poverty headcount at national poverty levels (%)
- Employment in agriculture (%)
- Agricultural irrigated land (%)
- INFORM flood and drought exposure index (an existing composite index)

Due to limited data availability, the final index consists of 42 countries. Each variable was ranked (the top ranking of 1 implies lowest risk) and the ranks were summed with equal weighting. The countries with the highest scores are those with the worst rankings across multiple indicators. Figure 2 depicts a country mapping for the entire index, with colour coding according to ranked deciles. The majority of the countries that are most at risk are concentrated in sub-Saharan Africa (SSA). These countries represent hotspots which face multiple and conflating risk factors in terms of climate hazards, water insecurity, gender inequality and rural poverty. The next most at-risk region is South Asia. South East Asia and Central and Latin America are at relatively lower risk.

Figure 2: Hotspot mapping for rural women’s water insecurity



Source: Author, created using mapchart.net using data sources explained in Annex 1

The top ten countries in our index are shown in the table below. All except Nepal are in SSA. The Democratic Republic of Congo (DRC) and Malawi have the highest risk scores, followed by Ethiopia. The DRC's score is mainly due to very low rankings for irrigation, with 9% coverage (ranked 40 out of 42 countries), high levels of climate risk (37 out of 42), and high gender inequality (40 out of 42). Malawi scores particularly badly in rural poverty rates, at 81.5% (42 out of 42); proportion of the population employed in agriculture, at 81% (39 out of 42); and irrigation coverage, at less than 1%, but ranks second for female agricultural holdings, at 32%. It is worth noting that Malawi's very low scores for the other indicators far outweigh a higher score for gender equality. Ethiopia scores poorly across climate hazards, with irrigation coverage at less than 1% and agricultural employment at 81% (39 out of 42), but scores comparatively well for female agricultural holdings, with 19%, generating a ranking of 14 out of 42 countries. For our case study sites, we selected Malawi and Ethiopia, the first- and third-ranked countries. The DRC was not chosen due to security concerns. Malawi was our primary case study, with the majority of field-based research. Research on Ethiopia was desk-based with key informant interviews.

For the case studies we undertook qualitative data collection within rural communities, complemented by interviews with experts and practitioners working on issues pertinent to our key research questions. In Malawi, we selected sites to capture a range of climate risks, social systems (matrilineal versus patrilineal, which affects land inheritance) and geographic locations. Details are included in Annex 2.

For our primary case study in Malawi, we adopted a range of techniques aiming not to exclude either sex but to compensate for the power dynamics embedded in society. We also identified approaches that were appropriate to a very rural context and would facilitate open and honest discussion among participants about potentially sensitive topics. Table 2 shows the range of primary research methods used and the data each aimed to provide. In collaboration with our local partners, we also identified key data about the village or community, focusing on social, economic and climate indicators. This helped contextualise the information collected and identify areas of cross-reference.

Table 1: Top 10 countries for rural women's water insecurity

Country	Index Score	Hotspot Rank
Congo, D.R.	154	1
Malawi	154	= 1
Ethiopia	153	3
Burkina Faso	142	4
Madagascar	136	5
Nepal	135	6
Senegal	135	= 6
Gambia	132	8
Tanzania	132	= 8
Nigeria	129	10

Box 2: Malawi country context

Malawi is a small landlocked country in SSA of 16.7 million people with high dependence on agriculture, high rural poverty, and high levels of climate risk, represented in our index (World Bank, 2015). The country experienced an economic crisis in 2012 after the death of the president. Growth has slowly recovered, and is projected to reach 5.5% for 2015, down from 5.7% in 2014, although inflation is high (Mwanakatwe and Kebedew, 2015). Agriculture is the primary economic sector, employing more than 80% of the population (World Bank, 2015). Rural livelihoods shape Malawi's 'social fabric' (Kilic et al., 2013). Malawi is very poor, ranked 173 out of 188 countries on the 2015 Human Development Index, with more than half the population living in poverty (UNDP, 2015).

Malawi has a subtropical climate, which is strongly seasonal. 95% of rain falls during the wet season from November to March/April (Malawi Meteorological Services, 2006). Malawi also experiences interannual rainfall variability, particularly related to El Niño (McSweeney et al., 2010a). As a result there are occasional droughts and low-lying areas are vulnerable to extreme floods (Malawi Meteorological Services, 2006). Recent extreme events have had devastating effects. In early 2015 major floods affected more than 1 million people and damage costs were estimated at USD 335 million, with total costs for recovery and reconstruction close to USD 500 million (Malawi Government, 2015). Later in 2015, failed rains contributed to the El Niño-related drought that has affected large parts of Southern Africa. The same communities have been hit. Falls in production have resulted in a 100% year-on-year increase in the price of staple crop maize for Q4 of 2015, and it is expected that poorer and female-headed households will be pushed into food stress and negative coping strategies (WFP, 2015).

There is a high degree of uncertainty regarding future rainfall, due to difficulties with downscaling. However, climate-change-related declines in rainfall across Southern Africa will significantly affect rainfed production, potentially driving down yields by 50% and revenues by 90% by 2100 (IPCC, 2014b). This will have a knock-on impact on rural livelihoods and poverty. Ahmed et al. (2009) predict that Malawi is one of the most at-risk countries in terms of increased poverty driven by extreme weather events.

Table 2. Methods used in country case studies

Research activity	Method	Objective
Focus group discussion	Mixed and single sex group; aim is to include mix of participants in terms of age, marital status, and access.	Identify men's and women's involvement in agricultural activities; access to different forms of capital, resources and opportunities; risks and responses to water insecurity and climate hazards; and the nature and impacts of project interventions and local innovations.
Community mapping	Working together in the focus groups, communities draw maps to represent their understanding of the resources in the surrounding area, and the built and natural environment, such as roads, housing areas, religious buildings, notable vegetation, and aspects of the terrain such as hills.	Identify current cropping areas and water sources, and areas of potential hazards; instigate discussion around livelihoods, the reliability of water sources, land productivity, what crops are grown where and by who, ownership, household division of labour and responsibility from a spatial perspective, and the mobility options for women and men.
Seasonal calendar	In a participatory format within focus groups, community members develop calendars, using their own time periods, to represent the different cropping seasons, lean seasons, rainy and dry periods, floods and droughts, and other issues they find pertinent such as income.	Understand regular cyclical periods and significant events that occur during a year and influence the life of a community; explore climate variability risks and how they influence men's and women's activities at different times of the year.
Key informant interviews	Conducted various interviews of different levels of formality: one-on-one semi-structured interviews with women and men in the local communities we visited, discussion with representatives of local organisations who work in rural development and gender empowerment, and formal interviews with more senior non-governmental organisation (NGO) staff and academics in the sector.	Provide more vertical depth to the information already gathered through focus groups and participatory exercises; cross-reference 'expert' opinions against local community perspectives, for example on gender equality, perceptions around climate risks and/or the impact or effectiveness of interventions.

There are various limitations to both the index and the primary research methods which should be acknowledged. The index is limited by the availability and reliability of data for component variables, and relies on subjective selection of variables and values. We have kept it as simple as possible, using ranking rather than aggregating scores. In terms of the primary research, time and resource constraints meant we could work with only a small number of communities, with limited time per visit, which inhibited representativeness. There were also the practical difficulties of trying to gain a suitable depth of analysis in the context of highly complex and embedded gender dynamic. Focus groups are an imperfect set-up, as dominant voices can skew results and affect participation of others, and fatigue affects engagement. Occasionally, working with male

facilitators in women-only focus groups creates barriers. There is also the issue of the observer effect, particularly in relation to how communities felt about interventions, as they may fear negative responses would lead to a reduction in funding or similar. To try and control and mitigate these, the research team explicitly explained the objectives of our research and our impartiality to other organisations. We used experienced local facilitators with connections with the local community to encourage participation, build trust and relationships and support an open discussion. However, a more in-depth analysis in future would require a longer research period, and adoption of ethnographic methods and social relations analysis.

Box 3: Ethiopia country context

Ethiopia is a landlocked country in the Horn of Africa with a population of approximately 97 million, 81% of whom rely on agriculture (World Bank, 2014a). In many ways, Ethiopia represents a development success (Lenhardt et al., 2015). The country maintained average gross domestic product (GDP) growth of 10.5% from 2010 to 2014, which supported a 33% reduction in poverty rates from 2000 to 2011 (World Bank, 2014a). However, Ethiopia remains one of the poorest countries in the world and is ranked at 174 out of 188 countries in the Human Development Index, with a rural poverty rate of 36% (UNDP, 2015; World Bank, 2015).

Ethiopia also has a highly variable climate, high risk of climate hazards (particularly droughts) and, as a result, high levels of hydrological variability across space and time (Mosello et al., 2015). The World Bank (Grey and Sadoff, 2006) has identified strong correlation between variation in annual growth rates and variation in rainfall, and projected that hydrological variability had an annual cost of 38% of GDP growth. IFAD (RPP, 2015) describe how inadequate and unreliable rainfall is a major factor in rural poverty and household food insecurity, as the majority of households depend on rainfed production. In 2015-2016, El Niño caused the main wet season rains to stop early, resulting in drought across the Horn of Africa. Ethiopia is the worst affected, with at least 10 million people in need of food aid in early 2016, and forced migration driven by lack of food (UNOCHA, 2016; McSweeney et al., 2010b).

High variability and inadequate data mean that precipitation trends are difficult to determine, but future projections suggest increased rainfall, most of which will fall in 'heavy' rain events, resulting in flooding (McSweeney et al., 2010b). Therefore, farmers will face more intense seasons, both wet and dry, which will have negative impacts on production. The World Bank (2010) assessed the economic impacts of future 'dry' and 'wet' scenarios and identified economic losses of 6-10% for dry, 1-3% for wet, and increased variability of agricultural growth, leading to significant welfare losses and food stress for poor rural households.

4. Research findings and recommendations

Our key research findings – from the literature review, the primary case study work in Malawi, and the secondary case study in Ethiopia – suggest that women are disproportionately negatively affected by water insecurity, and less able to autonomously engage effective coping strategies to adapt to climate variability. Our findings are categorised into three key themes, which represent key dimensions of rural women’s particular vulnerability to water insecurity, in a context of climate variability. The findings are grouped as follows:

1. Home and farm: How women may be caught in a double pinch of domestic and agricultural water insecurity.
2. Assets and institutions: How women may lack access to and control of assets and institutions for agricultural water management to buffer effects of variability-related water insecurity.
3. Mobility and livelihoods: How women may have fewer opportunities to pursue off-farm work or migrate to urban areas as a temporary coping strategy in case of seasonal food and income shortages and climate shocks.

4.1 Home and farm

4.1.1 Nature of the problem

Although domestic water supply is typically viewed and programmed as a discrete activity, in reality access to ‘domestic’ supply has both a direct and an indirect bearing on the ability of people, and women and girls in particular, to live healthy and productive lives. Households benefit through a range of educational, health, nutritional, production and broader livelihood impacts, with ripples that extend through economic multipliers in regional and national economies. The cumulative effect is significant, though not always obvious.

Most studies on the benefits of WASH have focused on health, and particularly children’s health. The preventable disease burden associated with inadequate WASH is

Key finding:

Time and labour costs associated with domestic water insecurity are disproportionately high for women, particularly during periods of water stress. This affects women’s capacity to participate in agricultural or other productive activities that support food security and income generation.

Recommendation:

Donors and implementing agencies should better plan for seasonal patterns of water insecurity and multiple uses of the same water source, which particularly affect women; and enhance complementarity between programming for food and water security.

dominated by mortality from infectious diarrhoea, with roughly 90% borne by children under five. The focus on acute diarrhoea, however, almost certainly underestimates the longer-term disease and malnutrition burden associated with inadequate WASH, and the ability of both men and women to engage in production and income-generating activities (Cairncross et al., 2013; Calow et al., 2015). Wiggins (2009) notes that a substantial part of the problem of child malnutrition comes from disease, not food supply. For better nutrition, he argues, the continent needs to do as much to ensure access to clean water, sanitation and primary health as it does to grow more food.

Although the evidence base linking improved WASH with non-health outcomes is weaker, there is a growing body of suggestive evidence linking access to safe WASH with benefits to education (particularly for girls), household welfare (e.g. through time savings) and poverty more broadly. For example, a study by Miguel and Kremer (2004) linked inadequate WASH with impaired learning, growth retardation, increased absence from school, and decreased (future) economic productivity.

The suggestive evidence, then, is that outcomes in health and education, linked to WASH, have a strong link with women’s productivity at home, in agriculture, and in entrepreneurship. The latter includes the ability of women to exploit opportunities in the farm economy, such as investing in water control and irrigation, and their ability to build assets and break out of poverty – moving up and out of the farm economy. Gender equality, especially through education, also has further growth implications through lowering fertility rates and increasing investment in children – and thereby future growth (Croppenstedt et al., 2013; Ellis, 2013).

Perhaps the clearest gendered link between water supply, agriculture, and rural livelihoods more broadly occurs through the issue of time – specifically, the inequitable gender division of labour that means women often work across domestic and non-domestic spheres, leaving them ‘time poor’. The relationship between rural women’s work for the household (including water collection, see Box 4) and for the farm is framed by sociocultural gender-based expectations (FAO, 2011b, 2015; World Bank, 2012; Koolwal and de Walle, 2010). Women have different responsibilities outside and within the household and consistently work more hours in both paid and unpaid work (USAID, 2005).

FAO (2005) describes how rural women experience ‘time poverty’. They take on the majority of household labour and their livelihood activities are characterised by mounting drudgery – collecting water and firewood, and labour-intensive agricultural tasks. A FAO (2015) analysis of rural women’s livelihoods identifies a ‘triple burden’ of work to support the productive, reproductive and social spheres. FAO (2015:1) suggests that this work ‘overload’ is mostly unpaid and unrecognised, and ‘restricts women’s

well-being and their engagement in activities of value, including remunerative activities'. A picture emerges of how 'time poverty' plays out: rural women are entrenched in activities in the home or with low monetary return per person-hour, while men are more able to pursue higher-return activities (Ellis, 2013).

The 'time poverty' of rural women has a strong seasonal dimension, likely to be magnified by climate change. This is because the rhythm of rural life throughout much of Africa is dictated by an inflexible seasonal calendar (Devereux, 2009; Ellis, 2013). Agricultural seasonality arises from the production of one (sometimes two) harvests each year; thus household income depends crucially on the size of the harvest. There is a need to devote labour at specific dates in the cropping cycle. For food deficit smallholders,¹ this means allocating scarce labour between earning food for today by working on neighbours' farms, or growing food for tomorrow by weeding and tending their own fields (ibid).

Failures of production force smallholders into adopting various coping strategies, such as rationing consumption, seasonal migration, or selling assets (e.g. livestock) – strategies that may deepen over time in terms of their 'commitment' and 'irreversibility' (Devereux, 2009). It follows that communities do not move together through cycles of accumulation and asset depletion; rather there are 'epicycles' linked closely with the economic circumstances of individual households within a community (ibid).

The difficulties rural women face in allocating labour, and the inflexible labour demands of the cropping season, conflict with the need to collect water. Moreover, seasonality also affects the quantity and quality of available water, and its accessibility. If rural women (and children) have to travel further to find and collect water, collection times go up, and the amount that can be transported goes down. Alternatively, women may trade off distance with quality, for example by using unprotected, poorer-quality sources if protected alternatives are too far away (Tucker et al., 2014). Both 'options' can have detrimental impacts on nutrition, health, livestock and production potential (World Bank, 2009). For self-provisioning farmers living each year on a knife-edge, this can mean the difference between survival and disaster.

Poorer households are particularly vulnerable, as they may have the least labour to release for water collection and the least flexibility in trading off water collection against productive activities (See Box 5). Within rural communities, therefore, the distinction between a dry season and a drought, or between a normal 'hungry season' and 'food famine/acute water stress', can be determined by each household's economic circumstances as much as by exogenous conditions.

Box 4: Water collection times – global and local evidence

There is now a wealth of evidence that improved WASH is linked with significant time savings – particularly in rural areas with more dispersed populations and limited access – and that these savings are valued by users. The roll-out of Joint Monitoring Programme (JMP) household surveys with questions on water collection times provides useful data. The JMP's 2010 update (WHO/UNICEF, 2010) showed that in several countries in SSA, over a quarter of households spend at least half an hour on a single trip to collect water. In 7 out of 10 households, across 45 countries, this burden fell primarily on women and girls.

Aggregate numbers can hide significant variation – between areas, wealth groups, seasons and years – and collection times can be much higher. Detailed rural water audits conducted in Ethiopia, for example, have shown that increased dry season collection times of up to six hours per day are not uncommon. Moreover poorer households were impacted most, since these had the least labour to release, the fewest assets to collect and store water, and the least cash to pay for it. They were also more likely to forgo income-generating activities in favour of water collection, and more likely to see the condition of their livestock deteriorate as a result of constrained water access.

Source: (Tucker, MacDonald, Coulter, and Calow, 2014).

¹ Those whose farming is subsistence-orientated but who depend on other sources of income because they do not achieve self-sufficiency in most years (Devereux, 2009).

4.1.2 Case study findings

Malawi has made remarkable progress in expanding water supply coverage over the last twenty-five years, comfortably surpassing the Millennium Development Goals' (MDGs) targets. In 2015, JMP estimated access to improved water sources to be 89% in rural areas, and higher still for urban populations (WHO/UNICEF, 2015a).

The national government claims that 93% of the population has an average collection time for drinking water of less than 30 minutes (Ministry of Irrigation and Water Development (MoIWD), 2014). However, the reality may be less positive. NGO mapping has shown access to improved water supply can be as low as 22% in some areas (DFID Malawi, n.d.) and there are questions regarding the sustainability of services. In rural areas particularly, rates of non-functionality of water point infrastructure are high. Nationally, an estimated 25-30% of water points are not working at any one time (MoIWD, 2014; GoM, 2012; Baumann and Danert, 2008). There are significant variations between districts, ranging from 98% functionality in Likoma to 52% in Dedza (MoIWD, 2014).

At community level, gender-based inequalities persist as women and girls carry the burden of fetching water, often walking long distances and carrying heavy loads, with associated risks and opportunity costs (DFID Malawi, n.d.). Country-level survey data finds women's engagement in productive employment and income generating activities is hampered by significant domestic workloads, whilst the large majority of rural men (88%) do not perform any domestic activities (FAO, 2011b citing data from the National Statistical Office of Malawi's Second Integrated Household Survey (NSO, 2004-2005). School dropout rates are also higher for girls due to their extra burden, with implications for future economic opportunities and well-being (FAO, 2011a; see also UNICEF, 2014).

While these figures capture some of the spatial variability in domestic water security in Malawi, they do not provide much insight into temporal patterns or their impacts. Our case study findings illustrate that seasonal patterns of scarcity and periodic extremes, such as the current El Niño drought, are critical to understanding the (gendered) relationships between water and food security.

“When the borehole breaks we use the river for our household needs but the quality is poor and there is a risk of diarrhoea. It is also far to walk” – Quote from the women-only focus group in Machinga.

At the end of the dry season when water is particularly scarce, communities experience longer queuing times at the borehole due to a lack of alternative sources. In Mitawa village, Machinga, it was also reported that the borehole was more likely to fail at this time of year, which could be due to increased strain on the hand pump (mechanical failure) and/or lowering of the water table (resource failure). As a consequence, women have to travel further to collect water (increasing the time burden), households may resort to lower quality sources (with associated health risks), and remaining sources come under greater pressure (more queuing). Seasonal patterns of water insecurity are exacerbated by drought, which intensifies and prolongs the period of water shortage. All these factors contribute significantly to the time-consuming domestic chore of accessing water, restricting women's ability to invest in agricultural activities. In poor rural households there are few labour saving options to reduce this burden, and women's access to potentially useful assets, such as bicycles to carry water, is very limited.

Seasonal calendars for Mello village in Nsanje (Figure 3) and Mitawa village in Machinga (Figure 4) give insights into the relationships between domestic water insecurity, agricultural activities and household food insecurity. In Mello, for example, peak water scarcity and collection times coincide with the beginning of the hunger season, when energy levels are likely to be low. In Mitawa, the hunger months fall exclusively within the rainy season, when the disease burden tends to be greatest: water sources are contaminated and malaria is coupled with hunger and malnutrition, which compromise the body's immune system (Devereux, 2009), increasing the healthcare burden and reducing household labour availability. These problems are exacerbated by floods.

Many poor rural households in Malawi suffer from the 'hunger season', where they run out of their own-produced maize several months before the next harvest of rainfed crops (FAO, 2011a). In the communities we studied, rainfed production remains the main source of both income and subsistence, even where irrigation is practiced. The hunger season therefore coincides with low cash flow months (see Figures 3 and 4) when households prioritise what little money they have to buy food – and when maize prices are at their highest (FAO, 2011a). During drought conditions the ultra-poor can spend 75% of their income buying food at the market (Murphy and Tembo, 2014). Little money is left to cover other expenses, potentially making it more difficult for a Water User Committee (WUC) to finance repairs to a broken water point. “We can't afford to fix the borehole because money is short; maybe we will fix it after we have harvested the crops” (Ntchisi, women's focus group). A borehole may be out of service for long periods of time, further contributing to seasonal water insecurity.

The seasonal calendar for Mello also shows that domestic water insecurity, and therefore peak collection times, coincides with a busy time in the agricultural calendar. Farmers are watering and harvesting the last of their irrigated crops whilst preparing land for rainfed production. Towards the end of the dry season, tension over labour allocation rises as water becomes scarcer and more effort is needed to abstract and/or convey the necessary volumes to irrigate crops.² In Mitawa, farmers reported that they were resorting to night irrigation due to water scarcity.

Finally, in cases where a water source (improved or unimproved) is used for multiple purposes, there are risks that certain uses are prioritised over others, particularly during times of scarcity when competition for water intensifies. Women’s ability to negotiate access to water, including for domestic needs, then becomes critical. This is an important consideration when introducing irrigation – a highly consumptive use of water during the driest months of the year.

An expert interviewee noted that there have been cases where certain domestic uses, such as clothes washing, are banned or restricted by a Water User Association to safeguard agricultural uses. This suggests women have little say in the decision-making process. Evidence from the Lake Chilwa catchment indicates that improved drinking water sources play an important role in supporting productive activities such as brickmaking, brewing and dry season vegetable production, contributing directly to household incomes and food security (Mulwafu, 2003). However, there have been disputes, both latent and overt, over the use and management of water for different purposes (Mulwafu and Khaila, 2002). Although this did not appear to be a problem in the sites we visited, where communities were reportedly using different sources for irrigation and domestic needs, an NGO representative noted that borehole sources were being developed in some parts of Nsanje for multiple needs and that governance of these sources was a key issue.

Table 3: Seasonal patterns of water availability and agricultural production in Mello village, Nsanje

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainy season												
Flooding												
Water-related diseases**												
Water scarcity at its peak												
Rainfed production	Millet*		Cotton	Maize; G/nut					Tilling			Planting
Irrigated production			Planting	Crop	sales	->	->	->	->			
Hunger period												
Low income months												

Notes: *Harvests for a selection of key crops. Harvests are intentionally staggered – millet provides much needed subsistence early in the year, ending the hunger period, however this reduces production later in the year and can exacerbate food shortages; cotton is prioritised as an important source of income, commercial markets opening May to June

**Malaria, diarrhoea, dysentery and cholera are common in Malawi during the wet season

2 On the other hand, in two sites the WUC will increase the irrigation intervals when water becomes scarcer; therefore, although irrigation turns are longer, they are also less frequent.

Table 4: Seasonal patterns of water availability and agricultural production in Mitawa village, Machinga

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainy season	■		■								■	
Water-related diseases*	■										■	
Water scarcity							■					
Rainfed production						Harvest	->		Tilling	->	Planting	
Irrigated production			Planting			Harvest & Planting			Harvest			
Hunger period	■											■
Low income months	■					\$	\$	\$	\$	\$		

Notes: *Malaria, diarrhoea, dysentery and cholera are common in Malawi during the wet season

Ethiopia has also made significant progress in extending access to safe water. The Universal Access Plan (UAP), launched in 2005 and revised in 2011, was key in galvanising political and financial support for water supply and sanitation as a means of alleviating poverty. More recently, the One WASH National Programme (OWNP) (FDRE, 2013) has reiterated the government’s commitment to achieving near universal access to safe water in rural and urban areas (98% and 100%, respectively) and extending access to basic sanitation.

The country started from a very low base. In the late 1990s, access to safe water and sanitation stood at roughly 19% and 5%, respectively. By 2015, government estimates – albeit contested – put the figures close to 80% and 70%, respectively. Figures for 2015 released by the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation put access to safe water and sanitation at 57% and 28%, respectively (WHO/UNICEF, 2015b).

Despite these gains, the number of people lacking access to safe water and sanitation remains amongst the highest of any African country (FDRE, 2013; Calow et al., 2013). A major factor is population growth: in 1980, Ethiopia’s population was roughly 35 million; by 2000 it was 66 million; and by 2020 it is expected to reach 112 million. In addition, sustaining existing services remains a key challenge: many systems fail to provide safe water on a continuous basis – for security of supply – or fail completely after construction. This has been termed a ‘hidden crisis’ because sector stakeholders have tended to focus on new infrastructure and assumed functionality, with coverage data based on systems installed rather than the services people actually receive (Calow, Ludi and Tucker, 2013).

The issue of sustainability, and links between water and food security, have been brought into sharp focus by the El Niño-related drought currently affecting large parts of the north and east of the country. Over 10 million people are in need of emergency assistance, with around 2 million estimated to have lost access to safe water (Ethiopia Humanitarian Overview, 2016). Although there is a well-developed early warning and response system, it remains geared towards food needs despite evidence from this and previous droughts that access to safe water is a major, interrelated problem. The ongoing failure of local springs and wells, the primary source of safe water in rural areas, is now a critical issue, with mounting evidence that malnutrition, disease and population movement is driven by water scarcity (ibid).

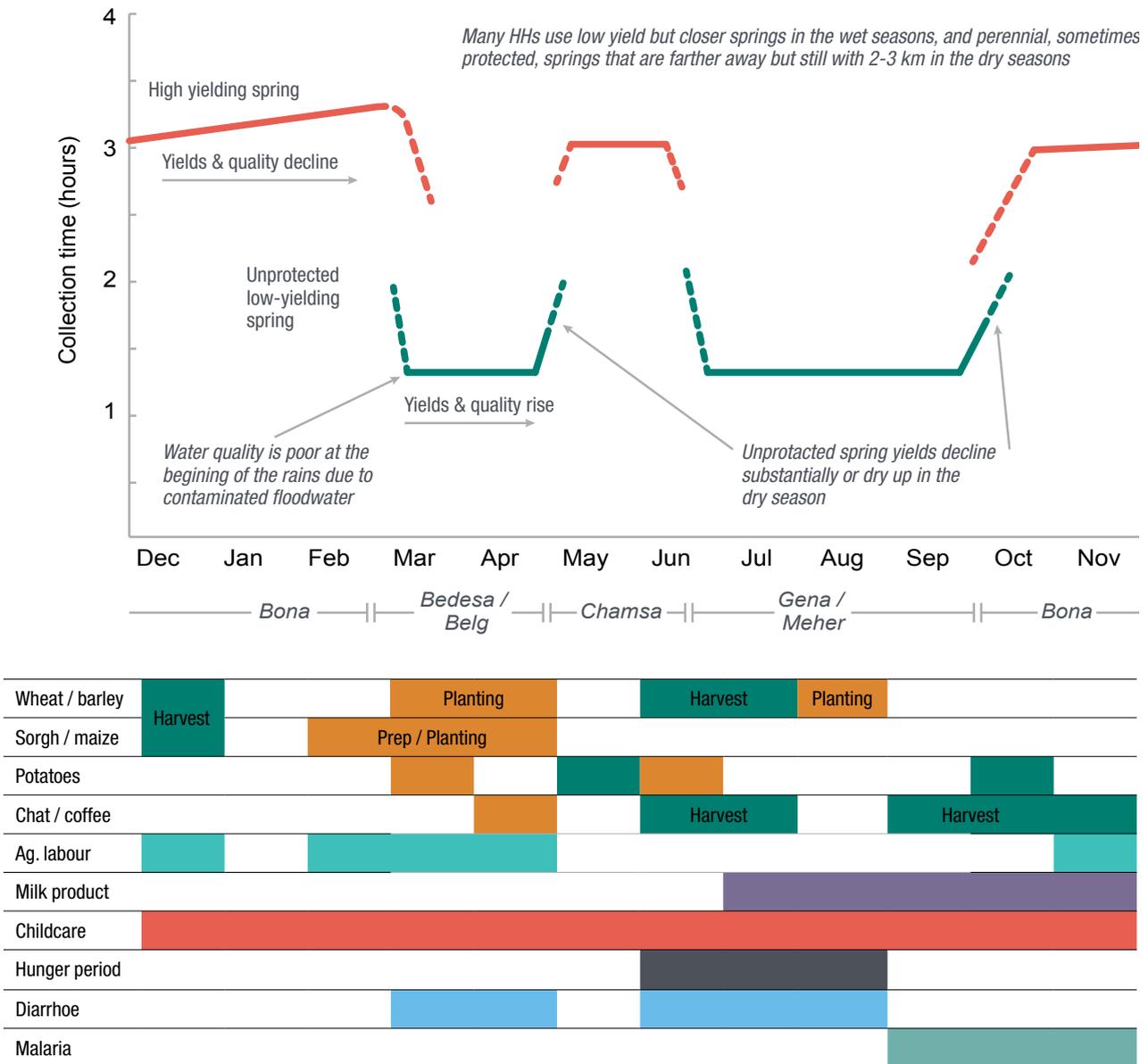
Despite evidence that food and water insecurity are inextricably linked, policy responses across SSA still focus overwhelmingly on food needs. In short, droughts (and other shocks) are viewed as ‘food crises’ (Calow et al, 2010; Tucker and Yirgu, 2011). This is symptomatic of a more widespread problem: food and nutrition are viewed as agricultural issues (Alpha and Gebreselassie, 2015). As such, the public works component of Ethiopia’s Productive Safety Net Programme (PSNP) – the largest social safety net in Africa – is focused on agriculture and natural resource management, and remains disconnected from (for example) OWINP. As Calow (2010) argues, the prevailing ‘food-first’ approach to drought response reflects the organisation and remit of government and donor bureaucracies rather than livelihood realities.

Insights into the links between water and food security, and the trade-offs that have to be made between agricultural and water calendars by women in particular, have been highlighted by detailed water audits (see Box 6). In Ethiopia, these have followed an approach

pioneered in the Research Inspired Policy and Practice Learning in Ethiopia and the Nile Region (RiPPL) programme called WELs: Water, Economy and Livelihoods analysis, led by the Overseas Development Institute (ODI). What emerges can be complex and context-specific, but at times of peak labour demand, convenience is consistently prioritised over quality, for example regarding use of a more distant improved source for drinking needs. The ‘mental map’ of choice

between sources evolves as part of a range of calculations about costs (and opportunity costs), the distance-time continuum, and perceptions (and knowledge of) specific risks and rights (Dessaiegn et al., 2013; Tucker et al., 2014). Often, women have to bear the mental and physical stress of these choices and trade-offs (Stevenson et al., 2012).

Figure 3: Conflicts between seasonal water access and livelihood activities



Box 5: Understanding seasonal conflicts over labour allocation

Detailed water audits conducted in Ethiopia show how families juggle the burden of water collection with agricultural labour and other productive activities. The WELs approach takes traditional seasonal calendars one step further by (a) plotting water collection times for each source used by households by month of access; and (b) repeating the exercise for different wealth groups within a community. Combined calendars reveal points of conflict over household labour allocation and other ‘pinch points’ – for example, when water quality dips, water-related illness becomes a problem, and off-farm income is affected. The approach also seeks to quantify how much water, of different quality, and from different sources, is used by similar groups of households over the year for comparison with international (emergency) thresholds^{*}, and for comparison between ‘normal’ and ‘drought’ years.

The calendar below (and in Figure 3) shows the relationship between water access and livelihoods in a ‘wheat, barley and potato’ livelihood zone in Oromiya Region. Similar calendars have been prepared for other livelihood zones, and show consistent trade-offs between water access, water quality, agricultural labour, and non-farm employment, including the ability to migrate. In each case, trade-offs are made by women, but with impacts that affect the entire household. And in each case, it is poorer households that are affected most as they typically have the least labour to commit to water collection, have limited water storage and transport options (e.g. donkeys), and have the least cash to pay for water charges or collection by others.

Periods of vulnerability for poor households in Wheat, Barley, and Potato Livelihood Zone in parts of East and West Hararghe, Oromiya Region:

- November – February. Peak agricultural labour season coincides with long lines and water collection times of the long dry bona season (3-5 hours in a normal year). Overlapping labour requirements restrict the ability of poorer households to secure enough good quality water, limiting both the frequency of water collection and the incentive to walk to higher quality, protected sources.
- March – April, the beginning of the Belg/Bedessa rainy season. Diarrhoea incidence peaks at the beginning of the rains, when water quality is extremely poor at springs due to contaminated floodwater run-off. Disease coincides with the peak agricultural labour season, decreasing the productivity of households and reducing income.
- July – August, the beginning of the Meher/Gena rainy season. Diarrhoea again peaks due to contaminated floodwaters. This coincides with the hunger season from June to August, when cash reserves are lowest before the harvest, and households’ own crop reserves have run out. Medical treatment is likely to be forgone in favour of food purchase during this period.

Note: * Defined by Sphere (2011) as 7.5 – 15 litres per capita per day for domestic use (drinking, cooking, personal hygiene and laundry/cleaning in emergency situations).

Source: Coulter et al., 2010.

4.1.3 Responses and recommendations

Although the evidence base linking WASH with gender equality and opportunity is weaker than often assumed, there is abundant suggestive evidence that access to safe water and sanitation can improve female market participation and raise women's productivity both within the home and within agriculture. However, WASH interventions do not generally take sufficient account of the multiple burdens women face across domestic and productive (and sometimes reproductive) spheres, and how these can intensify as seasonal 'pinch points'. Food security interventions, meanwhile, often ignore the critical importance of water.

We argue that donors and implementing organisations investing in water supplies should better plan for seasonal patterns of water insecurity and multiple uses of the same water source, which particularly affect women. Those supporting food security also need to build in a greater emphasis on water. Specifically, we recommend that they should:

- understand seasonality: how the demands of inflexible agricultural and water calendars interact and impact on women, and what can be done to plan for and predict 'pinch points'
- respond to how women and men actually use water, and design or adapt systems accordingly, for multiple uses
- increase complementarity between WASH and food security programming, to protect livelihoods before lives are threatened by food and water insecurity.
- In this section, we elaborate on each of the above points, building on promising examples we identified through our case studies and from the wider literature.

Understanding seasonality

The seasonality and sustainability problems associated with water services are well rehearsed, yet underappreciated in terms of their knock-on effects on women's workloads and the inflexible and precarious nature of the agricultural calendar. In planning and designing rural water services, much more can be done to account for seasonal fluctuations in the supply of and demand for water, and for longer-term pressures resulting from climate change and population growth that jeopardise sustainability. Sustainability is a core concern for the WASH community, and work is currently underway to better understand why so many rural water services fail completely or provide unreliable and/or poor quality water after completion (Bonsor et al., 2015).

Ways of operationalising this research are also emerging. Guidelines currently being rolled out across five regions in Ethiopia deal explicitly with predicting and mitigating seasonality-related risks in the wider catchment – for example from floods and from seasonal declines in water availability (Calow et al., 2015). Although they take a much broader view of sustainability, these approaches

still focus on the supply side. Practitioners also need to be equipped with corresponding tools to understand the demand side: how different groups of users (notably women) face trade-offs in their labour allocation, which can intensify seasonally. Simple approaches like seasonal calendars, developed through single and mixed-sex focus group discussions, provide a starting point.

In terms of follow-up maintenance and back-stopping, there is a welcome and growing recognition of the need to 'professionalise' services. Looking beyond the water point, water storage and transport emerge as key problems for poorer women. Those investing in water infrastructure would therefore do well to examine how donkeys, carts and containers (as examples) could ease the water burden and release labour for agriculture and other activities.

Meeting multiple needs

Women, and communities more generally, rarely want and use water for 'domestic' needs only. People also use water for productive needs, such as 'backyard' gardening, livestock keeping, the processing of agricultural products, brewing and brickmaking, even if (as is usually the case) the water point was only designed for 'domestic' use. The separation of 'domestic' and 'productive' water needs is unhelpful, reflecting sectoral divides not livelihood realities.

Although the reality of multiple uses is not new, they are rarely planned for. There is now a wealth of evidence and practical guidance regarding multiple use services (MUS) (van Koppen et al., 2014). Multiple use water services can be developed by upgrading single use systems, for example by adding cattle troughs or small irrigation systems to a domestic system ('domestic-plus'), or by adding a standpipe or washing basin to an irrigation system ('irrigation-plus'). Alternatively, a 'MUS-by-design' approach begins from scratch, matching design and provision to people's needs at the planning stage (Adank et al., 2008).

The best field examples show how basic needs can be protected, and women's priorities 'designed-in' to both hard infrastructure and local user-group institutions. Interest in MUS is on the rise in Ethiopia, though it remains a rarity. Several implementing organisations – mainly NGOs – have developed or upgraded to MUS over the last 10 years, and MUS is recognised as an important option in national planning guidelines. Nonetheless, more widespread adoption is hampered by the issue of sectoral boundaries: if MUS meets both domestic and productive needs, then it is neither a drinking water intervention (under the Ministry of Water, Irrigation and Electricity), or an agricultural one (under the Ministry of Agriculture). This suggests that operational guidance alone will not be enough and donors need to engage with policy dialogue and technical assistance to help overcome institutional siloes.

Increasing complementarity between WASH and food programming

Food security and nutrition programmes in SSA are often dominated by agriculture. Links between water, agriculture and food security may be known, but still figure too little in safety net programmes designed to prevent people slipping into chronic poverty, and early warning and response plans designed to prevent or mitigate crises. This point picks up on the prevailing ‘food-first’ approach to assessing and responding to climate hazards, and especially droughts, discussed above. It also relates back to our observation on the difficulties rural women face in allocating labour between water collection and farm/off-farm activities, but broadens the scope of our recommendations, beyond the WASH community, to those working on food security from both development (e.g. safety nets) and humanitarian (e.g. early warning and response) perspectives.

Social safety net programmes need to do more to incorporate WASH, recognising benefits from WASH (e.g. release of women’s labour for other activities, multiple uses of water), and benefits to WASH (e.g. protecting water infrastructure from land degradation). In Ethiopia, a pilot approach to extending the Productive Safety Nets Programme, ‘PSNP Plus’, aimed at supporting graduation from social assistance for vulnerable households, concluded that ‘safe access to WASH is a necessary condition for livelihood and food security initiatives to succeed’ (USAID, 2014).

Early warning and response systems need to recognise that water insecurity is part of the food and livelihood equation (Calow et al, 2010; Tucker and Yirgu, 2011). That implies: sharing information between sectors (water and food, humanitarian and development) on gaps in service provision and areas where water system functionality is a known problem; targeting water scheme rehabilitation to areas of known food and water insecurity; and adapting tools such as WELs to help identify ‘pinch points’ in agricultural and water calendars in the livelihood zones that are known to be most vulnerable to pressures and shocks.

4.2 Assets and institutions

4.2.1 Nature of the problem

Despite growing rates of urbanisation, Africa remains a predominantly rural continent, and most rural inhabitants depend on risky rainfed agriculture for a livelihood. Although water is vital for agriculture, and irrigation provides a buffer against rainfall variability, only 5% of Africa’s cultivated land is irrigated, and most of this is concentrated in a handful of countries (Foster and Briceno-Garmendia, 2010). Over the past 40 years, only 4 million hectares (ha) of new irrigation has been developed in SSA – by far the smallest expansion of any region (ibid).

Key finding:

Irrigation provides a medium-term buffer against seasonal and drought-related food insecurity for poor rural households. However, benefits for women are mediated by their access to other resources and opportunities, such as the economic means to invest in land, equipment and inputs, and the ability to participate in decision-making processes to secure water rights.

Recommendation:

Donors and implementing agencies should build greater sensitivity to gender-related economic and social barriers into their support for irrigation, and into their accompanying efforts to develop productive irrigation-based rural economies.

Against a backdrop of population growth, rising demand for food, and accelerating climate change, the irrigation picture looks set to change. Sustainable land management and reliable water control form the centrepiece of major new initiatives such as the Partnership for Agricultural Water for Africa (AgWa) under the Comprehensive Africa Agricultural Development Programme (CAADP), Feed the Future, and The New Alliance for Food Security and Nutrition (Calow and Mason, 2014). In Ethiopia, a country that has suffered more than most from chronic food insecurity linked (in part) to climate risk, the latest poverty reduction plan aims to triple the irrigated area by 2020 (FDRE, 2015). And beneath the statistical radar, smallholder-based groundwater irrigation is also beginning to accelerate in SSA as urban and rural economies converge, markets open up, and cheap pumps from India and China make irrigation more attractive (Calow and MacDonald, 2009; Dessalegn and Merrey, 2015).

Improved AWM and irrigation expansion has the potential to boost yields, increase climate resilience and reduce poverty. But who stands to benefit from the changes underway? More specifically, will investment in irrigation – both ‘formal’ and ‘informal’ – help close the gender gap in access to resources and opportunities, or merely accentuate it?

Ownership or control over natural assets – land and water – is clearly key. Although there is considerable variation within and between countries, women in SSA typically have much less control over land than men, through formal title or customary rights, and the size and quality of the croplands they use are lower. And since access to land typically goes hand-in-hand with access to water, women are at a double disadvantage (Meinzen-Dick et al., 1997; World Bank, 2009). Even where tenure or ownership systems have shifted to ‘joint titling’ (e.g. Ethiopia), strong customary pressures can still dictate that control over land-water, including inheritance, is dominated by men.

While control over land and water remains central, women experience many other gender-based constraints that limit their opportunities – for example, in terms of their access to farming technologies, inputs, livestock, credit, markets and agricultural extension services (FAO, 2011b; Agarwal, 2011; World Bank, 2014b; Doss and Morris, 2011; Meinzen-Dick et al., 2011).

However, there are nuances related to internal household dynamics. Women and men live in shared households and farms and the distribution of work, resources and control across the homestead can be fluid, and subject to constant renegotiation and flux (Okali and Keats, 2015; Cleaver, 2000). Women have agency which they can exert within the structural confines that limit their ability to participate. For example, Jackson (1998) describes how women negotiate relationships to their advantage within apparently oppressive patriarchal water and land regimes. Yet even when we acknowledge women's power within the household, and their informal or de facto control over shared resources, we are still left with the conclusion that women often plant less marketable crops, and have less access to the productive resources needed to boost production and income (World Bank, 2009). Our case study research explores how women are affected by productive water (in)security and the potential solutions supported by irrigation and AWM.

4.2.2 Evidence of the problem

In Malawi, agriculture is a major contributor to the economy. The sector generates 80% of foreign exchange earnings and supports the majority of livelihoods in the country, being the main source of employment for 80% of the labour force (FAO, 2011a). Smallholder farmers produce three quarters of Malawi's total agricultural output, commercial farmers the remainder (Murphy and Tembo, 2014). Women play an active role in production, which is the primary occupation of 94% of women compared to 85% of men. Most women work as *mlimi* – unpaid subsistence or family farmers (FAO, 2012a).

The vast majority of farmers in Malawi rely on rainfed agriculture, with little capacity to invest in irrigation. Rainfed production is highly sensitive to climatic variability, contributing to erratic productivity and food insecurity (Murphy and Tembo, 2014).⁴ “Last year the rains finished early before the crops had matured; this year they are delayed and people are queuing to buy food” (NGO representative speaking about the current situation in Nsanje). Whilst the Government of Malawi (GoM) recognises the potential of irrigation as a driver of economic growth and increased food security (GoM, 2012), there has been little in the way of public investment.⁵ In fact the Minister of Agriculture, Irrigation and Water has recently come under attack in the media

Box 6: Smallholder irrigation in Malawi

The irrigation potential for Malawi is estimated at 400,000 ha. To date, less than 20% has been developed, a third of which is under smallholder production (Wiyo and Mtethiwa, 2008, cited in Kamwamba-Mthethiwa et al., 2012).

Smallholder irrigation in Malawi falls into two broad categories – informal and formal (Mulwafu, 2003). Informal irrigation has its origins in *dimba* cultivation, where farmers grow crops on small plots of swampy or wetland areas, or *dambos* (Kamwamba-Mthethiwa et al., 2012). *Dimba* is widely practiced in rural Malawi and constitutes a large portion of smallholder irrigation. However, these sites are almost always neglected in the irrigation literature (Mulwafu, 2003).

Dimba was found to be most prevalent in Kambwiri village, Salima district, where the wetland floods seasonally, but in almost all case study sites some *dimba* gardens were being cultivated.* Farmers traditionally use watering cans or scoops to transfer water from shallow wells to crops, irrigating on an individual basis. With external support, some have started using treadle pumps and/or have formed groups for collective irrigation, pooling resources and sharing produce and income.

A second, formal, type of irrigation development is found in two case study villages, namely Mitawa (Machinga district) and Sambakusi (Ntchisi district). These gravity-fed canal systems or irrigation ‘schemes’ divert water from the river and, at least in theory, have the potential to irrigate a large area. They represent classic cases of irrigation management transfer, having been funded and built by external actors and handed over to a local Water User Committee for operation and management. Like many such schemes, the focus on infrastructure and ‘potential’ has diverted attention away from the underlying constraints to agricultural production (Chiroro, 2015).

Note: * The exception is Mello village, Nsanje, where irrigation had not been practiced prior to external intervention.

- 3 Other challenges include declining soil fertility, limited use and uptake of technologies, market failures, and a growing population leading to increasing pressure on natural resources and reductions in the size of land holdings (Murphy and Tembo, 2014; FAO, 2011a; World Bank, 2007, cited in Kilic et al., 2013).
- 4 Significant public resources are currently being channelled towards the Farm Input Subsidy Program in support of rainfed production. Concerns have been raised regarding the effectiveness of the program given the persistence of high poverty levels (Kilic et al., 2013).
- 5 The two villages in Ntchisi were the exception. Here seasonal off-farm employment is less common, perhaps because the communities are more remote.

Box 7: The gender gap in Malawi's agriculture sector

In Malawi, 32% of agricultural holdings are held by women – much higher than most African countries but still far from equal. The majority of plots (83%) are acquired through inheritance (Kilic et al., 2013). Despite the significant number of matrilineal communities in Malawi, particularly in the Central and Southern regions, women's access to land is often through the family head, who is almost always a man (FAO, 2011a). Female-managed plots are 12% smaller than those of their male counterparts on average (Kilic et al., 2013; see also FAO, 2011a).

Empirical analysis by Kilic et al. (2013) shows that female-managed plots are, on average, 25% less productive than male-managed plots. Key factors contributing to this gap are differences in the area under improved seeds or export crops, differences in land quality, access to farming equipment, and access to extension services on topics related to crop production and marketing. Relatively low levels of male household labour on female-managed plots, and high child-dependency ratios, serve to further exacerbate inequalities in productivity.

Low levels of male labour on female-managed plots highlight the constraints women face in mobilising or supervising male household members. However, female-headed households also have one third fewer working members than male-headed households, on average (FAO, 2011, citing data from the Rural Income Generating Activities (RIGA) database 2004-2005).

These findings highlight the importance of access to labour-saving technologies for women, especially in light of the domestic tasks (e.g. water collection) women also have to undertake (Kilic et al., 2013).

for not prioritising irrigation development in light of the ongoing drought.

In our case study sites, small-scale irrigation was found to play an important role in mitigating seasonal production deficits, allowing (limited) dry season cultivation of crops (Box 7). Irrigated production is mainly geared towards crops for sale, including green maize, and the income is primarily spent on buying food during the hunger season. Where irrigation activities exist, women actively participate and are represented equally on the WUC.

In Mello (Nsanje), Kambwiri (Salima) and Mitawa (Machinga) villages, most irrigators were women,⁵ the most common reason given being that women tend to prioritise food production whilst men pursue more lucrative income earning opportunities during the dry season.⁶ Nevertheless, women face more constraints that hinder their ability to reap the full benefits of irrigation investments, compared to men. Many of these barriers reflect gender inequalities in Malawi's agricultural economy (see Box 8).

Firstly, we found that women find it more difficult to secure the finances to rent land, purchase or rent equipment, and obtain inputs such as fertilisers and improved seeds. This is partly explained by differences in income earning opportunities between men and women, as well as control over household finances. The World Development Report (World Bank, 2012) finds that as many as 34% of

married women in Malawi are not involved in decisions about spending their earnings. Similarly, in our case study sites, although some women consult one another regarding sales and expenditure, authority ultimately lies with the husband. Covert means of resistance were evident, however. "Sometimes the men don't even tell their wives what they have sold, or might spend the money on beer. If the woman wants to prevent her husband from selling maize to keep some for food, sometimes she will go straight to the mill for pounding, and she can even leave the flour with her grandmother." (Ntchisi, women's focus group). Yet strategies such as this risk provocation. An NGO representative reported spikes in gender-based violence following harvest, when men are no longer reliant on women's contributions to production. On the other hand, where women are cultivating independently of their husbands (for example the Women's Group in Kambwiri, Salima), they appear to have greater control over the income generated.

Secondly, the ability to rent or purchase land and equipment clearly has direct implications for access to water and the ability to expand (or relocate) irrigated production. For example, in Kambwiri village, close to Salima town and its market, irrigation is perceived as a lucrative activity and rents have become more expensive. Most renters are men – except for the Women's Group, whose members have pooled resources – and tenure is insecure as rents are renegotiated each season. There is a risk that when irrigation is perceived to be a more

⁶ The observation that women tend to prioritise food production and men cash income (including cash crops) is also made by Murphy and Tembo (2014). Meanwhile Kamwamba-Mtethiwa et al. (2012) find that where both men and women irrigate, women tend to spend additional income from irrigation on food, whereas men are more likely to purchase non-food items.

profitable enterprise than alternative employment, women get pushed out of irrigation by men, who control the land or are better able to afford rents.

In Mitawa village (Machinga) the WUC has established a set of by-laws to obligate farmers with large land holdings on the irrigation scheme to rent some of their gardens, ensuring that every member of the group has an irrigated plot. Rent payments can also be deferred until after harvest. Nonetheless, rent is expensive, and for female-headed households, it can be difficult to raise the necessary finance.

Treadle pumps also make a significant difference to water access, as compared to watering cans or scoops, allowing farmers to irrigate larger areas and/or grow more than one crop a year (see also Lwesya and Vedeld, 2008). However, in these communities it is generally only the men who can afford to pay for hire, the implication being that women are reliant on external support to obtain pumps. Similarly, a study by Kamwamba-Mthethiwa et al. (2012) of treadle pump adoption found the vast majority of pump owners were men.

Interestingly, the research indicated that low subsidised pump prices were more conducive for adoption by women than was the provision of loans, whereas government policy currently promotes the latter approach.

Treadle pumps are actively promoted by the Government and some NGOs in dambos, where water is relatively easy to access, as a low cost option for the poor (Kamwamba-Mthethiwa et al., 2012). Several studies indicate that treadle pumps can improve smallholder income and food security in Malawi (Lwesya and Vedeld, 2008; Mangisoni, 2008; Kamwamba-Mthethiwa et al., 2012), although the technology is criticised due to the high human energy cost involved in pumping water (e.g. Lankford, 2009). The fact that women are willing to adopt this labour-intensive technology indicates that few alternative income-generating activities are available.⁷ However, research by Kamwamba-Mthethiwa et al. (2012) showed that adopters were generally better off than non-adopters from the outset on nearly all counts, indicating that poverty remains a barrier to uptake. Lwesya and Vedeld (2008) similarly observe that treadle pump adopters tend to control more land and labour, have higher education levels and are better able to access credit – all factors where women are at a relative disadvantage.

Thirdly, there were some indications from our case studies that social norms and local power – that shape decision-making and natural resource management at community level – were having a negative effect on women's access to

water on irrigation schemes managed by WUCs. Several experts noted that women's representation on WUCs does not necessarily equate to effective participation or control over decision-making. Moreover, although by-laws are in place to ensure equal allocations of water, their effectiveness is questionable (see also Chiroro, 2015). For example, when it came to negotiating irrigation turns with other farmers, women in Sambakusi village (Ntchisi) said they preferred to send their husbands, sometimes finding it difficult to assert their rights vis-à-vis men. This implies that when competition over water becomes more intense, female-headed houses are at a particular disadvantage.

Finally, there are serious questions regarding the sustainability of irrigation development in Malawi. In the communities we visited, farmers were highly dependent on external support to access irrigation technologies and there was little evidence that farmers were able to cover the cost of repairs. In Machinga, for example, a group of farmers had received treadle pumps free of charge as part of a donor project. These functioned for about three years before the pipes became damaged and farmers stopped using them. Replacing the damaged pipes was simply too expensive even for wealthier members of the community. Subsidies or giving pumps away for free allegedly undermines sustainability, which is why farmers are now expected to pay, with the help of loans. As noted above, however, subsidies may be more effective than loans in increasing women's access to treadle pumps (Kamwamba-Mthethiwa et al., 2012).

The canal systems we visited were relatively new, so it was difficult to ascertain their long-term sustainability. However, research by Chiroro (2015), among others, indicates numerous challenges with such schemes. His study of two irrigation schemes in Nsanje district revealed significant difficulties in ensuring equitable access to land and water, and in resolving conflicts. It found that a sense of collective responsibility was severely lacking. Moreover, although irrigation was contributing to food security, there was little evidence of financial profitability; set against high operation and maintenance costs, this implies that the viability of these schemes is unrealistic without external support. Chiroro argues for a reconsideration of the model of formal schemes, and suggests a move towards irrigation development centred on farmers' own innovations.

Ethiopia is even more dependent on agriculture than Malawi. Despite double-digit economic growth over the last decade and the growing importance of urban services and manufacturing to GDP, around 85% of the population still live in rural areas, with most depending on subsistence-orientated rainfed agriculture (Warner et

⁷ Lwesya and Vedeld (2008) find that irrigation has traditionally been perceived as a woman's task (men would not irrigate with watering cans) and therefore the introduction of treadle pumps has reduced women's workload.

al., 2015; FDRE, 2015). Moreover, millions of Ethiopians face a seasonal food crisis every year: smallholders are unable to produce a full 12 months of food, and face a pre-harvest hungry season characterised by high food prices and limited (and low-paid) off-farm work (Devereux, 2009).

This pattern of persistent and chronic vulnerability affecting the ‘bottom’ 20% has arisen for several interlinked reasons, including rapid population growth, dwindling farm sizes, functional landlessness (particularly affecting the young), land degradation, increased climate variability, and poorly functioning markets for inputs and outputs, especially in more remote areas (Ellis, 2013; Warner et al., 2015). In terms of women’s livelihoods, sector reviews highlight many of the same constraints discussed for Malawi: rural women have less access to and control over land and other assets, and less access to agricultural inputs, credit and labour markets (Warner et al., 2015).

Policy responses to address chronic vulnerability have for many years focused on social protection. Ethiopia’s flagship programme, PSNP, is intended to provide predictable transfers in cash or food to help bridge the hungry season, complemented with ‘household extension packages’ to help strengthen and diversify livelihoods. These focus mainly on agricultural activities. The PSNP is essentially a labour-based programme; around 85% of beneficiaries receive cash transfers through the Public Works component, under which households ‘build’ assets linked to natural resources management (e.g. terraces, community forests) in return for cash.

To its credit, the Ethiopian government has attempted to mainstream gender considerations across all of its flagship agricultural policies and programmes, and many others as well. The Agricultural Growth Programme (ADP), the Sustainable Land Management Programme (SLMP) and PSNP cover large parts of the country, and all set out to address women’s needs and gender-related gaps in access to assets and opportunities. For example, implementation guidelines for the PSNP address women’s workload, representation in committees, joint ownership of ‘client cards’, and targeting for specific groups such as polygamous women.

Translating policy prescriptions into action on the ground remains difficult however, leading Warner et al. (2015) to conclude that the government has not been able to implement effective gender-sensitive policies over the last 20 years. Key constraints appear to be similar to those that affect many programmes in Ethiopia: either policy prescriptions fail to reach those charged with implementing them, or those charged with implementation lack the capacity to do much because of high rates of staff turnover and vacancies at local levels.

Over the last 10 years or so, policies have also focused on exploiting the country’s water resources more fully to support ‘green’ growth and poverty reduction under the national Growth and Transformation Plan (GTP). The GTP is water and land centred in that it sets out ambitious plans to increase access to clean energy (through hydropower), extend the area under irrigation, and encourage the growth of water-dependent agro-industries (FDRE, 2015/16).



Photo: Naomi Oates — An all female focus group maps their village and surrounding environment, including different water sources. Kambwiri village, Salima district, Malawi

Current irrigation practices cover roughly 2% of the land area (FDRE, 2015), but investment in new irrigation schemes is increasing rapidly. A total of 5 million ha of irrigable land across 176 sites has been identified for feasibility assessment (FDRE, 2015). New irrigation is starting in the Omo, Awash, Didessa, Tana Beles, Baro Akobo and Tekeze river basins to supply sugarcane, cotton and other crops. Groundwater-based irrigation is also accelerating, much of it farmer-financed as new market opportunities open up for high value crops (Calow et al., forthcoming). While data on groundwater development by Ethiopian smallholders is lacking, it is clearly visible and growing where resource and market conditions are favourable. Indeed the scale and speed of development has raised concerns about the impacts of unconstrained development on other uses and users, including domestic supplies (ibid).

Expanding the area under irrigation, and reducing dependence on rainfed agriculture, has the potential to reduce many of the risks women (and men) face in the agricultural economy, and open up new opportunities through savings and investment. In practice, the distribution and level of costs and benefits depends heavily on how irrigation is conceived, implemented and managed. In terms of formal, state-funded irrigation schemes, a common criticism is that many are planned without much attention to either market opportunity or the operation and maintenance costs of running them. This creates a real risk that schemes will underperform against targets, and fail to deliver the reliable services that poorer farmers need to build assets (Oates et al., 2015).

More bottom-up, localised development of shallow groundwater irrigation may hold out greater promise for smallholders, and for women (FDRE, 2015; Gowing et al., 2016). Groundwater has the potential to meet both domestic and minor productive needs, and offers key advantages (over surface water) in terms of its reliability, scope for opportunistic development across wide areas, and controllability (Calow and MacDonald, 2009; Calow et al, 2010). Moreover, because groundwater can be accessed with simple technologies and its application controlled by individual farmers, it lends itself to small plot irrigation. This, in turn, can open up opportunities for women, since plot horticulture is traditionally viewed as the ‘women’s domain’ (FDRE, 2015).

Looking up the value chain, contract-farming or ‘out-grower’ schemes (e.g. for sugarcane) offer the potential to lower risk by helping small farmers overcome the technical barriers and transaction costs involved in meeting stringent demands. Commercial value chains for processing high-value irrigated products such as fresh fruit, vegetables and flowers are also growing rapidly in areas with reliable water and new transport links – to both national urban centres and international markets. Private investment, foreign and domestic, is being actively courted by federal and state governments through tax breaks and other ‘sweeteners’.

The impact of these trends for women remains unclear in Ethiopia. Evidence from other countries in Africa suggests female farmers are largely excluded from modern contract-farming arrangements because they lack secure control over land and family labour (FAO, 2011b). While data from other countries regarding female participation in high-value agricultural commodity chains are also limited, there is some suggestion that women dominate employment in Ghana, Malawi, Senegal, Kenya, Uganda and Zambia (Hertz et al., 2009, Maertens and Swinnen, 2009). While export-orientated agro-industries may not employ men and women on equal terms, they can, in places, provide better opportunities for women than exist within subsistence-orientated agriculture. Moreover, Maertens and Swinnen (ibid) suggest that new jobs in commercial value chains can act as ‘instruments of change’, with broadly positive implications for women and rural development, supporting a gender transformative agenda.

However, there remain significant challenges to the idea that participation in value chains for commercial, irrigated agriculture will offer a route out of poverty and towards empowerment for poor rural women in SSA. First, because of the inevitable gendered power dynamics at household and community levels. In out-grower schemes, for example, men may control contracts, while much of the farm work is done by women. Second, irrespective of gender, caution is needed about the scale of these value chains in the short to medium term. Ellis (2005), for example, argues that while high-value export crops (vegetables, flowers etc.) can generate significant foreign exchange earnings, they will not change the livelihood status of millions of poor farmers, since so few can be absorbed by such ventures. And third, there is the risk that commercial irrigation will lead to ‘capture’ of available water resources, to the detriment of smallholders. Calow et al. (forthcoming) highlight the dangers of privileging large-scale, water-intensive commercial agriculture and agro-industry at the expense of smallholders, or domestic users, in circumstances where competition for water is increasing.

4.2.3 Responses and recommendations

The discussion above has illustrated the importance of irrigation for increasing food security in a predominantly rainfed agricultural system, and the role that external actors can play in facilitating access to technologies. However, careful consideration is needed of the nature and gendered implications of such support, including appropriateness of technologies, governance arrangements, and financing mechanisms, to ensure effective targeting of poorer and more vulnerable groups. In particular, women may be disadvantaged in terms of access to and control of assets and rights that enable irrigation.

Our headline recommendation in this area is that donors and implementing agencies should build greater sensitivity to gender-related economic and social barriers into their support for irrigation and accompanying efforts



Photo: Aziz Ahmed — a woman collects water from a community pump, to use for drinking, cooking and washing. Metahara, Ethiopia.

to develop productive irrigation-based rural economies. Specifically, that means they should:

- invest in institutions to enable women’s collective action around irrigation activity such as women’s groups and savings and loan schemes
- use irrigation investments as a platform to challenge deeper gendered inequalities, for example by working with male champions of change and using qualitative monitoring to understand challenges and progress towards women’s empowerment
- facilitate women’s participation in the groundwater irrigation economy, with gender-sensitive delivery and communication for female smallholders; and appropriate safeguards (e.g. contracts and childcare) for female employees in commercial irrigation value chains.

We elaborate on each of these recommendations below, drawing mainly on examples from Malawi and Ethiopia.

Enabling women’s collective action for irrigation. Women smallholder farmers’ own agency is the starting point for enabling their enhanced participation in irrigation. External support agencies should see their role as facilitators of collective action by women (with men, as necessary) to improve gendered outcomes from irrigation investment themselves. Parallel investments in mechanisms and institutions that enable collective action are therefore just as important as providing equipment and infrastructure.

We found several positive examples in our Malawi case study. In Kambwiri village (Salima), members of a women’s group have overcome financial barriers to accessing land and inputs by clubbing together to rent a dimba garden and treadle pump for irrigation. The women share responsibilities, relieving the constraints on labour. Produce and income are shared equally within the group. The women involved felt that the group had empowered them to take more control over production and management of their finances. In Mello village (Nsanje) a similar group for collective irrigation has been formed with NGO support, which involves both men and women (although men are in the minority). Reported benefits included ability to better negotiate market prices (avoiding intra-community competition) and to secure access to irrigable land, which is scarce.

In Nsanje one NGO described how it was promoting village savings and loans (VSL) schemes as a means to boost women’s incomes. Members of the group have to contribute a fixed sum to the pool of savings, which is then loaned to individuals with interest. Profits made on these loans are subsequently distributed among group members. VSL schemes such as this are intended as self-sustaining and self-replicating mechanisms to overcome difficulties in access to credit for the poor in remote areas, and are also a vehicle for gender transformative change (Karlan et al., 2012).

Such schemes are not, of course, silver bullets, and care is needed to ensure they are resilient to environmental risks and social pressures. In terms of environmental

risks, in Mello village, Nsanje, floods associated with El Niño wiped out crops – and hence investments – making it difficult to raise VSL contributions the following year. Most households had invested returns in agricultural inputs to boost rainfed production. In terms of social pressures, research by Karlan et al. (2012) on the impacts of CARE’s VSL programmes in Ghana, Malawi and Uganda has shown that they have potential to contribute to women’s empowerment, particularly the degree of influence on household decision-making over business actions. There were also suggestions that women had more influence over food and education decisions as a result of VSL. However, the programme appeared to have little impact on women’s social capital or participation in other community meetings. Problems can also arise when a woman borrows money for the initial investment from her husband, who then claims the earnings for his own purposes.

Challenging gendered social norms

The above example highlights that institutions as much as infrastructure can be captured by more powerful interests – often male. Rather than shying away from these issues, external support agencies need to engage, taking an iterative approach to understand the dynamics of local gendered inequalities, and need to monitor change as sensitively as possible. Over time this can progress from a ‘gender sensitive’ to a more ‘gender transformative’ approach. Although water-related programming is unlikely to resolve deep-rooted discriminatory social norms, it can provide an entry point as an area in which both men and women have major stakes.

To understand how women and men differentially access and control institutions like land and water rights, as well as physical assets like irrigation equipment, those designing and planning interventions need to take time to assess the context-specific situation. Relatively simple participatory techniques such as focus group discussions, mixed and by gender, can go some way to avoiding unhelpful assumptions. It may be important to involve men in the process of challenging gender-based discrimination. One example from our Malawi field work is the use of male leaders of change, or role models, to promote gender equity, particularly in respect to management of household finances and decision-making. The NGO in Nsanje said it was using this approach to tackle some of the problems around capture of VSL proceeds (“it starts in the household”).

Monitoring gender equity with simple indicators of representation – such as the number or proportion of women in WUCs, or even the number of women in decision-making positions, is a start but can be deepened. Questions should be posed carefully regarding women’s and men’s relative influence within decision-making around water for productive purposes, both in group discussions and in individual interviews. Even these

qualitative approaches may be open to manipulation by more powerful interests, but could provide more of a guide to direction of change than simple quantitative metrics of representation.

Facilitating women’s participation in the groundwater irrigation economy

Groundwater-based irrigation offers a major opportunity for SSA’s smallholder farmers – female and male. While state-funded, formal irrigation projects may be falling into the same ‘underperformance’ trap as their South Asian equivalents did 30 years ago; household irrigation based on the exploitation of shallow groundwater may offer a more widespread counterbalance. At the same time, the growth of commercial agriculture and agro-industry, which is also often based on groundwater, can in some areas offer better paying employment opportunities for women in modern horticultural value chains. In both cases, however, tailored support is necessary to ensure that women benefit.

First, for smallholders irrigating themselves, a key advantage of groundwater is the scope for opportunistic, farmer-led development – especially of shallow groundwater – in the absence of a government programme or policy, and without subsidy. Nonetheless, external support may be needed to help overcome the familiar hurdles of deeply entrenched gender inequalities in access to land, and therefore water. In Ethiopia, a new initiative led by the Agricultural Transformation Agency (ATA) has developed a Household Irrigation Strategy (FDRE, 2015), which aims to accelerate development of the groundwater economy. The intention is to catalyse the development of a ‘vibrant and self-sustaining household irrigation sector’ (ibid).⁸ The strategy identifies 17 ‘systemic’ bottlenecks across the value chain, to be addressed by 29 ‘strategic interventions’. Bottlenecks affect farmers’ ability to understand irrigation potential, invest in technology, access inputs, achieve peak production, retain their harvest, access markets and achieve stable prices. Importantly, the strategy also deals explicitly with gender gaps in all of the above, for example in terms of flexible financing options targeted specifically at women’s groups, and tailored delivery methods for communicating technical knowledge and market information.

Second, looking to high-value commodity chains as they develop from their low base, action will be needed on two fronts. One is to ensure that women’s contracts and employment conditions are comparable with those of men, and are enabled by complementary services such as adequate childcare (Samman et al., 2016). The other is to ensure that powerful commercial interests do not transfer water by stealth from those with the weakest political voice – perhaps the smallholder looking to take her first step on the irrigation ladder. National governments bear primary responsibility on both counts, but donors and external agencies can help by ensuring these issues are prioritised in investment and technical support.

⁸ Defined by ATA as less than 5 ha and involving fewer than 10 households.

Key finding:

Migration is an important strategy at the household level to cope with seasonal food and income shortages, or the impacts of droughts or floods on production. Women generally have few options to pursue off-farm work in urban areas and industry.

Recommendation:

Governments and their development partners should support opportunities for diversification of rural women's livelihoods, while maximising the benefits of existing and inevitable patterns of migration from the farm to other areas.

4.3 Mobility and livelihoods

4.3.1 Nature of the problem and gendered view

We have so far focused on the farm and rural economy, but this perspective requires broadening for two reasons. First, the movement of people and money between rural and urban areas is inevitable and can play a role in the ability of women, and men, to withstand stress and shocks associated with climate variability and water insecurity. The impacts of the current El Niño-related drought have exposed the continuing vulnerability of 'successful', fast-growing economies. In truth, however, even modest disruptions to the timing, frequency and intensity of rains can mean the difference between 'coping' and 'not coping' for millions of poor, rural households in SSA.

Second, there remain questions about whether the primary focus for creating more equitable, resilient and transformative economic growth should be on rural areas at all. The 'agriculture first' view, dominant for last 10 years or so, argues that pro-poor growth comes from agriculture initially; more broadly, that agricultural growth is a prerequisite for the transformation of national economies and for the livelihood diversification that results. An opposing view – that of the 'agricultural sceptic' – is more likely to see diversification as responding to the failure of agriculture to generate secure livelihoods for rapidly growing populations. As Ellis (2005, 2013) argues, it is 'better to build upon and facilitate workable rural-urban mobility than fall back on false expectations about the poverty-reducing capabilities of farming on its own'.

We do not want to focus on the larger debates about 'what comes first'. Few observers doubt that agricultural development is a necessary, if not sufficient, condition for poverty reduction and food security in Africa (Wiggins, 2009). What we can say with some confidence is that livelihood diversification – and the opportunity it creates for households to spread risk between different areas, assets and activities – is likely to be low-regret whether it leads or follows growth. A key question is therefore how new pathways towards more secure and diversified livelihoods can be opened up for the most vulnerable. This is the focus of our third finding, which extends the

scope of the analysis to patterns of migration from rural agricultural economies to (predominantly urban) service and industrial economies – and the associated flows of remittances.

In Asia, labour mobility has been key to livelihood diversification and economic transformation. Despite well-publicised checks on permanent rural-urban migration in China, for example, human mobility and the associated flow of remittances have formed the cornerstone of that country's economic transformation. Despite widespread narratives about urbanising Africa and the growth of an urban middle class, this picture is less clear for SSA. While the 'urbanisation' picture does vary between countries, few SSA economies achieve productive urban economic development of the sort that leads to broad-based employment growth and investment (Potts, 2013). Caution is therefore needed about there being a vast and increasing 'pool' of livelihood opportunities in Africa's cities and towns. Opportunities do exist, however, for work in cities and, in many natural-resource-based economies, mines. Patterns of migration are often temporary, seasonal and circular.

Disentangling motivations for migration is also difficult, and more could certainly be done to understand the role of water insecurity and climate variability and change. Interviews with over 100 long- and short-term residents in informal settlements of Accra, Ghana, point to the precariousness of livelihoods based on dryland farming as motivating some migration, though conflict was also cited as a contributing factor (Tschakert and Tutu, 2010). Links between climate change and migration are a source of debate. Some have argued that climate change could create large numbers of displaced international 'climate migrants' (Myers, 2002). Gemenne (2011) and Dercon (2012) argue that the empirical basis for this scale of displacement is very thin. Rather, they support the view that lower wealth accumulation in rural settings may hinder large-scale migration from marginal areas, contributing to 'spatial poverty traps' in which people have no option but to remain in marginal and vulnerable lands. However, this argument may overemphasise costly migrations (especially international ones) relative to the types of migration in which poor people are more heavily engaged (seasonal, circular).

The gender composition of mobility can be mixed, though in SSA migration of all types has historically been dominated by men (Ellis and Harris, 2004). Where female migration does occur, it is restricted to particular national labour markets, such as domestic services in urban centres. However, where growth in manufacturing is occurring, and tasks are considered by employers to require female aptitudes ('nimble fingers'), migration opportunities for women can open up (ibid). This is the case in China, with millions of rural-registered women now working in urban factories making white goods. Since men have simultaneously sought work in construction, children have often been left behind in the countryside with grandparents.

If people can move, what about money? There is growing evidence of the importance of remittances in supporting the livelihoods of those that stay behind, particularly for women. Almost 20 years ago, a comparative study of household income portfolios in SSA revealed that 15% of rural incomes were accounted for by remittances (Reardon, 1997). Earnings or remittances from migration can play a key role in addressing what many rural households identify as a bottleneck to farm and non-farm investment: access to cash. This, in turn, can be invested in land improvements, irrigation, water storage, and education. International evidence (Box 9) also indicates how remittances can play a positive role in helping households deal with and recover from natural disasters (e.g. Mohapatra et al., 2009; Quartey, 2006; and Generoso, n.d.). However, there is little evidence of how remittances can facilitate preparedness (ibid). Moreover, research on Mali indicates that whilst remittances can enable households to solve temporary food security situations, their effect on structural food security issues may be minimal (Generoso, n.d.).

4.3.2 Evidence of the problem

Rural livelihoods in Malawi remain centred on farming activities, which account for 60% of household incomes (FAO, 2010, citing data from RIGA, 2004-2005). Subsistence farmers often work away from their farms, but much of this is wage labour on other people's land. Devereux (2009) states that *ganyu*,⁹ or casual agricultural labour, is one of the most important strategies for coping with the hunger season in rural Malawi. This was certainly the most common form of paid employment in our case study villages.¹⁰ A major disadvantage of *ganyu* is that it competes with a household's own farming

activities – peak demand coincides with peak labour requirements (Devereux, 2009). Diversification into non-farm income generation would offer more generous rewards as well as reducing the risks associated with dependency on rainfed agriculture.

Where employment opportunities are limited locally, one strategy that individuals or households can adopt is to migrate. In Malawi, 4% of household heads reportedly move on a long-term basis in a single year (Lewin et al., 2012, citing data from NSO, 2004-2005). The majority of permanent migration is from one rural locality to another (Montgomery and Balk, 2008, cited in Lewin et al., 2012). Rural-urban migration appears to be increasing, but is often circular – people migrating temporarily in search of cash (Lewin et al., 2012). Internal migration is primarily driven by rural poverty and growing pressure on land due to rapid population growth (Murphy and Tembo, 2014). Intra-rural migration has also been influenced by the presence of tobacco estates (Potts, 2006, cited in Lewin et al., 2012). International migration, meanwhile, has been low and declining since the 1970s when many migrants returned to Malawi, in part due to growth in national employment opportunities (Christiansen, 1984, cited in Lewin et al., 2012). Data show that over the 1998-2009 period, 90% of Malawian emigrants moved to other SADC countries, of which 79% went to South Africa. Most migrants find work in the mines or on farms (IOM, 2015).¹¹

Pull factors to urban areas include education and alternative income earning opportunities (Mwanakatwe and Kebedew, 2015). The extent of 'push' from climate and water insecurity is less clear. Experts we interviewed

Box 8: Remittances as a disaster response?

- Analysis of household survey data in Bangladesh shows that per capita consumption was higher in remittance-receiving households than in others after the 1998 flood.
- Ethiopian households that receive international remittances seem to rely more on cash reserves and less on selling household assets or livestock to cope with drought.
- In Burkina Faso and Ghana, international remittance-receiving households, especially those receiving remittances from high-income developed countries, tend to have housing built of concrete rather than mud and greater access to communication equipment, suggesting that they are better prepared against natural disasters.
- In Ghana, remittances were found to improve household welfare and help minimise the effects of economic shocks to household welfare. However, they do not offset the shocks completely, except for food crop farmers – the poorest in the country.
- In Mali, remittances enable households to solve temporary food security situations, but they have no effect on structural food security issues.

Summarised from Mohapatra et al. (2009), Quartey (2006) and Generoso (n.d.)

9 Referred to as *danyu* by Devereux.

10 Although some households made money selling fritters, fruits, firewood or charcoal, for example, there was little evidence that they were engaged in such activities on any significant scale.

11 Malawians have historically been a source of cheap labour to the Southern African mines, agricultural sectors and other social services. This trend has continued even after the lapse of the labour agreements under apartheid. Malawi has also recently signed an agreement with the United Arab Emirates to facilitate labour export (IOM, 2015).

in Malawi noted that temporary migration has always been a coping strategy for dealing with seasonal stresses and periodic shocks to agricultural production. Lewin et al.'s (2012) study of long-term, or permanent, migration in Malawi nonetheless found that individuals were less likely to migrate if their household had experienced a precipitation shock in the last five years, the hypothesis being that such shocks reduce a household's income and capital making it harder for them to move. The same authors note, however, that these findings are at odds with other empirical research that shows that weather shocks push people to migrate in low-income settings (e.g. Mueller and Osgood, 2009, on Brazil).

From a gender perspective, although national statistics for Malawi show that migration is not exclusively a male phenomenon, women are more likely to move shorter distances (e.g. within the district) whereas men travel further afield to nearby districts or towns or even abroad. Moreover, the main reason cited by rural men for migration was to look for work, whereas rural women tend to move primarily for marriage, although they may also find employment (FAO, 2010, citing data from RIGA, 2004-2005). Figures from the national population census (cited in FAO, 2011a) show that the sex ratio in rural areas changed by 1% over the 1998 to 2008 period (currently around 52% women compared to 48% men); in urban areas the pattern is reversed. The share of female-headed households in rural areas is also higher than urban areas (24% versus 15% in 2008), likely due to the out-migration of men (ibid). Consequently, rural communities are becoming increasingly feminised. At the same time, women, and female-heads of household in particular, have fewer options and have greater difficulty in translating their labour into secure paid work. Over 90% of economically active (rural) women are engaged in unpaid farming work compared to 79% of men (FAO, 2011a). Hyder and Behrman (2014) observe that Malawian women tend to be concentrated in sectors that don't require high skill levels – namely agriculture – suggesting that unequal education entrenches their limited opportunities to migrate.

Our case studies indicate that the pattern and extent of male migration varies between districts or even communities. Long-term or permanent migration appeared to be most pronounced in Kambwiri village, Salima. A local NGO estimated that roughly 30% of men had gone to South Africa, whilst most of the rest were in Lilongwe or other urban areas. In other case study sites, migration was strongly seasonal in nature. In Nsanje it is common for men to go across the border to Mozambique to work as agricultural labourers or find other employment. The men go for short periods of time (one to two weeks) during the lean months (September to January) and bring back money or food. Similarly in Machinga “it is common in a bad year for the men to

go away, for example to buy fish from Lake Chilwa to sell, or go to Mozambique for casual work – they can be away for a few weeks, or even months” (women's focus group). Migration was less common in the two villages in Ntchisi district, which are relatively remote, particularly compared to Salima, indicating that proximity to urban centres or transport appears to play a role. Whilst migration is clearly one way of dealing with seasonal or drought-related water-food insecurity, impacts on the women left behind can be mixed. Where husbands bring back food or money, or send remittances, there are obvious benefits: remittances help households survive at a time of year when food and cash run out. However, many women complained that their husband's contributions were unreliable and/or insufficient. “In some cases men are not able to send back remittances – it is not clear why, perhaps because life in town is expensive” (NGO representative). Credible data on the significance of remittances are scarce, particularly for informal channels. There are indications that remittances from diaspora through formal channels are increasing, offering prospects for supporting growth and economic development in the country (IOM, 2015).

There are social as well as financial transactions at stake, moreover. Some women in our case study communities felt abandoned by their husbands – left to fend for the household on their own. “They [the men] don't leave enough money behind, and when they go we [the women] don't have any coping strategies. The man is supposed to come with food and money but sometimes they stay away for too long” (women's focus group, Mitawa village, Machinga). In Kambwiri village, Salima, the women claimed that it was easier when their husbands remained at home. Female-headed households also struggled to keep children in school because they needed labour. Specifically, there is pressure on young girls to help mothers collect water, cook, and even earn money.¹² On the other hand, women also have more freedom to make household decisions, including those relating to agricultural production, when men are absent.

Many of the issues highlighted for Malawi also apply to Ethiopia. In particular, the reliance of subsistence-orientated farmers on off-farm labour; the constraints women face in accessing rural and urban labour markets; and the importance of remittances as a prop to rural livelihoods. Indeed remittances – especially international ones – may be playing a very significant role during the current drought in preventing a much bigger crisis.

One issue that sets Ethiopia apart, however, is its decades-long focus on agriculture-led poverty reduction and an explicit, or implicit, doctrine of ‘keeping people on the land’. As Ellis (2013) notes, this occurred for half a millennium under feudal relations of production. Following the revolution, land was nationalised by

12 Other risks associated with migration include HIV/AIDS transmission and prostitution. Marriages can also break down, especially when men move away for long periods of time.

the Derg in 1975 and eventually redistributed as small farm plots in a succession of land reforms. However, movements out of the village were, and still are, strongly discouraged. Ethiopia remains an overwhelmingly rural country. Insecure land rights and weak rental markets act as a continuing break on labour mobility, which a succession of reforms have only partially addressed. These can have particular implications for women and their ability to move.

Ethiopia has made progress towards gender equality in land rights through a number of reforms. Land remains state-owned, allocated according to the number of household members. The current legal framework still prohibits the sale or purchase of land holdings. However, certified use rights, introduced through a comprehensive land registration and certification process, are transferable through inheritance, gifting, divorce and rent, providing some of the advantages of land ownership. Specifically on women's rights, the most notable reform is towards joint titling (registering land in the names of both husband and wife). Joint titling is now mandated in Amhara and Oromia regions and the Southern Nations, Nationalities, and Peoples' Region (SNNPR). Tigray began registering land in 2003 before joint titling was introduced, and does not have this requirement. Tenure security afforded by land registration and certification is reported to have increased the productivity and welfare of female-headed households (e.g. Bezebih et al., 2012). Studies of the impact of joint land certification in SNNPR suggest the process has increased women's involvement in decision-making about land (e.g. Holden and Bezu, 2013).

Significant gaps remain, however, that serve to penalise women and impede labour mobility and livelihood diversification. First, formal reforms continue to be undermined by traditional practices, particularly around the gender imbalance in inheritance rights. Second, most regional and local land proclamations limit migration, the area of land that can be rented out, and the length of contracts. Depending on the region, contracts exceeding 3 years must be registered. Land holders may also be prohibited from renting all of their holdings, or lessees must only be engaged in farming. In most areas, a key conclusion is that tenure security is only achieved through constant use of land, and that female-headed households in particular are at risk of losing their rights if they do not maintain this. This creates a strong incentive locking women in agricultural livelihoods.

It is also getting harder for women to make a living from the land they are locked to. The average arable land area per person in Ethiopia is now less than 0.3 ha, and has been declining for decades. Jayne et al. (2012) reviewed land and farm size in 10 African countries and found that the greatest percentage reduction in mean arable area per person from the 1960s to the 2000s occurred in Ethiopia, with a 56% decline. The issue of diminishing farm size is particularly acute for women, since they have the smallest land holdings, control the poorest land, and have the weakest inheritance rights (if not in law, then in custom).

This in a context where a sizable and growing proportion of the rural poor already have insufficient land to produce food for the whole calendar year. Even when farms are not physically subdivided, inter-generational land-sharing reduces the effective land area for individual families in an extended family or clan. All the while, population growth adds roughly one million people each year to those trying to secure a viable livelihood from ever-smaller plots (Ellis, 2013). Whether the particular challenges for women are being picked up remains to be seen. Officials are likely more concerned with the pool of functionally landless (male) youth with few options to turn to.

Against this background, it is not unreasonable to question whether poverty reduction on the scale needed can continue to come from the farm economy. A much more rapid rural-urban transition may be needed to reverse declining farm size, provide a stronger domestic market for farm outputs, increase the cash circulating in rural areas, and take the pressure off degraded watersheds.

4.3.3 Responses and recommendations

Having expanded the scope of our analysis spatially, to urban and other off-farm locations for employment, we can see that women farmers face layered vulnerabilities. The first layer comes from the same drivers that encourage men to seek employment elsewhere (such as climate change, diminishing farm size, and land degradation). The second layer comes from the fact that women may face even greater labour burdens when they are left to look after farms (and families) on their own. This is not a simple picture. Family ties and remittance channels mean migrating household members, male or female, may support those who stay behind. As our case-study evidence begins to show, women can also gain greater control and agency over farm management decisions when men are absent. And women do themselves migrate in some instances.

What emerges from the above assessment is that productivity gains in agriculture alone will not be enough to build secure livelihoods for rapidly growing populations in the face of environmental change – for women or for men. Caution is needed around the ability of rural-urban migration to alleviate the pressures, particularly in SSA. But given that such migration for livelihood diversification will likely continue (albeit mainly circular), as a low-regret option for those households that have the option at all, ways need to be found to ensure the trends benefit poor rural women.

We therefore recommend that governments and their development partners support opportunities for diversification of rural women's livelihoods, while maximising the benefits of existing and inevitable patterns of migration from the farm to other areas.

That implies:

- increasing rural livelihood diversification opportunities, including broader investments in public goods, and extending public works

investments beyond agriculture to wider skills development

- facilitating remittances through mobile banking with a particular focus on women's access to financial services (as senders or receivers)
- investing in research to better understand opportunities and constraints for women arising from migration.

Drawing on the research, we expand on each of these as follows:

Increasing diversification opportunities

Some key constraints lie outside the remit of the water sector – for example, the lack of public goods like roads, electricity, and communications, which create local conditions for private initiative, exchange and mobility. However, closer to the domain of water management is the question of the production-orientated bias of many rural development and safety net programmes. This requires a rethink. The priority should be to support policies that have a broadly beneficial impact on all forms of economic activity, rather than a narrow focus on agriculture alone. In particular, the kind of agriculture- and water-management-focused activities that dominate public works programmes (such as catchment restoration, terracing under Ethiopia's PSNP) need to be supplemented with other activities aimed at providing people with the skills needed to pursue non-farm rural occupations and to diversify income sources.

Facilitating remittances

When women remain in rural areas while men migrate, they may benefit from remittances that can be reinvested in farm and off-farm activities. Ensuring that these flows are accessible to and empowering for women is therefore a priority. In Malawi, it was reported that a number of banks now offer services to facilitate sending and receiving remittances, particularly from people working in South Africa, but that these were more convenient for those in areas closer to town like Salima. Mobile money transfers are also available, with two service providers with wider coverage in Malawi providing such a facility.

The development of digital financial services such as this offers important opportunities for reach into remote areas, yet rural women will not inevitably benefit – over 1.7 billion women in low- and middle-income countries do not own mobile phones (GSMA, 2015), and the World Bank notes that much more needs to be done to make digital technologies gender informed, for example by involving women at early stages in their design (World Bank, 2016). The wider implications of digital financial services for women's empowerment also need to be better understood. For example, evidence from a cash-transfer programme in Niger indicated that women gained greater influence over household decision-making thanks to the privacy and

control associated with mobile money transfers, compared to conventional, manual transfers (Aker et al., 2014).

Investing in deeper analysis

While our research indicates that understanding needs to be deepened across many of the areas we have covered, the question of how rural women experience migration and livelihood diversification opportunities and constraints (both their own and those of men) is perhaps the most compelling. Key topics within this broad area include: control of resources and assets within farm economies when men are (temporarily or permanently) absent; how far remittances do effectively buffer climate-related shocks and particularly reduce structural vulnerability for female-headed households; and the role of different land and water governance systems (e.g. matrilineal vs patrilineal inheritance in Malawi, land rental markets in Ethiopia) in incentivising household (and male vs female) decisions about migration.¹³



Photo: Beatrice Mosello — Women in Malawi are responsible for collecting and carrying firewood for use in the home, a heavy time and labour burden. Zomba, Malawi

¹³ Expert opinion would suggest that the relationship is complex.

5. Conclusions

The impacts of El Niño-related drought in the Horn and Southern Africa in 2015-2016 have refocused global attention on water (in)security associated with climate variability. Developing countries that rely on rainfed agriculture for economic growth and livelihoods are particularly exposed. Much of SSA already experiences high levels of climate variability, and projections indicate that this will increase in many regions. Within this context, improving agricultural water management is critical – ensuring a secure supply of water to grow crops for sale (economic opportunity) and sustenance (household consumption).

We have argued that attention to the needs and capabilities of female farmers is critical to improving AWM, and to achieve SDGs 2 and 6. It is also critical to achieve other SDGs, including those on poverty reduction (SDG 1) and gender (SDG 5). Men and women have different access to, and different rights and responsibilities in relation to, land and water for agricultural production – meaning that water insecurity associated with variability will have different impacts. Yet AWM investments are still too often gender blind, or fail to make a link to the wider issues that constrain empowerment and agency of poor female farmers. There is a large amount of literature across disciplines that considers the relationship between climate change and gender, the climate impacts on water availability for agriculture, and gendered perspectives on production. Our analysis has sought to bring this together to understand how rural women and men are differently affected by water (in)security associated with climate variability, and how interventions to address the gender inequalities around water resource management might help support more sustainable and equitable outcomes.

From review of global evidence and country case studies in Malawi and Ethiopia we have drawn attention to three key ways in which women farmers can be differently affected by water insecurity, variability and drought:

- Women have to deal with inflexible agricultural and water calendars, with time-pressures and trade-offs increasing around periods of seasonal water scarcity and agricultural labour demand.
- Women often have less access to or control of assets as compared to men – assets that might be used to buffer against the effects of rainfall variability (for example the equipment, land, and access rights needed for small-scale irrigation).
- Women often have fewer opportunities to pursue off-farm work or migrate to urban areas as a temporary coping strategy, or as positive ‘step out’ of the rural farm economy.

The literature and our primary research corroborate this narrative at a general level, although it is a simplification. It is easy to perceive only disadvantage and vulnerability

in women’s roles around AWM, though this would be to deny the agency and ability of poor rural women to navigate constraints, to the benefit of themselves and their families. Nevertheless, we argue that much more can be done to facilitate this agency and ability, to support women’s practical needs and transformative change. Collectively, governments, donors and implementing partners that aim to unlock the benefits of AWM, for transformative growth and resilient livelihoods, must take concerted action make gender a central part of their programming. We therefore recommend that they should:

- Better plan for seasonal patterns of water insecurity and multiple uses of the same water source, which particularly affect women; and enhance complementarity between programming for food and water security.
- Build greater sensitivity to gender-related economic and social barriers into their support for irrigation, and into their accompanying efforts to develop productive irrigation-based rural economies.
- Support opportunities for diversification of rural women’s livelihoods, while maximising the benefits of existing and inevitable patterns of migration from the farm to other areas.

The detailed arguments and recommendations in Chapter 4 make clear that these ideas cover a range of sectors and scales. Too often, the sectors involved are siloed: water in the domestic domain (WASH) vs. the agricultural sector (AWM); emergency relief interventions vs. longer-term development programming; food vs. water security. Overcoming these siloes is crucial – and a constant challenge – for AWM generally. However, a common focus on gender could help encourage collaboration across disciplinary and sectoral divisions. Working at a range of scales is also important, as we have explored from the level of individual water points (Home and farm); to irrigation systems (Assets and institutions); to rural-urban interlinkages in the wider economy (Mobility and livelihoods). National governments are the entities with the ability to devise and drive policy across scales, and should be supported to do so by the external partners such as donors and International NGOs seeking to promote this agenda.

Finally, we urge progressively greater ambition, based on a thorough understanding of locally grounded norms around gender, water and agriculture. This may range from improving gender awareness – recognising differing rights, roles and power dynamics while working within existing gender norms – to more gender transformative forms of engagement which begin to question, and may ultimately seek to shift and redress unequal power dynamics and gendered vulnerabilities.

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Databases

- FAO AQUASTAT, available at <http://www.fao.org/nr/water/aquastat/main/index.stm>
- FAO Gender and Land Rights Database, available at <http://www.fao.org/gender-landrights-database/en/>
- IFAD Rural Poverty Portal, available at <http://www.ruralpovertyportal.org/>
- World Bank Data, available at <http://data.worldbank.org/>

Annex 1: Case study selection

To build the index, we chose indicators that addressed components of our research questions and also provided a reasonable level of disaggregated country-level data for as many countries as possible. Some data was supplemented from multiple sources. We selected five key indicators to include the following:

1. Distribution of female agricultural holders by sex (%). This indicator acts as a proxy for unequal gender relations, and differential access to land and water resources. Data for this indicator come from the FAO Gender and Land Rights Database, and measure the percentage of female agricultural holders out of the total number of agricultural holders.
2. Rural poverty headcount at national poverty levels (%). This indicator represents the degree to which rural communities are vulnerable to negative shocks, such as climate hazards. Poorer households are more sensitive to shocks as they lack 'buffer' assets (such as food stores or savings). Poorer households may also be less educated and less able to pursue alternative livelihood strategies, which means they cannot easily adapt to changing environments. Data from this indicator come from the World Bank Data portal.
3. Employment in agriculture (%). This indicator also comes from the World Bank Data portal and measures employment in the agricultural sector as a percentage of total employment. This indicator is important as it measures the number of people who rely on agricultural livelihoods in a developing economy.
4. Agricultural irrigated land (%). The data for this indicator are from the World Bank Data portal, with gap filling data from the FAO AQUASTAT database. They measure the percentage of cultivated agricultural land that is under irrigation. Irrigation can reduce water insecurity by providing water for crops when needed during the season, and also in case of short-term droughts or delayed rains. Irrigation canals can also be used for livestock watering, for washing, and in areas with limited alternative options, for household

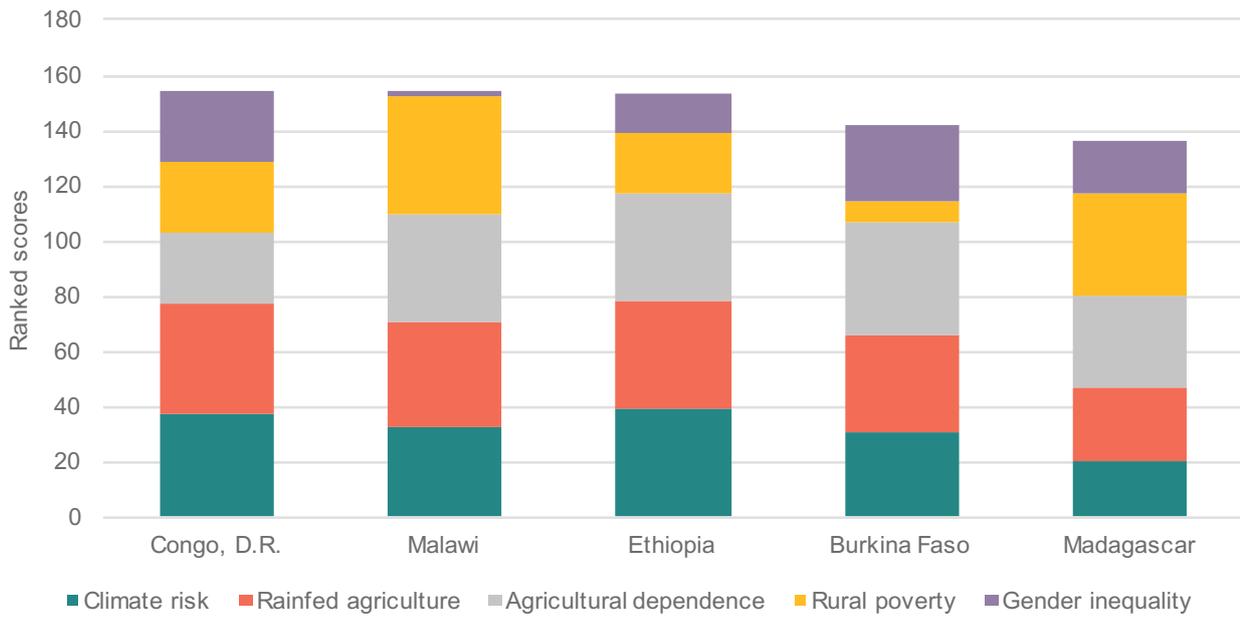
consumption. Therefore, this indicator acts as a proxy for water (in)security.

5. INFORM flood and drought exposure index. This is the only variable that is a composite index. There are multiple databases that assess climate risk. We used the INFORM Index for Risk Management, an open source tool to improve humanitarian disaster planning. The index includes data on hazard and exposure, vulnerability and coping capacity. We chose four indicators from hazards and exposure: frequency of drought events, people affected by droughts, agricultural drought probability, and physical exposure to floods. Data is sourced from the United Nations Environment Programme (UNEP) Global Risk Data Programme, which collates data from multiple sources.¹⁴

The figure below represents the proportion each variable contributes to the composite scores of the top five ranked countries. The maximum score for any indicator is 42, i.e. the country is most at risk for that particular variable. Therefore, the thicker bands of colour represent higher scores, and higher risk for the different parts of the index. All of the five top countries have high levels of agricultural dependence; however, rural poverty is particularly high in Malawi, Madagascar and the Democratic Republic of Congo (DRC). Climate risk is also relatively high for all countries except Madagascar. In contrast, Malawi, Ethiopia and Madagascar have relatively good scores for gender equality, i.e. a high percentage of agricultural land holdings are owned by women. This illustrates the importance of understanding the individual components of water insecurity within a given context. For example, in Malawi 32% of agricultural holdings are held by women, which is the second best index score after Cape Verde's 51%. This contrasts with only 9% in DRC and 3% in both Mali and Jordan. In terms of irrigation coverage, all the countries in the top five hotspots have low levels of coverage – below 10%.

¹⁴ It is difficult to develop a proxy for climate variability and hazards at the country level. Use of a single unit for climate variability is somewhat artificial, as variability includes multiple components such as different time frames (daily, seasonal, intra- and interannual) and longer-term oscillations (multi-decadal and centennial). Furthermore, climate variability data, generated by meteorological and hydrological stations and modelling, is often grid based. In developing countries, limited data collection facilities means reliance on modelling projections. For our analysis, we use climate hazards as a proxy for variability. Flood and drought are closely related to the vulnerability of individuals and communities, and support our framing within the context of increased climate hazards.

Figure A1: Top five 'hotspots' for rural women's water insecurity and rankings for each indicator



Annex 2: Malawi case study site characteristics

Table A1: Study sites – characteristics

Village*	Kambwiri	Sambakusi (A) and Nyanja (B)	Mitawa	Mello
Traditional Authority	Kambwiri	Nthondo	Chamba	Mbenje
District	Salima	Ntchisi	Machinga	Nsanje
Region	Central	Central	South	South
Climate risks	Drought, some flooding near the river (seasonal)	Less at risk, although affected by current drought	Drought	Extreme flooding, drought
Predominant inheritance system	Matrilineal	Matrilineal/mixed	Matrilineal	Patrilineal
Ethnicity	Yao & Chewa	Chewa	Yao	Sena
Predominant livelihood activity	Rain-fed agriculture supplemented with irrigation	Rain-fed agriculture supplemented with irrigation	Rain-fed agriculture supplemented with irrigation	Rain-fed agriculture supplemented with irrigation
NGOs currently active in the area	Salima Women's Action Group	Total Land Care	(Various)	Churches Action in Relief and Development (CARD) and partners
Other information	The village is located close to Salima town	These two adjacent villages are relatively remote (4-5 hours walk to the nearest market)	The village is located close to the border with Zomba district	This area is much drier than the other sites; it is very close to the border with Mozambique

Note: *General Village Headman (GVH).

Table A2: Data collection

Village	Kambwiri	Sambakusi (A) and Nyanja (B)	Mitawa	Mello
District	Salima	Ntchisi	Machinga	Nsanje
Focus group discussions	1 x women	1 x women (A) 1 x men (A) 1 x mixed (B)	1 x women 1 x men	1 x women 1 x men
Interviews with community members	1 woman	1 woman (B) 1 man (B)	1 woman 1 man	1 woman 1 man
Expert interviews	4 (2 academics, 2 NGO representatives)			

Table A3: Irrigated agriculture in our study sites – key characteristics

Village	Kambwiri	Sambakusi (A) and Nyanja (B)	Mitawa	Mello
District	Salima	Ntchisi	Machinga	Nsanje
Age of irrigation 'scheme'	~20 years; area previously used for seasonal fishing	~4 years (village A); both villages had some irrigation prior to this	~2 years; possible that there was some irrigation prior to this	1 year
Irrigated area	~5ha (area flooded seasonally by the river); some additional irrigation along the river bank	A = ~5ha B = unknown (plots are close to the river in both sites)	~10ha (potential estimated at 59ha); some additional irrigation along the river bank	0.1ha (2 irrigation groups; plans to move to another 10ha site)
Water source	Shallow wells adjacent to river	A = diversion from the river (weir) via PVC pipes B = shallow wells adjacent to river	Diversion from the river to a storage reservoir via PVC pipes	The river
Irrigation method	Treadle pumps, watering cans	A= Canal system (gravity-fed, mostly unlined) B = Treadle pumps (group), some HHs use watering cans	Canal system (gravity-fed, mostly unlined); outside the scheme HHs use treadle pumps or watering cans	Treadle pumps
Management arrangements	Individual HHs (4ha); Women's Group garden – managed collectively (1 ha)	A = Water User Committee manages the scheme B = pumps shared, irrigation individual (with exception of a small group garden)	Water User Committee manages the scheme	Group garden – managed collectively
Capital investment	Salima Women's Network on Gender has provided the Women's Group with a treadle pump	A = built by GoM with World Bank funding B = pumps bought by groups from Total Land Care	Funded by USAID as part of a catchment management programme	The group was given a treadle pump by CARD
Plot ownership	Inherited land	Inherited land	Inherited land*	Inherited land
Is renting common?	Yes	No	Yes	No
Main subsistence crop(s)	Maize	Maize	Maize	Maize, millet, sorghum
Other crops grown** <i>(Italic = solely a cash crop)</i>	<i>Cotton</i> , groundnuts, cassava, soya beans, pigeon peas, maize, vegetables, tomato, potatoes, rice	<i>Tobacco</i> , beans, onions, soya beans, groundnuts, sweet potato, Irish potato leafy vegetables, cabbage, cow peas	<i>Tobacco</i> , soya beans, pigeon peas, pumpkin leaves, sorghum, cassava, groundnuts, tomatoes, cabbage, rice, onions, vegetables, sweet potatoes, okra, millet	<i>Cotton</i> , <i>sesame</i> , maize, beans, sorghum, pumpkin, rape, tomatoes, cabbage, mustard greens, cassava, groundnuts, sweet potatoes
Other income sources	Remittances; selling firewood; selling fish from Lake Malawi; selling fruits; casual labour (agri); off-farm work e.g. in towns (men)	Casual labour (agri); selling forest products; generally few off-farm income earning options available	Casual labour (agri); selling firewood or charcoal; fish trading (Lake Chilwa); off-farm work e.g. in towns (men)	Selling firewood; making mandazi; moulding bricks; casual labour (agri); off-farm work e.g. in towns (men); village savings scheme

Notes: * There is a by-law (or MoU) in place that means all farmers who own land on the scheme have to surrender that land for irrigation. They can either irrigate themselves or rent the land to another farmer. If the piece of land is large they have to rent part of it to a HH with no land on the scheme, to ensure everyone has access.

** Note that tobacco, cotton, groundnuts, cassava, soy beans, pigeon peas and sesame are not grown under irrigation. In general irrigated crops are sold, whereas rain-fed crops are used primarily for household consumption, particularly maize. However, factors such as proximity to markets are likely to play a role. Some interviewees stated a preference for early maturing varieties in the irrigation season to allow two cropping cycles.

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