WORKING STRATEGY DOCUMENT

Realizing the Potential of Household Irrigation in Ethiopia

VISION, SYSTEMIC CHALLENGES, AND PRIORITIZED INTERVENTIONS
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List of Acronyms

A partial of list of key technical acronyms used in this document are explained below. For a list of organizations whose names may be abbreviated in the body of the text, please consult Section 1.4: Major stakeholders.

AGP Agricultural Growth Program
ATA Ethiopian Agricultural Transformation Agency
ATVET Agricultural Technical and Vocational Education and Training
DA Development Agent
ETB Ethiopian Birr
FHH Female-headed household
FTC Farmer Training Center
GDP Growth Domestic Product
GOE Government of Ethiopia
GTP Growth and Transformation Plan
HHI Household Irrigation
HVC High-value crops
HIT Household Irrigation Technology
ICT Information and Communication Technology
ISP Irrigation Service Provider
MDG Millennium Development Goal
MFI Microfinance Institution
MHH Male-headed household
MOA Ministry of Agriculture
NGO Non-governmental Organization
NRMD Natural Resources Management Directorate
PTP Pressure Treadle Pump
RBOA/BOA Regional Bureau of Agriculture
RWH Rainwater harvesting
RWP Rope-and-washer pump
SMH Smallholder Farmer
SSI Small-scale irrigation
SMS Subject Matter Specialist
SLM Sustainable Land Management
WOA Woreda Office of Agriculture
ZOA Zonal Office of Agriculture
Statement from the State Minister

Agriculture is one of the pillars of the Ethiopian economy and the overall economic growth of the country is highly dependent on the success of the agriculture sector. The Government of Federal Democratic Republic of Ethiopia has demonstrated strong commitment to agricultural and rural development through the allocation of over 10% of the national budget. Within the aim of ensuring food security of its nations, nationalities and people, the country has developed a clear roadmap of agricultural development investment framework (PIF). Irrigation development is one of the many intervention areas stipulated in PIF as a means to sustain agricultural growth. Within this, household irrigation has been identified as a key opportunity to transform the lives of smallholder farmers, increasing incomes and ensuring food security at both the household level and national level.

Based on the agriculture and rural development policies, strategies and approaches, and subsequent sector specific strategies and programs including Sustainable Land Management (SLM), Small Scale Irrigation Capacity Building, Climate Resilient Green Economy (CRGE) and the like, this household irrigation development (HHI) strategy is developed aiming at easing focused actions in view of exploiting development potential.

The strategy has been developed over a year of field research and assessment, analysis of available information, and discussions held with the participation of stakeholders. The process of strategy development has required the collective efforts of all stakeholders including regional stakeholders, federal ministries, development partners, research institutions, and NGOs. With the involvement of these stakeholders short- and long-term objectives of household irrigation have been defined. Moreover, the stakeholders have also identified their own responsibilities, and outlined a plan of action to monumental task within the next five years.

This sector strategy clearly defines the bottlenecks, interventions with their corresponding activities and time frame. It is also aligned with the government policy to encourage smallholder farmers practice household irrigation to improve their food security status and increase their household income. Considering the nation’s land and water potential and our current endeavor to let every households have at least one option of water source for irrigation, this document will aid in systematizing our planning and implementation, and especially to address household irrigation related challenges across its value chain.

With the tremendous potential of the sector in mind, I encourage all stakeholders to make their utmost efforts in the timely implementation of the interventions contained therein.

Together, we will be able to improving the livelihoods of smallholder farmers while contributing to Ethiopia’s overall vision of achieving middle income status by 2025.

Sileshi Getahun
State Minister, Ministry of Agriculture
Acknowledgements

It is with the support and contribution of many partners and stakeholders that this vision and strategy document was developed for the Ethiopian Household Irrigation value chain. Specifically, the efforts made by the MOA Natural Resources Management Directorate (MOA-NRMD) and the Agricultural Transformation Agency (ATA) Household Irrigation Program were enormous and I would like to express my appreciation for their conscientious to bring the household Irrigation Sector Strategy to its final stage. I would also like to extend my gratitude to all public, private, and NGOs at the regional, federal, and international levels who provided the data, insights, and support during the development of the strategy.

I would like to thank all who were involved in the development of the strategy document. Key partner organizations are recognized in the Stakeholders chapter of this document, and where key informants shaped our understanding of the sector, they are recognized in footnotes. The NRMD and ATA are highly appreciative of the tireless aid received during the drafting of this document, and look forward to continued collaboration toward the transformation of the household irrigation value chain and the agriculture sector as a whole.

Sileshi Getahun
State Minister, Ministry of Agriculture
Executive Summary

Household irrigation is a transformative opportunity for smallholder farmers. In a traditionally rain-fed agricultural calendar, household irrigation—defined here to cover under 5 ha and involve fewer than 10 households—opens cropping cycles during the dry season and enable farmers to grow high-value crops like vegetables. In many instances, irrigation can thus lift household income from USD$147/ha to USD$323/ha per year.¹

With current irrigation practices covering under 2% of total land area,² this income gain represents huge untapped potential for the country. It means household irrigation can enable more than 650,000 farmer households and almost 5 million Ethiopians to double their production and incomes, promoting food security, and catalyzing growth in their communities.³ The national household irrigation strategy was created to realize this opportunity.

OVERALL VISION: A vibrant and self-sustaining household irrigation sector

Increase the adoption and effectiveness of household irrigation technologies in order to
- Increase income for smallholder farmers, and
- Improve food security throughout the year
- Catalyse growth in farming communities.

Optimal returns for household irrigation depend on a strong value chain for high-value crops and reliable off-season systems for inputs and training. It will require promoting the use of both water-lifting and water-saving technologies, supplying inputs for high-value horticultural crops, and ensuring reliable market linkages for the resulting output. Smallholders must also apply best practices in agronomy and water management. Finally, services in the sector must be designed to serve the needs of vulnerable populations, like female-headed households, who have the most potential to transform their livelihoods through irrigation. (Chapter 2 explains the household irrigation context in more detail.)

To realize the full potential of household irrigation technologies, systemic bottlenecks will have to be addressed with strategic interventions across the value chain for irrigated agriculture. 17 systemic bottlenecks across the value chain have been identified, to be addressed by 29 strategic interventions. These 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. (Chapter 3 discusses these at greater length. See Table 1. Summary of objectives, systemic bottlenecks, and strategic interventions for a summary)

To be effective, interventions need to be sequenced in priority order, and implementation must be coordinated among governmental and non-governmental implementation partners. Each intervention requires activities owned by different stakeholders in the household irrigation sector and must be translated into specific, actionable deliverables owned by specific stakeholders. The final success of this strategy depends on appropriate ownership and accountability by relevant partners at all levels.

¹ BMGF and GGGI (2011).
² AGP Baseline 2011.
³ BMGF and GGGI (2011).
## Table 1. The household irrigation value chain and its components.

<table>
<thead>
<tr>
<th>Bottlenecks</th>
<th>Interventions</th>
<th>Sequence</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research, knowledge, and policy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The research system addresses all aspects of the irrigation agriculture value chain, helping policymakers make the best use of water resources, and government policies promote equitable, sustainable, and responsible use of water resources.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Poor information on the water resources available for irrigation agriculture and their current use</td>
<td>1.1a Map shallow groundwater resources nationwide and disseminate results</td>
<td>1</td>
<td>MOWIE</td>
</tr>
<tr>
<td></td>
<td>1.1b Establish national-level irrigation information management system</td>
<td>2</td>
<td>MOWIE</td>
</tr>
<tr>
<td>1.2 Best practices in irrigation agriculture not well-developed for Ethiopian context</td>
<td>1.2 Promote household irrigation in the existing agriculture research agenda</td>
<td>3</td>
<td>EiAR</td>
</tr>
<tr>
<td>1.3 Unsustainable water management practices are common</td>
<td>1.3 Enforce water management policies at the household level</td>
<td>3</td>
<td>MOWIE</td>
</tr>
<tr>
<td><strong>Technology access and adoption</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smallholders are able to access and afford household irrigation technology, after-sale services, and spare parts. Domestic producers are able to meet demands for inputs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Household irrigation pumps are low in quality and have high failure rate</td>
<td>2.1a Build the capacity of local manufacturers to meet demand</td>
<td>1</td>
<td>AMRC</td>
</tr>
<tr>
<td></td>
<td>2.1b Work with regulatory, trade, and enforcement authorities to produce and enforce national irrigation pump standards</td>
<td>1</td>
<td>MOA/ESA/ECAE</td>
</tr>
<tr>
<td>2.2 Inefficient supply chain and procurement procedures for household irrigation technologies</td>
<td>2.2 Define and install improved practices in the irrigation pump supply chain and procurement system</td>
<td>1</td>
<td>MOA</td>
</tr>
<tr>
<td>2.3 Tariffs on private imports drive up cost of irrigation technology</td>
<td>2.3 Extend the agricultural tax exemption to private procurement of household irrigation pumps</td>
<td>2</td>
<td>MOA/ERCA</td>
</tr>
<tr>
<td>2.4 Limited credit available for household irrigation technologies and associated inputs</td>
<td>2.4a Develop credit schemes that enable smallholders to invest in household irrigation</td>
<td>2</td>
<td>MOA</td>
</tr>
<tr>
<td></td>
<td>2.4b Establish a national household irrigation development fund</td>
<td>3</td>
<td>MOA</td>
</tr>
<tr>
<td></td>
<td>2.4c Build rental markets for household irrigation technology.</td>
<td>2</td>
<td>MOA</td>
</tr>
<tr>
<td><strong>Input production, procurement, and distribution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmers have reliable access to high-quality seeds, fertilizers, and pesticides for high-value crops that maximize their investment, throughout the year.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Limited availability of affordable, high-quality seeds for high-value crops</td>
<td>3.1a Ensure that all imported seeds adhere to necessary quality levels</td>
<td>3</td>
<td>MOA</td>
</tr>
<tr>
<td></td>
<td>3.1b Support the development of domestic high-value crop seed production</td>
<td>1</td>
<td>ESE</td>
</tr>
<tr>
<td>3.2 Ineffective distribution networks for irrigation agriculture inputs</td>
<td>3.2a Enable cooperatives/unions to collect demands and distribute irrigated agriculture inputs</td>
<td>3</td>
<td>FCA</td>
</tr>
<tr>
<td></td>
<td>3.2b Improve private sector supply chain for horticultural seeds</td>
<td>2</td>
<td>MOA/ESE</td>
</tr>
</tbody>
</table>
Table 2. The household irrigation value chain and its components (continued).

<table>
<thead>
<tr>
<th>Bottlenecks</th>
<th>Interventions</th>
<th>Sequence</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-farm production</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension services fully support farmers in irrigated agriculture. Farmers adopt best practices in irrigation agriculture for their local area.</td>
<td>4.1</td>
<td>Improve irrigation training curriculum and facilities for DAs</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4.1b</td>
<td>Capacitate FTCs and demonstration sites to be learning centers for HHI best practices</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4.1c</td>
<td>Employ ICT solutions to deliver timely, targeted information to DAs and farmers</td>
<td>1</td>
</tr>
<tr>
<td>4.1</td>
<td>Limited training and demonstrations for farmers on irrigation agriculture practices</td>
<td>4.2</td>
<td>Build capacity in manual well drilling through trainings and micro-enterprise</td>
</tr>
<tr>
<td>4.2</td>
<td>Limited knowledge and skill in well-drilling best practices among smallholder farmers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Post-harvest handling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Limited knowledge of best practices in post-harvest handling of horticultural crops</td>
<td>5.1</td>
<td>Train farmers on proper post-harvest techniques for horticultural and high-value crops</td>
</tr>
<tr>
<td>5.2</td>
<td>Limited access to storage and agroprocessing resources</td>
<td>5.2</td>
<td>Build storage and agro-processing capacity in cooperatives</td>
</tr>
<tr>
<td><strong>Market linkages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Inefficient linkages between smallholders and end markets for many high-value crops</td>
<td>6.1a</td>
<td>Support cooperatives/unions and private aggregators in linking with larger wholesale buyers</td>
</tr>
<tr>
<td></td>
<td>6.1b</td>
<td>Help farmers secure forward-delivery contracts in outgrower schemes</td>
<td>2</td>
</tr>
<tr>
<td>6.2</td>
<td>Limited market information available to farmers</td>
<td>6.2a</td>
<td>Build the capacity of local stakeholders as market extension resources</td>
</tr>
<tr>
<td></td>
<td>6.2b</td>
<td>Utilize ICTs to directly deliver market information to farmers</td>
<td>3</td>
</tr>
<tr>
<td><strong>Demand sinks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmers are able to access table markets with minimal supply glut and price issues</td>
<td>7.1</td>
<td>Enable woredas to determine appropriate high-value crops and cropping calendar for irrigation in their area</td>
<td>1</td>
</tr>
<tr>
<td>7.2</td>
<td>Low domestic consumption of horticulture crops</td>
<td>7.2a</td>
<td>Supply school feeding and other nutritional initiatives with local crop output</td>
</tr>
<tr>
<td></td>
<td>7.2b</td>
<td>Explore linkages to regional and international markets for horticultural crops</td>
<td>3</td>
</tr>
</tbody>
</table>
Chapter 1. Introduction

1.1 Purpose and scope of the document

This document was created to align stakeholders across the household irrigation value chain on a unified strategy that will improve the production and profitability of smallholder farmers by facilitating their use of household irrigation technologies. In particular, it aims to achieve three specific objectives:

- Identify the primary **bottlenecks** to smallholders’ success in each step of the value chain;
- Design a set of comprehensive, actionable **interventions** addressing these issues;
- Propose a series of key **activities** and appropriate owners to successfully carry out the strategy.

In the interest of brevity, this document does not include **implementation timetables, budgets, or resourcing assessment** for the proposed interventions, which will be designed by the implementing stakeholders after the national strategy has been finalized. Rather, it is intended to serve as the blueprint for the household irrigation sector, enabling stakeholders to coordinate their activities to be harmonious and comprehensive.

1.2 The household irrigation value chain and its components

A value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), and delivery to final consumers. Taking a value chain approach to economic development helps to address the major constraints faced by the sector under consideration and use opportunities available at multiple levels along the value chain. Though irrigation is a system, this document applies a value chain analysis in order to contemplate the full array of conditions that affect smallholders’ ability to engage in irrigation agriculture.

The stages of the household irrigation value chain are identified in **Exhibit 2**. For each of these stages, a vision statement captures its contribution to the household irrigation sector.

---

**Exhibit 2. The household irrigation value chain and its components.**

<table>
<thead>
<tr>
<th>Value chain step</th>
<th>Overall objective for the household irrigation sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research, knowledge, and policy</td>
<td>The research system addresses all aspects of the irrigation agriculture value chain, helping policymakers make the best use of water resources, and government policies promote equitable, sustainable, and responsible use of water resources.</td>
</tr>
<tr>
<td>Technology access and adoption</td>
<td>Smallholders are able to access and afford household irrigation technology, after-sale services, and spare parts. Domestic producers are able to meet</td>
</tr>
</tbody>
</table>

---

demands for inputs.

<table>
<thead>
<tr>
<th>Input production and distribution</th>
<th>Farmers have reliable access to high-quality seeds, fertilizers, and pesticides for high-value crops that maximize their investment, throughout the year.</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-farm production</td>
<td>Extension services fully support farmers in irrigated agriculture. Farmers adopt best practices in irrigation agriculture for their local area.</td>
</tr>
<tr>
<td>Post-harvest handling</td>
<td>Farmers are able to maximize their yield and profits through appropriate and timely post-harvest handling. The value of perishable crops is preserved through appropriate packing, sorting, and preservation techniques.</td>
</tr>
<tr>
<td>Market linkages</td>
<td>Farmers are able to efficiently access markets both domestically and abroad. Market channels for high-value crops give farmers the maximum profit on yield.</td>
</tr>
<tr>
<td>Demand sinks</td>
<td>Farmers are able to access table markets with minimal supply glut and price issues.</td>
</tr>
</tbody>
</table>

1.2 Strategy development approach

The following national household irrigation sector strategy was developed in a strategic, systematic, and stakeholder-consultative process, beginning when ATA’s Household Irrigation Project became a full program in the fall of 2012.

First, the ATA worked closely with the MoA, MoWIE, and other stakeholders to develop a vision for household irrigation in Ethiopia. Given the significant challenges present today, this vision statement aimed to be both inspirational and realistic, capturing a snapshot of what the household irrigation sector could look like in the near future.

Next, qualitative and quantitative analysis was conducted to understand the issues and constraints that formed bottlenecks to the achievement of the identified vision—the most critical of which are detailed in this document. Distinctions were made between bottlenecks affecting different parts of the value chain in order to frame solutions on discrete key issue areas that, though interrelated, engage distinct sets of stakeholders who can work independently to drive results in parallel. All bottlenecks have been identified through:

- Review and synthesis of existing diagnostic and strategy materials on the sector
- Systematic interviews with experts and stakeholders, including the Ministry of Agriculture, research organizations, academia, and other development partners, and
- Original research, including quantitative analysis on production, price, and sales trends, interviews and field visits, and case studies.5

5 This document is indebted to the Central Statistics Agency, the UN FAO, as well as numerous development and implementation partners who have collected systematic production, sales, climate, resource, livelihood, and outcomes data. A full list of data sources consulted and interviews conducted can be found in Appendix B.
Next, interventions were designed to address these groups of bottlenecks. Collaborating closely with the relevant stakeholders, the ATA developed a set of targeted interventions to address and overcome the constraints posed by bottlenecks in the household irrigation value chain, guided by the following:

- **Historical experience** in Ethiopia of successful and unsuccessful projects in the sector;
- **International best practices** that can be tailored to the Ethiopian context
- **Consultations with experts**, using problem-solving sessions to form workable hypotheses with the many stakeholders named in this document (see Appendix B. Key informants).

This set of systemic bottlenecks and strategic interventions, developed on sound analytical foundations in close partnership with stakeholders, forms the basis of the household irrigation national strategy. This document goes further to suggest activities that should be owned by stakeholders in the sector, proposing a prioritization scheme for the first five years.

### 1.3 Major stakeholders

To realize the ambitious vision contained in this document by 2020, stakeholders across all sectors and levels of government must be engaged. Below are some of the key stakeholders who have been deeply involved in the process of crafting this sector strategy, and who will become owners of specific interventions contained within it. The successful execution of this strategy will depend on their commitment, alignment, and continued engagement over the next five years.

**Ministry of Agriculture and regional Bureaus of Agriculture**

The Ministry of Agriculture (MOA) is responsible for developing and refining the overall national agricultural and rural development strategies and policies for Ethiopia, with input and support from the
regions and other stakeholders. Within MOA, the Natural Resources Management Directorate (NRMD) oversees the household irrigation program, and will be the primary owner of this sector strategy. The NRMD will coordinate implementation and regional ownership in collaboration with the irrigation offices at Regional Bureaus of Agriculture (RBOAs/Regional Irrigation Development Authorities and the zonal and woredal Offices of Agriculture (ZOA/WOA). In addition, NRMD will take the lead role in organizing joint planning, monitoring and evaluation session to align all stakeholders over the sector strategy. The MOA’s continued engagement on irrigation and the horticulture value chain—both through Irrigation offices and in its other projects—will be essential for the success of the household irrigation sector.

The Agricultural Growth Program (AGP) within the Ministry of Agriculture focuses on an agricultural growth agenda in 96 target woredas. As a major component of the GOE’s five-year Growth and Transformation Plan (GTP), the AGP supports the scale-up of household irrigation, with emphasis on groundwater resources and pump technologies. AGP funding is contributed by a number of international partners, with most irrigation-specific assistance from the World Bank. The initial focus of ATA’s household irrigation program was within AGP target woredas, and implementation of this sector strategy will continue to occur in close partnership with the AGP.

The MOA is the primary channel for agricultural research and extension services and trainings to reach SHFs in Ethiopia. Broadly speaking, agricultural research happens through the Ethiopian Institute of Agricultural Research (EiAR), which is responsible for the coordination of nationwide research trials that test such solutions, and the Regional Agricultural Research Institutes (RARIs), who are expected to conduct targeted research within various geographies to identify region-specific recommendations. Together, they will develop and disseminate research on irrigation best practices for Ethiopian smallholder farmers.

The Regional Agricultural Mechanization Research Centers (AMRCs) undertake research, production, and promotion of improved agricultural technologies for smallholders (e.g., manual irrigation pumps), with the mandate to scale production through capacity-building of domestic private manufacturers. Research is delivered to farmers through the Extension Directorate, and cascaded from EiAR/RARI experts to DAs through the Agricultural Technical and Vocational Education Training centers (ATVETs), who will be charged with improving their offerings on both irrigation technology and agronomic trainings.

Agricultural cooperatives have an important role to play in organizing smallholder farmers, providing inputs and output marketing services. There are about 50,000 primary cooperatives, 270 unions, and 3 federations in Ethiopia, playing an important role in distributing inputs and in aggregating smallholder production for the best returns at market. As such, cooperatives are envisioned to be the main entities of input and output market linkages for irrigated agriculture. The Federal Cooperative Agency (FCA), and the Bureaus of Cooperative Promotion (BCP), will be charged with the coordination and capacity-building tasks involved in engaging with these cooperatives.

Other public sector stakeholders

Any effort to transform agriculture will necessary reach far beyond the agricultural sector as it is to the larger institutional context in which it lies. For the household irrigation sector especially, institutions working in technology, infrastructure, and business development are particularly important. Key stakeholders outside the Ministry of Agriculture will include the following:
The Ministry of Water, Irrigation and Energy (MoWIE) has a mandate to undertake the management of water and energy resources of Ethiopia. In relation to the HHI strategy, MoWIE will be involved in the mapping and knowledge-building around water resources, as well as the enforcement of water use policies. The Ethiopian Geological Survey (EGS) provides geological data, laboratory testing, and advisory services to GOE offices and companies. It is charged with the assessment of national groundwater potential, and will be the final owner of maps generated. The National Meteorological Agency (NMA) can provide hydro meteorological data for target areas.

Several national GOE institutions outside the agricultural sector have a significant role in facilitating access to household irrigation technology. The Ethiopian Standards Agency (ESA) develops and implements national standards to regulate import and materials quality, including household irrigation technologies. The Ethiopian Revenue and Customs Authority (ERCA) is responsible for collecting revenue from customs duties and domestic taxes and regulating the import of goods. ERCA will have a role in enforcing import standards for HITs, and reforming import and procurement policies to increase the sustainability of private pump purchases. The testing of imports will be done by the Ethiopian Conformity Assessment Enterprise (ECAE), which provides inspection, testing, and certification services for regulatory bodies and importers/exporters. The Ministry of Industry works to promote the manufacturing sector, and can build technical expertise through promoting joint ventures with foreign HIT manufacturers.

**International partners and non-governmental organizations**

A number of international NGOs and implementers have prioritized irrigation as a key opportunity to support Ethiopia’s smallholders and the government growth and transformation plan. Often partnering with the GOE stakeholders described above, a few organizations are particularly worth mentioning for their contribution to the irrigation value chain.

Among partners engaged primarily in household irrigation is International Development Enterprises, Ethiopia (iDE), which is engaged in promoting access to manual irrigation pumps for smallholders through building the capacity of local manufacturers. The Japanese International Cooperation Agency (JICA) has implemented a similar program training manufacturers, which a focus on access to safe water for consumption, hygiene and sanitation.

In addition, other organizations are engaged in work on the horticulture value chain in Ethiopia at the time of writing, or will be during the term of this strategy. They include, but are not limited to, ACDI/VOCA, the International Livestock Research Institute (ILRI), CARE Ethiopia, DFID-UK’s Private Enterprise Promotion Ethiopia (PEPE) project, the International Potato Center (CIP), the Korea Rural Community Corporation (KRC), and Toward Sustainable Clusters in Agribusiness through Learning in Entrepreneurship (2SCALE).

Most significantly, the International Water Management Institute (IWMI) is a leading research institution on irrigation and water, which works towards improving the management of land and water resources for food, livelihoods, and the environment. IWMI has made significant contributions to research on irrigation in Ethiopia, with work on water management, agronomy, technology, scheme performance, and even market conditions for irrigated crops. Indeed, various studies made by IWMI were used as baselines during the development of this sector strategy.
**Government enterprise and market stakeholders**

Finally, as the household irrigation sector is based upon profitable market-oriented agriculture, the engagement of market actors will be absolutely critical to this strategy’s success. On the inputs side, this strategy engages private manufacturers, importers, and retailers of irrigation pumps, in the procurement of technology to new national standards. It relies on the Ethiopian Seed Enterprises to support the production and distribution of quality horticultural seeds and the Ethiopian Input Supply Corporation (EISCo) for fertilizer and agro chemicals. Technologies and agro-inputs will be linked to farmers through both private distributors and cooperative unions, to ensure a supply of both imported and domestic inputs.

**Microfinance Institutions (MFIs) and Saving Credit Cooperative Organizations (SACCOs)** have a significant role in providing credit and saving services to smallholder farmers to enable them to start-up or expand income generating activities, such as irrigation or HIT businesses. Finally, to build market linkages for smallholders, this strategy engages with large-volume buyers, wholesalers, and processors of horticultural crops. Key players in this sector include the government enterprise ETFRUIT, the export-oriented Ethiopian Horticultural Development Agency (EHDA), and numerous private-sector actors.

**Coordination of efforts**

The Government of Ethiopia established the Agricultural Transformation Agency (ATA) by Federal Regulation in December 2010, to promote agricultural sector transformation by supporting existing structures of government, private sector and other non-governmental partners. As part of ATA’s mission to deliver on a priority national agenda for achieving growth and food security, it will provide ongoing implementation support to the MOA and GOE on the household irrigation strategy.

Supporting the Natural Resources Management directorate, ATA’s coordination role includes analytical support in development of the sector strategy, coordination of activities, and capacity-building among stakeholders. For more on the implementation and coordination of this strategy, see Chapter 4.
Chapter 2. Overview of the household irrigation opportunity

2.1 Household irrigation in context.

Accounting for almost half of Ethiopia’s gross domestic product and employing 85% of the population, agriculture is the primary engine of the national economy of Ethiopia, with over 95% of the sector’s output produced by smallholder farms. Even as the sector has been characterized by continuous growth over the past decade, many of the country’s smallholder farmers continue to face food insecurity and low incomes—official estimates suggest that average smallholder income from the sale of crops is under 3,500 ETB/year.

Traditional smallholder agricultural production in Ethiopia’s cropping zones is rain-fed, heavily dependent on the kremt rains of June through September. This dependence has significant economic and health implications for smallholder farmers and rural populations. With variations in productivity and time of harvest come peaks and ebbs of food access: most supplemental food aid is disbursed in this period as well. For the rural poor, who supplement their livelihoods as agricultural laborers, rain-fed agriculture provides only intermittent and less-reliable opportunities for employment.

Exhibit 4. Seasonal food shortages are tied to the months before harvest

<table>
<thead>
<tr>
<th>Precipitation levels in the major cropping areas</th>
<th>The timing of the hunger seasons</th>
</tr>
</thead>
</table>


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7 AGP Baseline Survey (2012), conducted in 2011-2012 in AGP and non-AGP woredas. All household, national estimate. AGP households’ average income from sale of crops was 4,600 ETB/year. An additional 1,400 ETB was earned, on average, from sales of livestock (primarily cattle).
Although Ethiopia is rich in water resources, with twelve major river basins, about 122 billion cubic meters of runoff, and eleven major lakes comprising a total area of 750,000 ha, very little has been utilized for irrigation agriculture. The International Water Management Institute estimates that from the existing cultivated area of 15 million hectares, only about 4 to 5 percent is irrigated, with existing irrigation schemes covering about 640,000 hectares, scheme performance is estimated to be an average of 30 percent below design, implying a further loss of about 230 thousand hectares of irrigated land. While estimates of the country’s total irrigation potential differ due to the lack of standard criteria, it is clear that a significant portion of Ethiopia’s land currently not under irrigation could see improved use with irrigation technology.

### 2.2 Household irrigation as transformative technology

The agronomic and economic benefits of well-targeted irrigation projects, especially at a small scale, are immense and well-documented. Some of them include:

- **Potential to expand agronomy to higher-value and higher-yield crops.** A number of root vegetables and crops traditionally cultivated in Ethiopia require sustained access to water to thrive. These crops—including onions, shallots, potato, tomatoes, carrot, and head cabbage—command higher revenue per cultivated hectare.

- **Increased and resilient yield.** Unstable weather patterns can be a significant issue for smallholders. Given highly variable rainfall and recurrent droughts, heavy reliance on rain-fed agriculture presents major economic risks for smallholders. In fact, the World Bank estimated in 2006 that hydrological variability costs the Ethiopian economy over one third of its growth potential; worse, a full 25% of the extreme poor could have been lifted out of poverty with diversification away from rainfall-dependent agriculture.

- **Combined benefits with other improved inputs.** Unreliable access to water can be a strong limitation on the success of other agronomic improvements, such as fertilizer and improved seeds. With water access secured, farmers can make better use of investments in fertilizer and improved seeds. By the same token, the success of irrigation is highly dependent upon the presence of supplementary inputs.

- **Countercyclical employment opportunities and economic activity.** Although the vast majority of Ethiopia’s rural population is primarily employed in agriculture, labor requirements are cyclical with rainfall, leading to labor surpluses during the dry season.

- **Agronomic benefits.** Finally, irrigation during the dry period allows farmers to preserve and improve soil quality during the second season, since it allows for crop rotation between primary rain-fed cycles and ensures soil is well-preserved.

Ethiopia’s historical experience with irrigation includes a number of water sources. Traditional methods target larger-scale public works, often through infrastructure accessing water through river damming and diversion in the immediate watershed of a river, or tapping into natural springs. On the household

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9 Ministry of Water Resources, 1999
10 Based on data from IWMI (in Awulachew et al, 2007) and grey documents from MoWR and MoARD, There is some uncertainty about the exact number and location of some schemes, particularly small-scale irrigation and rainwater harvesting.
12 Fitsum et al. 2009
level, both rainwater harvesting, and drilling into shallow groundwater, can serve plots in the general watershed of a river but outside its immediate banks.

Household irrigation as compared to community solutions

In recent years, the government of Ethiopia has demonstrated commitment to irrigation, emphasizing its importance to the country in its Growth and Transformation plan (GTP). Through the Ministry of Agriculture (MoA) and the Ministry of Water and Energy (MoWIE), the government is pursuing irrigation projects at all levels of scale.

Exhibit 4. Various household irrigation types

<table>
<thead>
<tr>
<th>Category</th>
<th>Scheme size</th>
<th>Type of water</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale irrigation</td>
<td>&gt;3,000 ha</td>
<td>River Spring Rain Ground</td>
<td>Infrastructure projects damming and diverting from rivers Require high upfront investment and government management</td>
<td>Wonji-Shoa, Methara, Nura Era and Fincha</td>
</tr>
<tr>
<td>Medium-scale irrigation</td>
<td>200 to 3000 ha</td>
<td>River Spring</td>
<td>Small infrastructure projects utilizing various sources; involve community water use committees</td>
<td>Sille, Hare and Ziway</td>
</tr>
<tr>
<td>Small-scale irrigation</td>
<td>&lt;200 ha</td>
<td>River Spring Rain</td>
<td>Irrigation managed at household level through water-lifting/saving technologies</td>
<td>Jemjem, Silala, Mamo (AGP schemes)</td>
</tr>
<tr>
<td>Household irrigation</td>
<td>&lt;5.0 ha and &lt;10 HH</td>
<td>Rain Ground</td>
<td></td>
<td>Butajira (SOS); Ziway, Meki (iDE)</td>
</tr>
</tbody>
</table>

- **Large-scale** irrigation projects, what are often thought of as irrigation public works, have a command area greater than 3,000 ha, and are either commercially or publicly sponsored. There are a number of large-scale irrigation projects in Ethiopia, including the Wonji-Shoa, Methara, Nura Era and Fincha irrigation schemes.

- **Medium-scale** irrigation projects are typically community-based and publicly sponsored, and cover a command area between 200 and 3,000 ha. Examples include the Sille, Hare and Ziway irrigation schemes.

- **Small-scale irrigation projects** cover less than 200 ha. In general, these projects are operated at the level of farmer groups and households. Household irrigation is often considered one type of small-scale irrigation project by its watershed-engineering characteristics; for economic reasons, however, the two types are distinguished in this strategy.

- **Household irrigation** has a command area less than 5 ha, for plots of fewer than ten households. As such projects are independently managed by households, public efforts to promote household
irrigation will necessarily rely on interventions on a systemic level to facilitate smallholders’ independent access points to irrigation at the household level.¹³

Large and medium-scale irrigation projects are managed directly through MoWIE, while systemic interventions to support small-scale and household irrigation projects are managed through the MoA and regional BoAs.

The recent consensus on the potential of household irrigation in Ethiopia—across government, multilateral institutions, NGOs, academia, and the private sector—is founded on a number of key benefits of household-level interventions over community-based (large, medium and small scale) projects.

- **Empower entrepreneurship in smallholder farmers and micro-businesses.** Farmers drive the process of pump investment and use themselves, and have the further opportunity to scale-up to larger, motorized pumps and sell water to others.

Exhibit 5. The household irrigation opportunity by irrigation type

<table>
<thead>
<tr>
<th>Potential for irrigation, thousand ha</th>
<th>Applicability of household irrigation techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 5,300</td>
<td>- High variability</td>
</tr>
<tr>
<td></td>
<td>- Limited storage capacity</td>
</tr>
<tr>
<td>1,160</td>
<td></td>
</tr>
<tr>
<td>3,640</td>
<td>- Reliable, -demand water source</td>
</tr>
<tr>
<td></td>
<td>- Well-distributed and widely available</td>
</tr>
<tr>
<td></td>
<td>- Domestic and geopolitically stable sources</td>
</tr>
<tr>
<td></td>
<td>- Fewer institutional prerequisites for managing</td>
</tr>
<tr>
<td>500</td>
<td>- Requires drilling—only accessible within shallow depths</td>
</tr>
</tbody>
</table>

- **Less reliance on community coordination and infrastructure.** Household technologies necessarily require far less stakeholder coordination at the community level. While smallholders will still benefit from collectivization when interacting in the market, having access to irrigation technologies on the household level means that they can take steps to invest even if their immediate neighbors lack interest or capacity. This means that irrigation investments will be accessible to vastly more households and communities.

¹³ Definitions of the Ministry of Water and Energy; examples taken from Awulachew 2010.
• **Utilize cost-effective, existing technologies.** While community irrigation interventions require sophisticated infrastructure and engineering expertise for both construction and maintenance, household irrigation technologies can be sustainably maintained without specialize expertise.\(^{14}\)

In the absence of reliable data on Ethiopia’s groundwater resources, current estimates of Ethiopia’s groundwater potential are uncertain. The current conservatively assumption, based on existing groundwater maps, is that at least 10% of Ethiopia’s households can access usable groundwater for household irrigation.\(^{15}\)

For that group, irrigation is a promising means to increase farm income, improve food and nutrition security, and promote quality of life in rural areas. The benefits in income generation are staggering—smallholder managed irrigation systems are estimated to generate approximately US$323/ha, as opposed to US$147/ha under rain-fed systems.\(^{16}\) Even based on a partial groundwater resource mapping, the cumulative effects of this transformation over five years could enable at least 650,000 farmer households to become entrepreneurs, increase family income and food security for almost 5 million Ethiopians, and add 30,000 jobs to the economy.\(^{17}\)

**Household irrigation technologies**

Household irrigation technologies (HITs) comprise the full set of simple technologies that set up farmers for irrigation at the household level. At a high level, the technologies involved are the following:

- **Water-lifting technologies** comprise different types of irrigation pumps and lifting mechanisms (like pulleys), and can tap into surface water or groundwater made accessible by a tube well.

- **Water-harvesting technologies** catch and store water from various sources (rainwater, river diversion, or pumps). Storage of harvested water can occur in small tanks if water supply is regular (e.g., groundwater pumping), or large, underwater tanks for longer periods of time (as common with rainwater). Plastic sheeting is used to line tanks and reduce seepage.

- **Water-saving technologies** enable frequent application of small amounts of water to crops’ root zone. They include drip, micro sprinkler, bubbler, and micro jet irrigation systems. In addition to reducing water use, these systems can preserve soil conditions and improve product quality. In the absence of water-saving systems, SHFs use hand-watering methods or surface irrigation.

Each of these technologies has its advantages and disadvantages in distinct contexts. Because of the seasonality of rains and the high cost of building large-capacity water storage tanks, this strategy document is mainly focused on the groundwater opportunity, and the first step for smallholders to begin irrigation: water-lifting technologies like manual and motor-powered irrigation pumps. Pumps are further discussed in Section 3.2 Technology Access and Adoption.

Manual and motorized pumps are complementary rather than competing technologies, suitable for smallholders at different points in their growth and production. The skills farmers have developed in appropriate water management will continue to be applicable even as they move to motorized pumps.

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\(^{14}\) Awulachew 2010; McKinsey 2011.

\(^{15}\) The statistic remains uncertain. Based on the research from detailed groundwater mapping work planned to take place, a far larger number could be identified.

\(^{16}\) Fitsum et al 2009.

\(^{17}\) From a 2011 McKinsey study and research conducted by IWMI in 2010.
With additional capital, smallholders can add drip irrigation to a system supported by pumps. Finally, wells dug for a manual pump can easily be retrofitted to serve an engine pump, and water distribution and saving mechanisms remain the same, so that upgrades are significantly less time and resource-intensive than original establishment of irrigation systems.

Exhibit 6 explains the process by which a farmer new to household irrigation can increase his/her investment—and returns—over time.

Exhibit 6. Target farmer experience using household irrigation technology (ETB/yr)\(^{18}\)

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Rope and washer pump</th>
<th>Motor pump (shared in co-op)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 yr: 70</td>
<td>4yr: 360</td>
</tr>
<tr>
<td></td>
<td>2 yrs: 150</td>
<td>5yr: 520</td>
</tr>
<tr>
<td></td>
<td>3 yrs: 150</td>
<td></td>
</tr>
<tr>
<td>Plot size</td>
<td>0.1 ha Partial irrigation of holding</td>
<td>0.4 ha Full plot</td>
</tr>
<tr>
<td></td>
<td>0.4 ha Full plot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.0 ha Renting neighbor’s plot during dry season</td>
<td></td>
</tr>
<tr>
<td>Additional income (ETB/yr)(^{1})</td>
<td>1.0 ha Renting neighbor’s plot during dry season</td>
<td></td>
</tr>
</tbody>
</table>

The opportunity that household irrigation presents for the Ethiopian economy extends beyond the agricultural sector. A thriving HIT market will host small and micro level enterprises, including those providing well-drilling services, after-market sales of replacement parts and fuel, maintenance and advisory, and finance opportunities for entrepreneurs—including irrigation service providers (ISPs) that might supply a combination of services. The cultivation of cash crops also provides a market outlet for seed enterprises and input retailers. Finally, cash infused into rural communities in a countercyclical harvest will have multiplier effects on growth. A holistic household irrigation strategy, then, must take into account how technology can leverage Ethiopia’s agricultural gains in the development of the rest of the economy.

2.3 Horticulture and irrigation

To maximize the returns on irrigation, farmers should grow the highest-profit crops for their area. Given the importance of crop rotation in sustaining soil quality, and the high price of horticultural crops outside the rain-fed season, farmers usually opt to grow fruits and vegetables on irrigated plots. Simultaneously, the capital investments required to purchase and maintain all the components of a household irrigation system means that farmers need to generate the maximum income possible in the first few seasons after investment in order to repay loans or rebuild savings.

\(^{18}\) Calculations include investment for pump (USD 80 for treadle, USD 120 for shared motor pump) fully deducted; fuel: 120 USD/ha/year; maintenance: 20% of pump cost; average rent of 4,000 ETB/ha. Source: McKinsey report on household irrigation technologies, 2011.
The initial diagnostic work in AGP woredas confirms that horticultural crops have the largest potential return on investment to farmers at current prices, given the agronomic irrigation potential in those areas. However, that potential was far more difficult for smallholders to access, given the absence of quality seeds nearby, the scarcity of local wholesalers, and the absence of appropriate agro-processing, and storage facilities, and appropriate market linkages. Though vegetables are a strong candidate for household/d irrigation, this requires some change from their current role as a low-volume supplementary food. Under 9 percent of plots (averaging 0.25-0.4 ha each) together were used for growing vegetables, fruits, and roots together in 2011, and about two-thirds of that was directly for consumption, with the sale of horticultural crops accounting for under 5 percent of overall farmer income.

For this reason, a household irrigation sector strategy must also support the full value chain of horticultural and other high-value crops that help farmers make the most of their investment in

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19 Woreda officials in 84 AGP woredas where a high-value crop assessment tool was piloted in 2012; team analysis; expert input
20 HHI team’s work with AGP woreda agricultural offices in Fall 2012, implementing a diagnostic of the high-value crops for each woreda using a MS Excel-based software tool drawn from agronomic and market data
21 Table 3.2 of AGP Baseline Survey (2012). The proportion of plots used in horticulture was 9.5 percent in AGP woredas.
22 Table 6.1 of AGP Baseline. Overall, 72 percent of vegetable cropping, 65 percent of roots, and 58 percent of fruit was directly for household consumption (as opposed to see or sale. The consumption orientation was slightly lower (and market orientation higher) for AGP woredas.
23 Table ES.29 of AGP Baseline. Market orientation was 5.8 percent in AGP woredas.
irrigation. Exhibit 7 shows that an assessment of profit potential illustrates the value of horticulture crops to smallholders—and the diverse market-access constraints that contribute to underperformance against the potential of household irrigation.

Household irrigation, while a technological intervention, thus functions as a sector with a full value chain around the high-value crops it enables. It is no simple silver bullet, and can only work if other components of the agricultural system are also effective. If successful, however, household irrigation in Ethiopia could represent a cornerstone of the agricultural development of the country.

2.4 Gender implications

Women constitute half of the rural farming community in Ethiopia, contributing 48% of labor over all agriculture, and 70% of household food production.24 A number of studies indicate that investments in women’s access to agricultural inputs and agronomic practices can bring up to a 30% increase in production.25 Similarly, addressing gender inequality at the national level can contribute up to a 1.9% increase in GDP.26 Further, investments in women farmers’ productivity and income has a ripple effect on improving household nutrition, children’s schooling, and the ability of the household to make further investments through nest egg savings. Realizing this fact, the national Growth and Transformation plan has clearly underlined the need to involve both men and women, supporting women’s institutions and targeting at least 30% female-headed households (FHHs) in all extension services.27

Household irrigation has many important implications for gender mainstreaming and gender relations. Because it is usually undertaken on a small plot of land with intensive care, horticulture is traditionally placed in women’s sphere. Thus, because irrigation introduces cash potential into a traditionally female domain, it can be a powerful tool to increase women’s empowerment both through greater access and control over income, and through overall improvements in quality of life.

On the other hand, female farmers’ productivity and their engagement is lower than that of their male counterparts. Woman-headed households have significantly lower take-up rates of irrigation as compared to men: only 2.9% of FHHs, but 4.8% of MHHs, currently use irrigation.28 Though this can be partly explained by the fact that woman-headed households tend to have lower incomes, that does not seem to be the only explanation—women are also less likely to know about supply channels or have access to credit.29 Thus, the gender implications of household irrigation are twofold: while irrigation can do a great deal to improve women farmers’ quality of life, it must also be implemented with women’s particular needs in mind.

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24 Ministry of Agriculture, Environmental Protection and Development Report (1992), A case study On Women’s Access to Agricultural Extension Services
25 Creating Gender-Responsive Agricultural Development Programs— an orientation document February 2012, Bill and Melinda Gates foundation
28 Estimated national baseline, including non-AGP woredas, from AGP Baseline Survey 2011; includes all types of irrigation
29 IWMI AgWater Solutions, 2010
Benefits of household irrigation for women

Access to and control over household income. Studies on the gender implications of irrigation in Ghana and Zambia found that, in male-headed households, the wife’s decisions about the use of produce from her own plot and the husband’s plot appears to be stronger when irrigation is used, versus in households reliant on rain-fed agriculture.\(^{30}\) In Nepal, 92% of women in the study area of a drip irrigation pilot did not have any income source under their own control at the start of the study, but by the project’s conclusion, women custodians of the irrigation income were able to exert more influence in their community and even benefited from a more equitable distribution of household labor.\(^{31}\)

Exhibit 8. Impact of household irrigation on female decision-making authority in IWMI Nepal project (2003)\(^{32}\)

Improved health and nutrition: Women also benefit greatly from irrigation interventions in terms of their quality of life. As women often eat after the rest of the family, they are the first exposed to food scarcity. During lean periods—the hunger season—the consumption of vegetables and pulses are a minimal or nonexistent part of many poor female farmers’ diets.\(^{33}\) Thus, the improvements to food security that irrigation provides will be especially felt by women.

Reduced work burden: In addition, women tend to be responsible for guaranteeing a steady supply of water, and many spending up to two hours a day walking to retrieve water.\(^{34}\) When irrigation agriculture makes a water pump affordable and justifiable for farm households, it can help reduce some of women’s labor needs.

Key challenges of women farmers in household irrigation

 Appropriately implementing irrigation will require sensitivity to women’s needs, to ensure women have access to both irrigation pumps and the full suite of services that permit its optimal use. Interventions across the HHI value chain should aim to be gender-sensitive in key areas:

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\(^{30}\) Wahaj et al, IFAD, 2012; \(^{31}\) Drip-Irrigation Technology: A Case of Nepal, International Water Management Institute
\(^{32}\) Ibid. \(^{33}\) Drip-Irrigation Technology: A Case of Nepal. International Water Management Institute, 2003
\(^{34}\) Interview with ATA Gender Mainstreaming team, May 2013
\(^{34}\) Wahaj et al, IFAD, 2012.
Access and adoption to HITs and irrigation agriculture inputs: Some household irrigation technologies are more gender-sensitive than others. With treadle pumps, operators are elevated above the ground in exhausting physical activity that communities sometimes consider undignified and inappropriate for women.\(^{35}\) Other styles of manual pumps—such as rope and washer pumps and hip-height pumps—are comparably affordable and effective and have been more easily adopted by women.\(^{36}\)

- There is evidence that flexible financing options dramatically increases women’ adoption rate. In Kenya, women were only 11% of the purchasers of pumps under straightforward purchase, but comprised 33% who purchased under a layaway scheme for KickStart’s hand-powered pumps.\(^{37}\)
- Finally, working through women’s groups as collective purchasers is an effective means to increase adoption of motor pumps among female-headed households.\(^{38}\)
- Women tend to have less control over input purchasing decisions, especially of costly improved inputs, and thus must be proactively targeted in input-collection schemes.\(^{39}\)

On-farm production and post-harvest practices: Technical support and knowledge delivery methods for on farm production and post-harvest processing often fail to address the needs of women farmers, who may not be able to attend trainings far from home.

- Research institutions should develop irrigation technologies with women’s different use patterns in mind. The extension system must provide adequate training and knowledge which considers these constraints.
- In addition, women tend to have less access to technical support and services to help them best use their irrigation pumps, when sellers of pumps assume that the direct purchasers—men—are the end-users at home.

Market linkages and demand sinks: Women have disproportionately less access to market information and face more constraints to mobility, presenting a huge challenge for achieving fair returns to production. Women-led small-scale agro-processing projects provide one important way to promote women farmers.

Harm mitigation. Finally, a gender-sensitive strategy must mitigate of potential ill effects of irrigation. Despite the benefits of household irrigation for women’s lives and livelihoods, it presents a number of risks along the full value chain.

- The introduction of cash and market interactions with the purchase of a pump can shift roles into men’s domain; though women are the primary source of labor in irrigated agriculture, they risk of losing access to that source of income at the point of market linkages.
- Carrying water is a social and community-building occasion for women otherwise restricted to the home; more needs to be known about the potential risk that household irrigation can reduce women’s sphere of influence inside and outside the home.

\(^{35}\) Kay and Brabben, 2000.  
\(^{36}\) For more on women and household irrigation technology, see Section 3.2.  
\(^{37}\) Interview with Beatrice Sakwa, gender expert at KickStart, a social enterprise, in Jun 2013.  
\(^{38}\) Peterman et al 2011.  
\(^{39}\) Wahaj et al, IFAD, 2012.
Some irrigation technologies are less suitable for women, due to their high physical exertion requirements, sometimes leaving women too exhausted to fulfill “expected” duties.

The interrelationships of irrigation and gender are too complex to be exhaustively listed here. To ensure women are included in Ethiopia’s agricultural transformation, gender sensitivity must be addressed in the design of specific interventions on the ground level. A gender perspective engaged throughout the sector strategy will ensure women and men benefit equally from the development endeavor, and will tap into the potential of both in order to enhance effectiveness in the sector.

2.5 Ensuring sustainable irrigation

Ethiopia is blessed with a rich ecosystem for agriculture, but in recent years the strains of increasing human demands have begun to show significant impacts. Increasing demand for resources, particularly deforestation for household fuel wood, has led to significant land degradation, greenhouse gas emissions, and severe soil erosion, particularly in Tigray, Oromia, SNNPR and Amhara. Moreover, as a result of long-term result of resource overuse around the world, global climate change threatens smallholders’ resilience to severe weather events. As population is expected to rise from 91M today to almost 150M by 2050, these impacts will only worsen without significant improvement in resource management practices.

**Land degradation from deforestation is a significant challenge for Ethiopia's environment.** Though Ethiopia was originally highly forested, only 3% of virgin forest land remains today. Forests are an essential source of economic output, e.g., through honey and wild coffee, as well as a habitat to key flora and fauna. In addition, the loss of carbon sinks through deforestation contributes to over one third of Ethiopian greenhouse gas emissions. Finally, the loss and fragmentation of grasslands and moorland due to agricultural conversion of afroalpine and subafroalpine areas has threatened some of Ethiopia’s rarest animals, including the Ethiopian Wolf Gelada Baboon.

**Adaptation to human-caused climate change will be a key challenge for smallholders in the next decades.** Global temperatures have already increased by 1°C since the 1960s. Experts have linked this temperature increase to highly variable rainfall conditions, as well as increased weather events like drought and flooding. Annual rainfall variation now varies by ±25% (in some regions ± 50%), and evidence indicates it has declined by 20% in the South. As global temperatures in the country are expected to increase by up to 0.5-2.0°C by 2050 as compared to today, highly impacted by El Niño events, these negative impacts are likely to increase in the future: some areas will become slightly warmer and wetter, others much hotter and drier. Reliance on rain-fed agriculture practices leaves Ethiopia vulnerable to these changes: extreme droughts are already shown to have impacted GDP by up to 10%, and soil erosion alone costs 2-3% of yearly agricultural GDP.

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40 Calow et al 2013
41 Ethiopian Government National Biodiversity Strategy and Action Plan 2005
42 CRGE 2011
43 Climate and Society 1
44 IPCC 2013
45 CRGE 2011
Reliability of access to water is a key resource challenge for farmers. Compounding the risks presented by its highly rain-dependent agriculture, Ethiopia has little water storage infrastructure to protect farmers from rainfall variability. Despite abundant water resources, the country has one of the lowest reservoir storage capacities in the world, at only $50 \text{m}^3$ per person, compared with $4,700 \text{m}^3$ in Australia.\textsuperscript{46} Climate information—both via gauges of recent rainfall and predictions of upcoming rain—is thus crucial to help farmers know the optimal time for the best planting and harvesting. Inexpensive, rain gauges can help farmers measure historical rainfall, but are not yet widely used in the country. Regional Meteorological Agencies (RMAs) are charged with providing predictive information, but historically their performance in observational weather monitoring has been poor, with large gaps in data\textsuperscript{47} and a lack of timely, downscaled regional forecasts for use by farmers.

Benefits of household irrigation to climate adaptation and environmental conservation

Irrigation provides a safety net of climate adaptation. Adapting to variable rainfall is a key challenge for smallholders. Paired with effective climate information, household irrigation technologies and practices can provide a supplementary water source during the traditional rain-fed agriculture season, protecting the viability of staple crops in key phases of the cropping cycle—permitting the planting of wheat or maize on time, for example, or ensuring seedlings do not wilt if rains are inconsistent after planting. Developing household irrigation capacity should thus be a priority for protecting smallholder crop and food security, even for households with a strong focus on traditional rain-fed agriculture.

Intensification of existing land through irrigation reduces environmental degradation and greenhouse gas emissions. Because irrigation intensifies land use, it can considerably reduce the amount of land required to produce the same output, reducing pressures to clear additional land. In addition, the farmer will have access to a more sustainable source of biomass for fuel—the excess biomass from harvested crops—which could potentially reduce deforestation of land for fuel wood. Finally, irrigation can contribute to the lasting effectiveness of agricultural lands when practiced with conservation agriculture techniques, such as crop rotation and/or double cropping. This allows nitrogen-fixing plants (e.g. chickpea) to be planted in the traditional off-season, returning nutrients to the soil between plantings of nitrogen-greedy cereals.

Key environmental challenges and opportunities of household irrigation

Appropriately implementing irrigation will require sensitivity to its potential impact upon Ethiopia’s climate and natural resources. Interventions across the HHI value chain should aim to be climate-sensitive in key areas:

Incorrect implementation of irrigation can result in major environmental damage and soil degradation. Appropriately implementing irrigation requires careful consideration of the environment in two key areas. Firstly, irrigation schemes diverting existing watercourses can contribute to severe soil erosion, increases of pH due to alkaline soil incursion, and thus loss of productivity. Secondly, flood irrigation, for example in areas of the Ethiopian Rift Valley, has led to high levels of soil salinity that can reduce productivity so much that, in some cases, it eliminates the usefulness of agricultural land: more

\textsuperscript{47} Calow \textit{et al.}
than 4000 ha of farmers are abandoned because of salt built up in the River Awash basin in Ethiopia.\(^{49}\) In India, otherwise a triumph of household irrigation adoption, saw major salinity issues arise that put roughly 25% of India's food harvest was put at risk through inappropriate groundwater resource management.\(^{49}\)

Appropriate household irrigation techniques should minimize the harms of large-scale flood irrigation. Even at the household level, flood techniques must either be used carefully, enabling necessary drainage of water throughout the season, or in cases of severely salinated soil, alternative forage crops must be used to reduce salinity. An alternative—drip irrigation techniques—are substantially better for the environment, and should be prioritized where possible (see below).

Overuse of water can result in long-term depletion of water resources. Over-extraction of water for irrigation—whether through diversion of natural waterways or removal of groundwater—can have serious and permanent environmental impacts. Overuse of water for irrigation have results in the dramatic shrinkage of aquifers and lower river flow. The lowering of water tables have serious human and environmental impacts, reducing water security, endangering forest growth, and rendering irrigation far less effective. (See Exhibit 8 for more detail.) At worst, unsustainable groundwater abstraction can deplete aquifers rapidly, result not only in lower water tables, but to the spread of saltwater into fresh aquifer areas. Once displaced, the fresh water cannot easily be restored and the land becomes unproductive.

\(^{48}\) Girma, 2005

\(^{49}\) BMGF/GGGI 2010, citing IWMI, World Bank, and Shah 2007

\(^{50}\) BMGF/GGGI 2010
Improving the environmental outcomes of irrigation

**Employ carbon-neutral, water saving technologies wherever possible.** Currently, the most commonly used household irrigation technology in Ethiopia is the diesel-powered engine pump—a technology which consumes fossil fuels in addition to abstracting large quantities of water. Manual pumps trade human labor for fuel, reducing environmental impact at the cost of farmers’ time. Yet water-saving technologies—such as drip, micro sprinkler, bubbler, and micro jet irrigation systems enable frequent application of small amounts of water to crops’ root zone, thereby dramatically reducing water needs for the same crop productivity. Many of them especially drip irrigation, boast minimal or no fossil fuel consumption in addition to minimal labor requirements. In addition to reducing water use, these systems preserve the farmer’s own soil conditions and improve her produce quality. (Water-saving technologies are discussed in greater detail in Chapter 3.2, Technology Access and Adoption.)

**Practice careful, community-level management of watersheds.** In addition to the adoption of water-saving technologies, communities can carefully manage water through smart environmental practices. Employing rainwater harvesting and drought-resistant varieties help to reduce water use, while integration of watershed management approaches helps to recharge of groundwater. Water use must be negotiated within communities to reflect members’ competing needs and what the watershed can absorb. A critical intervention to ensure these behaviors is the careful design of water use policies and effective enforcement of them. (See Bottleneck 3.1.3, Unsustainable water management practices are common, for more discussion on this point.)

The many diverse interrelationships of irrigation agriculture with environmental stewardship are impossible to address exhaustively here. To ensure environmental protection and climate resilience are built into Ethiopia’s agricultural transformation, sustainability and climate issues must be addressed in the design of specific interventions on the ground level. Ensuring the appropriate consideration of environmental perspectives throughout the sector strategy will ensure endeavors last in the long term, and that agricultural land and productivity is preserved for future generations.

### 2.6 Transformed livelihoods

The potential of household irrigation to transform individual farming households’ lives is immense. By opening the opportunity for income through the dry seasons, irrigation enables farmers to invest in household consumption as well as additional income-generating opportunities. By providing food security and increasing resilience against drought, it also can improve household welfare in nutrition, health, and disease outcomes.

In addition to increased, consistent, and higher-value crop yield, three adjacent opportunities are of especial importance to the household irrigation opportunity:

- **Livestock:** A steady source of water—though it may be small—is essential for raising farm animals. Egg-laying hens require about a liter per day each, well within the excess capacity of a small irrigation pump, and can provide a steady stream of income and high-protein eggs and milk throughout the year.

- **Sanitation:** Water access creates opportunities for additional health and sanitation activities. In addition to improved nutrition from a varied diet, wells and water-lifting technologies provide a secondary channel for household water use.
• **Entrepreneurship:** A thriving irrigation sector will support three sectors: a microenterprise sector in pump rentals, parts, and maintenance; the manufacturing sector in pump manufacturing, maintenance, and repair; and the agricultural extension sector in seed production, agro-input production, and associated retail activities.

A long history of projects in Ethiopia and abroad illustrates the long-term potential of irrigation to set households on a path to sustainable, higher-income livelihoods. By creating opportunities for farmers to begin that trajectory, a systemic approach to facilitating household irrigation can create transformational change in smallholders’ lives.
Chapter 3. Systemic bottlenecks and strategic interventions

Key stakeholders within the Ethiopian household irrigation sector have agreed upon the following long-term vision for household irrigation productivity and sustainability in Ethiopia:

OVERALL VISION: A vibrant and self-sustaining household irrigation sector

Increase the adoption and effectiveness of household irrigation technologies in order to

- **Increase income** for smallholder farmers
- **Improve food security** throughout the year, and
- **Catalyse growth** in farming communities.

While the adoption of household irrigation practices continues to grow dramatically, the sector’s continued growth and its ability to achieve transformational change for Ethiopian farmers relies on a number of institutional supports coming into place.

Thus, one focus of the vision is an emphasis on **sustainability**. While it may be that direct intervention in the procurement and distribution of irrigation technologies may be the best way to place them in the hands of farmers, such actions will not lead to a sustainable household irrigation extension market in the long term. Framed in such a way, the objective of this strategy is to examine what actions will move the sector toward long-term, demand-driven, sustainable growth.

Exhibit 9 The household irrigation value chain and its components

The remainder of this chapter discusses the **systemic bottlenecks** that the sector must solve to achieve the objectives for each step of the value chain. Each of the bottlenecks identified limits the productivity, profitability, or sustainability of the household irrigation sector. Their collective impact is felt on farmers wishing to practice household irrigation, consumers who purchase their crops, private companies interacting in agriculture-associated space, and government agencies supporting smallholder agriculture.

One to three **strategic interventions** with transformative potential are then proposed for each bottleneck, along with a subset of **key activities**. By implementing these interventions, stakeholders will move closer towards achieving transformational growth for Ethiopia’s agriculture sector and for the country as a whole.

It is important to note that the systemic bottlenecks and strategic interventions identified here are not exhaustive; they reflect only high-priority items that stakeholders believe the household irrigation program should address. When the strategy is refreshed in five years, this list may look quite different given the results of interventions taken initially, trends at that time. Moreover, it will integrate the learnings from the first five years of activity, and emerging international best practices.

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3.1 Research, knowledge, and policy

Vision for Research, knowledge, and policy

The research system addresses all aspects of the irrigation agriculture value chain, helping policymakers make the best use of water resources, and government policies promote equitable, sustainable, and responsible use of water resources.

Irrigation has been highlighted as one of the priority strategic intervention areas in Ethiopia’s 2011-2015 Growth and Transformation Plan (GTP), and is thus fortunate to be a focal highlight of key stakeholders at every level of government. Indeed, institutional support across agencies—appropriate regulatory enforcement, directed research agendas, and supportive tax incentives—is critical to promoting smallholder engagement and success. Nonetheless, the policy and research environment is not yet fully set up to support smallholders in their efforts to employ household irrigation technologies.

Agricultural research in Ethiopia is largely organized through national and regional-level research institutes (RARIs). Traditional rain-fed agriculture still remains the emphasis of research institutions and existing policy structures, for understandable reasons. Still, the relative lack of experience and attention to irrigation through the research system limits its usefulness to smallholder farms.

On the policy side, existing policies in Ethiopia do not always account for the unique issues that household irrigation creates—such as the need for national-scale, household-level water policies and tariff policies that enable private-sector imports of pumps. For adoption of household irrigation to reach scale, it will be necessary for policymakers to align in this area.

<table>
<thead>
<tr>
<th>Bottlenecks and interventions for Research, knowledge, and policy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bottlenecks</strong></td>
</tr>
<tr>
<td>Poor information on water irrigation and water resources</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Best practices in irrigation agriculture not well-developed for Ethiopian context</td>
</tr>
<tr>
<td>Unsustainable water management practices are common</td>
</tr>
</tbody>
</table>

Bottleneck 1.1: Poor information on the water resources available for irrigation agriculture and their current use

The first step to beginning groundwater-sourced household irrigation is drilling a shallow well, a time and labor-intensive process. In areas of the country where irrigation practices are not well-known, this is a substantial investment that currently cannot be guaranteed—farmers may have no way to know whether a well excavation will be successful before making an attempt. They are thus forced to drill blindly in a costly trial-and-error approach; if not successful, they can only go to another site and try...
again, still without confidence that the groundwater resources are available at all in that woreda, and the depth at which it should be accessible.

Public sector institutions and NGOs have employed a variety of different techniques to map groundwater resources in Ethiopia. These disparate projects have generated some useful results, but fall short of the comprehensive assessment—including detailed mapping at an operational scale—that is needed to help smallholder farmers make an informed decision about the groundwater potential of their plots. Moreover, the existing maps provide inadequate information on water quantity, quality, and depth for irrigation purposes, which means well-drilling activities, are mostly based on past experience rather than scientific reasoning.

Further, information that sheds light on to what extent HHI is practiced in the country is insufficient, and what information exists is not conveniently centralized in a single database or source of authority. Coordination between the vast range of government agencies, NGOs, and development partners working on water issues is therefore difficult. At the level of central planning, this makes it difficult to understand and learn from the range of household irrigation techniques currently practiced in Ethiopia. At a local level, farmers and extension experts are unable to confidently understand the feasibility of irrigation for their areas.

The relative absence and decentralization of data on existing practices, compounded by the lack of information on groundwater potential, is a major obstacle for policymakers and local officials. Smallholder farmers therefore lack clarity on not only on where to dig wells, but also on how much water exists, how large command areas are, how much and which crops can be irrigated in each local area, and how many households can be supported by those groundwater sources.

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52 Among the public sector actors involved are the Geological Survey of Ethiopia (GSE), Ministry of Water and Energy (MOWIE), and Ministry of Agriculture (MOA). In civil society, International Development Enterprises (iDE), International Water Management Institute (IWMI), and Addis Ababa University are among a range of institutions that have undertaken or commissioned groundwater mapping activities in Ethiopia.
Intervention 1.1.a: Map shallow groundwater resources nation-wide and disseminate the results to local governments

The mapping of shallow groundwater resources nation-wide will remove a key obstacle to the adoption of household irrigation. Not only will it help planners and policymakers set a national strategy, focusing irrigation interventions only where they make sense, it will help woreda-level officials justify the wisdom of investment in irrigation-supporting infrastructure. Most importantly, it will permit smallholder farmers to predict the likely success of drilling wells before that costly investment is undertaken, guiding them as to the depth of the wells and the chance of success.

IWMI 2010:19, based on data from EIGS, British Geological survey and study team analysis
A mapping of shallow groundwater at the national level will be critical to the success of the household irrigation sector strategy, guiding stakeholders’ decision-making in this arena, and ensuring resources are invested wisely and well. A range of technologies exist for this function; on a coordinated national level, the methodology chosen should contemplate the following:

Such a comprehensive assessment would include:

- A standard approach to estimating groundwater potential, accounting for quality and depth of water, command area and beneficiary households as well as appropriate scale for accurate results
- Coverage of all the high-potential agricultural regions with sufficient speed and scale to produce results within the next five years
- Geographic mapping at a sufficient level of detail to guide woreda-level decision makers and operational recommendations for smallholder farmers themselves

**Key activities proposed:**

- Collecting and compiling secondary data, such as existing hydrogeology maps, topography maps, and other data that will contribute to the base layer for a groundwater map
- Conducting a phase-based national shallow groundwater mapping, beginning with a targeted pilot to prove the technological solution

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**Intervention 1.1.b: Establish a national-level irrigation information management system**

The diverse range of irrigation projects in Ethiopia are driven by a similarly diverse set of government agencies, international funders, and NGOs. The Ministry of Water and Energy (MOWIE) administers larger infrastructure projects, while the MOA’s AGP small-scale irrigation unit builds small-scale irrigation projects and supports household irrigation projects. At the same time, regional governments, NGOs, and development partners operate small irrigation projects in different parts of the country.

This diversity of irrigation projects has been beneficial for the sector, but one consequence is the relative lack of coordination of efforts happening across the country. The lack of integration among sector actors is an additional bottleneck to sector-wide action, as it prevents clear delineation of responsibilities.

Though overall irrigation data is currently sampled by the Central Statistics Agency and aggregated at the zonal level, the lack of specific information about household irrigation activities prevents stakeholders from optimally targeting interventions. In addition, better information about current practices and best-practices will promote scale while ensuring sustainable management of watershed resources, balancing the needs of upstream and downstream users. A national information management system on the uses of irrigation water, made available to all actors of the sector, would enable stakeholders to ensure alignment in household, small-scale, medium and large-scale irrigation activities.

**Key activities proposed:**

- Developing a central resource to capture information about household irrigation currently going on in the country
- Establishing regular processes for regional BoAs, the MoA, the MOWIE, and other stakeholders to collect and report household irrigation data, and to benefit from this system’s output

**Bottleneck 1.2: Best practices in irrigation agriculture not well-developed for Ethiopian context**

When introducing any new agricultural technologies, a solid research foundation regarding correct irrigation practices is necessary to build the right background of knowledge about irrigation best practices. The potential of irrigation to transform smallholder agriculture is largely dependent on such practices being adopted and applied.

Researchers in Ethiopia can learn from decades of experience with household irrigation initiatives in other smallholder agriculture contexts—in the South Asian subcontinent, Southeast Asia, and even Western and Central Africa. Yet, those experiences are deeply colored by distinct agro-ecological, economic, and social contexts. Many of the practices adopted from other countries are yet untested for Ethiopia’s unique agro-ecological conditions, and this reduces the confidence that Development Agents (DAs) can have when conveying agronomic advice to farmers.

In addition, the following adaptations of existing literature are essential to the success of smallholder irrigation in Ethiopia:

- **Technical practices in water management:** The quantity, timing, and method of water application will vary by soil, crop, and climate conditions, which vary dramatically across the country.
Suitable inputs for irrigation. Because irrigation permits water level control, the right seed varieties, fertilizer, and pesticide levels will also vary from both rain-fed agriculture and from the experiences of other countries.

Crop selection and calendar: The timing and number of planting cycles, and the selection of optimal crops, varies based on both market and agronomic conditions. Woreda-level experts lacking knowledge about this variation are not able to ensure crops planted will grow successfully under irrigation.

These recommendations need to be specifically appropriate to each of the many diverse agro-ecological zones in Ethiopia, which comprise a wide variety of soil conditions, altitude, temperature, sunshine hours, sunshine intensity, and humidity conditions. Without that specificity, smallholder farmers may not make informed decisions on which crops to grow, what complementary inputs to use, and how to employ irrigation most effectively on their plots.

Intervention 1.2: Promote household irrigation in the existing agriculture research agenda

Both the Ethiopian Institutes for Agricultural Research (EIAR) and the Regional Agricultural Research Institutes (RARIs) are deeply constrained by high staff turnover and budget limitations. Given this, they do not prioritize work on irrigation agronomy or water management problems, focusing primarily on rain-fed agriculture practices over irrigation agriculture within their research agendas. On the operational level, this means linkages between subject matter specialists (SMSs) within research institutions and Development Agents (DAs) are organized around the traditional rain-fed agriculture cycle. The knowledge gap on irrigation practices in Ethiopia must therefore be addressed through appropriate institutional prioritization as well as through increased resources and expertise.

In designing a national irrigation research agenda, techniques in irrigation agriculture can be borrowed from other countries and adapted to Ethiopia’s specific agro-ecology and climate conditions to complement locally derived best practices, as discussed above. With a focus on adaptive trials, the research institutes can leverage international experience while saving time and resources in defining the appropriate research. Coordination between government and non-governmental research institutions—such as NGOs and universities—will ensure a central and authoritative view of irrigation agronomy becomes available for policymakers and smallholder farmers.

Taking as inputs national groundwater maps and historical data, the ideal output of such an endeavor will capture trends and recommendations for smallholder agriculture under irrigation, for the full range of agro-ecologies in Ethiopia discussed above. It will include, but will not be limited to: technical instruction on water management, recommended levels of seeds, fertilizer, and pesticides, and a multi-cycle cropping calendar. Finally, the system must trickle down findings to smallholder farmer’s level—a significant endeavor through the extension system (discussed further in Chapter 3.4, On-farm production).

55 Team consultation with National Irrigation Research Coordinator, Tilahun Hordofa from EIAR.
56 Gaps in knowledge about irrigation and other technologies have been flagged as a priority area for work within the Research and Extension systems. Please see the 5-year strategy for the transformation of the research system (ATA 2013) for more.
Key activities proposed:

- Coordinating stakeholders on the irrigated high value crops research dissemination so that research centers are integrating high value crops research into their agenda
- Establishing a system in which research findings are translated and disseminated to farmers through the BoA extension directorate

**Bottleneck 1.3: Unsustainable water management practices are common**

Among many smallholder farmers, current well-drilling and water use practices leave much to be desired from both sustainability and an efficiency standpoint. In agricultural regions with a longer history of irrigation, such as southern India, unsustainable water management practices—such as flood irrigation and over-abstraction—have had serious environmental and agro-ecological consequences in both urban and rural setting.

Aquifers have been depleted in the hard rock terrain of peninsula India, in the coastal regions, and in the sedimentary aquifers of the Ganges valley.\(^{57}\) It is clear that the long-run impact of irresponsible use of groundwater resources can be devastating for two major reasons. Watershed depletion will not only reduce future irrigation potential but can threaten the availability of water for household use. Furthermore, the high water use levels in flood irrigation can increase salinity levels and harm soil quality, damage that is difficult to repair.

Ethiopia, with less widespread adoption, has not yet faced this issue at the same scale. Still, flood irrigation practices are widely used, and unsustainable well spacing has been observed in the Raya valley of Tigray.\(^{58}\) For household irrigation to be sustainable at scale, SHFs must adopt improved practices in appropriate well-spacing and careful water management.

While the MoWIE has defined high-level water resource management policies,\(^{59}\) they are nonspecific and thus unenforced. The reasons of this are driven largely by the availability of data; since watershed and aquifers are not well-defined, the water policy cannot be specific to the household level. Without woreda-level water allocation decisions, household-level water management policies are nonspecific and unenforceable.

**Intervention 1.3: Promote responsible water use and enforce water management policies at the household level**

The sustainability of water management practices will only result if water resource management is taken seriously. Even though water management policies exist in the country, they do not fit the need of household level irrigation activities due to their limited scope. National efforts towards efficient, equitable, and optimal utilization of available water resources not only need to be tailored to household irrigation activities, but also need to be better enforced.

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\(^{57}\) World Bank, Garduño et al (2011). The situation with groundwater use in India is well described in a number of recent publications, such as “Deep Wells and Prudence” (World Bank 2010), “Taming the Anarchy” (Shah 2009) and several GWmate papers.

\(^{58}\) Team field visits to the Raya valley of Tigray, June 2013.

\(^{59}\) MoWIE enforces the Ethiopian Water Sector Policy, last set in 2001.
First, a committed Ministry such as the MoWIE must be identified to own the regulatory responsibility for household water utilization. Especially for groundwater resources tapped in relatively arid areas, the MOWIE should proactively manage water levels through the following:

- **Prescribe well-spacing guidelines:** The appropriate well-spacing depend on the watershed; conventional practices in Oromia regulate at least 500m space between wells. (Better estimates of well-spacing can be reached after operational groundwater maps are generated.) Woreda-level experts should determine the optimal well spacing based on that information, and encourage responsible use to those parameters through the extension system.

- **Promote water-saving:** water-saving methods and technologies, such as drip irrigation, can reduce any impact of water overuse on soil salinity. Irrigation technologies operating on the basis of water-saving are more sustainable than water-abstracting technologies, and smallholders can be incentivized to favor them instead.

- **Incentivize groundwater recharging interventions:** Artificial groundwater recharging interventions, such as percolation tanks, can improve the sustainability of well yields.

- **Define water use rights and enforce responsible use:** in areas where there is a possibility of overuse of groundwater resource, local officials may be required to enforce minimum well spacing and abstraction levels through the awarding of permits or program incentives. Taking into account the gaps in information that limit the woreda’s ability to enforce these regulations, the Regional Bureaus of Water and Energy/Irrigation Authority must work with the national MOWIE to design the national water policy, designing a model to determine local prescriptive requirements, and developing a set of recommendations.

**Key activities proposed:**

- Design mechanisms to reinforce the current groundwater policy to fit HHI needs and define water use rights for smallholders
- Develop technical guidelines for optimum well spacing and abstraction levels that balance individual with collective needs
- Promote groundwater recharging activities through targeted incentives
- Define processes to ensure policies are understood and enforced at the local level
3.2 Technology access and adoption

**Vision for Technology access and adoption**

Smallholders are able to access and afford household irrigation technology, after-sale services, and spare parts. Domestic producers are able to meet demands for inputs, while foreign technologies and expertise are accessed through imports and joint venture partnership.

Household irrigation technologies comprise the full set of simple machines that set up farmers for irrigation on the micro-scale. Largely based on gravity-fed drip irrigation infrastructure, household irrigation systems can source water from *rainwater catchment systems*, such as storage tanks and plastic sheeting, or *groundwater systems*, built from wells and irrigation pumps. Because of the seasonality of rains and the high cost of building large-capacity water storage tanks, the sector strategy here is focused on the groundwater opportunity.

**Exhibit 12 Three pump types often used in household irrigation**

<table>
<thead>
<tr>
<th>Drive system</th>
<th>Water source</th>
<th>Price and running costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual pump</td>
<td>• Static water level of up to 18 m depth (for irrigation)</td>
<td>• Price: USD 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 4 h of labor to irrigate 0.1 ha (opportunity costs of ~15 ETB/day)</td>
</tr>
<tr>
<td>Treadle pump</td>
<td>• Static water level of up to 6 m depth</td>
<td>• Price: USD 135 (pressure)/ USD 30 (suction only)</td>
</tr>
<tr>
<td></td>
<td>• Suitable for nearby surface water</td>
<td>• 4 h of labor to irrigate 0.25 ha (opportunity costs of ~15 ETB/day)</td>
</tr>
<tr>
<td>Engine pump</td>
<td>• Static water level of up to 3 - 6 m depth</td>
<td>• Price: USD 300 - 3,000</td>
</tr>
<tr>
<td></td>
<td>• Suitable for surface water</td>
<td>• Variable costs and irrigable area depending on size of engine, assumed average of 3 ha</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fuel cost 120 USD/ha/yr</td>
</tr>
</tbody>
</table>

Within the suite of household irrigation technologies, the most transformative and cost-effective technology for groundwater are small household irrigation pumps. These can be motorized or non-motorized, differing in coverage area, lifting capacity, and cost.61

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60 Total operating costs include labor cost (opportunity cost of 15 ETB/day), fuel/oil cost (diesel pump), maintenance, and depreciation; does not include transaction cost of organizing farmers in cooperatives (which is usually necessary for efficient use of motor pumps). From GGGI/IWMI 2011.

61 Please see Chapter 2 for more information.
• **Non-motorized pumps** come in a range of forms, with two being most widely used in Ethiopia. *Rope-and-washer pumps* cost about 2,500 ETB and operate by hand. *Treadle pumps*—including pressure treadle pumps, suction only treadle pumps, and overflow treadle pumps—operate by foot, cost about 3,600. The advantage of these pumps include: low installation, operation, and maintenance costs.

• **Motorized pumps** can be powered by diesel, petrol, electricity, wind, or solar power, and are similarly available in a wide range of styles. They range from 5,000 to 16,000 ETB in capital, depending on type and channel of procurement, in addition to ongoing fuel and maintenance costs. The primary advantage of motorized pumps is their ability to irrigate larger areas of land with a single well, and the reduced requirement for labor. Due to their additional complexity, however, farmers buying them must be conscious of the availability of spare parts for ongoing repairs. Each of these pump styles can be best suited for different contexts. A table comparing some of their best uses is included below.

The production, procurement, and distribution channels of both of these are quite complex and both require substantial capital, making appropriate financing critical. Thus, both access and cost bottlenecks present opportunities for systematic interventions that transform the accessibility of irrigation agriculture.

<table>
<thead>
<tr>
<th>Bottlenecks and interventions for Technology access and adoption</th>
<th>Bottlenecks</th>
<th>Interventions</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Household irrigation pumps are low in quality and have high failure rates</td>
<td>2.1a</td>
<td>Build the capacity of local manufacturers to meet demand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1b</td>
<td>Work with regulatory, trade, and enforcement authorities to produce and enforce national irrigation pump standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1c</td>
<td>Encourage joint ventures and knowledge-sharing to gain foreign expertise</td>
</tr>
<tr>
<td>2.2</td>
<td>Inefficient supply chain and procurement procedures for household irrigation technologies</td>
<td>2.2</td>
<td>Define and install improved practices in the irrigation pump supply chain and procurement system</td>
</tr>
<tr>
<td>2.3</td>
<td>Tariffs on private imports drive up cost of irrigation technology</td>
<td>2.3</td>
<td>Extend the agricultural tax exemption to private procurement of household irrigation pumps</td>
</tr>
<tr>
<td>2.4</td>
<td>Limited credit available for household irrigation technologies and associated inputs</td>
<td>2.4a</td>
<td>Develop credit schemes that enable smallholders to invest in household irrigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4b</td>
<td>Establish a national household irrigation development fund</td>
</tr>
</tbody>
</table>

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62 Team consultation in March 2013 with HAGBES PLC, the leading private importer of engine pumps, noted that prices were 13,000-16,000 ETB for private pumps imported outside of central procurement channels, around 40% higher than the prices for centrally procured pumps.
Bottleneck 2.1: Household irrigation technologies are low in quality and have high failure rates

For both motorized and non-motorized pumps, gaps in the availability of reliable, high-quality pumps are a major obstacle to SHF adoption. While a comprehensive study on failure rates is not yet available, case research undertaken by IWMI and the ATA indicate failure rates of 20-60% within the first year. 

Non-motorized pumps: the majority of non-motorized pumps produced domestically in small workshops, with poor quality control and training. While some manufacturers are trained by NGOs (see Intervention 1 for more detail), most manufacturers lack the capacity and skill to produce irrigation pumps of the quality and quantity needed to meet demand. Until very recently, many woredas have no local manufacturers of irrigation pumps at all. Problems faced by SHFs include the following:

- **High failure rate:** High failure rates are common across pump types. Popular locally-manufactured pressure treadle pumps (PTPs) in particular suffer from low-quality production, leading to a high failure rate. Diaphragm pumps are also known for a high failure due to wear-and-tear in seals, and cannot be repaired in those cases. Rope and washer pumps tend to have rope failure, though this is a more addressable problem with replacement ropes.

- **Low labor efficiency:** Many models require a great of labor input for water delivery, with inefficient labor conversion, greatly limiting farmers’ irrigation area. Treadle pumps, in particular, have been problematic for women and children.

- **Fragmented, unbranded market:** With fragmentation of manufacturing and large quality variations between manufacturers, smallholders are less able to make educated purchase decisions. The lack of consistent specifications also means that parts are harder to replace when they wear out.

Engine-powered pumps: The availability of domestically-produced motorized pumps is even lower. The primary producer is the state-owned Metal Engineering Corporation (METEC), which assembles under 7,000 engine-powered centrifugal pumps per year, less than 7% of the amount imported from foreign manufacturers. METEC’s ability to meet demand is limited due to gaps in the necessary production and test facilities. Imported engine-powered pumps similarly present a large range of problems for smallholders. The market for motorized pumps is currently dominated by cheaply-manufactured models imported through neighboring countries through both legal and unregulated channels.

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63 A comprehensive study of irrigation pump quality falls under the scope of the study portion of Intervention 3. Define and install improved practices in the irrigation pump supply chain and procurement system.
64 ATA visits to AGP woredas in Spring 2013.
66 ATA field visits in ATA woredas (2013) found that pressure treadle pumps (PTPs) currently being manufactured are of old models with design problems and high exposure to frequent failures. Out of 21 SHFs using PTPs, 12 reported them to be malfunctioning at the time of visit.
67 ATA consultation with Shabel Eyasu, METEC, July 2013.
68 Though METEC is interested in scaling its manufacturing of engine pumps, it also engaged in the production of larger agricultural machinery, which means the scaling of domestic engine pump manufacturing will be a gradual, longer-term process.
69 In interviews with engine pump retailers, ATA has encountered a number who are unwilling to name the upstream suppliers for their imported pumps, indicating the likelihood of unregulated pump trafficking into the country.
- **Low performance**: The failure rate of cheap imported models is high, including breakages in housing, wear in seals, and warps in shaft and bearing indicating poor original design. Failure rates of up to 20% within the first year are highly discouraging, given pumps’ high cost.

- **Fragmented, unregulated market**: A large diversity of options exists, and the differences between high and low-quality brands are difficult to assess without testing or prior knowledge. Little guidance for the procurement or selection of pumps is currently available. Both end-user SHFs and procurement officials, lacking deep technical knowledge of irrigation technology, can thus struggle to choose high-quality options.

- **Difficulties in repair and maintenance**: Both the poor quality of original construction and the wide variety of models makes repair difficult, while fragmentation, import difficulties, and supply chain gaps mean that replacement parts are difficult to access.

- **Quality risks**: In most cases, warranties are not available for irrigation pumps. Given the high failure rates of available models, the lack of warranty is a strong discouragement against purchase by SHFs.

**Drip irrigation kits**: Preliminary assessments of the limited market for drip irrigation technologies indicates that the quality of available drip kits is similarly low—with leakage and other manufacturing errors limiting smallholders’ faith in them.  

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Exhibit 13. Projected scale and productivity of household irrigation in 5 years, via two primary methods

<table>
<thead>
<tr>
<th>Scale, thousand ha irrigated with HIT</th>
<th>Productivity, USD/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 240 GoE</td>
<td>~ 640 Optimal scale/productivity</td>
</tr>
<tr>
<td>~ 6 NGO</td>
<td>~ 60 Large-scale technology distribution</td>
</tr>
</tbody>
</table>

---

70 October 2013 consultations with woreda and regional irrigation experts, reporting field experiences. Preliminary; more research in this area is planned to assess the appropriate course.

71 BMGF/GGGI 2011; adjusted for 2013 baseline instead of 2011. Value creation of pump distribution and ancillary market not included.
The poor quality of both domestically-manufactured and imported HITs is a major bottleneck for HHI. It exposes them to financial risk in the cost of repair/replacement, as well as risk of crop failure during the downtime of disrepair. Efforts to combat quality issues—both through capacity-building and regulation—can yield huge dividends for SHF adoption of irrigation.

**Intervention 2.1a: Build the capacity of local manufacturers to meet demand**

Several NGO stakeholders are currently engaged in promoting the capacity of domestic pump manufacturers. iDE launched its project in Ethiopia in 2007. JICA is similarly training its own targeted manufacturers, with models appropriate for potable water rather than irrigation. Their models suggest that capacity-building for pump manufacturers requires a package of services including skills training, design specifications, linkages to purchasers, and sustainable parts supply.

While these NGOs are doing excellent work, a sustainable, cost-effective, scalable solution will require institutional support and accreditation through the Ethiopian extension system. Thus, GOE could help achieve scale through the mainstreaming of this process in by employing existing institutions such as the Agricultural Research and Mechanization Centers (ARMCs) and ATVETs to provide training on the manufacture and maintenance of pumps, and ensuring access to the kinds of business support and finance services that such local manufacturers would need.

**Key activities proposed:**

- Assess and identify the local capacity gaps in the production of quality motor/engine pumps
- Adopt best-in-class models and prototypes for the Ethiopian context in partnership with NGOs and researchers at work on pump models
- Train domestic manufacturers on the production of quality manual pumps

**Intervention 2.1b: Work with regulatory, trade, and enforcement authorities to produce and enforce national irrigation pump standards**

To protect SHFs from poor-quality pumps, and to reduce the difficulties faced by RBOAs in technically complex procurements, establishing uniform standards for pump purchases is a critical step to ensuring pump quality. Even if not mandatory, suggested standards and evaluation metrics against them will aid RBOAs in the selection of the high-quality pumps for central procurement, reducing the uncertainties that arise in association with quality problems currently observed in imported pumps.

These standards fall into three overall types:

- **Product standards**, which define the specifications and performance thresholds that products must reach, e.g., fitness for use, interface and interchange ability, safety, and environmental protection
- **Test standards**, which define the method of measurement and analysis of the test results;
- **Fundamental standards**, which concern the terminology, metrology, conventions, signs and symbols used to describe and annotate the products.

In addition to the benefits of standards to help RBOAs and farmers select the right pumps for purchase, and to restrict import of low-quality pumps into the country, standardization has important benefits for the development of a well-function domestic pump manufacturing sector.
- **Provides guidance for high-quality designs:** Standardization facilitates and accelerates the transfer of efficient pump technologies to small-scale manufacturers, making it possible to master the technical characteristics of pumps, to validate the manufacturing methods. This increases productivity and gives operators and installation technicians a feeling of security that their designs are appropriate.

- **Catalyzes research, development, and investment:** Standards provide the starting point for research and development for further improvement of the product. By providing a benchmark level of quality, they can also help local companies signal their quality and produce models that compete effectively in the global market.

With stakeholder alignment on the need for quality standards, these principles can be codified and enforced with the collaboration of relevant stakeholders in the sector. Appropriate enforcement will require further efforts to build an appropriate testing facility and design processes to verify compliance of both imported and locally manufactured pumps to the determined national standards.

**Key activities proposed:**

- Determine the need for pump standards and the appropriate set of technical standards, through diagnostic studies on current failure rates and technical causes
- Align national stakeholders on standards and achieve endorsement by the National Standard Council
- Establish a testing facilities and processes to enforce standards with both domestics and imported pumps

**Intervention 2.1c: Encourage joint ventures and knowledge-sharing to gain foreign expertise**

Foreign investments in equipment manufacture are one of Ethiopia’s priority areas for increasing growth in the country. Such projects increase training, permit technology leakage, and increase availability of high-quality technology.

To promote manufacturing investment extra incentives should be provided for manufacturers bringing new forms or technologies to the country. Difficulties in starting business can be facilitated by active assistance by the Ministry of Industry, which can expedite processes and facilitating linkages with domestic firms interested in joint ventures with foreign investors.

**Key activities proposed:**

- Include irrigation technologies among the high-priority sectors worked on by the MOI in its efforts to facilitate foreign manufacturing investment
- Provide incentives to investors choose joint venture models with training components for local partners

**Bottleneck 2.2: Inefficient supply chain and procurement procedures for household irrigation technologies**

Feedback from current users indicates that the existing supply chain of manual and engine pumps in the country fails to fully serve smallholder farmers on providing pumps, spare parts and maintenance services easily and on time. Low existing demand makes it difficult to sustain a large supply—but the lack of supply of such pumps in turn limits awareness of irrigation and opportunity to demand pumps.
The scarcity of manufacturers also reduces access to spare parts and maintenance services, further reducing smallholders’ ability to use irrigation effectively.

As the popularity of groundwater-based household irrigation has grown in recent years, the irrigation pump market in Ethiopia has evolved beyond central procurement to include independent sales channels. The nascent private sector does not independently fill all SHF needs, especially for after-sale services. While parts may be very inexpensive—under 100-200 ETB/year—transport costs to city centers where they are available can be prohibitively high, even when linkages to distant retailers are established. At the same time, a large number of pumps are still imported through regional governments and NGOs. This decentralized procurement of small quantities may increase in the price of HITs, and potentially leaves some WOAs/ZOAs to navigate their own procurement procedures at low volumes and without equal technical expertise.

Thus, the impact of a weak supply chain on smallholder production is significant, since it means that SHFs may not be able to purchase pumps when they wish to. Existing owners may find their pumps out of commission for long periods, or that they function at far below optimal capacity, without access to spare parts and repair services. In this way, an unreliable market for pumps, parts, and after-market services ultimately leads to lower productivity and less willingness by SHFs to adopt HHI at all.

Exhibit 14. Open questions on the supply chain of irrigation pumps in Ethiopia

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where do imported pumps come from? Who imports them? At what mark-up?</td>
<td></td>
</tr>
<tr>
<td>How do BoWEs get pumps-parts and at what mark-up? What about woredas?</td>
<td></td>
</tr>
<tr>
<td>How do smallholders access maintenance services and parts?</td>
<td></td>
</tr>
<tr>
<td>What is the feasibility of rental models to increase access?</td>
<td></td>
</tr>
<tr>
<td>Are there other ways we can help smallholders appropriately</td>
<td></td>
</tr>
<tr>
<td>How many pumps are imported illegally? Where do they go?</td>
<td></td>
</tr>
<tr>
<td>Where do private retailers get their pumps? What is their margin?</td>
<td></td>
</tr>
<tr>
<td>Where are there local manufacturers of manual pumps?</td>
<td></td>
</tr>
<tr>
<td>Engine pumps in legal transactions</td>
<td></td>
</tr>
<tr>
<td>Engine pumps in illegal transactions</td>
<td></td>
</tr>
<tr>
<td>Manual pumps</td>
<td></td>
</tr>
</tbody>
</table>

Intervention 2.2a: Define and install improved practices in the irrigation pump supply chain and procurement system

Not enough is yet known about the irrigation pump supply chain to be certain of the appropriate nationwide initiatives to address those gaps. In addition to the interventions outlined above, one immediate-priority intervention towards bringing about a more effective supply chain of irrigation pumps is to build

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72 Based on prices of iDE and Kickstart annual replacement costs for the plastic components of manual pumps.
a better understanding of the major bottlenecks. To this end, a detail analysis should be undertaken on the existing supply chain and procurement systems in the entire network from international, national, regional and woreda levels to the end consumers at kebele level.

Following this, improved practices need to be identified best that are suited for practical implementation and implementation support for irrigation pumps in the way that can possibly be scaled-up.

**Key activities proposed:**

- Conduct a study of the existing supply chain and procurement practices in place to determine the highest-priority gaps and areas of impact
- Determine appropriate revisions to procurement policies and incentive structures to change private supply chain behavior
- Implement policy changes through fast-tracked process with ERCA, ECAE, and MOT

**Bottleneck 2.3: Tariffs on private imports drive up cost of irrigation technology**

Set by the Ministry of Trade, tariffs can comprise a significant component of cost for imported goods into Ethiopia. Liquid pumps—whether used for water, oil, or gas—as well as their engines and parts are entered into the same import category. The same tariff applies to imported drip irrigation kits, since they are categorized as tubing and ancillary equipment. If purchased through private means, taxes on these include a duty tax and WH tax in addition to VAT, totaling over a 40% rate of the pre-import cost. Ultimately, these charges comprise about a third of the price of pumps—both motorized and non-motorized—that are imported via private supply lines. Under import, the pumps are regulated under the same standards as other pumps designed for domestic water supply, treatment plants, swimming pools, dispensing fuels, and other construction and industrial purposes.

While agricultural technology can be exempted from import tariffs if centrally procured through government channels, these exemptions are difficult for RBOAs, ZOAs, and WOAs to attain. Official procurement requires careful official technical evaluation of options on the market and cost-based purchasing, a lengthy process that may not result in the highest quality results. Given the additional difficulties of international procurement, WOAs in at least one region have centrally procured pumps from private importers, including the significant markup of the tariff, and passed that on to the SHFs and cooperatives that are their end-buyers.

The current tariffs for irrigation technology are a major obstacle to promoting adoption among SHFs, especially where credit is relatively inaccessible. Unsurprisingly, the significant price increase in technology has been described as prohibitively high by retailers and irrigation service providers, who are disincentivized to build a reliable, demand-driven supply chain for irrigation pumps. Tariffs thus add

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73 The statistics of 37% is cited by Dr. Gebregziabher, Gebrehaweria in “Motorized water lifting in Ethiopia” (2011); team analysis on ERCA tariff data revises this estimate to 30% of irrigation pump cost.
74 Consultation with ERCA in August 2013, toward the “Supply chain and procurement of irrigation pumps in Ethiopia”
75 Team discussions with RBOAs, ZOAs, and WOAs indicate that awareness of tariff-exempted import procedures is uneven.
additional work for RBOAs, ZOAs, and WOAs, who must procure and facilitate the distribution of pumps to help SHFs access it. Finally, by adding to the problem of illegal imports, tariffs put the supply of pumps available to farmers at risk by reduce the government’s ability to regulate their quality and conformity to national standards.

**Intervention 2.3: Extend the agricultural tax exemption to private procurement of household irrigation pumps**

Explicitly extending the current import tax exemption on agricultural inputs to household irrigation technologies would be a major and transformative means to make those technologies more affordable to low-income smallholder farmers, and increase their adoption throughout the country.

Such a tax exemption should be carefully applied, so that it promotes efforts to cultivate domestic pump manufacturing, rather than stifling them. For example, perhaps only demonstrably-effective pumps will be eligible for the exemption through a specially-designated import category restricted to tested, certified, and approved technologies (see Section 3.2 Technology access and adoption for more detail). A tax exemption could be paired with policy promoting domestic production by the companies currently importing pumps. Finally, the exemption could be staggered to promote the import of complex parts in engine-driven pumps. This tariff exemption must be carefully designed to ensure the cost reduction is directly passed on to smallholder farmers.

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**Exhibit 15. Illustrated impact of tariff on price of engine pumps**

<table>
<thead>
<tr>
<th>Size of market</th>
<th>Access to pumps</th>
<th>Exemption</th>
<th>Assembled</th>
<th>Dis-assembled</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 100,000 pumps / year&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Via local woreda bureau of agriculture</td>
<td>~ 55,000 pumps / year&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Retailer shops in Addis and regional towns</td>
<td>Shipment route comes through private importers</td>
</tr>
</tbody>
</table>

<sup>1</sup> Average for 2008-2010; assumes 13,000 ETB base cost of engine pump. From interviews with private importers and regional BOWE, March 2013
Key activities proposed:

- Study the effects of high tariffs on HIT adoption rates and smallholder incomes
- Design the form and extent of the tax exemption, to ensure maximum benefit for smallholder farmers and sufficient encouragement of domestic manufacturing
- Align stakeholders on the appropriate path for repeal of taxes on household irrigation technologies, if determined to be appropriate

**Bottleneck 2.4: Limited credit available for household irrigation technologies and associated inputs**

The Ethiopian economy is significantly credit constrained, with credit supply roughly USD 3 billion short of credit demand. Though hundreds of MFIs and well over a thousand SACCOs serve smallholders, input credit for agriculture purposes remains difficult for significant structural reasons.

- **High transaction costs.** Transaction sizes are small, with the average size of agricultural loans in 2007 only 1,250 ETB (100USD at the time). Rural customers are geographically dispersed and difficult to reach through spotty telecommunications networks. Finally, since most are illiterate, pamphlets and mass communication is less effective, and contract terms must be carefully explained.

- **Complex risk management and cash flow.** Cash flows are lumpy and cyclical within a geographic area, with outflows at planting and recovery at harvest times. Risk is highly covariant across borrowers, since investment returns depend on that year’s local climate, while agricultural activities and practices are also specialized enough to make the monitoring before harvest—in order to gauge risk halfway through—difficult for under-resourced MFIs.

Irrigation agriculture in particular is strongly affected by these constraints. Standard input-credit schemes have a limited applicability since they are designed on shorter loan periods, with repayment terms dependent on the traditional rain-fed agriculture cycle. In areas with limited irrigation activities during dry seasons, financial institutions are not inclined to design specialized schemes to account for the different needs of irrigation.

The difficulty of accessing credit is a critical obstacle for smallholders in greatest need, who lack alternative access to the necessary capital for investment in household irrigation technologies and associated agricultural inputs. Interventions to address this issue must address both the existence of loans and the terms under which they are given.

Finally, access to finance is essential not only for farmers but also for investors in the sector—the manufacturers, retailers, and after-sales service providers discussed in this chapter. Over 90 percent of manufacturers and retailers surveyed by iDE consider credit the main constraint to their production. Finance gaps are thus spread across the full ecosystem of businesses engaged in irrigation.

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77 Amha and PECK, AEMFI, 2010
78 AEMFI 2008
79 Invalid source specified.
80 IDE Ethiopia 2011. “Establishing a Pro-Poor Sustainable Supply Chain of HITs.”
Intervention 2.4a: Develop credit schemes that enable smallholders to invest in household irrigation

Standard irrigation credit schemes should be designed to support capacity-constrained MFIs and ensure farmers have access to finance to procure irrigated agriculture input, especially water-saving and water-lifting technologies. Ideally, these models must fit several basic requirements, including:

- **Appropriate repayment timelines** aligned with varied irrigation-agriculture harvests, with the flexibility for farmers to grow a range of appropriate HVCs
- **Collateralization on the HIT purchased** so that failure to repay would not threaten the farmers’ existing assets and expose households to unnecessary risk, while MFIs can reclaim pumps from SHFs who fail to repay.
- **Integrated design** that supports other financial products, such as purchase warranties, savings/layaway schemes, collective purchasing, and agro-input financing, that are relevant for the SHFs served
- **Longer-term financing**, over the course of 2-3 years rather than a single year, to account for a multi-year repayment horizon for technological equipment

Exhibit 16. Successful model of BOA-MFI partnership to deliver pump access to farmers

Successful design of this system will be complex, requiring input from both finance and agricultural experts, learning from best practices other countries, and alignment from public and private-sector

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81 Team visit and interview with Amhara Bureau of Agriculture, March 2013
stakeholders. Observing a successful model of irrigation pump procurement (see Exhibit 16), WOAs can work with MFIs to verify the creditworthiness of borrowers, authorize the release of stock centrally procured from pump providers.

Recent experience designing input financing packages indicates that stakeholders with strong credibility and cash reserves have a critical role in backing this experimental design as a partial guarantor. National backing for such programs through the establishment of a seed fund or guarantee program could catalyze the introduction of these programs in Ethiopia’s many MFIs.

**Key activities proposed:**

- Collaboratively design a model for HHI/HIT financing, including perspectives from finance and agriculture experts, public sector stakeholders, and pump suppliers
- Align appropriate stakeholders on central funding supports necessary to support it, such as a central revolving fund

**Intervention 2.4b: Establish a national household irrigation development fund**

To promote investment in household irrigation, national-level stakeholders can create a rotating development fund that backs MFI programs issuing credit to household irrigation. This type of funding to household irrigation can be designed similarly to the funding mechanisms used to incentivize larger-scale irrigation activities, such as the Ministry of Water’s fund for water supply, medium and large-scale irrigation activities, which enables development of water supply schemes in different parts of the country.

Establishing a similar fund for household level irrigation activities could be transformative for the sector, enabling dramatic increases in investment by cooperatives, WOAs, and private entrepreneurs. Such a fund should go beyond small credit schemes for SHFs to buy technology, as described in Intervention 4a. Develop credit schemes that enable smallholders to invest in household irrigation, to additionally address the credit needs of other actors: manufacturers, maintenance and repair providers, local seed producers, well drillers, pump rental providers, input wholesalers and retailers (unions, cooperatives, and private suppliers), and output aggregators (cooperatives and buyers).

A revolving fund of 100M ETB, backed by national stakeholders in household irrigation, would provide the leverage to spur action in the sector by MFIs and investors. Such a fund could take a range of forms, but should contain the following elements:

- **Partial financial backing to** credit programs that incentivize, to build MFIs capacity to invest in irrigation over time
- **Technical guidance on appropriate HHI investments** (e.g., manufacturing, well-drilling, rental, parts retail, etc) undertaken by all sectors, whether GOE, private, or cooperatives

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82 MOA/ATA project designing input financing for the Wheat Initiative has included a 50% seed fund.  
83 See Intervention 4c. Establish a national household irrigation development fund for more.  
84 The 100M ETB amount is proposed based on a 5-year investment repayment period, to permit longer-term entrepreneurial investments. At that rate, it would provide 500k ETB for each of 200 woredas.
• **Sustainable, pro-poor scheme design** providing cheap, accessible credit but generates sustainable returns to maximize scalability

By incentivizing MFIs to provide irrigation-related loans, a national household irrigation fund would provide leverage in facilitating finance linkages to promote these activities. In that way, it would promote entrepreneurial investment in the irrigation sector and build the sustainable economy around household irrigation.

**Key activities proposed:**

- Develop a detailed design for a sustainable system, adopting successful practices from other countries and sectors
- Identify potential funding entities, including donor agencies and government funding streams
- Set up a section at the MOA to coordinate, administer, and monitor the use of funds

**Intervention 2.4b: Build rental markets for household irrigation technology.**

Given the high price point of engine-powered irrigation technology, their high water-lifting capacity (irrigating up to 4 ha), and the importance of skilled operation, there is tremendous natural opportunity for cost-sharing among farmers through the use of shared pumps, facilitated through micro-entrepreneurs. These so-called irrigation service providers (ISPs) own portable motorized pumps along with hoses, pipes and other accessories. ISPs rent a pump set to an individual or a group of farmers for a fixed period of time, and assume responsibility for operations and maintenance of the pump set. Typically, farmers pay a fixed rate per hour that covers all costs and leaves a profit. In some cases, ISPs extend services to offering loans for inputs, agronomic advice, and credit (see Box 1 for more).

While these small-scale entrepreneurs are certainly motivated by profit, their contribution to the sector is threefold. First, they can make household irrigation more accessible in the absence of credit for smallholders. Second, as many provide maintenance and associated services, they provide supplementary on-farm training to limited official programs through FTCs. Finally, they also play a critical role in enabling skeptical farmers to test household irrigation for a season before large capital investments.

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**Box 1**

**CASE STUDY: A rental service provider for irrigation technologies**

Desta Tesfaye is a farmer in the Wondogenet woreda of the SNNPR. With his brother, he irrigates 3 ha of land using the water from the Woreka River that crosses the woreda. He uses a 3” petrol pump bought second-hand from another farmer with 6,000 ETB, three years ago.

Besides using the pump to irrigate his land, Desta is known in the village as a **pump rental service provider**. More than 40 farmers, with an average irrigated land holding size of 0.4 ha, obtain pump rent services to irrigate their plots. Peak demand for the pump rental services runs from January up to April.

**Design of the service model:** Depending on the crops to be irrigated, their fee varies from 100 to 150 ETB per hour. In addition, client farmers cover the fuel costs of approximately 23 ETB per hour. The oil cost will be borne by the rent provider.

**Client study:** Million Warssemo is one of the farmers who receive the rental service from Desta. He grows potato on 0.4 ha of irrigated land by using Desta’s pump to deliver water from the river to his plot. He needs the pump four times per growing period; each time, he rents for three hours at a rate of 150 ETB/hour. During the last irrigation season (Jan- April 2013) he has paid a total of 1,800 ETB for the pump and 276 ETB for the fuel.

**Challenges:** Desta finds that the critical challenges for his pump rental business are the absence of maintenance/parts providers and the shortage of petrol suppliers in his woreda.

Source: Key informant interviews with pump rental providers and users in Wondogenet, July 2013.
To support the formation of rental markets and make the introduction to household irrigation technologies more affordable for farmers, local partners should support entrepreneurs in the procurement of pumps, and simultaneously ensure they provide quality technologies and materials to farmers.

**Key activities proposed:**

- Include rental agents into government irrigation pump distribution channels and SHF marketing
- Educate woredas/DAs on the role of rental agents and the services they should provide
### 3.3 Input production and distribution for high-value crops

**Vision for Input production, procurement, and distribution**

Farmers have reliable access to high-quality seeds, fertilizers, and pesticides for high-value crops that maximize their investment, throughout the year.

Achieving full return on irrigation investment requires an uninterrupted flow of consumable agricultural inputs—seeds, fertilizer, pesticides, and herbicides. Access to these inputs present distinctive challenges for irrigation agriculture for two reasons:

- **Off-season demand.** Irrigation agriculture, especially growing short-cycle crops like vegetables, can add 1-3 additional cropping cycles every year. To do this, farmers require access to seeds quickly at each of their planting seasons—a tall order for Ethiopia’s current system for input distribution, for which farmer cooperatives and cooperative unions (CUs) are the primary channel of distribution.

- **Alternative channels for high-value crop seeds.** While seed distribution of staple crops occurs primarily through the Ethiopian Seed Enterprises (ESE), the traditional production model through ESEs is significantly less developed for horticultural crops. Instead, most horticultural seeds are imported privately and sold by seed shops throughout the country.

**Exhibit 17. Use of improved seeds and fertilizer, by crop type (AGP baseline 2011)**

- **Inorganic fertilizer** (% of households)
  - Wheat: 11
  - Teff: 6
  - Barley: 4
  - Maize: 3
  - Root crops: 2
  - Pulses: 2
  - Vegetables: 2
  - Oil seeds: 3
  - Sorghum: 1

- **Improved seed** (% of households)
  - Wheat: 74
  - Teff: 63
  - Barley: 52
  - Maize: 42
  - Root crops: 31
  - Pulses: 21
  - Vegetables: 12
  - Oil seeds: 6
  - Sorghum: 5

- **Higher price seeds at lower volumes.** High-value crops, such as vegetables, can have far more expensive seeds, especially for improved varieties with dramatically higher yields. Improved onion seeds can run well over 3,000 ETB/ha, in contrast to wheat seed prices of 1,800ETB/ha.\(^8\) While the

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\(^8\) Calculations based on average onion seed price of 800 ETB/kg and seed rate of 3.5 kg/ha, and bread wheat seed price of 10.5 ETB/kg and seed rate of 175 kg/ha. Seed rates taken from national crop registry database, averaged across improved varieties, and prices taken from HHI team’s survey of woreda-level horticultural input prices in AGP woredas.
high productivity and price of the resulting crop justify these prices, the high price of seed is a huge up-front capital requirement of irrigation agriculture.

Overall, a well-functioning input distribution system for rain-fed agriculture will be similarly helpful for irrigation agriculture. Since the input requirements for irrigated agriculture are distinct in these key ways, however, the appropriate interventions may be slightly different.

### Bottlenecks and interventions for Input production, procurement, and distribution

<table>
<thead>
<tr>
<th>Bottlenecks</th>
<th>Interventions</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Limited availability of affordable, high-quality seeds for high-value crops</td>
<td>3.1a Ensure that all imported seeds adhere to necessary quality levels</td>
<td>MOA</td>
</tr>
<tr>
<td></td>
<td>3.1b Support the development of domestic high-value crop seed production</td>
<td>ESE</td>
</tr>
<tr>
<td>3.2 Ineffective distribution networks for irrigation agriculture inputs</td>
<td>3.2a Enable cooperatives/unions to collect demands and distribute irrigated agriculture inputs</td>
<td>FCA</td>
</tr>
<tr>
<td></td>
<td>3.2b Expand existing private sector seed distribution for horticulture</td>
<td>MOA/ESE</td>
</tr>
</tbody>
</table>

#### Bottleneck 3.1: Limited availability of affordable, high-quality seeds for high-value crops

Seed is a key input for improving crop production and productivity. Improved varieties of onions and potatoes achieve yield increases of 300-500 percent over local varieties⁸⁶; thus, investing in improved seed is a critical step and catalyst in agricultural transformation. Despite the availability of a number of promising improved varieties, the availability of improved seeds is very limited, especially for vegetables. Together, these factors mean that only 12 percent of household use any improved seed (see Exhibit 17).

A major constraint in the adoption of improved seed is a lack of reliable and high-quality supply. There is minimal domestic seed production and multiplication effort for horticultural crops due to limited research and technology. Improved seeds for some crops—carrot, cabbage, and kale—are not domestically produced at all given lack of necessary technology, while other vegetables—gomen, tomato, and onion—could be domestically produced at greater scale without more technology. With the exception of potato and capsicum crops, the vast majority of vegetable seeds available for purchase on the open market come from abroad.

The Ethiopian Seed Enterprise (ESE) dominates seed production in the formal seed sector. Approximately 80% of all commercial seed was produced by the government, and the remaining by private producers, still leaving substantial gaps in availability and supply. Recent government efforts to address this shortage have liberalized the seed sector, licensing Regional Seed Enterprises (RSEs) as well as private seed companies.⁸⁷ Though this effort is encouraging, both the ESE and RSEs are mainly involved in the production of cereals such as wheat, teff, barley and oilseeds, producing an insignificant quantity of certified capsicum and onion horticultural seed (see Table 1).

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⁸⁶ According to the MOA crop database (2012), onion productivity is almost 58,000 kg/ha with improved seed, vs 9,500 kg/ha with local seed.

⁸⁷ Seed system potential in Ethiopia, IFPRI, July 2012
Exhibit 18. Certified seed produced by Ethiopian Seed Enterprise (quintals)

<table>
<thead>
<tr>
<th></th>
<th>FY2006</th>
<th>FY2007</th>
<th>FY2008</th>
<th>FY2009</th>
<th>FY2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>181,526</td>
<td>195,734</td>
<td>226,954</td>
<td>302,883</td>
<td>524,303</td>
</tr>
<tr>
<td>Pulses</td>
<td>16,783</td>
<td>19,771</td>
<td>19,689</td>
<td>28,408</td>
<td>14,847</td>
</tr>
<tr>
<td>Oil seeds</td>
<td>8,819</td>
<td>6,206</td>
<td>5,792</td>
<td>5,955</td>
<td>2,981</td>
</tr>
<tr>
<td>Horticultural crops</td>
<td>2</td>
<td>30</td>
<td>45</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>Fiber crops</td>
<td>240</td>
<td>--</td>
<td>33</td>
<td>--</td>
<td>1,000</td>
</tr>
<tr>
<td>Forage crops</td>
<td>89</td>
<td>103</td>
<td>--</td>
<td>176</td>
<td>93</td>
</tr>
<tr>
<td>Total</td>
<td>207,459</td>
<td>221,844</td>
<td>252,512</td>
<td>337,441</td>
<td>543,254</td>
</tr>
</tbody>
</table>

Instead, the supply of horticultural seeds in Ethiopia providers is comprised of two major sources: seeds saved and informally exchanged, and improved varieties largely brought in through import channels. As a result, the right approaches to the irrigation input supply chain and the horticultural seed sector will necessarily differ from that for cereal and root crops.

Gaps in horticulture seed import control and testing have translated into farmers’ suffering substandard seed quality. During an ATA field visit undertaken in Gomma woreda, farmers reported that head cabbage and tomato seeds failed to germinate and give yields due to the use of expired seeds. When poor seeds lead to crop failures, farmers have low confidence in their investments in improved horticultural seed varieties, which in turn restrict the development of a truly thriving domestic horticultural seed sector.

**Intervention 3.1a: Ensure that all imported seeds adhere to necessary quality levels**

Ethiopia currently has ten seed testing laboratories in the country that sample-test imported seed and verify that they have adequate germination, purity, and health. Despite the importance of import quality-assurance to horticulture, none of these labs has the capacity to undertake significant testing of horticultural seed imports. Beginning this quality testing may require improvements in equipment, expertise, and policy.

Farmers need to adopt the utilization of quality seeds to attain increased production. There is minimal effort in regulating the quality of imported as well as locally produced seeds. In light of this, there is a need for quality control labs with adequate equipment, facilities and sufficient number of highly skilled staff to serve as inspectors, lab technicians and administrators. Current gaps in testing are largely due to a lack of physical capacities—e.g., appropriate laboratory reagents—due to a larger emphasis on testing

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88 ATA field visit to Gomma woreda, April 2013.
89 National Seed System Strategy, ATA, 2013
cereal crops. Seed labs’ mandate to test horticultural seeds, as outlined in the Seed Proclamation (2013), should be re-emphasized, with accompanying incentives and funding.

Key activities proposed:

- Define baseline quality standards that must be met by all seed, both imported and domestic
- Build capacity of seed testing laboratories with the necessary equipment and skills
- Incentivize existing seed testing laboratories to include quality assurance of imported and locally produced horticultural crop seeds

Intervention 3.1b: Support the development of domestic high-value crop seed production

To increase the availability of horticultural seeds in Ethiopia, both the number of improved varieties and the volume of their production must be increased.

First, large-scale producers must expand production of horticulture varieties. ESE and the RSEs must dramatically increase horticultural seed production, expand their varieties, and increase volume. The MOA can work with regional irrigation offices to make an investment case for high-priority varieties that farmers are likely to purchase, and to link these research enterprises with the seed multiplying enterprises and cooperatives that can produce at sufficient volume for farmers.

Second, support in technological capacity-building would enable the ESEs to expand their horticultural seed production to some staple crops currently missing on the market. Without temperature-control facilities and associated knowledge and skill needed to artificially initiate flowering and seed bearing, ESE and other seed suppliers lack the ability to produce staple horticultural crops seeds, such as kale, cabbage, and carrots. For tomatoes, large-scale seed extraction remains difficult because of the necessity of special equipment to crush and ferment ripe fruit to facilitate extraction of the seed. Thus it is important to address the seed production issue through the availability of technical facilities, knowledge and skill needed for large-scale seed production.

Finally, both formal-sector enterprises and NGOs engaged in horticulture seeds— like CIP and 2scale— can work with seed-multiplying cooperatives to quickly multiply and distribute improved seeds so that they are more readily available to smallholder farmers within their local towns and woredas. Once demand is assessed by WOAs and recommended cropping schedules are determined through agronomic and market assessments (see Intervention 7.1: Enable woredas to determine appropriate high-value crops and cropping calendar for irrigation in their area), WOAs should link with seed-producing cooperatives to advise on the right crops and varieties for local multiplication efforts.

Key activities proposed:

- Incentivize large-scale producers to expand production of horticulture varieties
- Build technological capacity of seed enterprises to produce horticultural seeds
- Train seed producing cooperatives on seed multiplication techniques and best practices

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90 Discussion with Amhara RBOA, July 2013
• Create linkages between farmers and intermediate sector seed producers (e.g., seed producing coops, small-scale private outgrower schemes), aligned with woreda crop recommendations

Bottleneck 3.2: Ineffective distribution networks for irrigation agriculture inputs

An integral aspect of putting an efficient household irrigation system is the provision of necessary inputs such as seeds and fertilizers in a cost effective and timely manner. In the Ethiopian case however, the supply system could not satisfy the needs of smallholder farmers due to growing demands. Smallholder farmers face difficulties in accessing inputs in the dry season due to the limited involvement of actors in the input supply system, i.e. cooperatives, unions and input retailers. Demand collection for irrigated agriculture is also scarce as compared to the rain fed system. The few cooperatives that distribute these inputs are usually based on the demand collection made by the agricultural bureaus, which isn’t organized and sustainable.

Exhibit 19. Existing input supply system for vegetable seeds and fertilizer

Smallholder farmers have difficulty in accessing other irrigation agriculture inputs such as pesticides and fertilizers. The primary source of fertilizers is the Agricultural Input Supply Enterprise, and distributes to cooperative unions, focusing on the distribution cycle used in rain fed agriculture. Farmers undertaking irrigation activities on the other hand do not have the proper access to these inputs as demand aggregation does not occur in the same way during dry seasons. Though the situation is less pronounced as with seed, because there are typical leftover stocks of fertilizer due to farmer under-utilization, smallholders are less able to access sufficient fertilizer and pesticides for their “off-season” cropping.

Economies of scale are also working against irrigated agriculture inputs because the aggregated demand is not large enough to justify a lower cost. As a result, local dealers opt not to engage because their

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92 Report on fertilizer in Ethiopia, IFPRI, 2012
engagement is not as profitable the dry season as compared to the main growing season. This has implications on availability and affordability of these inputs towards to smallholder farmers.

**Intervention 3.2a: Enable cooperatives/unions to collect demands and distribute irrigated agriculture inputs**

An effective input delivery system is necessary to ensure SHFs access to high-value crop seeds, fertilizer, and pesticides outside of the traditional rain-fed agriculture system.

In most of Ethiopian agriculture sector development strategies and plans, farmer cooperatives and unions take the lead in distributing inputs to member and non-member farmers. Cooperatives account for more than 85 present of the total input supply to the community, and the price reduction to members through competitive bidding is on average 10-15 percent. The majority of the cooperatives do not take on this role during the dry seasons for irrigated agriculture, specializing in the rain-fed cycle.

In the absence of formal engagement of the extension system on the irrigation cycle, cooperatives can assess demand of members and aggregate orders to purchase from private suppliers and input providers. Modeling input supply after that of successful irrigation cooperatives (see Box 2 for the case study of a cooperative in Butajira), cooperatives can assess demand and deliver inputs throughout the year, negotiating contracts with central suppliers of inputs.

Finally, while many of the seeds available on the market are of unreliable quality, cooperatives can help farmers by ensuring they only procure high-quality seeds for their members. Horticulture experts can provide trainings to cooperatives participating in a seed provision scheme to help them determine what varieties to buy, what prices to pay, and what markers of quality to look for in seeds’ appearance and packaging. It is also necessary to introduce the best way of seed handling by seed distributing agents in

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**Box 2**

**CASE STUDY: Technology and input delivery provided by an irrigation cooperative union**

The Tiret irrigation union in Butajira, comprised of 17 PCs with ~2000 households, has operated in the woredas of Sodo, Meskan, and Mareko for the past 3 years. Members are primarily involved in the production of tomatoes, cabbage, onions, carrots and pepper, harvesting three times a year due to short planting cycles. Both groundwater and river sources are used, primarily with motor-powered pumps. (The project was initially sponsored by an NGO, SOS Sahel, who provided pumps to groups of 5-7 farmers at a 50 percent discount, and still pays salaries of some union staff.)

**Best practices:** The CU practices several important best practices. Fifteen-day **pump maintenance trainings** are provided by the RBOA to one farmer per kebele, who provides maintenance services in the kebele; difficult cases are referred to the WOA. Tiret **collects demand and distributes agricultural inputs** like seeds and chemicals, sourced from private importers in Addis Ababa (as discussed in Intervention 3.2).

**Challenges faced:** Importers do not always provide **quality seeds**: spoilage of cabbage and onion seeds was reported by many farmers. The CU has not been seeking market linkages on behalf of PCs, leaving them to sell to traders; farmers reported selling onions as low as 0.6 ETB/kg in the market flooding that follows harvest due to common cropping preferences.

**Source:** Focus group interviews with 23 farmers in Tiret cooperative union, June 2013

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93 ACDI-VOCA, Revitalizing Market-Oriented Agricultural Cooperatives in Ethiopia

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order to avoid germination loss during seed distribution and transit. Horticultural seeds should also be tested before they are distributed to assure best quality seed reaching small holder farmers.

**Key activities proposed:**

- Set a standardized input demand collection system for household irrigation agriculture
- Train cooperatives/unions to act as input distributors for their members

### 3.2b: Improve private sector supply chain for horticultural seeds

The vast majority of imported horticultural seeds are distributed via private seed shops, moving down the chain from central importers to small outlets in rural towns. The previous intervention discussed how quality can be improved through better testing equipment at the seed testing labs. Yet, even when imported horticultural seeds are tested and found to be of high-quality, they may still suffer degradation while navigating the supply chain to smallholder farmers, due to poor shipping and transport practices for a highly delicate good.

Unlike cereal seeds, many species of vegetable seeds must be carefully protected from oxygen, heat, and moisture to prevent their early germination. Onions, for example, are particularly sensitive and must be packed in air-tight aluminum foil to prevent germination. Yet suppliers used to consider goods in bulk import their seeds in large cans, often causing major degradation of the supply before it reaches retailers who repack seeds in paper envelopes for sale.

This is not to discourage the scale-up of direct seed marketing, which is currently under pilot by the MOA for major cereal crops. The few categories of vegetable seeds currently produced by ESEs would also benefit from direct marketing, which shortened the seed supply chain from producer to consumer, minimized carryover seed and waste when retail outlets were able to return unsold supplies, and increased private sector competition improving farmers’ access to quality seeds at good prices. Yet that pilot and the existing experience of horticultural seed sellers both demonstrate an important gap to address: the limited technical capacity of both wholesale dealers and retail shop owners contributes to seed quality degradation and a poor germination experience for farmers.

Since this effect is most strongly felt with horticulture seeds, proper supply chain handling should be addressed in a three-part approach. First, import certification should include stipulations on the appropriate packing of seeds that ensure their quality preservation, with importers held accountable for quality spot-testing at the farmer level. Second, dealers and retailers can be trained in handling techniques.

**Key activities proposed:**

- Issue guidelines for appropriate seed storage and packaging along the horticultural value chain, and hold importers responsible for packaging by sample-testing seed quality at the farmer level
- Train retailers and distributors on the appropriate packing and shipping techniques to preserve seed quality
- Train farmers on how to select quality seeds through the extension system
3.4 On-farm production

**Vision for On-farm production**

Extension services fully support farmers in irrigated agriculture. Farmers adopt best practices in irrigation agriculture for their local area.

Irrigation agriculture is an entirely different set of practices as compared to rain-fed agriculture, and requires additional training to ensure farmers have a high return on their irrigation investment. Though smallholders are knowledgeable about the importance of irrigated agriculture, they may lack the skills to effectively manage resources for the productivity of their crops.

Farmers are especially limited in knowledge on the water management aspect of irrigation—for example, how and when to water crops and how much water to use. For many high-value crops, effective water management is essential to maximizing yield and ensuring the best return on investment: vegetables, with short roots, are especially sensitive to moisture depletion and hence require consistent irrigation short intervals. In addition, farmers may need training on well drilling and basic irrigation pump management—skills that they would not have developed practicing rain-fed agriculture.

The agricultural extension system through the Ministry of Agriculture and regional Bureaus of Agriculture is the traditional channel for education about new technologies and best practices. Specifically, kebele-level Farmer Training Centers (FTCs) and the Development Agents (DAs) that work there are charged with teaching farmers about new agronomic practices, demonstrating their best use, and serving as a resource for farmers to consult as needed. In their turn, DAs are trained at Technical and Vocational Education and Training (TVET) Centers around the country.

As a skilled agricultural practice, household irrigation is designated to be taught through the agricultural extension system. Yet both overall capacity gaps and a specific lack of emphasis on irrigation limits that system from fulfilling its promise in ensuring the best in irrigation agriculture techniques are practiced by smallholder farmers.

<table>
<thead>
<tr>
<th>Bottlenecks and interventions for On-farm production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottlenecks</td>
</tr>
<tr>
<td>4.1 Limited training and demonstrations for farmers on irrigation agriculture practices</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>4.2 Limited knowledge and skill in well-drilling best practices among smallholder farmers</td>
</tr>
</tbody>
</table>
Bottleneck 4.1: Limited training and demonstrations for farmers on irrigation agriculture practices

As somewhat to be expected with new technologies, farmers’ limited awareness of proper irrigation agriculture is compounded by the lack of awareness and emphasis within in the extension system. Since fully 98 percent of farmers list DAs as a primary source of information and over 80 percent utilize and visit FTCs, the lack of emphasis on irrigation in the formal extension system is a significant.

First, many development agents simply are not adequately trained on irrigation through the TVET program. A recent assessment of the Mersa and Wukiro centers noted that the centers are trying to incorporate practical training sessions apart from theoretical classes for their students, but are struggling to provide hands-on training because of a lack of infrastructure and water sources.

Second, although the national government has placed great emphasis on irrigation in the GTP, the farmer extension curriculum at lower levels does not yet reflect that priority. In many woredas, subject matter specialists (SMSs) seem to lack the knowledge and experience to assist development agents appropriately on what to advise the farmers on irrigation water management. In other cases, they may have the experience but lack the necessary physical resources—pumps, wells, and so on—do hold trainings and propagate best practices.

Intervention 4.1.a: Improve irrigation training curriculum and facilities for DAs

Since irrigation water and crop management covers a minor portion of Development Agents’ training, newly graduated DAs have little to offer farmers in the way of best practices or experience in irrigation. Thus in collaboration with the MoA’s initiative to improve the curriculum of the DAs training on irrigation agriculture, the necessary training materials and additional courses should be included in the DA curriculum.

On a basic level, this means including updated information reflecting the best practices for irrigation known at this time. In addition, it may require increasing the capacity of TVETs to teach about irrigation practices with the inclusion of on-site technologies, water access points, and demonstration areas. Finally, it means that subject matter experts on the woreda levels must be accessible resources for the DAs in their areas, and supported in reaching DAs.

Key activities proposed:

- Updating irrigation agriculture training and operational manuals to reflect the best known information of the present time
- Improve the resourcing of TVETs with irrigation technologies, water access points, and demonstration areas
- Provide accelerated courses to DAs currently operating in woredas identified to have HH irrigation potential

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94 “Enhancing farmer-info-services in Ethiopia: A critical review of Sources, Channels and Formats,” study by Precise International commissioned by ATA, August 2013
95 Study conducted by MoA on March 2012
96 Consultation with State Minister Sileshi—during steering committee meeting on Dec 4, 2012
Intervention 4.1b: Capacitate FTCs and demonstration sites to be learning centres for HHI best practices

The lack of emphasis placed on irrigation within the extension system also affects the availability of physical resources that DAs can use to demonstrate irrigation. Only 19 percent of FTCs have the capacity to demonstrate water harvesting resources of any kind,\(^\text{97}\) and far fewer are able to demonstrate irrigation. The absence of demonstration equipment—for example, irrigation pumps—compounds the lack of technical knowledge and means that FTCs are very limited in their ability to serve as resources for farmers interested in irrigation.

Of course, the capacity of FTCs as centers of irrigation training is highly dependent on their overall capacity. Almost one in five FTCs do not have demonstration plots of any kind, and about two in five lack adequate housing resources for DAs. The success of initiatives to build the capacity of DAs and FTCs overall is thus critical to the success of the household irrigation strategy.\(^\text{98}\) The first step in improving them for the purposes of household irrigation must be to raise overall conditions in FTCs. This effort is already a focal point for the Ministry of Agriculture’s plans for FTCs, and should be pursued with all possible urgency.

In FTCs that are designated for improvement and those that are to be constructed, regional BoAs should ensure that each has appropriate resources—water availability at the site, suitable soil quality, irrigation technologies, and staff training—to be a resource on irrigation to farmers.

Key activities proposed:

- Increasing the overall capacity of FTCs and demonstration sites, as currently underway
- Supply FTCs or other demonstration sites with the necessary materials to effectively demonstrate irrigation practices

Intervention 4.1c: Employ information and communication technologies to deliver timely, targeted information to DAs and farmers

One way to address the gaps in the extension system is to use information and communication technologies (ICTs) to directly reach DAs and practicing farmers. A centralized ICT system would enable experts to pass information to development agents outside the annual trainings that precede planting season. This would increase the scope of what they can present to farmers, to include agronomic advice tailored to changing weather conditions. More importantly, it means that DAs have a reliable source of information on a topic they may not be as knowledgeable about.

Furthermore, farmers new to irrigation agriculture will benefit most from active “coaching” through all steps of the irrigation agriculture process as they begin new practices. Information and communication technologies can bridge the adoption gap. An ICT system could deliver messages on the crops SHFs are producing specific to the agro-ecology of their location, as well as their topics of interest. It would also

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\(^{97}\) Tesfaye 2010.

\(^{98}\) Five-year strategy for the transformation of the Extension sector of Ethiopia.
make targeted support on specific subjects more sustainable through dialing into a central system with pre-recorded messages or experts on call. Finally, as WOA/BOA irrigation services are scaled up, ICT can be a reliable way of alerting farmers to relevant training, extension, and market events happening in their area.

**Exhibit 19** describes how an inexpensive ICT platform can deliver agronomic information that both complements and builds upon the existing extension system. **Automatic calls** can deliver targeted guidance in agronomy and post-harvest practices, **recorded-message hotlines** can provide guidance on more detailed topics, and **text messages** can provide automatic updates of weather, market, hazard, and event information that are relevant beyond irrigation to general agricultural practice.

**Exhibit 20. Flow of information through traditional extension system vs targeted ICT platform**

<table>
<thead>
<tr>
<th>Information flow through extension system</th>
<th>Information flow through ICT solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIAR / RARI</td>
<td>EIAR / RARI</td>
</tr>
<tr>
<td>RBOA</td>
<td>RBOA</td>
</tr>
<tr>
<td>Zonal SMS</td>
<td>ICT platform</td>
</tr>
<tr>
<td>Woreda SMS</td>
<td>Zone and Woreda SMS</td>
</tr>
<tr>
<td>DAs</td>
<td>DAs</td>
</tr>
<tr>
<td>Smallholder farmers</td>
<td>Smallholder farmers</td>
</tr>
<tr>
<td>Annual training cycle</td>
<td>1-3 wks to reach</td>
</tr>
<tr>
<td>Efficient ICT channel will provide DAs and farmers with tailored, real time information, and reduce the loss from too many actors along the way</td>
<td></td>
</tr>
</tbody>
</table>

**Key activities proposed:**

- Design an ICT system that can target messages across a large range of dimensions, and is adapted to SHF literacy and language constraints
- Coordinate sustainable channels for content generation within EIAR and the RARI
- Train RBOAs, ZOA, and WOAs in how to leverage the ICT system to engage with SHFs, and train DAs on how to help SHFs use ICT platforms

**Bottleneck 4.2: Limited knowledge and skill in well-drilling best practices among smallholder farmers**

Manually drilled shallow tube wells are a cost effective source of irrigation water for smallholder farmers, where groundwater is close to the surface and soils are productive and free of rock beneath the
surface. The technology is not complicated and acceptance by farmers is increasing. Tube wells can be one of the better investments for poverty reduction, and they are already common in many parts of Asia and Africa. In Ethiopia, however, household well-drilling is a fairly new practice, with two major implications. First, smallholder farmers are often unaware of best practices and techniques; thus, where manual well-drilling is practiced, the techniques in traditional well-digging are not always appropriate or efficient. In addition, relevant well-drilling tools and technologies (e.g., augers and pits) are difficult to access. These labor-saving devices could reduce the time required for well-drilling while also increasing those wells longevity, capacity, and integrity.

As a result of the lack of experience and equipment for manual well-drilling, farmers can experience well failures. Badly-drilled wells in the traditional style are less effective for hygiene and sanitation. The higher cost and difficulty of digging wells without improved methods is a deterrent to the adoption of irrigation.

**Intervention 4.2: Build capacity in manual well drilling through trainings and promoting micro-enterprises**

Until recently, little formal training or support existed on well-drilling, with limited engagement by stakeholders on the issue. Few private enterprises provided well-drilling services, often because a major limitation for manual well-drilling enterprises is access to funding in the purchase of basic well-drilling technologies. Building the capacity of these enterprises—and ensuring their access to finance and technology—is a key lever to enable farmers to drill high-quality wells.

Through the Agricultural Growth Program (AGP), the Ministry of Agriculture and regional Bureaus of Agriculture are presently engaged in building the capacity of woreda and zone-level organized enterprises in manual well-drilling. Their program has provided the basic manual well drilling equipment’s with intensive training for the organized enterprises. The MoA has also prepared and distributed a guide on manual well drilling and installations based on the simple sludge drilling technique. Efforts of this kind should be actively scaled up to other areas where manual well drilling is feasible. In SNNP, local WOAs have taken the initiative to cascade manual well-drilling trainings received from the AGP. Scaling up efforts of this kind will require sustained investment of training, finance, and certification to ensure the continued quality of drilled wells.

**Key activities proposed:**

- Scaling up existing programs such as those of the Ministry of Agriculture and AGP to more well-drilling enterprises
- Cascading trainings through woreda offices of agriculture and cooperatives
- Facilitating access to drilling equipment for manual well-drilling enterprises, through financing or equipment rental options

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100 MOA 2012

101 Discussion with SNNP RBOA in July 2013.
3.5 Post-harvest handling

<table>
<thead>
<tr>
<th>Vision for Post-harvest handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers are able to maximize their yield and profits through appropriate and timely post-harvest handling. The value of perishable crops is preserved through appropriate sorting, packing, transportation, and preservation techniques.</td>
</tr>
</tbody>
</table>

A significant proportion of Ethiopia’s annual harvest is typically lost due to spoilage, exposure, contamination, and incomplete capture in post-harvest processing. Standard estimates of the share lost between harvest and final consumption range between 25 and 35 percent.\(^\text{102}\) For fresh fruits and vegetables, which have very limited shelf life and typically require expensive cold-chain processes, over 50 percent loss has been reported.\(^\text{103}\) Even this loss figure underestimates the impact of poor processing, as it excludes low-grade and damaged produce that is primarily taken up by farmers themselves for household use. Furthermore, post-harvest spoilage of fruits and vegetables extends beyond the problem of loss. Degraded produce that is eventually consumed poses health risks. The short shelf life of crops after harvest also reduces smallholder farmers’ ability to negotiate with dealers and to attain the best prices at market.

Most of the high-value crops most eligible for household irrigation agriculture in Ethiopia have a highly restricted shelf life. Unprotected ripe tomatoes may last only days before spoilage past marketable levels. With only 5% of produce currently processed or preserved after harvest, the margin of error in which to ensure productivity is slim.\(^\text{104}\)

<table>
<thead>
<tr>
<th>Major vegetable crops for Ethiopia</th>
<th>Storage temperature (°C)</th>
<th>Storage life (wks)</th>
<th>Est. post-harvest loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>13—15</td>
<td>0.5 – 1.0</td>
<td>40-50</td>
</tr>
<tr>
<td>Potato</td>
<td>10—16</td>
<td>1.5 – 2</td>
<td>10-20</td>
</tr>
<tr>
<td>Onion</td>
<td>7—13</td>
<td>20—30</td>
<td>10-20</td>
</tr>
<tr>
<td>Sweet pepper</td>
<td>7—13</td>
<td>2—3</td>
<td>15-25</td>
</tr>
<tr>
<td>Green beans</td>
<td>4—7</td>
<td>1.0—1.5</td>
<td>20-25</td>
</tr>
<tr>
<td>Garlic</td>
<td>15—18</td>
<td>20—30</td>
<td>10-25</td>
</tr>
</tbody>
</table>

Reducing the proportion of spoilage is critical to helping farmers realize the full value of their harvests. Yet, in working to preserve a horticulture crop, farmers face strong technical constraints in the scarcity and expense of storage technologies. Ideal processes include temperature- and humidity-controlled storage, plastic packaging materials, and cold-chain motorized shipment—processes that are prohibitively expensive for smallholders. The preservation of crops, especially via **temperature-controlled storage**, have revolutionized the supply chain of horticultural produce for farmers around the world; at the high cost of equipment and coordination that cold chain requires, however, Ethiopian

\(^{102}\) Jibat 8  
\(^{103}\) EHDA  
\(^{104}\) EHDA
smallholders selling for domestic market cannot enjoy its value preservation benefits. Affordable technologies that smallholders currently use to preserve cereals—for example, grain silos—are less applicable to bulky produce.  

**Bottlenecks and interventions for Post-harvest handling**

<table>
<thead>
<tr>
<th>Bottlenecks</th>
<th>Interventions</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Limited knowledge of best practices in post-harvest handling of horticultural crops</td>
<td>5.1 Train farmers on proper post-harvest techniques for horticultural and high-value crops</td>
<td>MOA</td>
</tr>
<tr>
<td>5.2 Limited access to storage and agroprocessing resources</td>
<td>5.2 Build storage and agro-processing capacity in cooperatives</td>
<td>MOA</td>
</tr>
</tbody>
</table>

**Bottleneck 5.1: Limited knowledge of best practices in post-harvest handling of horticultural crops**

Though ideal cold-chain preservation of crops may be unattainable, a number of post-harvest best practices, developed by local and international researchers, have demonstrated huge potential to preserve delicate crops, but not all of these practices are well-known or adopted among smallholder farmers for both cost and knowledge-gap reasons.

Exhibit 22. Top sources of post-harvest loss of horticultural crops

<table>
<thead>
<tr>
<th>Category</th>
<th>Crops included</th>
<th>Causes of post-harvest loss</th>
<th>Example post-harvest recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root vegetables</td>
<td>Carrots, Beets, Onions, Garlic, Potato, Sweet Potato</td>
<td>Bruising</td>
<td>Diffused-light storage (DLS) for potatoes</td>
</tr>
<tr>
<td>Leafy vegetables</td>
<td>Lettuce, Chard, Spinach, Cabbage, Green onions</td>
<td>Over-ripe, Water loss</td>
<td>Curing with high heat after harvest</td>
</tr>
<tr>
<td>Immature-fruit Vegetables</td>
<td>Carya, Squash, Cucumbers, Eggplant, Okra, Snap beans</td>
<td>Under-chilling, Decay</td>
<td>Proper bundling with moist paper/fabric</td>
</tr>
<tr>
<td>Mature-fruit vegetables and fruits</td>
<td>Tomato, Mango, Melons, Citrus, Bananas, Apples, Grapes, Cherries</td>
<td>Under-chilling, Over-ripe</td>
<td>Reduced sun exposure</td>
</tr>
<tr>
<td>Flower vegetables</td>
<td>Artichokes, Broccoli, Cauliflower</td>
<td>Over-ripe, Water loss</td>
<td>Sun-drying/processing peppers</td>
</tr>
</tbody>
</table>

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106 Kitinoja and Kader 2003; ATA experience;
While this capacity gap is significant enough for cereal and pulse crops, it is even more marked for horticultural crops. Traditional storage techniques are less applicable for delicate vegetables. The common practice of field storage exposes crops to sun and damage. When crops are stored at the household level, a traditional basket-like structure called *gotera* are often used, though they are not ideally suited for fleshy produce.107

The lack of such post-harvest handling practices causes preventable post-harvest loss. Mechanical damage, late harvest, and poor storage are direct damage factors. Further, injuries open produce to more decay and increased water loss leading to quick deterioration. Exhibit 22 explains more detail on the leading causes of post-harvest loss in horticultural crops, and preventative measures that smallholders could pursue.

Increasing smallholders’ practice of these basic post-harvest handling techniques will have two major impacts. First, it will increase the ability to sell produce to distant markets, by extending the shelf life of crops, and thus ensuring more of it survives long journeys to high-price urban markets. Many urban markets also have far more stringent quality requirements for produce, and sorting produce to ensure that level of quality opens these markets up to rural smallholders.

**Intervention 5.1: Train farmers on proper post-harvest techniques for horticultural and high-value crops**

While the ideal cold-chain for post-harvest shipment of horticulture is financially inaccessible to SHFs, other post-harvest techniques are straightforward and cost-effective. Smallholders can thus be trained on the appropriate techniques to process, pack, and store their own horticultural output:

- **Cleaning, sorting, and grading** to remove damaged and diseased produce.
- **Storing** with temperature control, humidity control, air circulation and ventilation, and avoiding incompatible product mixes—especially in absence of refrigeration facilities.
- **Packing** crops for long-distance transport or storage, often at the moment of harvest.108

Specific practices differ by crop. For potatoes, it means the adoption of Diffused Light Storage (DLS); for tomatoes, it means on-field crate packing for longer-distance storage. A number of domestic and international research institutions are engaged in research on this subject, including the Ethiopian Horticultural Development Agency (EHDA), which is particularly focused on the export-market opportunity, and the International Horticulture Agency (IHA).

**Key activities proposed:**

- Prepare materials on best practices in the post-harvest handling of horticultural crops, adapted to the Ethiopian smallholder context
- Provide trainings to irrigation/horticulture cooperatives on small-scale post-harvest processing
- Train smallholder farmers on appropriate post-harvest techniques through the extension system

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107 Role of agricultural cooperatives and storage in rural Ethiopia: a study made for the Ethiopian Agricultural Agency, September, 2012
108 Lubelo 2010
Bottleneck 5.2: Limited access to storage and agro-processing facilities

Even after storage, crops will still have to be sold in a short number of days after harvest. Though surveys indicate 97% of farmers have some storage capacity at the household level, improved storage facilities providing refrigeration and humidity control are difficult to access. Communal storage facilities are usually tailored towards cereals, limiting their applicability to high-value horticulture. These storage facilities at the cooperative level often have corrugated metal roofs that quickly heat up in the dry seasons, as well as holes that permit significant transfer.

For some crops—e.g., peppers and tomatoes—agro-processing is an important alternative to long-term storage that have extremely fast points of spoilage but can be easily processed into high-priced preserved foods. Local varieties of hot pepper, for example, are easy to process into berbere spice that is easy to ship. Many of the high-value crops produced under irrigation will be destined for immediate consumption without significant post-harvest processing. Within domestic markets, only five percent of horticultural production is processed. A small market of urban consumers interested in prepackaged high-volume staples—canned tomatoes, beans, jams, and sauces—are largely reliant on imports from regional exporters in the Middle East.

At the same time processed goods are being imported into the country, agro-processing facilities are scarce and SHFs rarely supply horticultural crops to them. Domestic agro-processing firms tend to source from large-scale commercial farms rather than SHFs through cooperatives. Small-scale agro-processing of spices and herbs is similarly poorly linked with higher-value urban and export opportunities. A survey of woreda and zonal experts in 2012 indicated that of the 84 AGP woredas, only five had larger agro-processors in their areas for any of the high-value horticultural crops.

Intervention 5.2: Support the construction of storage and agro-processing capacity in primary cooperatives

Smallholders’ access to collective resources that protect commodity value after harvest, both in preserving quality and adding value through agro-processing, can be dramatically improved by building them at the level of primary cooperatives and cooperative unions. Adding these services to cooperatives’ portfolio allows them to be a key channel through which smallholders act collectively in the marketing of their crops and access otherwise-unaffordable technologies.

Storage facilities for horticultural crops: In the same way that cooperatives have storage facilities for major cereals and export crops (e.g., grain silos), maintaining storage facilities at the primary cooperative level for horticultural crops can be hugely beneficial for smallholders seeking short-term storage solution. Facilities will vary by the crop grown, but temperature-controlled environments—through effecting shading and ventilation, concrete flooring, etc—are more affordable on the cooperative level than at households. Communal storage centers can also distribute household-level

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109 Role of agricultural cooperatives and storage in rural Ethiopia: a study made for the Ethiopian Agricultural Agency, September, 2012
110 Woreda officials’ input was collected via the assessment of high-value crops, undertaken by the ATA household irrigation team in the fall of 2012. Agroprocessors identified included chickpea, potato, tomato, and shallot (2).
storage equipment, such as bags and cases for crop transport. As an additional benefit, shared storage facilities enable farmers to conveniently aggregate their household-level production to a sufficient scale for larger buyers. The importance of communal storage and aggregation to smallholder market power is discussed further in the next chapter.

**Small-scale agro-processing groups:** Primary cooperatives can also play a larger role of diversifying their members’ product lines through the development of agro-processing functions on members’ output. For spices, herbs, and other processed goods traditionally produced at home (e.g., hot pepper into *berbere* spice), agro-processing groups can collaborate in aggregating and marketing their product, ensuring quantity, and providing mutual self-help in exchanging techniques and support. Setting up such groups and connecting them to smallholders in the same woredas will benefit both. This intervention also has a strong gender-sensitivity component: such groups are often composed of women working at home, and provide an independent source of income for their members.\(^{111}\)

**Key activities proposed:**

- Conduct needs assessment at HH and PC level to determine specific areas where additional storage investment is most profitable and attractive
- Build new storage facilities and tailor existing ones to include accommodation of moderately-perishable horticultural crops
- Through cooperatives and unions, support smallholder farmer groups in building home agro-processing capacity in production, quality certification, and linking to markets

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\(^{111}\) ATA’s Gender team is currently working on agroprocessing projects for women smallholder groups, via the Women’s Economic Leadership pilot project.
### 3.6 Market linkages

**Vision for Market linkages**

Farmers are able to efficiently access markets both domestically and abroad. Market channels for high-value crops give farmers the maximum profit on yield.

Market linkages are critical to the success of the irrigated agriculture sector. They are not only important to realizing cash crops’ income potential, but also critical to ensuring that farmers produce appropriately for existing demand and invest wisely in future inputs. While agricultural market linkages are an opportunity for improvement across the board, efficient markets are far more important to the household irrigation value chain than they are to traditional rain-fed agriculture. Many irrigated crops are highly perishable, making speed-to-market especially important to capturing their value. Local markets may not be as strong, given crops’ high prices, which means strong links to profitable urban markets is essential. Strong linkages thus encourage smallholders to invest in household irrigation.

The best current research of the sector indicates that the vast majority of smallholder production is sold into informal broker-driven supply chains. There, crops must travel through a series of markets to reach their final domestic consumers. Box 3 describes these markets and Exhibit 23 outlines the horticultural market linkage chain.

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**Exhibit 23 Map of supply and market linkages in the horticultural sector, from farm gate to urban market**

**EXAMPLE: RED ONION, HARAWARI TO DIRE DAWA**

- Major channels with varying farm-gate prices
  - Direct/informal
  - Cooperative-mediated
  - Broker-intermediated
  - Commercial
  - Minor channels
  - Potential channel through EtFruit partnership

**XX** Transaction cost per quintale flowing through broker system

- Farmer’s share of final price highly dependent on the number of intermediaries
- In example, farm-gate price was 50% retail

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112 Figure not drawn to scale. The urban market is estimated to be closer to 10% of the vegetable market. Example drawn from CARE Ethiopia analysis of 2006 CSA data (Harari to Dire Dawa); prices adjusted up 48% for overall red onion price increased due to inflation.
In addition to the informal broker system for domestic sale, there are two sanctioned channels for aggregation of agricultural output to international markets. The Ethiopian Commodities Exchange (ECX) aggregates production for a small number of cash crops—e.g., coffee, sesame, and haricot bean—but does not offer a channel for horticulture. Farmer cooperatives can be an excellent institution to aggregate production for sale, but only a small handful of cooperatives in Ethiopia target horticultural crops, as opposed to traditional cash crops like sesame and coffee. Understandably, few smallholders sell to export markets at the current time.\(^{113}\)

### Bottlenecks and interventions for Market linkages

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### Bottleneck 6.1: Inefficient linkages between smallholders and end markets for many high-value crops

Market efficiency is an important concern across agriculture for those who want to preserve SHF’s share of retail prices. Here, Ethiopia compares very favorably for farmers’ share against other countries. For example, Ethiopian SHFs earn about 75% of maize retail prices, compared to 58% in Rwanda and 48% in Kenya.\(^{114}\) In comparison, local studies indicate that smallholders’ farm-gate price can be less than 50% of retail prices for fruits and vegetables,\(^{115}\) though it can also go to 65-70% when they sell at the local market.\(^{116}\) Still, given the strong price variation between urban and rural markets, this trend is also partly an indicator of how close to farms SHFs production often ends up.

The high cost of market linkage is evident in the large number of intermediary stages that are often involved in connecting smallholder product to higher-price urban markets, and the remaining inefficiencies in these linkage functions as they exist today. With an underdeveloped agricultural market linkage system, Ethiopian farmers tend to interact with traders on the basis of personal and known relationships. While this system addresses many of the reputational and transactional costs of businesses at scale, it does lead to several risks for smallholder farmers:

- **Localized and inconsistent prices**, depending on the broker network in the area and their personal networks and relationships

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\(^{113}\) The international market opportunity will be discussed at greater length in the “Demand sinks” chapter.


\(^{115}\) The 50% figure has been validated in studies in various places in the country: in Oromia by the Oromia RBOA (2011), in the Dire Dawa area by CARE Ethiopia (2006), and Amhara by Ahmed (2007).

\(^{116}\) Oromia RBOA.
• **High degree of price-setting power concentrated in brokers**, especially when localized networks act collusively to reduce farmers’ bargaining power.

• **Reduced access for groups traditionally disadvantaged** in status, such as female-headed households and ethnic and religious minorities.

Secondly, while commercial growers and exporters can afford cold or refrigerated trucks to ferry the highest-value produce to airports and sea ports, the equivalent technologies are not currently available to smallholders at domestic price points. Nonetheless, transportation of bulky crops from farms to consumer locations is a key cost in horticultural marketing. For vegetables, this can comprise 9% of the total sale price—compared to 1% for cereals.

• **Porters**: Transport from the field can be highly manual, with porters carrying bales of produce on their heads.

• **Small carts**: Powered by animals, bicycles, or motorcycles, carts may be used to ferry produce to rural periodic markets (e.g. weekend markets) and within a circumscribed geography.

• **Motor trucks**: Open-air trucks may be used when volumes are large and distances are long. Opportunities to ship via large trucks are limited.

Both low production volumes and insufficient infrastructure force smallholders to interact with a large number of intermediaries to reach final markets. Since investing in household irrigation may require growing crops new to them on only part of their holdings, they will be even more exposed to the disadvantages of that market position. As a result, interventions to simplify the complex market linkage system faced by smallholders should focus on helping them aggregate production and more easily access end markets.

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117 Females are historically disadvantaged in interactions within the broker-dominated market. For more background on women’s roles in Ethiopian agricultural markets, please see the MOA’s Gender Mainstreaming strategy.

118 Table 6.5, AGP Baseline Survey 2011
Intervention 6.1a: Support cooperatives/unions and private aggregators in linking with larger wholesale buyers

Previous experiences have shown that farmers benefit most when they work in groups instead of selling their harvests on an individual basis,\footnote{IPMS case studies; iDE case experiences.} for several reasons. First, group marketing gives farmers more negotiating power in their interactions with brokers. Not only can they bargain collectively with brokers, groups of farmers can attract wholesale buyers and so eliminate layers of the marketing chain.

In addition, collective marketing is a proven mechanism for smallholders to access markets farther from home. Nearby towns, urban areas, and international markets often afford higher prices to farmers than local or individual markets, where they must compete with other local producers on a similar cropping calendar. Accessing those markets, however, requires sufficient scale to afford logistical costs and interact with wholesalers and retailers.\footnote{Markelova, H. and Meinzen-Dick, R. 2009.}

Assistance to cooperatives in aggregating horticultural production can take a variety of forms. In the absence of output financing, cooperatives aggregate their members’ production on the basis of trust, and thus they should be trained and empowered in the appropriate techniques to ensure appropriate aggregation.\footnote{Building the capacity of cooperatives can be a complex endeavor. For more on bottlenecks in the cooperatives system, see the 5-Year Strategy for the Cooperatives System of Ethiopia (2013).} They can be collectively linked to wholesale buyers or to agro-processors, who are in a better position to market and process foods for urban customers and export.

Local private aggregators provide the same collective bargaining opportunities to farmers outside cooperatives. WOAs can work with them to build relationships with distant urban wholesalers in much of the same way, thus increasing market opportunities for farmers who are not members of cooperatives, and cultivating viable options where cooperatives are not engaged in irrigation.

The most important step in linking smallholders with aggregators and processors will be to identify the quality and type of inputs processors require, and to establish contracts to meet those quantity demands. Reliable linkages with cooperatives will help them plan for their member’s irrigation outputs.

Key activities proposed:

- Organize farmers into irrigation and horticulture cooperatives in order to market collectively
- Design output financing schemes and connecting cooperatives with financing options that enable them to buy and aggregate smallholder production
- Undertaking a systematic study of the marketing channels for horticulture crops to better understand the best opportunities to act nation-wide
- Build cooperatives’ capacity to negotiate contracts with aggregate buyers, such as wholesalers, agro-processors, and contract buyers
Intervention 6.1b: Improve cooperatives’ access to markets through contract farming schemes

In the absence of a well-developed market, one of the most promising options for smallholder farmers is participation in an end-to-end contract farming or out-grower scheme. Such partnerships are difficult for smallholder farmers to achieve, however, given their stringent requirements in term of quality, quantity, and timing.

In contract farming schemes, the provision of credit and inputs to the farmers are embedded. Done well, contract farming has a number of important advantages not merely restricted to market linkages. First, they give farmers access to superior agronomic and post-harvest trainings from the out-growers’ agricultural experts, including water management and planting techniques that have spillover benefits to non-participating farmers and to rain-fed season practices. Second, post-harvest loss can be reduced due to a reliable delivery supply chain, storage destinations guaranteed by the out-grower, and the provision of appropriate trainings and tools. Third, out-growers can provide farmers with a reliable supply high-quality inputs, including improved seed, fertilizer, and pesticides. Of course, the greatest advantage is guaranteed market linkages that solve liquidity gaps, allow farmers investment in irrigation technology, and permit long-term planning.122

In previous MOA/ATA experiences supporting contract farming for teff, between the Erer Cooperative Union and a domestic injera producer, successful linkages required intensive third party support through the process—including contract design, renegotiations, operational support, and arbitration.123 To sustainably scale these projects, then, it will be essential to set up a sustainable model for facilitating the creation, oversight, and enforcement of bilateral contracts through an independent platform, rather than relying on third party support for ad-hoc, one-off contracts.

The ECX contract platform, which will provide a structure for independent facilitation of contracts between CUs and buyers without central intermediation, is a promising option to facilitate this option. Designing the scope of that platform and incorporating provisions within it that address horticulture is a promising way to increase access to markets for irrigation. Such design should include provisions for the following:

Box 4

Obstacles to scaling contract farming

Contract farming arrangements in Ethiopia have suffered a range of complications, limiting investors’ willingness to begin new projects.

- **Side-selling** is a strong temptation due to seasonal price fluctuations, making contract enforcement difficult for PCs
- **Access to credit for output aggregation** for PCs/CUs, even in small quantities, is often difficult, restricting their ability to aggregate output
- **Quality and process controls** are important for sustaining high prices for aggregated produce, and these skills must be taught to farmers
- **Cooperatives’ capacity** to complete the administrative and logistical work necessary to fulfill a contract effectively
- **Risk of cancellation** in case of business changes huge risk to smallholders with unenforced contracts
- **Transaction costs** from the low capacity of cooperatives

To encourage more contract farming, national-level stakeholders can address these issues on a systematic basis to lower the risks and transaction costs that

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122 Mahaftar and Graylee, 2013
- **Planned and just-in-time delivery** for horticultural crops that can’t be easily stored at a central ECX location, with **cold-chain shipment** options for perishable crops

- **Price discovery** mechanisms for horticultural crops, so that contract prices can be sensitive to regional and seasonal fluctuations

A contract platform will lower the cost of pursuing contracts with both domestic and international buyer, incentivizing growth in such contracts. To build on the advantages of such a platform, enforcement of contracts must remain strong, and the new opportunities provided should be marketed to both CUs and potential buyers.

**Key activities proposed:**

- Build a central platform to facilitate contractual arrangements between buyers and large cooperatives, sensitive to the needs of horticultural crops

- Establish guidelines and processes to help BOAs/ZOAs to facilitate the establishment of out-grower contracts, with trustworthy enforcement mechanisms

- Promote contract farming opportunities to potential buyers (international companies, exporters, domestic processors) and producer cooperatives

- Facilitate linkage between producers group/cooperatives and consumers association/cooperatives

**Bottleneck 6.2: Limited market information available to farmers**

For smallholder farmers in particular, all these problems are further exacerbated by their lower access to information and capital. Lack of information about prices makes them more vulnerable to abuse by middlemen. Unsold or spoiled crops can be financially ruinous. Finally, the confidence that they will be able to sell output at fair prices is an important element of the decision to invest in expensive household irrigation systems—and, without it, the expense of purchasing equipment is difficult to justify.

Market information is largely inaccessible to smallholder farmers for the crops best suited for irrigation agriculture. Three components of market information are especially important for high-value crop agriculture:

- **Commodity demand and prices.** Current and historical prices in local and distant markets allow farmers to understand what they can expect to earn in future production, and ensure they sell their crop for the best price.

- **Potential buyers and markets.** Farmers need to know the identities and locations of assembly and wholesale buyers—especially when they are looking for an alternative to farm-gate options. This information is necessarily informal in nature.

- **Market linkage options.** Farmers with sufficient production to contemplate transporting and marketing goods themselves need to be aware of storage and transportation options

For some crops destined for export—coffee, sesame, and haricot bean—the Ethiopian Commodities Exchange (ECX) is a reliable source of market information. Access to similar resources for horticulture is very crop and location-specific; for many farmers in many areas, informal relationships are the only reasonable source for information-gathering. No matter what crops are grown, of course, irrigation as a transformational technology is most relevant when farmers are able to expand into the cultivation of crops that were not an option previously—and this can only happen when information on the market for those crops is known to them.
As one example, a marketing study in the Alamata woreda of Tigray found that only 18.4% of farmers found information about onion prices from local cooperatives, and 40.4% from traders; the remaining 31.6% determined pricing information by visiting markets themselves.\(^{124}\) The limitations of that approach are significant: visits are time-consuming and costly, and they only give smallholders information on their own rural markets, reaffirming their isolation from urban and regional markets where their output is likely to command higher prices.

The negative impact of limited market information is threefold. First, unable to tailor production to demand, smallholders risk producing unmarketable crops, losing an entire harvest to low prices. Second, without reliable sources of information about fair prices, they do not reach the best sales channels, and are limited in their bargaining power with intermediaries.\(^{125}\) Finally, the absence of secure markets lowers farmers’ risk tolerance their willingness for long-term investments, meaning they may never make the investment in transformative household irrigation technology.

**Intervention 6.2a: Build the capacity of local stakeholders as market extension resources**

The priorities of existing GOE stakeholders supporting smallholder agriculture leave a mandate gap in the dissemination of market information on the high-value crops important to irrigation. With its focus on agronomic practice, the current extension system is not well-positioned either to **collect** demand and price data, or to **disseminate** that data to smallholder farmers. Likewise, local offices of the Ministry of Trade have only recently started to focus on smallholder agricultural production, overlooking the horticulture sector. In general, the Office of Trade at the woreda and zonal level do not currently have the capacity to provide up-to-date market information to farmers. Simultaneously, unreliable telecommunications networks in many rural geographies mean that stakeholders must work creatively to create price-dissemination formats that work through a variety of existing channels.

Therefore, efficiently delivering market information to farmers might be best performed by primary cooperatives and cooperative unions. As previously noted, farmers can improve their market bargaining position through collectivization in cooperatives, unions, and other forms of farm groups. Collective arrangements places cooperatives in an excellent position to gather market information directly from a range of brokers, wholesalers, and other buyers, and pass relevant guidance back to farmers to best align the **quantity**, **quality**, and **timing** of their harvests with demand.

Providing higher-level market information services will require collecting and processing market data systematically, and making them available to farmers in a form relevant to their decision-making. Building the capacity of cooperatives/unions to assume the key role in the collection, analysis and interpretation of market information will thus enable farmers to access market information through more reliable channels than informal broker networks alone. This will include teaching them the concepts, collection methods, and analytical frameworks most appropriate for quickly interpreting market signals—as well as supplying them with the technological and infrastructural tools to stay up-to-date on market information.

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\(^{124}\) Analysis of fruit and vegetable market chains in Alamata, Southern Tigray; The case of Onion, Tomato, and Papaya; Adugna Gessesse, 2009

\(^{125}\) Gebremedhin 78-79.
Key activities proposed:

- Build the capacity of cooperatives and unions to collect, analyze, and act upon market information, as well as their dissemination systems to smallholder members
- Providing marketing information through the marketing offices within regional Bureaus of Trade

**Intervention 6.2b: Utilize ICTs to directly deliver market information to farmers**

While smallholder farmers still rely primarily on traditional routes of information exchange with other farmers and via the extension system, recent years have seen rapid increase in the adoption of broadcast and mobile technologies. Fully 65 percent of farmers have access to radio and 46 percent have access to mobile phones, with 70 percent of mobile users already employing them to access market and price information.\textsuperscript{126}

With effective means to gather market information to a central clearinghouse, Information technologies will become a relevant means of accelerating their impact. Formal programs and platforms have several important advantages over informal knowledge-sharing via ICTs: they help push reliable, better information to farmers; they improve access for vulnerable individuals with weaker social networks; and they are more cost-effective and scalable in the long run than contact information for reliable experts.

In distributing price information to smallholders themselves, WOAs can explore a range of public-dissemination channels to consistently communicate price information to smallholders—whether through radio, SMS, or response hotlines. Technologies chosen should be relevant to the individual customers in terms of its comprehensibility, accessibility, and cost.

Key activities proposed:

- Developing standard forms of market and price information so that media outlets can disseminate it
- Explore appropriate information technologies to provide up-to-date price and demand and information to cooperatives and farmers
- Build sustainable platform that is specifically relevant for women, low-literacy individuals, and regional language speakers; train appropriate regional experts on how to use and maintain it

\textsuperscript{126} ATA farmer communication study.
3.7 Demand sinks

**Vision for Demand sinks**

Farmers are able to access table markets with minimal supply glut and price issues.

Irrigation is one of the best means to mitigate demand sinks for farmers, because it offers an opportunity for farmers to sell counter-cyclically, harvesting outside the traditional rain-fed season. In general, this means their access to domestic markets happens at a more advantageous price moments.

Nonetheless, localized supply gluts can be extremely damaging for farmers. Recent years have seen dramatic fluctuations on the price of common horticultural crops, such as onions. Because fruits and vegetables are not a primary export category in Ethiopia, with low domestic demand and weak market and transport linkages, it is difficult for farmers to mitigate the impact of price collapses by delivering to distant markets.

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**Bottleneck 7.1: High price variability presents investment risks**

Though the majority of this paper treats increased production as a wholly positive result, there are dangers to sudden and short-lived gluts of supply. Specifically, due to weak market linkages and high perishability, farmers are usually eager to sell soon after harvest and are extremely vulnerable to collapsed prices. Current prices for perishable horticulture are very high in off-season, but if a woreda is actively promoting the use of irrigation, much of the income gains farmers should expect may be at risk. A 2009 analysis found that returns to farmers varied between 0 and 150% depending on the price achieved at sale—a variability of price that meant farmers faced tremendous risk.\(^\text{127}\)

With little investment capital to spare, smallholder farmers are incredibly risk-averse. High price variability over time and geography is thus especially disadvantageous when considering the start-up costs of irrigation technology, improved inputs, and fuel.

From a policy perspective, the issue of supply intermediation is complex: while high supply in a given cropping geography can hurt farm-gate prices, a high level of production is necessary to attract large-scale buyers, whether in contract farming or generalized procurement. Studies into contract farming indicate that price fluctuations introduce a risk of defection and side-selling, with potential implications into the willingness of investors to engage in contract farming agreements in the first place. The right solution will depend on the context of investment, and whether, in a particular case, an aggregate buyer can be found.

**Intervention 7.1: Strengthen the capacity of woredas level stakeholders to determine appropriate high-value crops and cropping calendar for irrigation in their area**

To achieve the best returns on investment in irrigation, farmers must plant in their local areas as is most appropriate given the particular context. This will be a complex and dynamic determination, changing along with agronomic and market conditions on an annual basis. To assure farmers that their investments are going to good use, woredas can undertake a cost-benefit analysis of the various crops and varieties that could be grown in the area under household irrigation. A range of factors should be contemplated in this determination: soil, agro-ecology, length of growing period, inputs, agronomy, market linkages, and supporting infrastructure. The analysis of this kind will merge understanding of agronomy and appropriate cropping patterns, with an assessment of market demands.

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**Exhibit 24 Typical cropping pattern with and without irrigation; Hararghe, Eastern Ethiopia (2006)**

This intervention will comprise two main parts. First, woreda-level agriculture experts and local stakeholders should be trained to assess and determine the appropriate high-value crops for their areas, with training and support from central offices. Second, the promotion of high-value crops must be sensitive to the geographic context of that woreda near its immediate neighbors so that supply gluts are avoided to the extent possible.

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128 Mahaftar and Graylee and Aras 2013.
129 Emana and Gebremedhin, 2007
To ensure the results of this assessment are market-sensitive, a key output will be intelligent demand forecasting that gives woreda officials the ability to design appropriate cropping recommendations that coordinate the production of neighboring areas to create a balanced production in the area.

**Key activities proposed:**

- Create a tool that enables woreda officials to determine the optimal crops for high-value irrigation in each geography, and training stakeholders on their use
- Ensure coordination between woredas in cropping calendar promotion to minimize localized production gluts
- Develop high-value crop cropping calendars based on geographic belts

**Bottleneck 7.2 Low domestic consumption of some high-value crops**

Due to both cultural preferences and economic conditions, overall consumption of vegetables in Ethiopia is lower than typical in other parts of the world. Total consumption of vegetables in Ethiopia is estimated to be about 2.86 million tons.\(^{130}\) Given their higher price and lower caloric density, fruits and vegetables may not command a sufficient market in some of the rural areas where they are otherwise profitable to grow. Other high-value crops suffer from weak domestic markets due to cultural taste: mushrooms, for example, are largely absent from traditional cooking.

Cultural preferences may be difficult to change, but regional export markets hold promise as potential destinations for higher production of horticultural and other high-value crops. Smallholders tend not to grow for export, due both to poor information and structural bottlenecks in export market linkages. Their market position—favoring domestic rural markets—accesses comparatively price points and is unlikely to generate the greatest financial returns for smallholders.

**Intervention 7.2a: Supply school feeding and other nutritional initiatives with local crop output**

One of the primary reasons for the low domestic consumption of fruits and vegetables in Ethiopia is rural communities’ relative inability to afford high-cost foods. A varied diet beyond staple cereals is out of reach of many of these households, contributing to chronic malnutrition around key micro-nutrients.

The high-value crops that can be grown under irrigation are not luxury goods: they are the best available sources of vitamins and minerals that are essential to the healthy development of young children. Especially among young children, malnutrition remains common, with rates of stunted ranging between 40-50% based on geography.\(^{131}\) Many rural areas have high rates of blindness due to vitamin A deficiencies—easily resolvable with the regular consumption of carrots. Overall, childhood malnutrition costs have both humanitarian and economic implications, as it leads to lifelong stunting of growth, handicaps, and learning deficiencies, exacerbating inequalities between wealthy and poor.

School feeding coverage is low, with only 5% of school-age children in Ethiopia falling under the program supported through the Ministry of Education and the World Food Programme (WFP)—about 700,000 students in 1,200 schools across Afar, Amhara, Oromia, Tigray, Somali, and SNNP receiving one meal a

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\(^{130}\) Jibat p. 8.  
\(^{131}\) Benson 2005
day, largely using imported, fortified foods.\textsuperscript{132} By replacing some of these foods with locally-grown crops—including pulses and vegetables, and fruits—the MoE can reduce its reliance on imports while still providing necessary micro-nutrients. At the same time, it will be providing a reliable market for farmers in the community to invest in irrigation agriculture.

The intersection of nutrition and agriculture presents a natural opportunity. Stakeholders across government, NGOs, and the private sector are aligned against mitigating and addressing childhood malnutrition through a combination of education, food security disbursement, and preventative aid.\textsuperscript{133} To create a virtuous cycle of community self-reliance, agricultural promotion programs should be joined with these programs at every level, from national strategy to woreda-level programming.

Key activities proposed:

- Consultative meetings between directorates of the Ministry of Agriculture and World Food Programme to ensure strategic alignment on nutritional and food aid policies
- Facilitate sourcing agreements for school feeding programs and other food aid disbursements to procure from local irrigation cooperatives and farmer groups
- Align with local nutritional programming in trainings and recommendations to smallholder farmers, to best leverage irrigation as a food and nutrition security opportunity

\textbf{Intervention 7.2b: Explore linkages to regional and international markets for horticultural crops}

While Ethiopia’s horticultural exports have grown dramatically over the past decade (see Exhibit 22. \textit{Exports of horticultural crops, compared to top export crops} below), overall export penetration of horticultural crops remains startlingly weak. Only $35 million of the top high-value irrigation crops were exported in 2011,\textsuperscript{134} a tenth of the sesame exports that same year; the vast majority of those sales were delivered through commercial farms and aggregators inaccessible to smallholder farms.

\textsuperscript{132} World Food Programme, \textit{State of School Feeding Worldwide 2013} 17
\textsuperscript{133} For more detail, see the National Nutrition Strategy of Ethiopia by the Food Security Coordination Bureau.
\textsuperscript{134} Ethiopian Revenue and Customs Authority data as of January 2013; team analysis
Global markets for horticultural crops are strong and growing. Thus, the opportunity to link smallholders with exporters could be significant, opening new crops for potential cash production (e.g., mushrooms, which have a particularly weak domestic market but strong international potential), and providing reliable demand sinks for seasonal gluts in supply.

Promoting the export opportunity for bulky horticultural crops will require a nuanced and complex approach. First, the costs and inconveniences of working with large numbers of smallholders are prohibitive—so strong marketing linkages with cooperatives will be critical to establishing export opportunities. Second, supply chain costs in transportation are prohibitive via air freight or seaport travel in Djibouti for all but the high-value crops, which means cropping for export, will often have to be highly targeted—unless intermediated by significant agro processing. Third, smallholders often struggle to meet export quality standards, and would need to be supported in understanding those quality requirements. Finally, since fruits and vegetables are as critical for food and nutrition security as they are promising for income generation, regulations should be sensitive to the potential that local residents could be priced out of access to affordable food if export-marketing is pursued too aggressively.

Key activities proposed:

- Investigate export potential of various crops in regional markets, e.g. East Africa and the Middle East
- Create high-value crop specialization geographic belts to present sourcing channels for international investors and foreign exports
- Investigate opportunities to reform trade policy to improve export linkages
- Facilitate direct linkages between large cooperative unions and foreign investors
Chapter 4. Implementation plan

4.1 Implementation framework

The Federal Ministry of Agriculture’s National Resource Management Directorate (NRMD) is best positioned to own and drive the overall household irrigation strategy. As can be seen from Exhibit 26, lead entities could be the principal implementers of each intervention, working in close collaboration with regional governments, implementing NGOs, and other relevant stakeholders. The Agricultural Transformation Agency will support the implementation of the identified interventions by working with the lead organizations on different levels of implementation support.

Exhibit 26. Key stakeholders and their overall roles during implementation of the HHI sector strategy

<table>
<thead>
<tr>
<th>Role in promoting HHI</th>
<th>Priority interventions</th>
<th>Sub-agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoA/RBoAs Agriculture</td>
<td>• Primary owner of the HHI strategy and outputs&lt;br&gt; • Provides training through FTCs/DAs</td>
<td>• Disseminating agronomic best practices for household irrigation through extension system (SMEs and DAs)&lt;br&gt; • Implementing national pump standards&lt;br&gt; • Providing training on manual well-drilling techniques&lt;br&gt; • Owning results of shallow groundwater mapping pilot</td>
</tr>
<tr>
<td>MoWE/RBoWEs Water &amp; Energy</td>
<td>• Manages water policies&lt;br&gt; • Some RBoWE directly procure engine pumps</td>
<td>• Improving HIT supply chain and procurement system, especially in spare parts and maintenance&lt;br&gt; • Enforcement of water use policies.&lt;br&gt; • Co-own results of shallow groundwater mapping</td>
</tr>
<tr>
<td>EIAR/RARI Research</td>
<td>• Provides basic seed&lt;br&gt; • Conducts research on agricultural practices and mechanization</td>
<td>• Promoting improved horticulture seeds by providing basic seed for multiplication&lt;br&gt; • Cascading trainings in irrigation agronomy and post-harvest practices through extension system&lt;br&gt; • Training HIT manufacturers and maintenance providers</td>
</tr>
<tr>
<td>MoT/RBoTs Trade</td>
<td>• Collects market data&lt;br&gt; • Facilitates linkages</td>
<td>• Facility market linkages and market information for HVCs, especially horticulture</td>
</tr>
<tr>
<td>Other agencies and offices</td>
<td>• Policy support in tax and finance environment&lt;br&gt; • Data and information to inform impl. Decisions</td>
<td>• Policy support: Standardization and import regulations around HITs; promotion of HVC agroprocessing&lt;br&gt; • Implementation support: Groundwater mapping, HIT/pump testing and supply chain capacity-building</td>
</tr>
</tbody>
</table>
4.2 Prioritization and sequencing of interventions

A systematic prioritizing and sequencing of interventions is essential for the achievement of the household irrigation sector vision. While all of the interventions described in Chapter 3 present an opportunity to improve the household irrigation value chain, immediate focus should be on those interventions that have the greatest potential impact. The achievement of these prioritized interventions is expected to lay a foundation for optimal execution of other interventions.

Prioritization and sequencing has been developed by stakeholders through ATA coordination and with respect to the magnitude of opportunity, feasibility of impact, and criticality to other interventions. This sequencing and activity plan will refined over time, incorporating various learning from the field and emerging international best practices.

The initial prioritization, as outlined below, was developed using a framework analyzing feasibility with potential impact. Interventions that must be completed as inputs to others—such as groundwater mapping—were given higher priority, with that precedence considered as part of their overall impact. Projects requiring greater alignment of stakeholders, a baseline of other conditions, or significant design time, were considered lower in feasibility: this gives them more time to consider and develop via a later start date.

Exhibit 27. Prioritization and sequencing of interventions according to impact and feasibility
Priority interventions already begun

While the prioritization of interventions for national roll out and implementation of the strategy will follow the outline above, it must also recognize that activities related to many interventions in the strategy have already commenced. These activities have been in progress concurrently with strategy writing and publication, and will continue to be pursued during the strategy period.

Table 3. Priority interventions for the household irrigation sector

<table>
<thead>
<tr>
<th>Priority interventions already begun</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1a Map shallow groundwater resources nationwide and disseminate results</td>
<td>MOWIE</td>
</tr>
<tr>
<td>2.1a Build the capacity of local manufacturers to meet demand</td>
<td>AMRC</td>
</tr>
<tr>
<td>2.1b Work with regulatory, trade, and enforcement authorities to produce and enforce national irrigation pump standards</td>
<td>MOA/ESA/ECAE</td>
</tr>
<tr>
<td>2.2 Define and install improved practices in the irrigation pump supply chain and procurement system</td>
<td>MOA</td>
</tr>
<tr>
<td>3.1b Support the development of domestic high-value crop seed production</td>
<td>ESE</td>
</tr>
<tr>
<td>4.1c Employ ICT solutions to deliver timely, targeted information to DAs and farmers</td>
<td>ESE</td>
</tr>
<tr>
<td>4.2 Build capacity in manual well drilling through trainings and micro-enterprise</td>
<td>MOA</td>
</tr>
<tr>
<td>5.1 Train farmers on proper post-harvest techniques for horticultural and high-value crops</td>
<td>MOA</td>
</tr>
<tr>
<td>7.1 Enable woredas to determine appropriate high-value crops and cropping calendar for irrigation in their area</td>
<td>MOA</td>
</tr>
</tbody>
</table>

Medium-term interventions not yet begun

Several medium-term interventions are proposed to begin in with the release of this strategy. The specific activities for these interventions are largely understood. Stakeholders should push to translate these into specific, well-defined deliverables with implementation timetables, resource requirements, and direct accountability pathways.

Table 4. Secondary interventions for the household irrigation sector

<table>
<thead>
<tr>
<th>Secondary interventions to launch in the near future</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1b Establish national-level irrigation information management system</td>
<td>MOWIE</td>
</tr>
<tr>
<td>2.3 Extend the agricultural tax exemption to private procurement of household irrigation pumps</td>
<td>MOA/ERCA</td>
</tr>
<tr>
<td>2.4a Develop credit schemes that enable smallholders to invest in household irrigation</td>
<td>MOA</td>
</tr>
<tr>
<td>2.4c Build rental markets for household irrigation technology.</td>
<td>MOA</td>
</tr>
<tr>
<td>3.2b Improve private sector supply chain for horticultural seeds</td>
<td>MOA/ESE</td>
</tr>
<tr>
<td>4.1a Improve irrigation training curriculum and facilities for DAs</td>
<td>MOA</td>
</tr>
<tr>
<td>4.1b Capacitate FTCs and demonstration sites to be learning centers for HHI best practices</td>
<td>MOA</td>
</tr>
<tr>
<td>6.1a Support cooperatives/unions and private aggregators in linking with larger wholesale buyers</td>
<td>MOA</td>
</tr>
<tr>
<td>6.1b Help farmers secure forward-delivery contracts in outgrower schemes</td>
<td>MOA/ECX</td>
</tr>
</tbody>
</table>

Finally, this strategy names interventions that have high potential impact on the sector but whose implementation is highly dependent on the execution of other interventions or require detailed activity mapping. To plan for implementing these longer-term interventions, stakeholders should align on their strategic direction now to lay the groundwork for success.
### Table 5. Tertiary interventions for the household irrigation sector

<table>
<thead>
<tr>
<th>Tertiary interventions to plan and design</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 Promote household irrigation in the existing agriculture research agenda</td>
<td>EiAR</td>
</tr>
<tr>
<td>1.3 Enforce water management policies at the household level</td>
<td>MOWIE</td>
</tr>
<tr>
<td>2.1c Encourage joint ventures and knowledge-sharing to gain foreign expertise</td>
<td>MOI</td>
</tr>
<tr>
<td>2.4b Establish a national household irrigation development fund</td>
<td>MOA</td>
</tr>
<tr>
<td>3.1a Ensure that all imported seeds adhere to necessary quality levels</td>
<td>MOA</td>
</tr>
<tr>
<td>3.2a Enable cooperatives/unions to collect demands and distribute irrigated agriculture inputs</td>
<td>FCA</td>
</tr>
<tr>
<td>5.2 Build storage and agro-processing capacity in cooperatives</td>
<td>MOA</td>
</tr>
<tr>
<td>6.2a Build the capacity of local stakeholders as market extension resources</td>
<td>MOA/MOT</td>
</tr>
<tr>
<td>6.2b Utilize ICTs to directly deliver market information to farmers</td>
<td>ETC</td>
</tr>
<tr>
<td>7.2a Supply school feeding and other nutritional initiatives with local crop output</td>
<td>MOA/MOE/MOH</td>
</tr>
<tr>
<td>7.2b Explore linkages to regional and international markets for horticultural crops</td>
<td>MOT</td>
</tr>
</tbody>
</table>
4.3 Monitoring, Learning and Evaluation

Monitoring, Learning, and Evaluation rely on the results framework to track progress of planned activities towards meeting stated objectives. To that end, this strategy document outlines a results framework for the intended interventions that identifies indicators at the output, outcome, and impact levels. These results are expected to be achieved in five years and should directly result from interventions discussed in this document.

Exhibit 30 Monitoring, learning, and evaluation framework

Targets indicated by an asterisk (*) will be disaggregated by the sex of the head of household. A baseline assessment is expected to be completed in 2014Q1, at which point targets may be revised or refined to values, instead of proportionate increases.

Table 1 Key performance indicators and targets for the household irrigation sector strategy

<table>
<thead>
<tr>
<th>Impact</th>
<th>Indicator</th>
<th>Five year Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Increased income and productivity for men, women, and youth smallholder farmers</strong></td>
<td>1.1 Farm level yield from HVCs grown under HHI</td>
<td>20% increase*</td>
</tr>
<tr>
<td></td>
<td>1.2 Farmer annual income from HVCs grown under HHI</td>
<td>30% increase*</td>
</tr>
</tbody>
</table>
### Outcomes

<table>
<thead>
<tr>
<th>Expected result</th>
<th>Indicator</th>
<th>Five year Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Increased land area irrigated through HHI</td>
<td>1.1 Area of land irrigated using HIT (hectares)</td>
<td>20% increase*</td>
</tr>
<tr>
<td><strong>2</strong> Enhanced adoption of quality pumps and associated inputs</td>
<td>2.1 Imported irrigation water pumps that fulfill national mandatory standard</td>
<td>100% of pumps</td>
</tr>
<tr>
<td></td>
<td>2.2 Proportion of households with access to water practicing household irrigation</td>
<td>20% of HH*</td>
</tr>
<tr>
<td></td>
<td>2.3 Average service downtime of irrigation pumps due to malfunction</td>
<td>50% reduction</td>
</tr>
<tr>
<td></td>
<td>2.4 Average pump maintenance and parts replacement cost</td>
<td>50% reduction</td>
</tr>
<tr>
<td></td>
<td>2.5 Farmers whose demand for improved seed and agro chemicals was fulfilled</td>
<td>50% increase</td>
</tr>
<tr>
<td></td>
<td>2.6 Amount of improved high value crops seed produced domestically</td>
<td>15% of potato and onion seed</td>
</tr>
<tr>
<td><strong>3</strong> Improved access to HHI financing</td>
<td>3.1 Households desiring credit for HHI-related purchases are able to secure it</td>
<td>30%*</td>
</tr>
<tr>
<td></td>
<td>3.2 HIT manufacturers and service providers able to access credit for investment and inventory</td>
<td>30%</td>
</tr>
<tr>
<td><strong>4</strong> Improved farm management practices</td>
<td>4.1 Farmers that adopt best practices in irrigated farm management recommended by MOA/EIAR</td>
<td>60% of HH*</td>
</tr>
<tr>
<td></td>
<td>4.2 Post-harvest loss of horticultural crops</td>
<td>30% decrease*</td>
</tr>
<tr>
<td><strong>5</strong> Enhanced market performance by smallholder high value crop farmers</td>
<td>5.1 Share of smallholder farmers from the final crop retail price</td>
<td>25% increase*</td>
</tr>
<tr>
<td></td>
<td>5.2 Households linked with final/big buyers of their HVCs through cooperatives/institutions</td>
<td>100,000 new HH*</td>
</tr>
<tr>
<td><strong>6</strong> Capacitated farmer training resources</td>
<td>6.1 FTCs capacitated to demonstrate HITs and irrigation farm management</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>6.2 Subject matter experts trained on HITs and irrigation farm management</td>
<td>80%*</td>
</tr>
<tr>
<td></td>
<td>6.3 DAs trained on HITs and irrigation farm management</td>
<td>80%*</td>
</tr>
<tr>
<td><strong>7</strong> Improved access to high value crops output market</td>
<td>7.1 Cooperatives/unions able to aggregate high value crops grown in their area</td>
<td>10% of PCs and 10 CUs</td>
</tr>
<tr>
<td></td>
<td>7.2 Agreements established between coops/unions and big buyers of high value crops</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>7.3 Market information dissemination systems established for high-value horticultural crops</td>
<td>2 channels; 90% operational</td>
</tr>
</tbody>
</table>
### Outputs

<table>
<thead>
<tr>
<th>Expected result</th>
<th>Indicator</th>
<th>Five year Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground water resource mapped and water sources identified in all woredas in the country</td>
<td>1.1 Shallow groundwater resources (command areas and number of HHs with access) defined for <strong>200 woredas</strong> on woreda level</td>
<td>200 woredas</td>
</tr>
<tr>
<td></td>
<td>1.2 Appropriate water lifting technologies have been defined on woreda level</td>
<td>200 woredas</td>
</tr>
<tr>
<td>Improved regulatory environment for irrigation water development and management</td>
<td>2.1 Establishment of national mandatory motor irrigation pump standard</td>
<td>Established</td>
</tr>
<tr>
<td></td>
<td>2.2 Irrigation water pump testing facility established to enforce the mandatory irrigation pump standards</td>
<td>Established</td>
</tr>
<tr>
<td>Improved access to reliable, sustainable and affordable HITs</td>
<td>3.1 Capacity of local engine driven pump assemblers</td>
<td>1 assembler increased 100%</td>
</tr>
<tr>
<td></td>
<td>3.2 Local manual pump manufacturers established and certified</td>
<td>100 manufacturers</td>
</tr>
<tr>
<td></td>
<td>3.3 Local HIT maintenance and spare part providers available</td>
<td>All woredas</td>
</tr>
<tr>
<td>Improved access to irrigated farm inputs (fertilizers, seeds &amp; agro chemicals)</td>
<td>4.1 Local cooperatives/ groups enabled to produce local high value crops</td>
<td>400 CUs established</td>
</tr>
<tr>
<td></td>
<td>4.2 Local cooperatives/ groups enabled to distribute high value crops seed to farmers</td>
<td>10% of PCs</td>
</tr>
<tr>
<td>Strengthened credit-provisioning system</td>
<td>5.1 Irrigation output financing programs established with MFIs and other financial service providers</td>
<td>4 regions have MFI linkages</td>
</tr>
</tbody>
</table>

### 4.4 Strategy review and amendment process

This sector strategy is envisioned as living document that provides meaningful and impactful guidance to sector participants to reach the vision for the sector as a whole, and for each of the identified components. Achieving this goal requires a structured way to review this strategy on a periodic basis, and improve on it based on lessons learnt and changing realities within the sector.

#### Original review and syndication

The review process for this sector strategy reflects the diversity of perspectives contained within. Early reviews were conducted by irrigation, agronomy, water management, and technology experts as well as key stakeholders at the **MOA NRMD, EIAR, MOWIE, and IWMI**, throughout 2013.

At the discussion and alignment workshop in **October 2013**, we were honored to be joined by representatives from the MOA, MOWIE, RBOAs, other GOE agencies, and relevant NGOs. A full list of workshop attendees is included in **Appendix B**.

Stakeholders at the workshop were charged with the following, among others:

- Reviewing and refining **specific activities** for all interventions
- Aligning on the appropriate **ownership** over specific interventions
Integrating prioritized recommendations into their own activity plans

At the conclusion of the workshop, the household irrigation sector strategy was reviewed by the National Household Irrigation Steering Committee, the Transformation Council, and other key stakeholders.

Implementation and ongoing review

The working document will be owned and administered by the National Household Irrigation Steering Committee through the MOA and RBOAs. ATA will provide ongoing implementation and coordination support.

At periodic checkpoints, success will be measured against the targets outlined in Section 4.3, with resulting revision of strategies and deliverables to reflect the most urgent needs on the ground. With the next Ethiopian Growth and Transformation Plan (GTP) for 2016-2020, this document is expected to contribute strategic thinking to the nationwide targets set, while revised national goals impact the prioritization of interventions within the household irrigation sector.
Chapter 5. Conclusion and way forward

The Government of Ethiopia has set an audacious target to reach middle-income country status by 2030. Household irrigation, involving simple water-lifting and water-saving technologies, and the cultivation of high-value horticultural crops for market, has the potential to contribute enormously to that goal. Irrigation is a tremendous untapped opportunity: only 2% of the country’s arable land is irrigated, and tapping into that lifts household income from USD$147/ha to USD$323/ha per year. Realizing this opportunity in full can enable more than 650,000 farmer households and almost 5 million Ethiopians to double their production and incomes, promoting food security, and catalyzing growth in their communities.

This document proposes a total of 27 independent systemic interventions to increase the adoption and effectiveness of household irrigation technologies and build a vibrant and self-sustaining household irrigation sector. With the overall target of 20% of households with access to water practicing irrigation, the GOE and its partners are now aligned on a path forward to aid farmers in household irrigation at every step of the value chain: research, knowledge, and policy; technology access and adoption; input production and distribution for high-value crops; on-farm production; post-harvest handling; market linkages, and demand sinks. These interventions will take into account the continuing challenges of gender sensitivity, water resource management, and sustainable impact.

With the commitment of stakeholders to translate this aligned strategy into action and impact, and the continuing support of partners to see its vision through, the household irrigation sector of Ethiopia has the potential to truly transform smallholders’ lives in the coming years.
Appendix A. References

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