The enabling environment to scale water and irrigation solutions and services in Ethiopia

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SUMMARY

This report presents an overview of the enabling environment for scaling water and irrigation technologies in Ethiopia. The assessment is based on a desk review and content analysis using inventory database templates. A total of 104 documents were analyzed: 43 on policy, 41 on irrigation-related development interventions and 20 on informal institutions. Cluster and cross-cluster analyses for policy, interventions and informal institutions were conducted to identify enabling and hindering factors for scaling. Following these steps, the results from policy, interventions and informal institutions analyses were triangulated to complete a synthesis analysis. The latter aims to provide a holistic view with key highlights on the actor and stakeholder landscape, typology and sustainability of irrigation development, key policy trends, and approaches to interventions.

The findings show barriers and opportunities for scaling across policy, interventions, and informal institution domains. Recent (and ongoing) policy developments, institutional rearrangements and interventions generally reflect the recognition and focus on inclusive small scale irrigation development for building resilience against climate variabilities and shocks, strengthening food and nutrition security, and alleviating poverty. There are also efforts to improve the enabling environment for increased availability, affordability, and access to suitable irrigation technologies and solutions for smallholders. To this end, several barriers were found, including policy gaps, limited implementation, ineffective institutional arrangements, and unclear roles. There is also a possible overlap of mandates and conflicts of interests—across sectors and between water institutions, between regions, and between regions and the federal state. The analysis confirmed significant gaps in implementation capacity and procedures in the procurement, construction, operation, maintenance and follow-up of public water and irrigation schemes. Irrigation-related interventions had gaps in design, coordination, and implementation capacity. At the same time, systemic socioeconomic barriers created several challenges that affect users (including women and youths) from accessing key resources, services, and inputs and adopting technologies and best practices. Informal institutions are still active and relevant, but their performance and synergy with formal institutions in natural resource management and utilization are limited.

For scaling irrigation technologies and services sustainably and inclusively, it is crucial to adhere to the following main objectives:

- Enhance the enabling environment for scaling irrigation technologies and services.
- Enhance the credibility and efficiency of irrigation development and interventions.
- Strengthen technology supply chains and partnerships.

LIST OF ABBREVIATIONS

AGP	Agricultural Growth Program
CRGE	climate resilient green economy
DFID	Department for International Development
EIA	environmental impact assessment
EPA	Environmental Protection Agency
GTP	Growth and Transformation Plan
GEWE	gender equality and women's empowerment
HIS	household irrigation system
IFAD	International Fund for Agricultural Development
IWRM	integrated water resource management
M4P	Market 4 Poor
M&E	monitoring and evaluation
MFI	microfinance institute
MHIS	micro and household irrigation scheme
MIS	micro irrigation system
MLSI	medium- and large-Scale irrigation
MoA	Ministry of Agriculture
MoWIE	Ministry of Water Irrigation and Energy
MWRD	multipurpose water resource development
NGO	non-governmental organization
NRM	natural resource management
O&M	operation and maintenance
PSNP	Productive Safety Net Program
PPP	public-private partnership
RuSACCO	rural savings and credit cooperative
SDG	Sustainable Development Goals
SIA	strategic impact assessment
SMEs	small and medium enterprises
SMIS	Small and Micro Irrigation Support
SNNPR	Southern Nations, Nationalities and People's Region
SSI	Small Scale Irrigation
USAID	United States Agency for International Development
WASH	Water Sanitation and Hygiene
WUA	Water User Association

1. INTRODUCTION

Ethiopian agriculture is dominated by subsistence and rainfed agriculture and is highly vulnerable to climate change and variability (Kassie et al. 2014; Moges and Bhat 2021). Agricultural water management and irrigation solutions could transform agriculture by increasing production, productivity, and food and nutrition security. There is huge potential for irrigated agriculture, which can be used for sustainable and improved livelihoods and agriculture-led industrialization, thereby achieving overall economic development (Xie et al. 2014; Denison 2020). Even though there is potential for irrigation development in Ethiopia, where about 10% of the arable land is irrigable (MoFED 2013), reliable access to water and technologies is essential to make agriculture more productive and to mitigate the uncertainty that climate change poses (Gebrehiwot and Gebrewahid 2016; Denison 2020).

These require wide-scale adoption of agricultural water management solutions and innovations among smallholder farmers to fully realize the benefits of irrigation development, including small-scale irrigation (SSI). However, innovations remain "shelved" while many smallholder farmers continue their rudimentary practices (Minh et al. 2021). One of the reasons is that many interventions terminate at the piloting stage because of the assumption that scaling will occur spontaneously and organically. For scaling to be successful and inclusive, it is key to have an enabling environment with a set of conducive policies, informal institutions, support services and other conditions that maintain a general operational environment and bring together value chain actors in a cooperative manner (Herman and Minh 2020). Furthermore, many scaling efforts have also overemphasized technical replications and reaching a specific number of end-user beneficiaries—to neglect "softer elements" that create the enabling environment for successful scaling (ibid). These elements include, but are not limited to, people, supply chains, markets, financing mechanisms, policies and regulations, professional knowledge, power relations, incentives, and history.

Although piloting plays a key role in testing the success of innovations, transitioning from controlled pilot environments to the "real world" at scale requires different attitudes, skills, and approaches, as well as attention to the organizational and institutional processes intertwined with the innovation. Therefore, understanding the hindering and enabling factors across the operating environment and their influence is crucial for successfully integrating and scaling irrigation technologies and water solutions (Lefore et al. 2019). To help scale water solutions, this study analyzed the enabling environment to understand the influence of factors that enable or hinder farmers in adopting the technologies so that measures are put in place to ensure success. The analysis specifically aims to achieve the following:

- Characterize the enabling environment that influences the scaling of water solutions and irrigation technologies and services to smallholder farmers.
- Identify barriers and opportunities to scaling irrigation technologies and services.
- Develop recommendations for the sustainable and inclusive scaling of irrigation technologies and services.

The report starts with an analytical framework adapted from the enabling environment framework developed by Minh et al. (2021). It is followed by the methodological approach used in this study. The results section presents the single and cross-cluster analyses of the policies, interventions, key actors and their roles and informal institutions that influence irrigation development. The report concludes with a synthesis analysis of barriers, opportunities, and recommendations for scaling water solutions and irrigation technologies and services in Ethiopia.

2. ANALYTICAL FRAMEWORK

In this report, we view the scaling of water solutions and irrigation technologies and services from a systemic, adaptive perspective (IWMI 2021). Specifically, systemic, adaptive scaling of water solutions and irrigation technologies and services is the "*processes by which diverse actors and actants*

cooperate, feed off, adapt to, support, and interact with each other, forming different multi-actor networks and corresponding collective actions to undertake various functions in the scaling ecosystem" (IWMI 2021). These processes involve removing contextual barriers and enhancing incentives from the supporting system. Understanding factors that influence such scaling of water solutions and irrigation technologies and services requires a comprehensive analysis of the enabling environment in which the scaling is embedded. We, therefore, adapted the tools for analyzing the enabling environment (Minh et al. 2021) to the context of systemic, adaptive scaling (Figure 1).

Enabling business environments are defined here as sets of policies, institutions, support services and other conditions that collectively improve or create a general business setting where enterprises and business activities can start, develop, and thrive. Specifically, the enabling environment in an (irrigated) agricultural value chain is the sets of policies, informal institutions, support services and other conditions that create or improve and maintain a general operational environment, bringing together value chain actors in a cooperative manner. Therefore, the environment can be distilled down into three categories: 1) the policy/regulatory framework (or formal institutional context), 2) interventions, and 3) the informal institutional context.

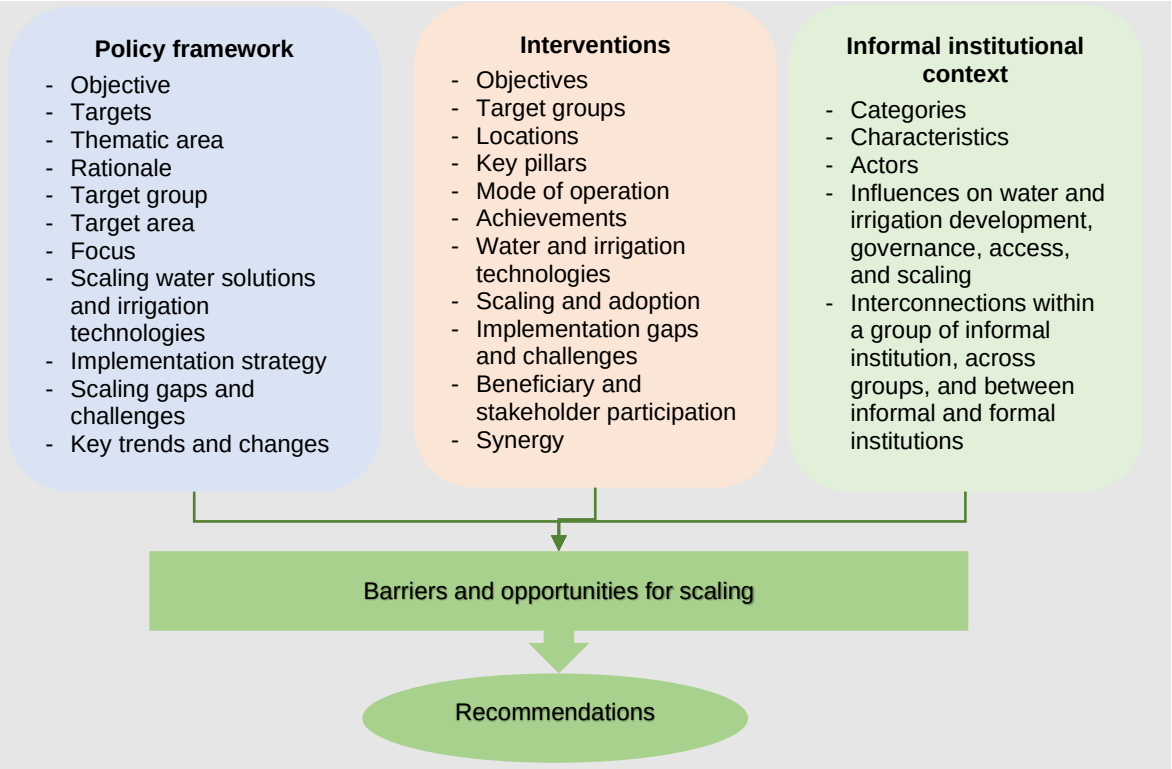

FIGURE 1. Analytical framework. Source: Adopted from Minh et al. 2021.

The policy framework encompasses policies and regulations that establish the basis for irrigation development and actors' behaviors and power relationships affecting the scaling of water solutions and irrigation technologies and services. As such, we analyzed policy frameworks, institutional arrangements, and governance to 1) assess the focus, priority and perspectives of national and sectoral policies influencing the development of irrigated agriculture, 2) determine the policy agenda and approaches for scaling water solutions and irrigation technologies and services, and 3) identify the enabling actors for the scaling.

The interventions encompass programs and projects as well as services and support provided by the government, non-governmental organizations (NGOs), the private and public sectors, and other practitioners who support irrigation and agricultural development. In analyzing these interventions, we explored five areas: 1) diverse actors and their roles in the scaling, 2) dynamics and approaches that focus interventions and activities for the scaling, 3) achievements and bottlenecks for scaling, 4)

dynamics and changes in activities, implementation approaches and new intervention directions, and 5) synergies between interventions.

Informal institutions can refer to different forms of rules that are not established by the government. Instead, users are the ones who establish these rules, which are used to manage communal resources, the rules of the village (Yami et al. 2011) and rules inherited from the previous generation that will be transferred to the next generation. Such institutions shape the day-to-day activities and socioeconomic interactions of communities. These gradually and inherently evolving informal institutions are deeply rooted in local communities and are embedded in and interwoven with existing customs, traditions, norms, beliefs, and folklore (Mowo et al. 2013). Informal institutions can guide the use of communal resources, resolve conflicts among users of natural resources, mediate access, and allocation of benefits among users, determine contributions for collective action in protection and maintenance work, and enforce sanctions on free riders (Yemi et al. 2011). Informal institutions also contribute to collective investment in natural resource management (NRM) and assist in regulating the use of common property resources and dealing with externalities. Local organizations have a mixed impact on farmers' private decisions to adopt resource conservation measures. Hence, scaling agricultural innovations requires a balanced focus on technical and social dynamics surrounding scaling targets, the actors involved and their social relations (Gebreyes et al. 2021).

Informal institutional context embeds several types of informal institutions. *Customs, beliefs, traditions, and social norms* shape the practices of different actors regarding irrigation development and the scaling of technologies and services. Such institutions are enacted by the community, including individual members and leaders/influencers. These institutions play a central role in different aspects of the society in which they operate and make up significant aspects of informal institutions. These institutions influence and operate differently in the context of gender relations, NRM, agricultural activities, and the development and governance of water and irrigation.

Policy and development norms refer to the different notions, approaches, mentalities and organizational cultures of policy/decision-makers, government institutions, extension systems, non-governmental development actors, and private actors involved in agricultural and rural development as well as water and irrigation development and management. Like other forms of informal institutions, these norms also influence different aspects of agricultural and rural development, natural resource management, water and irrigation development, finance, and gender equity in the development and implementation of the policy framework.

Individual cognition in this study refers to the mentality, attitude and perceptions of people that shape decision-making about risks, equity, inclusion, and innovations, among others. At the same time, this is reflected in agriculture, NRM and irrigation development. There is an intricate relationship between cognition and some components of other informal institutions, including incentive structures, beliefs, and political and development norms. *Incentive structures* in the day-to-day operations of value chain actors, specifically farmers and private sector farmers, influence decision-making among actors on whether to promote scaling irrigation technology (Minh et al. 2021). In analyzing these informal institutions, we explored key actors, their characteristics and how they influence water and irrigation development. The factors influencing the systemic, adaptive scaling of water solutions and irrigation technologies and services are, therefore, barriers and opportunities from the environment that enable or hinder the investment in irrigation by farmers, including smallholders, women, and vulnerable groups of farmers.

3. METHODOLOGY

3.1. Overall analysis process

This analysis of the enabling environment is a stepwise process used to analyze the policy framework, policy implementation and informal institutional contexts to provide recommendations for systemic, adaptive scaling of irrigation and water management technologies. This is followed by a synthesis

analysis, consultation, validation, and reflection (Figure 2). We applied a qualitative content analysis, by which the text is coded, or broken down, into manageable categories on various levels—word, word sense, phrase, sentence, or theme—and then examined using either a conceptual or relational analysis (Neuendorf 2016).

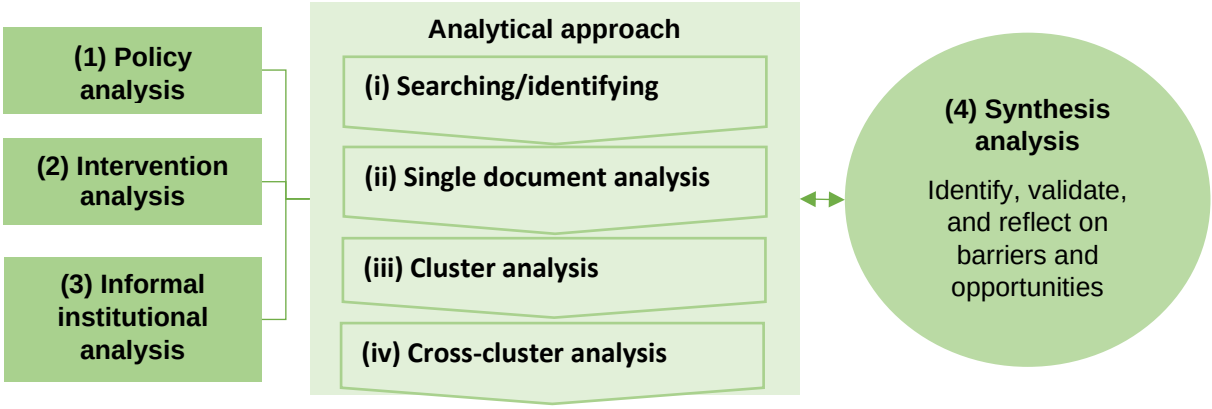

FIGURE 2. Overall assessment process. Source: Minh et al. 2021.

3.2. Policy analysis

Policies developed and implemented across various sectors influence how water solutions and irrigation technologies are scaled to smallholder farmers. Accordingly, the relevant policies, strategies, programs, and legislations were extensively explored.

Searching policy documents: Policy documents were searched from online sources and key informants. The search scope ranged from the regional to the national level and targeted thematic areas from general development policies and strategies to those specific to irrigation. The search was guided by combining the words "policy" or "strategy" interchangeably with other keywords such as food security, climate change adaptation, poverty reduction, rural development, water management, land ownership and use, agricultural development, environment, irrigation development, agricultural extension, agricultural finance, and public-private partnership. In this study, a total of 116 documents were downloaded. Of these, 43 policy documents were analyzed and added to the policy inventory (policy database) based on two criteria. Policy documents included in the analysis either contribute to irrigation development and scaling water solutions and services or create a pathway to indirectly impact the water solutions for agriculture. Documents in which those criteria were absent were considered not relevant to the focus of this study.

For each policy, a **single document analysis** was performed to capture the elements related to the scaling of water solutions, such as the objective, target, thematic area, rationale, target group, target location, priority, implementation strategy, implementation mechanism, conflicting issue, dynamics, and policy change and gaps. Single policies were then grouped into eight clusters, as presented in Table 1. The cluster analysis investigated the objective, thematic area, target group, policy trend, scaling water solutions and irrigation technology, and cluster level gaps.

An overall assessment of the policy framework for irrigated agriculture was also carried out. The emphasis is on the types of irrigation systems promoted by the different policies. For each type of irrigation, the analysis focuses on the target beneficiary groups, the different services/activities undertaken, and the technology deployed. It also includes the approaches used for developing and implementing policies, the changes/trends, social and gender inclusiveness, the opportunities created for scaling water solutions, and the gaps observed across the clusters.

3.3 Interventions analysis

This assessed a snapshot of in-country programs and interventions implemented by government and non-government entities such as development partners and donors, local and international NGOs,

civil society, and the private sector. **Intervention documents were searched** by combining the words *Ethiopia*, *project,* or *program* interchangeably with a set of keywords: agriculture, water, irrigation, women, social inclusion, natural resource management, and climate change adaptation. A total of 55 documents, including project documents, evaluation/final reports, websites, and program factsheets, were identified and downloaded from secondary sources. Of those, 41 intervention documents were selected for the analysis. The remaining documents were not included because they did not have enough information about the interventions.

A **single intervention analysis** was done for each selected intervention document to explore the following: objectives, target beneficiaries, key pillars, duration, operational mode, monitoring and evaluation (M&E) structure, scaling model, irrigation technologies implemented, technical knowhow and knowledge, participation of stakeholders and beneficiaries, achievement toward the objectives and impacts, synergies between actors, bottlenecks for potential beneficiaries to participate, and recommendations.

Based on the thematic areas of the interventions, six clusters were then derived from this analysis (Table 2). An **intervention cluster analysis** explored the objective, target group, location, key pillar, achievement, irrigation technology, scaling, implementation challenges, beneficiary and stakeholder participation, gap in scaling water solutions and technologies, and recommendation. An **intervention cross-cluster analysis** presented an overview of the achievements and shortcomings of irrigation development by focusing on different irrigation typologies and approaches, and strategies for scaling observed in the intervention cluster analysis.

3.4 Informal institutions

An informal institutions analysis is used to better understand institutions' role and influence on water and irrigation development and scaling irrigation technologies and services. **Relevant documents** were searched using a combination of the words *informal* or *traditional institutions* with a set of keywords, such as rural development, water resources development, irrigation, gender, social capital, technology adoption, and innovation. Documents were then reviewed to identify and categorize informal institutions and to examine their characteristics. Of the 34 documents that were downloaded, 20 were reviewed and analyzed. Those that remained were not included in the analysis because they lacked relevance to the subject matter and their year of publication.

An **in-depth analysis** examined and characterized the different groups of informal institutions, identified the influences of such groups on various aspects of water and irrigation development, assessed interconnections within and between these groups, and looked at interplays with formal institutions as well as barriers and opportunities for scaling.

3.5. Synthesis analysis

This analysis gave an overall picture of the enabling environment and laid the foundation for making recommendations. It brought together key aspects and findings from an analysis of policy, interventions, and informal institutions. It identified issues like the governance and sustainability of scaling water solutions and irrigation technologies and services, enabling and hindering factors, and interactions and interconnections across the three components in the enabling environment.

4. POLICY FRAMEWORK ANALYSIS

The inventoried policies were organized under eight clusters. An overview of the policy framework is presented in Table 1.

TABLE 1. An overview of policy framework for irrigation development in Ethiopia.

Policy and cluster	Objectives	Thematic areas	Target groups	Trends and Changes	Scaling	Gaps
Cluster 1. General Development						
1. Plan_PASDEP_MoARD_2006 2. Policy and Strategy-RDPS_MoFED 2003 3. Plan_CRGE NAP_ FDRE 2019 4. Strategy_CRGE CRWE FDRE_ 2015 5. Plan_GTP I _FDRE 2010 6. Plan_GTP II_ FDRE 2015 **7.** Plan_10 YEAR PDP_FDRE 2020	Guide the transformation of the economy and the agriculture sector to adapt to and build resilience against the impacts of climate change	Food security, nutrition, climate change adaptation, NRM, agribusiness and market development, water resource and irrigation development	General public, rural community, vulnerable and food insecure households	- Market-oriented direction - Increased attention to participatory approaches, climate change, stakeholder engagement and partnerships, including the private sector	**Technology**: water points, harvesting and retention, water storage facilities, promoting alternative energy technologies **Services**: EIAs[a] and SIAs,[b] improved scheme designs and management **Practices**: soil and water conservation, land use and soil fertility, irrigation water management and efficiency, watershed development **Scaling**: expanding schemes, user-based water uses and conservation, private sector investment, research, partnerships	- Lack of synchronization between investment, available resources, and needs, as well as regional investment plans with national development goals - Poor regional coordination for transregional and spatial issues in development plans - Interregional and intraregional disparities in infrastructural development and service access - Limited access, use and coverage of rural development programs
Cluster 2. Agricultural Development						
1. Food Security Program -FSP-MoARD 2009 2. Strategy-CRforAG&FR-FDRE 2015 3. Plan- AGP 2015 4. Plan-AnNRS GTP II FDRE 2016 5. Proclamation_CS_FDRE 2016 6. Strategy- AESE-MoNAR 2017	Ensure food security, climate change adaptation, agricultural productivity, enhance extension system and institutional setup of cooperatives	Climate change adaptation, disaster management, food security, livelihoods, NRM, value chain and markets, land use, poverty reduction	Smallholders, rural women and children, food insecure households, cooperatives	- Inclination toward market-led and extension services - Alignment with the SDGs[c] - Support for local supply chain of technology and inputs - Participatory and demand-driven approaches in the latest policies	**Technology**: water and energy-saving technologies and different dams, reservoirs, and wells **Services**: technology supply chain, drilling, market-based water infrastructure, finance, marketing, and capacity **Practices**: on-farm soil and water management, water use efficiency, participatory NRM **Scaling**: technology transfer systems, expand SSI, existing platforms for scaling, SME[d] technology development	- Lack of packaged/holistic approaches - Top-down approaches to agricultural development interventions, including technology introduction/promotion and extension services
Cluster 3. Water Resources Development and Management						
1. Policy-EWRMP-MoWR 2001 2. Strategy-EWSS-MoWIE 2001 3. Program-WSDP MoWR 2002 4. Proclamation WRFD FDRE 2002 5. Regualtion_WRM_FDRE_2005 6. Proclamation-RBCA_FDRE 2007 7. Proclamation WRFD FDRE 2008 8. Guideline WAUTWDC AAU 2018 9. Regulation_WUC_ FDRE 2019 **10.** Policy NWPS_ MOWIE 2020	Enhance and promote efforts toward the efficient, equitable and optimal use of the available water resources for sustainable socioeconomic development	Water resource management, disaster management, development, agricultural production and productivity, irrigation	General public, water users, supervisory bodies and related institutions, service providers	- Adoption and provision of IWRM[e] framework and decentralized approaches - Adopted basin-level approach to IWRM - Plans to establish a national water fund	**Technologies**: local manufacturing, water harvesting and storage structures **Services**: O&M[g] water infrastructure, capacity building, involving the private sector in financial services, setting tariffs **Practices**: IWRM, watershed management, basin-level approach, irrigation water management, EIA adoption **Scaling**: private sector involvement, research and development, partnerships, expansion of water infrastructure	- Limited guidance to the proclamation of irrigation associations and WUAs[f] - Missing regulations and guidelines from WUAs - Limited provisions to ground water and climate change - Lack of mechanisms for regulating water fees and charges, enforcing water protection measures, and providing incentives

Cluster 4. Irrigation Development						
1. Policy-EWRMP-MoWR 2001 2. Strategy-EWSS-MoWIE 2001 3. Program-IDP- MoA 2011 4. Strategy-SSICBS- MoA 2011 5. Proclamation_IWUA_FDRE 2014. **6.** Strategy-NSIDS- MoANR ATA MoWIE 2018	Set the road map to sustainably develop and manage irrigated agriculture to meet targets of food self-sufficiency, industry, and exports	Irrigation, water and natural resource management, agricultural productivity, climate change, food security	Smallholder farmers, water user groups, irrigation development and management institutions	- Provided legal basis for irrigation associations and WUAs - Increased focus on decentralized, user-based SSI	**Technologies**: pumps, drip kits, sprinklers, well drilling and maintenance **Services**: O&M standards and guidelines, input supply, credit and marketing, knowledge management and information systems, improved design, and planning **Practices**: improved land, drainage, and watershed management, integrated and participatory approaches **Scaling**: private sector engagement, scheme expansion, research and extension, technology supply chain	- Gaps in the earlier regulatory framework for irrigation schemes, including water fees, water rights, water conflict resolution - Lack of mechanisms for scheme O&M, monitoring and reporting - Lack of standardized tools for project management - Unclear strategy for scaling - Instances of unclear duties and responsibilities between the local, regional, and federal levels
Cluster 5. Agricultural Finance						
1. Proclamation_ MFB_FDRE 2009 2. Framework_EASPIF - MoARD 2010 3. Policy_PPP_ MoFEC 2017 4. Proclamation_MFB_ FDRE 2019 5. Regulation_IDII_FDRE 2009	Improve rural finance, provide agricultural investment planning framework, and guide private sector partnerships	Agricultural production and rural development, food security, NRM, climate change	MFIs[h] financial service providers, smallholders, private and public rural enterprises	- Improved rural finance and the roles and services of finance institutions - Developed private-sector policy - Provided digital financial services	**Services**: microfinance institution governance, improved irrigation schemes' planning and design, EIAs, finance and incentives for irrigation investment **Practices**: water productivity, integrated land, and water management **Scaling**: financing schemes, private sector partnerships	- In water/irrigation sectors, the provision of services by the private sector is not clearly elaborated as infrastructure development - Irrigation /water sector-specific PPP strategy/regulation/ guidelines yet to be developed
Cluster 6. Gender and Social Inclusion						
1. Policy _EWNP_ TGE OPM 1993 2. Guideline_GMAS_MOA 2011 3. Policy_NSPPE_MoLSA 2012 4. Strategy_GESAS_MoANR Final draft 2017 **5.** Guideline_GMA_MoA 2020	Create an enabling environment for GEWE[j], incorporate gender issues and protect the vulnerable from shocks	General development, agricultural production, and productivity, GEWE	Women, vulnerable communities	- Women-specific policies - Shift from a social welfare approach to holistic actions - Integrations with climate, nutrition pastoralist issues	**Technology**: Gender-sensitive technologies for water harvesting, lifting and application **Services**: gender-responsive planning and M&E, capacity building, GEWE strategies **Practices**: watershed management, water harvesting **Scaling**: equal participation and benefits for women in water use institutions	- Access to water primarily seen from the perspective of WASH[k], and irrigation is not clearly recognized for poverty reduction and inclusive agri-food systems in social protection and safety net strategies
Cluster 7. Environment						
1. Policy_NCS VII NPNRE MNRDEP 1994 2. Policy-EPE-EPA and MoEDC 1997 3. Proclamation Environmental Impact Assessment, FDRE 2002 4. Proclamation_EPC_FDRE 2002 **5.** Proclamation_ PES_ FDRE 2019	Improve health and quality of life and promote sustainable social and economic development	Environment, NRM, sustainable land use, water resource development and management	General public, licensing authority, consulting firms, implementers	- Capturing sustainable development principles for mainstreaming at different levels - EIAs made mandatory	**Services**: scheme cost-benefit analysis, and environmental, social, and economic impact assessments **Practices**: on-farm water/land management, integration of wetland and forest rehabilitation and protection, water conservation in low rainfall areas	- Gaps in mechanisms and policy tools necessary to implement and enforce environmental laws effectively - Lack of incentives and incentivizing mechanisms for environmental protection
Cluster 8. Land use and ownership						

1. Proclamation_RLA_FDRE 1997 **2.** Proclamation_RLUA_FDRE 2005	Set principles and lay out the legal foundations for rural land use and administration	NRM, land use, environment	Farmers, pastoralists, investors, government bodies	- Equal land rights - Inclusion of land use obligations, integrated land use planning, sustainable water use	**Services and practices:** enhanced consistency of land and environmental protection laws, equitable water use systems among watershed communities, sustainable management of rural lands and wetlands, soil conservation	- No integrated land use plan at the national level - Regulatory framework does not create a strong enough 'sense of ownership' and tenure security for rural land holders

Source: Authors' creation.

[a] Environmental Impact Assessments
[b] Strategic Impact Assessments
[c] Sustainable Development Goals
[d] Small and Medium Enterprises
[e] Integrated Water Resource Management
[f] Water User Associations
[g] Operation and Maintenance
[h] Microfinance Institutes
[i] Public Private Partnerships
[j] Gender equality and Women's Empowerment
[k] Water, Sanitation and Hygiene

4.1. General development

This cluster guides the economy transformation, including the agricultural sector and the adaptation to resilience building to climate change impacts. This cluster targets rural communities, including farmers and pastoralists, vulnerable households, and food-insecure rural households.

The various implementation strategies are identified across the cluster. Strategies for increasing crop and livestock production and productivity include disseminating appropriate technology, developing irrigation, managing and using land and water resources sustainably, and scaling best practices. The capacity building focuses on improving the skills of farmers and implementers and strengthening institutions. Mainstreaming climate change in national and sectoral policies is strongly considered in the policies for a climate-resilient green economy (CRGE). The research and extension components include preparing area-compatible development packages, strengthening markets and research-extension-farmer links, and managing information and knowledge, especially on climate change. Financial and private sector investment promote horticulture development and large-scale farming, while attracting foreign investment, improving the rural financial system and institutions, and linking the private sector with smallholder farmers (RDPS 2003). In the CRGE, establishing effective and sustainable funding mechanisms focuses on implementing planned adaptation projects from a financial perspective. The Ten Years Perspective Development Plan (2020) includes climate-resilient and sustainable agricultural development, livestock, animal feed and animal health, reduced dependence of the agricultural sector on rainfall, inclusive irrigation development, and alternative financing for water and irrigation.

Gaps include a lack of synchronization between available resources, investment, and development needs, and limited access, use and coverage of a rural development policy program targeting different segments of people in rural areas (Welteji 2018). At the federal, regional, and district-level investment plans are weakly aligned with the national development goals. At the region, coordination is poor because of low consideration for transregional and spatial issues in the development plans of regional states and interregional and intraregional disparities in infrastructural development and access to services.

4.2. Agricultural development

In appreciating the role of agriculture in sustainable socioeconomic development, the government is paying more attention to transforming the sector. It is developing policies to guide the progress over many years. This cluster aims to ensure food security by building resilience against climate change, improving agricultural production and productivity, transforming the extension system, and improving the institutional setup of cooperatives (Table 1).

The 2009 Food Security Program lays out institutional arrangements for managing, coordinating, and linking the program with other sectors, financial management, M&E, and accountability. Key pillars in this program include productive safety nets and financing de-risk mechanisms, building household assets, complementary community investment, and resettlement.

The 2017 Extension Strategy guides the inclusive process and results-oriented extension services, participatory and cluster-based approaches, and a market-oriented and demand-driven extension system. It promotes collaboration and harmonization with other complementary services, scaling good practices out and up, and the extension system's responsibility and accountability. The strategy is implemented by improving institutional arrangements, establishing a results-based monitoring, evaluation and learning system, building the capacity of farmer training centers and enhancing knowledge and information services. It also promotes client-oriented and multi-actors' advisory services, market links and value chain development, mainstreaming gender, youth and nutrition, and environmentally sustainable agricultural practices.

The Climate Resilience Strategies for Agriculture and Forestry (2015) focuses on 1) human, natural and physical capital, 2) stability, market institutions, and financing mechanisms of interventions, and 3) implementation arrangements at the federal, basin and regional levels. Key implementation strategies

include improving crop and livestock production practices for food security and income while reducing emissions, protecting and re-establishing forests, expanding electricity generation from renewable energy sources, and leapfrogging to modern and energy-efficient technologies.

The second Growth and Transformation Plan for agriculture and natural resources (ANR GTP II 2015) follows regional specialization and diversification in agricultural production clusters. The plan focuses on 1) improving production, productivity, quality, storage, aggregation, and market links, 2) developing a technology transfer system, 3) strengthening rural finance institutions and enterprises and 4) expanding health and education services. The Cooperative Societies proclamation details cooperative societies' formation, registration, operation, obligation, and roles.

Historic gaps in agricultural policy frameworks lay in policies' approaches and implementation strategies. These include the dominance of traditional top-down approaches to development interventions and promoting and transferring technologies. The focus is strong on horizontal technology dissemination and input use. Yet, there is a lack of holistic approaches that can provide direct and indirect complementary services and components, like market, information, technical support, and finance. Key principles are not clearly defined in most of the policy documents.

4.3. Water resource development and management

Policies under this cluster address the need for judicious water management policy, institutions, finance, and priority setting. The aim is to enhance and promote national efforts toward the efficient, equitable and optimal use of available water resources for significant sustainable socioeconomic development. They emphasize developing and managing water resources for more than one purpose, with legislation that focuses on regulating the use, management and supervision of water resources and infrastructure and funding for water resource development. Policies in the cluster primarily target different groups of water users, supervisory bodies, related institutions, and service providers. And they accentuate multipurpose water resource development of the water supply for drinking and sanitation, irrigation and livestock, and hydropower generation.

Guiding principles in this cluster include recognizing water as an economic and social good, rural-centered, and decentralized water development and management, and adopting social equity, efficiency, reliability, and sustainability norms in developing and managing water resources. Further principles point toward applying integrated and participatory approaches, ensuring consistency among national policies and strategies and international development goals, and incorporating links with ongoing and planned projects.

One of the key implementation strategies is strengthening the enabling environment for water resource development and management to ensure institutional arrangements. These allow for decentralized and user-based water management, community involvement and the formulation of subsequent water legislations necessary to implement policy. Another strategy is making research and development better by focusing mainly on mapping water resources, institutionalizing meteorological and hydrological services, and strengthening the management of knowledge information in the sector. In the Guideline for Setting Water Abstraction/Use and Treated Wastewater Discharge Charge 2018, for instance, the policy prioritizes identifying different water user groups and piloting a water charge system.

Implementing the policies requires establishing and strengthening relevant institutions at the federal, regional and community levels, such as river basin authorities and water user groups. It is also done by conserving, protecting, and enhancing water resources and the overall aquatic environment through integrated water resource management practices and community-based watershed management. In this regard, two important criteria are adopting the basin-level approach and including an environmental impact assessment (EIA). As for the capacity building, it is directed toward developing human resources, strengthening water resource institutions through structural reforms, and providing equipment, vehicles, and materials to build the necessary labour, and institutional capital.

The cluster also attempts greater private sector engagement in water infrastructure development and management, and an increased role for communities and women in managing water resources locally. It highlights coordination mechanisms, integration of water resource development with national plans and strategies, and links with sectoral developments in health, mines, energy, and agriculture. Finance and economics for implementation are based on cost-recovery principles through setting tariffs for different water users, establishing a water resource development fund to secure the financial sustainability of water development, supporting institutions to be self-sufficient, and providing grants and long-term loans.

Despite all this, there are still several gaps in the policies and how they are implemented. These include overlapping mandates among regional states and/or between a regional state and the federal government in water governance. There is a distinct lack of coordination and monitoring mechanisms (Mosello et al. 2015) and difficulties in governing the transfer of water from one basin to another or within different regions in the same basin (Nigatu et al. 2016; Tekle 2019). There is also a potential regulatory task-related conflict between the Environmental Protection Authority and the Ministry of Water Energy and Irrigation. Furthermore, the earlier policies gave due consideration to neither irrigation water use and management at the community level nor climate change in the water sector. However, these have been addressed by the Water User Associations (WUA) proclamation 2014 and the Water Policy and Strategy 2020, respectively. Still, gaps remain in the mechanisms necessary to manage and utilize ground water, regulate water fees and charges, enforce water protection measures, and provide incentives. There are efforts to address these gaps, such as the recent developments in establishing the Guideline for Setting Water Abstraction/Use and Treated Wastewater Discharge Charge 2018 and the draft regulation on Water Uses Charges 2019 are expected to provide the legal framework and guide to tariff setting and payment for water abstraction and dischargers of treated wastewater for the first time.

4.4. Irrigation development

National policies, strategies, programs, and legislations regarding irrigation reflect the need to exploit the country's agricultural potential for food, nutrition, industry, and exports and boost socioeconomic development by sustainably managing and using water for irrigation. These policies aim to lay a road map to sustainably develop and manage water resources for irrigated agriculture. The goal is to make socioeconomic improvement and meet food self-sufficiency targets, industry demand and export earnings nationally.

Irrigation policies and programs focus on developing schemes and improving water management at different scales while prioritizing regional SSI and multipurpose schemes. The primary targets are smallholder farmers and various institutions involved in developing, managing, and supervising irrigation. In particular, the Small Scale Irrigation Capacity Building Strategy 2011, the Agriculture Growth Program 2015 and the National Smallholder Irrigation and Drainage Strategy 2016 attempt to enhance smallholder irrigation development.

Here the common guiding principle is that water is a natural endowment that is commonly owned and that irrigation development should be based on fairness, sustainability, equity, and participatory approaches under an integrated framework. The implementation strategies focus on establishing and strengthening appropriate institutions at different levels, including water user associations (WUAs) and cooperatives at the grassroots levels, as a prerequisite for community-based irrigation development and decentralized water management.

Gaps observed in the regulatory framework include issues of water fees, water rights, water conflict resolution, incentives for environmental management, inefficient mechanisms for effective operation and maintenance (O&M), monitoring and reporting. Earlier policies lack clear strategies for groundwater development, scaling irrigation technology and services, and standardized approaches to irrigation project management. There are potential overlaps and conflicts in mandates, duties, and responsibilities among the local, regional, and federal institutes and poor coordination across different sectors (Tekle 2019). Such gaps have historically affected implementing of integrated water resource

management, balancing upstream and downstream uses and interests, sharing management of water resources across administrative boundaries, and environmental considerations (Hagos et al. 2009). Recent policy development in the water and irrigation sectors is expected to address these challenges. These include the 2020 Water Policy and Strategy, Smallholder Irrigation and Drainage Strategy 2018, WUA proclamation 2014, draft Water Use Charges Regulation 2019 and the Guideline for Setting Water Abstraction/Use and Treated Wastewater Discharge Charge 2018. For example, the Smallholder Irrigation and Drainage Strategy 2018 lays out a clear analysis of bottlenecks for scaling and recommends priority actions to address them.

4.5. Agricultural finance

Four policies and regulatory documents regarding rural finance and agricultural investments, microfinancing, and public-private partnerships (PPPs) are analyzed in this cluster (Table 1). They aim to improve rural financial services, provide a framework for prioritizing and planning agricultural investments, and guide partnerships with the private sector. The main target groups are microfinance institutions and financial service providers like financial cooperatives, smallholder farmers, commercial farms, agri-businesses, agro-industries, and private and public enterprises.

Among these, the microfinancing business proclamations are implemented by outlining the legal provisions that guide the purpose and functions of microfinancing businesses, conditions, license requirements, operational and financial requirements, and limitations. For instance, the amended Microfinance Business proclamation 2019 changes and adds provisions regarding ownership of microfinancing businesses, outsourcing digital financial, interest-free, and agent banking services. Developing subsequent regulations and directives is key to implementing the proclamations. The earlier Policy Investment Framework 2010 laid out a 10-year investment plan focusing on agriculture productivity and production, rural commercialization, NRM, disaster risk management, food security and an institutional framework for its implementation. In 2017, the PPP Policy outlined the roles and responsibilities of various parties and the process of engaging various actors to successfully design, evaluate, implement, and monitor projects. It includes institutional setups to manage grants, partnership projects, contracting authorities, the overall PPP framework, and government support and participation. It details the PPP projects' scope, use, preparation, implementing guidelines, manuals, and regular bid documents. The implementation modalities for the PPP policy include setting up an institutional framework for technical and budgetary coordination, collaboration with other federal line ministries, identification of approaches, and the role and responsibility of stakeholders. Additional means are arranging financing modalities and aid management capacity, Paris Declaration and Aid Harmonization, M&E and ensuring mutual accountability. The 2009 regulation on Irrigation Development and Investment Incentives encourages private sector investment in irrigation for more than 50 hectares (ha) of land. This is implemented by providing exemptions for water use charges, making available projects with finalized feasibility studies and designs, and building major infrastructures, such as dams, main canals, and access roads, at government cost.

Policies in this cluster play an important role in scaling water solutions by facilitating financing, partnerships, and investment in the irrigation sector. Strengthening and improving microfinancing systems and institutions, partnering with the private sector, and prioritizing and guiding agricultural investments will improve the availability and access to financial services, including savings and credit for agricultural and rural development purposes.

There are gaps in agricultural finance policies and practices. The agriculture sector receives the least amount of credit facilities from commercial banks; provision of microcredit for agriculture and farmers is especially low because of the risks it poses, lack of collateral and unpredictable earning structures, as well as strict policies and highly formal lending procedures (Admasu and Paul 2010). Although the investment framework aims to increase private sector involvement, it does not clearly outline the role of the private sector except for generally mentioning infrastructure development. The PPP policy focuses on the participation of the private sector, primarily in water and irrigation infrastructure and the potential for involvement in other aspects, like services, should be elaborated more. While the rural microfinancing sector has grown in the past decades, several issues remain. Practices like

collateral-based lending exclude many smallholders from accessing finance, and the demand for services outstrips supply. There is a lack of input and equipment credit for agricultural technologies, insurance for smallholders, export financing for exporters, and inventory financing for traders (CIMMYT 2015). A sector-specific PPP strategy for irrigation is being developed to make clear provisions and to structure private sector partnerships and investments.

4.6. Gender and social inclusion

This cluster includes four policies, strategies and guidelines that address gender equality, women's empowerment, and social inclusion. Their purpose is to facilitate and create an enabling environment for gender equality and women's empowerment, including equal access to basic services and benefits, property rights, eliminating prejudices and increasing the meaningful participation of women in agricultural development and social insurance. Inclusion of particularly rural women, youth, and vulnerable community segments is targeted by addressing existing barriers and gaps, making agricultural development more inclusive and reducing poverty.

The main strategies include mainstreaming gender in (agricultural) development and social protection programs and building capacity. The policies grant women equal participation and benefits from different agricultural and natural resource development activities, including watershed management programs and SSI schemes. Also, the policies encourage greater involvement of women in water use/ management institutions and increased access to safe water.

The first national policy that specifically focused on women was back in 1993. It laid the foundation for strategies to ensure that all appropriate measures were put in place so that women's democratic and human rights were respected, including a combination of legislative measures, awareness and education about harmful practices and prejudices against women. Since then, gender-specific policies, strategies and guidelines have emphasized building the capacity of systems and individuals for gender equality and gender-responsive programming, creating a positive organizational culture and conducive work environment and adopting gender-sensitive services and programs. In the 2012 Social Protection Policy, for instance, implementation mechanisms included vulnerable segments of communities, such as women, in social safety nets, livelihood and employment schemes, and social insurance. It also addressed inequalities in accessing basic services at a policy level.

The 2011 and 2020 Guidelines for Gender Mainstreaming in Agriculture provide detailed strategies from gender analysis, using gender-disaggregated data and gender-sensitive indicators, to gender-responsive budgeting, M&E, and gender audit. The 2020 guideline identifies sectoral gender issues, guides, checklists and indicators for agricultural and livestock development, markets, NRM and other sectors to mainstream gender. It also makes several prerequisites for gender mainstreaming, such as political will, statistics and comprehensive knowledge of gender relations, financial and human resources, participation of women in leadership positions and decision-making processes, mechanisms for accountability for mainstreaming gender, and sharing knowledge. The Gender Equality Strategy for Agriculture Sector was developed in 2017. It stresses the importance of key mechanisms for applying gender-transformative and rights-based approaches that recognize women's rights to social, economic, and political equality and prohibits discrimination by sex. Furthermore, the strategy recognizes and builds upon indigenous knowledge and good practices. It also empowers women, promotes results-based approaches toward gender equality, and encourages affirmative action for rural women.

Even though the constitution and policies on women adequately recognize their equal rights concerning access to and control of property, including land, this is often not the reality because of prevailing gender-restrictive norms and beliefs. This has affected policy implementation and prevented women from participating in and contributing to irrigated agriculture, as land ownership and access are mostly a prerequisite for accessing irrigation water. In the social protection policy, access to a water supply is primarily seen from the perspective of water, sanitation, and hygiene (WASH) procedures, and irrigation is not clearly recognized as important for reducing poverty and creating inclusive agri-food systems. Also, the policy lacks internal and external coherence, specifically

the link to agriculture and food security, urban development, health, education, and industry (Lemma and Cochrane 2019).

4.7. Environment

This cluster features five policies recognized in Ethiopia's constitution and national economic policies and strategies as a key prerequisite for lasting socioeconomic development. The cluster aims to enhance health and quality of life for all Ethiopians and sustainable socioeconomic development through the sound protection, management and use of natural, humanmade and cultural resources and the environment. Here the priority is on certain sectors: sustainable agriculture, forest resources, biodiversity, water, energy and mineral resources, human settlements, urban environment and environmental health and pollution. The focus is on protecting, conserving, and sustainably using natural resources. The legislation targets environmental authorities, service providers, investment and trade licensing agencies, and proponents.

The Environmental Policy of Ethiopia (1997) is among the earliest and basic policies. The general guiding principle is that every person and species has the right to live and exist in a healthy environment. The policy implementation emphasizes the use of community-based approaches and appropriate and affordable technologies. It addresses market failures, social equity, awareness gaps, and mainstream environmental sustainability across sectors. The implementing strategies include creating and strengthening legislative frameworks, improving M&E, and conducting a policy review to follow up and report on policy implementation and enforcement at various levels. The environmental pollution prevention and EIA tools are developed for the effective enforcement of environmental inspections, management of waste, environmental standards, and penalties for offenders as central strategies. They also focus on protecting essential ecological and life-support systems, such as biological and genetic diversity, preventing land, air, and water pollution in the most cost-effective way possible, and sustainably exploiting natural resources. Other key aspects include considering the full economic, social, and environmental costs and benefits of natural resource development in the planning, implementation, and accounting processes and subjecting major development projects (including irrigation) to an EIA. Stakeholder participation and integrated approaches to developing natural resources are also among the most common methods in this cluster.

To guide water resource management and development, the National Conservation Strategy (1994) principles include, among others, adopting integrated approaches, prioritizing water development for basic domestic and subsistence purposes, and using "drainage basins" as the basic planning and development unit. Additional principles include managing sustainable water resource development at the lowest appropriate government or community level and increasing the participation and role of water users, especially women and pastoralists.

Strengthening the enabling environment is one main strategy for environmental policies. The goal is to establish and strengthen institutional frameworks for effective and coordinated management of the environment and natural resources, including appropriate arrangements and assigning clear roles and responsibilities. To accomplish this, capacity building is geared toward providing technical and credit support to the private sector in water resource development and strengthening and developing the ability of institutions to assess water resources. The cluster supports the promotion and adoption of appropriate technologies for sustainably using and managing renewable and non-renewable resources. It is also stated that technologies for SSI and village water supplies should always be simple, acceptable, easy to handle and affordable (National Conservation Strategy 1994) and controlling environmental health hazards should be a necessary condition in designing, building, and using dams and irrigation systems (Environmental Policy of Ethiopia 1997).

Despite this progress, there are still gaps in integrating, implementing, and enforcing environmental laws. Binding instruments for implementing different aspects of some policies are missing, and the regulatory framework and institutional arrangements are also inadequate to prevent environmental degradation (Yigzaw 2020). For instance, there are no regulations or directives for public participation in the EIA process, and the hierarchical structure of environmental agencies may lead to weak

coordination between agencies and ineffective implementation of proclamations (Yigzaw 2020). In addition, there is no clear means to provide financial incentives and technical support for cleaning the environment and preventing pollution (Gubena 2016). Inconsistencies and a lack of complementarities among institutions and between environmental and investment policies and proclamations are also reported (Ruffeis et al. 2010; Gubena 2016).

4.8. Land use and ownership

The Constitution of Ethiopia gives the right to land ownership to the state and the people, and it empowers regional governments to administer land and other natural resources per federal laws. Even though there are no national policies, strategies, or planning documents specific to land use, the Rural Land Use and Administration proclamation, developed in 1997 and later amended in 2005, set out principles and lays the legal foundations for using and administrating rural land. This cluster also addresses free and equal landholding rights for farmers, pastoralists, and men and women in general. It puts in place the necessary legal conditions needed to firm up the land use rights of farmers that encourage them to take the required conservation measures in areas where mixed farming of crops and animals is prevalent and where soil erosion and forest degradation are present. The proclamations have provided a legal framework for women's equal rights regarding land use, administration, and control.

The proclamations primarily target rural landholders, including individual farmers, pastoralists, investors, and government authorities. Central strategies are the general and specific provisions for holding and administrating rural land. The basic guiding principle is that land is a common property of Ethiopia's Nation, Nationalities and Peoples and should not be subject to sale or another means of exchange. As for NRM, the principles include using land, water, and biodiversity sustainably and rehabilitating and conserving resources.

Although the amended proclamation of 2005 attempted to include sustainable land use, no such integrated national plan exists. This has led to serious land degradation because the land use policy is not enough by itself, and there is no real legal framework to enforce it (Gebeyehu et al. 2017). Different land tenure and ownership policies have influenced agricultural land management, maintenance, use of technologies, and tenure security (Zerga 2016). In some cases, policies are criticized for inadequate consideration for land maintenance as transcending individual users with the obligation and motivation to properly maintain, improve and transfer it (ibid). Additional land can only be acquired through leasing, as current policy restricts consolidating holdings and prohibits holdings from being sold or bought. Farmers have title deeds for user rights only and cannot transfer land through sale or use, as land is officially government-owned. Such regulatory frameworks affect farmers' investment and access to finance as well. These land ownership issues, together with unclear property rights and the absence of a registry system for movable assets, undermine the ability to identify appropriate collateral for lending (Amha et al. 2017). Implementing land use and ownership policies is also challenging for women's access and use of land. Current laws adequately recognize a woman's right to equal access and control of property; however, certain customs and gender biases hinder women from possessing and controlling land (Tura 2014).

4.9 Key policy trends and changes

General development cluster: Over the past decade, the general development policy framework has given increased attention to climate resilience, the green economy, and commercial and market-oriented agricultural development, as well as participatory approaches, stakeholder engagement and partnerships. There is also alignment with Sustainable Development Goals and other international initiatives on climate change.

Agriculture development cluster: Key trends in this policy cluster include shifting the extension strategy from a top-down approach to a more client-oriented, complementary one with strategic interventions that are market-led and applied across the system to achieve its intended vision, mission, and objectives. The ANR GTP II (2015) looks to local small and medium enterprises (SMEs) and light industries to produce agricultural technologies and inputs, including irrigation equipment.

The Cooperative Societies proclamation 2016 established a cooperative advisory council directly accountable to the Ministry of Agriculture (MOA). The previous agriculture and rural development policies are being revised to reframe key policy aspects and address existing policy and implementation gaps. The new policy directions on irrigation emphasise mechanisms for handing over and developing irrigation infrastructure, operating, and managing it, ensuring financing and cost recovery, creating an irrigation development fund, and harvesting rainwater for agricultural water and energy-efficient technologies. Agriculture water management also has a few new directions, focusing on harvesting and using rainwater as the main source of agricultural water and groundwater development as the second source while incentivizing suppliers and users of power-saving water technologies.

Irrigation and water resource development and management: Compared to practices and approaches before the year 2000, water policies have, for the first time, laid the overall framework to manage, use and protect water resources in a coordinated manner. Key trends in managing and developing water resources include adopting IWRM principles, basin-level and decentralized and user-based approaches, and a legal basis for establishing and operating WUAs. More recent policies at the 'draft' stage lay a framework for implementing water fees and charges and guidelines for abstracting and using water. The Water Policy and Strategy of 2020 clarifies the roles and functions of the federal bodies and regional states, the coordination and intersectoral administration of water resources, and federally and regionally horizontal integration between water-related organizations. Additional developments are establishing the National Water Resources Information Centre and a corresponding information management system. The draft Water Use Charge Regulation of 2019 addresses gaps in regulating water use and water works permits, discharge of used water, water quality control, and water fees and charges. Irrigation development policies have focused more on diverse irrigation types. Key changes include adopting micro/household irrigation typology in small scale irrigation strategies. The proclamation for WUAs provides the legal basis for establishing WUAs and gives a formal structure for water resource management at the grassroots level. In recent decades, the focus of national irrigation development has increased toward decentralized, user-based SSI, even though medium- and large-scale irrigation schemes are also prioritized (AGP 2015; NSIDS 2018). There is also greater attention to the private sector and community engagement and provision of legal bases for community irrigation institutions.

Agricultural finance: Over time, this cluster has recognized the need to improve rural finance and the role of microfinance institutes (MFIs) and financial cooperatives in driving agricultural growth and rural development. Accordingly, the purpose and activities of MFIs are being broadened to include providing financial leasing services and local money transfer services, allowing banks to engage in microfinancing, easing license applications for MFI businesses, permitting foreign ownership of MFI businesses, and offering additional services and financial products. The adoption of PPP policy supports attracting greater private sector involvement. At the time of this study, the policies and practices are being revised to improve collateral-based lending practices and include land certifications and other moveable assets as collateral. Also, a quota is being proposed for banks to allocate a certain percentage of their loans to the agriculture sector. These developments are expected to greatly improve access to financial services for smallholders, including women and youths.

Gender and social inclusion: Since the early 1990s, policies have been developed to specifically reflect a commitment to gender equality and to grant women the right to property, equal benefits, and participation. However, sector-specific implementation tools for the policies were missing for years until the strategies and mainstreaming guidelines were developed. These are instrumental to mainstreaming gender in agricultural development policies and programs and creating an enabling environment for women's active participation and empowerment. These policies have included livestock components and pastoralist perspectives, sub-sectoral gender, and specific issues of female-headed households. Emerging issues like women and climate change, and nutrition are increasingly emphasized. Social protection policies have shifted from a social welfare approach to a complete framework, resulting in coordinated actions for sustainable development.

Environment: Over time, policies in this cluster have tried to integrate environmental and sustainable development principles into policy, planning and management. The 2002 EIA proclamation made EIAs a mandatory legal prerequisite for all major development projects, including programs and plans for developing irrigation. The recently drafted Payment of Ecosystem Services proclamation (2019) and Community Watershed proclamation (2020) implemented an environmental fee/tax for rehabilitating watersheds to improve soil and water conservation, to use slopes, gullies, and wetlands sustainably and to generate ecosystem services.

Land use and ownership: While the 1997 proclamation is very general, the amended one (2005) adds more details, particularly on land use for different purposes. The revised version has moved beyond land rights and administrative issues to include the legal obligation of landholders, dispute resolution and restrictions on unsustainable land use, especially on cultivating land based on the different degrees of slopes. It also promotes equitable water use between upstream and downstream users.

5. INTERVENTIONS ANALYSIS

The inventoried interventions were organized under six clusters. An overview of the intervention framework is presented in Table 2.

5.1. General development

This cluster features six interventions in rural development, climate change adaptation and resilience led by Development partners such as USAID and the Japan International Cooperation Agency, and local and international NGOs. These aim to promote local, system-level adaptive capacity and governance changes, enhance households' resilience and livelihood options to climate-related shocks, and enable poor farmers to strengthen their food and income security. This cluster targets agro-pastoralist and pastoralist communities, smallholder farmers, government institutions and staff at different levels, food-insecure households, and beneficiaries of the Productive Safety Net Program (PSNP). The resilience-oriented interventions mostly took place in the arid and semi-arid regions of the country that are vulnerable to weather-related shocks and stresses and were implemented with due consideration to pastoral and agro-pastoral communities. These regions include Oromia, Tigray, Amhara, Somali, Afar, Benishangul Gumuz and the Southern Nations Nationalities and People's Region (SNNPR).

There are three groups of activities in this cluster. Agriculture, NRM and resilience-oriented activities are livestock productivity and competitiveness, pastoral NRM and climate change adaptation, and dryland farming and irrigation (Woodfine 2013; JICA 2016; Smith et al. 2019). Creating an enabling environment includes strengthening market development, access to finance, microcredit and savings solutions for prudent risk-taking and risk reserves, infrastructure development and access to early warning systems, weather information and weather index insurance (ibid). Capacity building targets different stakeholders at different levels. For example, the African Climate Change Resilience Alliance program helped government entities across ministries and between ministries and regions to coordinate better with regard to climate change planning. The remaining interventions focused on providing support and technical assistance for vulnerable communities to make them more resilient and able to withstand climate change impacts by strengthening and diversifying livelihoods, assets, and access to necessary information and services (ibid).

The cluster contributes to mainstreaming adaptive thinking into the national and *woreda* (district) level disaster risk mitigation/ adaptation guidelines and strengthening the planning capacity of local CRGEs to integrate best practices into different national policies (Colvin and Mukute 2018). It also significantly helped local institutions manage disaster risks, climate change impacts and climate-smart agriculture. Climate information services have been developed by testing innovations such as satellite-based precipitation data, climate insurance policies, weather index insurance, and work-for-insurance schemes to help resource-constrained smallholders (JICA 2016; Sharoff et al. Undated). Various programs and projects have helped households in their ability to absorb, adapt, transform and be resilient to shocks using different means, such as market development, livelihood diversification and access to finance.

TABLE 2. Overview of interventions.

Cluster and intervention documents	General objectives	Components	Target area	Water and irrigation technologies and solutions	Gaps and Challenges
Cluster 1. General Development					
1. African Climate Change and Resilience Alliance (ACCRA II) 20112–016 2. Ethiopia Pastoralist Areas Resilience Improvement and Market Expansion (PRIME) 2012–2017 3. Rural Resilience Enhancement Project (RREP) 2012–2015 4. R4 Rural Resilience Initiative in Ethiopia (R4) 2011–ongoing 5. Enabling Pastoral Communities to Adapt to Climate Change and Restoring Rangeland (EPCACCRR) 2000–2013 **6.** Graduation with Resilience to Achieve Sustainable Development (GRAD) 2011–2016	Adaptation and resilience of vulnerable households, NRM[a], livelihood diversification, capacity building	Agriculture, livestock, rural development, NRM, climate change, enabling environment	Arid and semi-arid areas, Oromia, Tigray, Amhara, Somali, Afar, SNNPR[b], Benishangul	**Technologies**: water points, wells, ponds, rainwater harvesting, improved schemes, pipes, canals, motorized and manual pumps **Services**: access to finance, information, services and inputs, market development, human and institutional capacity building **Practices**: soil water conservation and management, climate-smart agriculture, improved irrigation practices, floodwater capture, testing innovations, documenting, and mainstreaming best practices	- Gaps in data, irrigation infrastructure, irrigation management and enforcement - Limited capacity, coordination, and collaboration among actors - Top-down approach - Gender bias and lower participation of women
Cluster 2. Environment, Land and Water Resource Development					
1. Sustainable Water Harvesting and Institutional Strengthening in Amhara (SWHISA) 2005–2011 2. Ethiopia Water Program 2010–2013 3. Rayitu Community Development Project (RCDP) 2003–2013 4. Community-based Integrated Natural Resources Management (CINRM) 2010–2018 5. Land Administration to Nurture Development (GRAD) 2013–2018 6. Sustainable Land Management Project I (SLMP I) 2009–2013 **7.** Strengthening Land Tenure and Administration Program (ELAP) 2005–2012	NRM, resilience, agricultural development, capacity building, rights-based approach to productive resources, improving land administration and certification	NRM, agriculture, water, land, enabling environment, community development	Amhara, Oromia, Tigray, Afar, Somali, SNNPR	**Technologies**: water points, ponds, tankers, reservoirs, shallow wells, roof water harvesting and hand-dug wells, water diversion schemes, motorized and rope and washer pumps **Services**: water resource development, capacity building, organizing, and supporting WUAs **Practices**: watershed management, soil water conservation, sustainable land management and land use, experience sharing and demonstrations, improving water potential, participatory learning processes	- Land tenure and insecurity-related issues - Delayed delivery and poor quality of water infrastructure - Lack of contextual understanding and integrated approaches - Limited access to services, inputs, and resources - High cost and low adoption of technologies - Low women participation
Cluster 3. Agricultural Development					
1. Agricultural Growth Program – Agribusiness Marketing and Development (AMDe) 2011–2016 2. Agricultural Growth Project (AGP I) 2011–2017 3. Productive Safety Net (PSNP) 2005- ongoing 4. Drylands Development Program (DRYDEV) 2013–2019 5. Agricultural Value Chain in Oromia (AVCO) 2011–2016 6. Development Food Assistance Program (DFAP) 2016–2020 7. Pastoral Community Development Project (EPCDP) 2005–2015 8. Food Security Program (FSP) 2010–2014 9. National Nutrition Program (NNP) 2009–2012	Agricultural production, productivity, commercialization, food security, nutrition, value chain and market development, WASH, NRM	Agriculture, enabling environment, NRM, community development, social security	Oromia, Tigray, Amhara, Somali, Afar, SNNPR, AGP[c] and PSNP[d] program areas	**Technologies**: water harvesting and microstructures, ponds, dams, water points, boreholes, hand-dug wells, shallow wells, expansion of SSI schemes **Services**: access to finance, market and agribusiness development, capacity development, social protection **Practices**: community-based watershed management, on-farm soil fertility and water management	- Limited implementation capacity and delayed delivery of infrastructure, limited WUA performances - Limited beneficiary access to finance and resources - Limited participation of women and stakeholders - Lack of gender and communication strategies

10. Rural Advisory Services Program (RASP) 2010–2015 11. BOAM Fruit Value Chain Program (BOAM) 2007–2015					
Cluster 4. Irrigation Development					
1. Participatory Small Scale Irrigation Development Program (PASIDP I) 2008–2015 2. Irrigation and Drainage Project (IDP) 2008–2017 3. Wesha Small-Scale Irrigation Project (WSSIP) 1980s–ongoing **4.** Small and Micro Irrigation Support (SMIS) 2014–2019	Agricultural productivity, food and nutrition security, income and livelihoods, climate change adaptation, scaling of water solutions, supporting policy implementation	Water, climate, agriculture, enabling environment	Oromia, Amhara, Tigray, SNNPR	**Technologies**: shallow wells, ponds, dams, tanks, reservoirs, pumping stations, rope and washer and solar pumps, canals, tractors with drip kits, low-cost irrigation schemes **Services**: market links, strengthening WUAs and support services, gender-sensitive SSI **Practices**: documenting and mainstreaming lessons learned, piloting and testing technologies, water, soil and crop management practices	- Limited WUAs' capacity - Delayed delivery and poor quality of water infrastructure - Public and private actors' limited capacity in designing, planning, constructing schemes, M&E, and contract enforcement - Limited participation of women, stakeholders, and beneficiaries - No scaling strategies
Cluster 5. Agricultural Finance					
1. Agriculture Sector Policy and Investment Framework (SPIF) 2010–2020 2. Rural Financial Intermediation Program (RUFIP) 2001–2010 3. Evaluation of Development Credit Authority (DCA) 2004–2015 4. Private Enterprise Program Ethiopia (PEP) 2013–2021 5. 2SCALE 2012–2017 **6.** Strengthening African Rural Smallholders (STARS) 2016–2021	Prioritize and plan investments, income diversification, access to capital, capacity building, support PPP, financial inclusion	Agriculture, water, investment and finance, enterprise development, enabling environment	National level, SNNPR	**Technologies**: SSI scheme development **Services**: capacity building and technical support for rural financial service providers and borrowers, increasing access to finance, business and market development, resource mobilization, **Practices**: best practices to improve agricultural productivity and food security, developing agribusiness clusters and partnerships	- Limited stakeholder participation, weak synergy and coordination - Collateral-based lending system - Limited access to productive resources, services, and inputs
Cluster 6. Gender and social inclusion					
1. Berchi or 'be strong' Project 2013–2015 2. Joint Program on Rural Women's Economic Empowerment (JPRWEE) 2013–2018 3. Empower Youth for Work Program (EYWP) 2016–2021 4. Youth Development Program (AYDP) 2017–2021 5. Western Ethiopia Women Empowerment Program (WEWEP) 2012–2014 **6.** Joint Program on Leave No Woman Behind (LNWB) 2009–2013	Food and nutrition, livelihoods, GEWE and youth empowerment, capacity building	Women and youth, water, education, agriculture, enabling environment	Amhara, Oromia, Afar, Somali, Tigray, SNNPR, Addis Ababa and Dire Dawa	**Technologies**: water collection and lifting technologies, ponds and pumps **Services**: business development, gender-sensitive extension, policy for GEWE[d], capacity building, access to productive resources, finance and services, inclusion and representation, education **Practices**: improved agricultural practices, community engagement, advocacy	- Gaps in resources, operational and institutional arrangements for implementation - Restrictive gender norms and limited awareness of beneficiaries and actors - Context misunderstanding

Source: Authors' creation.

[a] Natural Resource Management

[b] Southern Nations, Nationalities and People's Region

[c] Agricultural Growth Program

[d] Productive Safety Net Program

[e] Gender Equality and Women's Empowerment

The cluster contributes to improving water conservation, harvesting, storage and lifting technologies for irrigation development and promoting irrigation practices and irrigated agriculture in agropastoral areas (JICA 2016). It also promotes irrigated backyard gardens (Smith et al. 2018), floodwater capture (SI 2017) and community-based irrigation schemes, soil-water conservation (Sharoff et al. Undated) and improving agronomic practices like soil fertility management, climate-smart agriculture, and input supply (Colvin and Mukute 2018).

Challenges in this cluster are mainly with program design, including the impractical choices for pilot project sites, a mismatch between capacity-building training and beneficiary needs, and overlapping community activities with government-initiated programs (JICA 2016). A lack of proper community engagement and sensitization and insufficient understanding of the socioeconomic context have limited participation in insurance schemes (Woodfine 2013; Sharoff et al. Undated). Cultural and resource barriers also affect new practices from being used. Several factors limit women's participation, including long distance to markets, additional workload, lack of access to finance and other services, cultural bias and restrictions on mobility (SI 2017; Smith et al. 2019). There were also limitations in the ability to manage and implement projects, deliver irrigation infrastructure, and enforce contracts, as well as in ineffective facilitation and monitoring and in technical gaps among stakeholders in implementing the weather index insurance (JICA 2016). External and systemic challenges include the lack of rainfall data, information, and technological means to communicate weather data, a shortage of rainfall/water for irrigation and the high mobility of pastoral communities during the dry season (JICA 2016). Finally, there is a lack of coordination and synergy between key actors, intersectoral collaboration and joint action (Woodfine 2013; JICA 2016), and political tension between key government actors, specifically the Disaster Risk Management Commission and the Environmental Protection Authority.

5.2 Environment, land, and water resource development

This cluster features seven land/water/biodiversity conservation, rehabilitation, management, and development interventions. They include watershed development, water supply, INRM, land use and tenure (Table 2). The analyzed interventions were mainly either led by or supported financially and technically by NGOs, development partners and international organizations, specifically USAID, the International Fund for Agricultural Development (IFAD) and the Food and Agriculture Organization. The interventions were implemented in different parts of Ethiopia and across various agroecological regions. These include the regions of Amhara, Oromia, Tigray, Afar and Somali and the SNNPR. At all levels, these interventions target different groups of rural communities as beneficiaries, including the landless, smallholder farmers and pastoralists, youth, women, cooperatives, WUAs, relevant government institutions and staff.

This cluster aims to promote sustainable conservation, use of natural soil, water, flora, and fauna resources, and promote land rights and tenure for sustainable agricultural and rural development. Specific objectives include the following:

- Promote the adoption of sustainable land management practices and technologies to combat degradation.
- Enhance community-based watershed development and INRM to improve agricultural production, productivity, and access to safe water for human and livestock consumption.
- Promote the right over water for smallholders for consumption and production.
- Strengthen women's empowerment and gender equality in water resource management.
- Create an enabling environment and build capacity at different levels.
- Establish a locally appropriate model to legally recognize and protect communities' land and resource use rights and strengthen customary land governance institutions.
- Support the government's development of a well-defined and computerized land certification system and the legal framework on land administration and promote tenure security.
- Increase public information, awareness, and the capacity of land administration institutions.

There are three groups of activities in this cluster. Natural resource and agricultural development include participatory watershed management and soil water conservation, SSI, and forestry and pasture production (Addisu et al. 2013; Emana et al. 2014; IFAD 2019; Schmidt and Tadesse 2019). Land rights and tenure focus on improving land administration and certification and strengthening land tenure security for rural communities and smallholder farmers (CG 2016; IFAD 2019; Schmidt and Tadesse 2019). Capacity building targets various stakeholders, including institutions and community groups. Examples are strengthening the capacity of land administration institutions and key stakeholders in land use planning, governance, and certification (ibid), sharing experiences, and providing demonstrations and continuous training for farmers, *kebele* (lowest administrative level) administrators, development agents and other government bodies (Addisu et al. 2013). In addition, capacity building aimed to empower women to have more influence on decision-making regarding developing the SSI system (Emana et al. 2014).

This cluster contributes to increased land productivity by rehabilitating the degraded land, improving the water potential, and improving agronomic and on-farm soil management practices. Improvements in income, food and nutrition security are achieved by introducing high-value crops (Addisu et al. 2013; IFAD 2019) and increasing sustainable land management practices and agricultural productivity (Schmidt and Tadesse 2019). Establishing watershed models and developing integrated watershed management plans have also been reported (ibid). Strengthening the Land Tenure and Administration Program increases household likelihood with second-level certification to credit for farming purposes, the feasibility of a woman possessing land, land held jointly by husband and wife or by female-headed households, and a wife deciding which crops to grow on lands under her control (CG 2016).

The Water Program (2010) contributes to irrigation development by implementing gravity and pumped SSI, organizing and strengthening several WUAs and their members, and successfully introducing backyard irrigation schemes using low-cost equipment (Emana et al. 2014). Additional achievements include building different pieces of water storage and distribution infrastructure, establishing various cooperatives and installing facilities like stores and grinding mills (ECDSSC 2013). Capacity building across these interventions has enhanced the ability of farmers, development agents, district experts and related institutions to properly plan and manage integrated NRM, watershed development, and land administration and certification. Irrigation technologies introduced or promoted across these interventions include water harvesting and storage structures, water diversion schemes, and motorized and rope and washer pumps (Table 2).

Challenges in program design include gaps in the market for irrigated products, beneficiary access to finance and water resources, and lack of complementary packages like improved inputs, agronomic practices and irrigation extension (Emana et al. 2014). Women's participation in the land certification process was weak, as only 28% of the women were consulted during the certification process despite their presence in the area (CG 2016). Better targeting is recommended for capital-intensive irrigation and harvesting water technologies (Addisu et al. 2013). Private and public contractors have critical capacity gaps to timely deliver quality infrastructure. Significant infrastructure quality and delivery issues have led to lower operation capacity and, thus, fewer people benefiting from them (ECDSSC 2013). External or systemic factors include low levels of education and awareness of community and government staff, water shortages, poor awareness of gender and development, and low capacity of local institutions (ECDSSC 2013). The adoption of water harvesting and irrigation-related technologies was also low (Addisu et al. 2013) because of the high cost of building a water harvesting structure and the limited financial capacity of beneficiaries.

5.3 Agricultural development

This cluster includes 11 programs and projects on agribusiness and marketing, agricultural production and productivity, food and nutrition security, value chain development and community development (Table 2). Both government and non-governmental actors (development partners and NGOs) initiated and implemented these interventions; information on private sector-initiated interventions is

unavailable. Government-initiated national programs like the Food Security Program, Agriculture Growth Program (AGP), PSNP and Nutrition Program are usually supported with funding or technical support from development partners like the World Bank and USAID. Most of the interventions target the regions of Oromia, Tigray, and Amhara and the SNNPR, while few target Somali and Afar. In addition, common target areas are chosen, sometimes in advance. These include PSNP *woredas*, which are chronically food insecure and vulnerable areas, and AGP *woredas*, which are areas that hold high potential for agriculture.

These interventions try to strengthen and improve capacity, the enabling environment, value chain competitiveness, access to finance, investment, markets and innovations for crop and livestock production and productivity, participation of women and youth, resilience to shocks and stresses, water capture and soil fertility, income, and livelihoods. These places are also areas of interest for development partners/programs like USAID's Feed the Future initiative. The primary beneficiaries of these interventions are rural communities and farmers in general, particularly smallholders, pastoralists, PSNP beneficiaries, women and youth, and cooperatives.

There are four key pillars and activities in this cluster. Agricultural and rural development activities include introducing, testing, and promoting innovations, improving farming practices and technologies, enhancing value chain links and competitiveness, increasing access to finance and credit and necessary services like credit, loans and extension services, and developing agribusiness and markets by supporting SMEs (Fox et al. 2015; Welteji et al. 2017). Strengthening the enabling environment encompasses developing small-scale rural water and irrigation infrastructure, strengthening knowledge and information systems (Damiba 2013; ACE Europe 2013), promoting finance and investment in priority areas (WB 2016) and improving market development and access (ibid). Some interventions also had activities to facilitate policy and regulatory improvements in the financial sector (Fox et al. 2015; WB 2017), policy analysis, advocacy (MDF 2018) and reform (WB 2016). NRM focuses on community-based soil and water conservation works, managing watersheds, rangeland, and on-farm soil fertility and water (ibid). Capacity building is part of these interventions as a crosscutting or stand-alone pillar. For example, the financial sector stimulates lending through guaranteed funds, developing new financial products and services (Fox et al. 2015) and building the capacity of implementing partners (Damiba 2013). Others include strengthening households, communities, and institutions to enhance adaptive capacity (USAID 2017), risk management and project management, as well as technical support and training at different levels (WB 2016) and to strengthen local and institutional governance (MDF 2018).

This cluster contributes to agricultural and rural development with the improvement of value chain competitiveness and increasing access to finance and investment (WB 2017;) as well as access and development to markets (ACE Europe 2013; Fox et al. 2015; IDC 2016; WB 2017; Welteji et al. 2017; MDF 2018). The interventions also improved agricultural production, productivity, and food security and strengthened disaster, risk management, and climate resilience (ibid). Programs have strengthened the enabling environment by improving the policy and regulatory environment and stimulating innovations (ibid).

This cluster also contributes directly and indirectly to irrigation development by introducing and promoting different irrigation technologies and rehabilitating and expanding SSI infrastructure (Hoddinott et al. 2011; WB 2017; USAID 2017; MDF 2018). A component of small-scale rural infrastructure development and management (WB 2017) supported investments in irrigation, road access and markets by developing and managing small-scale agricultural water, building SSI infrastructure, conserving soil and water, and developing market infrastructure like small-scale feeder roads, footbridges, roadside drainage, and market centres. They also include developing institutions and building capacity at the *woreda*, *kebele* (lowest administrative level) and community levels.

Challenges were found in program design and implementation. Communication was weak, awareness was low, there was no gender strategy in most projects, and the local context and needs were poorly

understood. Lack of participation among key stakeholders, like the private sector, in the identification and formulation stages of projects also affected involvement in implementation (IDC 2016). Capacity gaps concern actors with technical know-how, safeguards, procurement, and financial management skills, including implementing partners, government, the private sector, and beneficiaries. The private sector lacks technical and financial capacity, resulting in low quality and delayed delivery of critical infrastructure and services. There are also difficulties in supervision and contract enforcement. Additional issues include a lack of access to finance for beneficiaries and the low functionality of WUAs. Limited synergy and coordination between different actors in, for example, the AGP I made it difficult to manage and enforce contracts, while poor synergy between growers and credit providers was the case in the agricultural value chain in the Oromia project (IDC 2016).

5.4 Irrigation development

This cluster includes seven programs and projects for developing irrigation schemes, practices, and related technologies. Interventions from the government and NGOs dominate the available information on interventions in irrigation development. Development partners such as IFAD and the World Bank usually support government-led interventions; information on private sector-led interventions was unavailable. This cluster focuses on the arid and semi-arid areas where most irrigation interventions have taken place, such as Oromia, Amhara, and Tigray regions and the SNNPR. This cluster primarily targets smallholders, women, youth, PSNP beneficiaries, and government institutions involved in irrigation development (SMIS 2015; IFAD 2017; Mossisa and Bezabih 2017; WB 2019).

The interventions focus on raising agricultural production and productivity, strengthening food and nutrition security, increasing income, diversifying and improving livelihoods and adapting to climate change. To do so requires increasing access to irrigation and drainage services, water lifting technologies, and supporting the government in building up SSI. This is accomplished by ensuring that public and private institutions have the institutional, human, and technical capacity required for gender-responsive, sustainable SSI development in a coordinated manner and following IWRM principles. Key pillars and activities in irrigation development interventions can be grouped into SSI development, capacity development and agricultural development.

SSI development includes building new SSI schemes and related infrastructure. The SSI Development Program involved developing pro-poor, small-scale, low-cost irrigation schemes (spate, spring and pump supported) that farmers own and operate (IFAD 2017). Two measures were used to introduce water collecting and lifting technologies. One was promoting small-scale rainwater harvesting technologies and structures (SMIS and SSWHT program), and the other was introducing and testing water lifting technologies of drip, solar, and rope and washer pumps (Nigussie et al. 2017) as well as low-cost and effective (hand-driven) pumps for micro irrigation systems (SMIS 2015).

Capacity development is a major component of this cluster, either as a cross-cutting issue or as a primary objective of the interventions. For example, the Small and Micro Irrigation Program was primarily a capacity development program to help relevant stakeholders implement the national SSI Strategy. These activities targeted different actors, including smallholders, WUAs and irrigation user associations, development agents, and relevant government staff and institutions. Capacity building specifically targeted resource-poor smallholders to provide them with irrigation to fully own and operate themselves (IFAD 2017; WB 2019) by training, sensitizing, and creating awareness for WUAs to operate and manage irrigation facilities, recover costs, and manage irrigation water. In addition, training on watershed management, irrigated agriculture and organizing WUAs were provided for regional and *woreda*-level staff at water and agriculture bureaus, communities and beneficiaries, and farmer groups. The SSI and Drainage Program's capacity building involved providing technical assistance for feasibility studies, supporting strategic impact assessments (SIAs) and EIAs, and helping with irrigation project management, including planning, design, and M&E (WB 2019). In addition, the

Small and Micro Irrigation Project aimed to build the capacity of agricultural technical vocational education colleges to teach and demonstrate irrigation and water management on campus.

Agricultural development relates to direct and indirect supports and services relevant to developing irrigation successfully. These include establishing and strengthening support services and facilities, such as farmer training centres, farmer research groups, and community-managed nurseries, and promoting best practices needed to, for example, conserve soil and water (IFAD 2017). Services to strengthen agricultural development include the value chain and market development (WB 2019) and facilitating credit access for buying irrigation equipment by linking farmers with financial organizations and promoting multiple uses of water (Nigussie et al. 2017).

Contributions to irrigation development include better planning of catchment areas for small-scale irrigation schemes and strengthened WUAs and agricultural support services, like farmer training centres. The Small and Micro Irrigation Support (SMIS) Program has helped build the capacity of various actors toward improved planning, design, and construction of gender-equitable and sustainable small-scale and micro irrigation schemes by both public and private institutions. The program also improved management, such as schemes by WUAs and individual users, with support from key public institutions. Various programs have improved water, soil and crop management practices for irrigated crops that male and female farmers have adopted (SMIS 2015). They have also improved agricultural practices (IFAD 2017), increased production and productivity, improved value chain development and market links and increased income (WB 2019). Promoting water lifting and irrigation technologies have increased production and income, eased workload, saved time, and improved water access for domestic use (Nigussie et al. 2017). These water storage technologies include water harvesting and collection infrastructure, such as shallow wells, village ponds, sand dams and water tanks, dams, and reservoirs. Water pumping stations, rope and washer and solar pumps, different types of canals for diverting water, and tractors with drip kits are mentioned. Programs have also helped develop different types of small-scale, low-cost irrigation schemes, such as spate, spring, and pump, that farmers can own and operate.

There were challenges in program design that limited achievements and the participation of stakeholders and beneficiaries, including women and youth. There is a lack of a specific gender strategy and insufficient time and support for beneficiaries to actively participate in the design of SSI schemes at the project planning stage (IFAD 2017). Despite having a gender-specific outcome and intermediate indicators in the M&E framework, this data was not used and did not lead to any actions that would facilitate women's participation in project benefits (WB 2019). Participation among researchers in farmer research groups was also low because of a limited number of incentives or an absence altogether. WUA memberships were discouraging because the benefits were sometimes unclear, and non-members got to use the water resource. Cultural barriers, lack of awareness, and workload also have limited women's participation. Furthermore, there is a limited capacity for the different actors involved. Although private contractors could not deliver quality irrigation infrastructure on time (WB 2019), beneficiary participation in the cost-sharing of SSI schemes was not achieved because of a lack of financial capacity to participate (IFAD 2017).

There is a lack of synergy between different actors in contract enforcement, infrastructure and service deliveries, and market linkage creation. There was insufficient external/internal support from relevant stakeholders in small-scale rainwater harvesting technologies and irrigation schemes (Mossisa and Bezabih 2017) and inappropriate institutional arrangements, weak oversight that constrained ownership, uncertainty in structuring PPPs and a lack of contract enforcement (WB 2019). These affected private actor participation, irrigation investment, and performance of irrigation interventions. Technical limitations of introduced water lifting technologies have affected their adoption (Nigussie et al. 2017). Diesel pumps, for instance, require a lot of investment upfront, yet they must be maintained frequently, and spare parts are often unavailable, while rope and washer pumps were affordable but deemed too labor-intensive. The preference was for solar pumps with additional energy storage. There is no clear and concrete scaling-up strategy as part of project designs.

The reported scaling efforts are focused more on expanding irrigation schemes and disseminating technologies and best practices horizontally.

5.5 Agricultural finance

Sectoral investment frameworks, rural finance and credit programs, programs financing selected value chains, PPPs, and private enterprise development programs are analyzed in this cluster (Table 2). The information available about this cluster is dominated by interventions from NGOs and development partners. USAID, Department for International Development (DFID), United Nations Development Program (UNDP), and United Nations Industrial Development Organization (UNIDO) supported interventions financially and/or technically. Most interventions operated nationwide, while some targeted specific regions like the SNNPR. This cluster aims to provide a strategic framework for prioritizing and planning investments by sustainably increasing productivity and production, rural commercialization, NRM, disaster risk management and food security. The cluster also supports diversifying income, fostering better access to capital and capital market development, improving the competitiveness of the private sector, strengthening access to finance, addressing market and government failures, and deepening and scaling PPPs.

Intervention approaches in this cluster are more focused on the private sector and PPPs, in addition to smallholders. For instance, the Agriculture Policy Investment Framework focuses on getting the private sector to play a larger role in financing and driving agricultural development (Chipeta et al. 2015), while the 2Scale project successfully designed and implemented a bottom-up PPP strategy and partnerships between smallholders and the private sector (SEO A.E. 2018). STARS 2016 and the Private Enterprise Development Program followed the Market for Poor (M4P) approach. These interventions also attempted to adopt gender-sensitive programming to varying degrees. The main target groups include rural enterprises (SMEs), financial institutions, smallholders and pastoralists, commercial farmers, agro-industries and businesses, entrepreneurs, cooperatives, academic institutions, business development service providers, government agencies related to finance, and the development of cooperatives. Key pillars and activities are grouped into three components: rural and agricultural development, capacity building and strengthening the enabling environment.

Rural and agricultural development activities aim to improve agricultural production and productivity, food security (Agriculture Sector Policy and Investment Framework) and rural commercialization and to help form agribusiness clusters (SEO A.E. 2018). Other examples include targeting different value chain actors, such as smallholder women and female-headed enterprises and households, to develop an inclusive value chain (STARS 2016; SEO A.E. 2018).

The capacity building focuses on the institutional development of MFIs and rural savings and credit cooperatives (RuSACCOs). It includes supporting coordination and management, providing a regulatory framework, supervisory oversight (IFAD 2011), technical support for rural financial service providers, and testing products and services tailored to smallholders. Additional efforts to build capacity include developing risk control mechanisms and tools (STARS 2016), supporting partner banks and borrowers, providing loan guarantees to minimize or share risks, and increasing access for smallholders, including women (Development Credit Authority Program and STARS 2016). Smallholders, enterprises, and producer organizations received training in organizational strategies, financial management, marketing, and business skills (STARS 2016; SEO A.E. 2018).

Strengthening the enabling environment includes mobilizing financial resources for different national strategies, plans and projects (SPIF 2010) and providing a line of credit through the Development Bank of Ethiopia to eligible MFIs and RuSACCOs (IFAD 2011). It also includes supporting an investment climate in policymaking, providing grants to private sector companies, and strengthening business service providers (UKAID 2018). Additional activities include improving business development services, promoting entrepreneurship and private sector development by acting as an agribusiness incubator for inclusive businesses in the agri-food industry, and developing markets (SEO A.E. 2018).

Contributions to irrigation, agricultural and rural development achieved, among others, strengthened rural financial institutions, increased user access to financial services, support for rural enterprises, and market and value chain development. Access to financial services via MFIs and RuSACCOs has been increased for the rural population (IFAD 2011; SEO A.E. 2018). Interventions also supported the institutional development, expansion, and growth of rural enterprises (including SMEs and cooperatives) and the rural microfinance subsector through different types of technical and financial support. IFAD (2011) made accessing loanable funds from MFIs easier, and RuSACCOs significantly supported their liquidity requirements and increased outreach. The Development Credit Authority Program helped SMEs gain access to credit, developed markets and enabled SMEs' business growth, profitability, and reach (USAID 2016). In addition, the 2Scale project improved smallholders' farming practices, production and innovative investment and strengthened value chain links for producer organizations, SMEs, and female-headed businesses (SEO A.E. 2018). One of the most important investment areas of the Agriculture Sector Policy Investment Framework is irrigation development, along with NRM, market development and rural commercialization (Chipeta et al. 2015). The framework also attempts to increase under-irrigated agriculture, improve soil fertility management, and enhance the skills of state actors in these areas as well.

Challenges in agricultural finance interventions relate to program design issues, although rarely documented in the analyzed financial intervention documents. One issue is looking at smallholders as one homogeneous group and not understanding that not all smallholders are the same. Focus on smallholders requires greater nuance and clarification because there are differences in the capacities and resources of smallholders to benefit from the Policy Investment Framework (PIF) efforts in transforming agriculture, raising its productivity, and commercializing the sector (Chipeta et al. 2015). Furthermore, limited stakeholder involvement in project design and joint planning negatively affected synergy and coordination (IFAD 2011). There are also challenges in the operating environment, such as sales and supplies, labor, finance, business, and infrastructure (UKAID 2018). In addition, financial institutions regard agriculture as a high-risk sector. The collateral-based lending system discourages SMEs from taking out loans and participating in program activities (USAID 2016). Most interventions do not have a clear and strategic plan for scaling. The focus of their activities is to reach more people and expand outreach. Yet efforts for scaling up and embeddedness in systems are not visible in the available information.

5.6 Gender and social inclusion

This cluster includes six programs and projects on gender equality and the empowerment, participation, education and employment of women and youth. According to the documents accessed, gender and social inclusion interventions are mostly led by international NGOs, such as Oxfam and CARE, and international organizations or development partners, such as UN agencies and IFAD, in partnership with the Ethiopian government. Some of the interventions were implemented nationally, while others targeted rural areas in Amhara, Oromia, Afar, Somali and Tigray and the SNNPR as well as urban centers like Addis Ababa and Dire Dawa. Except for the Youth Empowerment Program, which also worked in urban areas, the interventions primarily focused on rural women and youth. The primary beneficiary target groups were the vulnerable and food-insecure women, women-headed households, women- and youth-run businesses, and youth associations.

The interventions aimed to empower women and youth, particularly chronically food-insecure women. The goal was to help both groups achieve sustainable livelihood security, accelerate financial empowerment among rural women, and effectively empower economically and socially youth in climate change-affected regions. Capacity building was a key approach that enabled beneficiaries to actively participate in economic betterment, democratization, and the overall nation-building process by addressing the persistent challenges of youth unemployment, income generation, and recreation and sports facilities. Key pillars and activities undertaken across the cluster to achieve the planned objectives are grouped into three components: women and youth empowerment, agricultural and rural development and enabling environment.

Women and youth empowerment is the main component. It includes a range of approaches and activities across the interventions. Among them are gender equality and empowering women and youth through capacity building, access to productive resources, inputs and services, enhanced inclusion, representation, and education. Institutional strengthening and human capacity building target training for government staff, beneficiaries and community facilitators on gender equality and women's empowerment (GEWE) (TZBMC 2016) and enhancing entrepreneurship, business skills and agency (MoFED and UNICEF 2012; Hando et al. 2018; OXFAM 2019). Access to key assets, resources and services for youth, women and their enterprises focuses on promoting equitable access and control over productive assets to ensure livelihood security. Increasing financial access emphasizes saving schemes, microfinance, and revolving assets (ibid), facilitating a loan guarantee fund for youth-led SMEs (ibid) and creating access to business development services (ibid). Leave No Women Behind has activities to give access to healthcare and education (Kabuchu 2013).

The agricultural and rural development component supports women's participation in agricultural value chains and improvement of association and cooperative function (Hando et al. 2018) by providing inputs, promoting best agricultural practices and technologies (TZBMC 2016; Hando et al. 2018), and developing gender-sensitive agricultural extension services (Hando et al. 2018) and livelihood diversification (Timonen et al. 2014).

Some activities aim to improve or create an enabling environment for women and youth empowerment. For instance, the Joint Program on Women's Economic Empowerment had a component on the development of gender-responsive policy and an institutional environment for women's economic empowerment (Hando et al., 2018), while influencing social norms and policies on women and youth through community engagement, dialogue and advocacy was part of the Empower Youth for Work project (OXFAM 2019).

Contributions to irrigation development and gender and social inclusion include significant outcomes in terms of social, cultural and livelihood improvement for females and female-headed households (TZBMC, 2016), improved food and nutrition security, and increased household productivity level and increased income (Hando et al. 2018). The interventions also support women being more involved in decision-making structures at different levels (Timonen et al. 2014; Hando et al. 2018), increasing participation among women and youth in self-help and income-generating activities (MoFED and UNICEF 2012), and enhanced capacity, literacy, skills, and livelihood opportunities (Kabuchu 2013; OXFAM 2019). As a result of the interventions, gender norms have started to change (Kabuchu 2013; Timonen et al. 2014). Access to and use of productive assets, health and education services, finance, and critical services have increased (Hando et al. 2018; OXFAM 2019). There is also more support for creating gender-responsive policies and an institutional environment allowing women more economic power (Hando et al. 2018). In addition, the capability and functionality of the Women's Department are much stronger (Timonen et al. 2014). A few of the analyzed interventions had water and irrigation-related components. Among these, the Joint Program for Women's Economic Empowerment (Hando et al. 2018) and Leave No Women Behind promoted water harvesting structures, like ponds and pumps, for water lifting (Kabuchu 2013).

Challenges related to program design were often highlighted, for instance, the mismatches between activities and the actual needs of the beneficiaries and a lack of budget and diversification in capacity building (MoFED and UNICEF 2012). There were also limitations in many areas, including the scope and quality of technical skills training, understanding local demand, considerations on climate change, and male involvement in women empowerment (Hando et al. 2018). In addition, beneficiaries had limited involvement in program design, implementation, and M&E, leading to an inadequate understanding of the local context. There was also poor communication and engagement with stakeholders and beneficiaries to create awareness and buy-in about the goals and benefits of the programs (OXFAM 2019). Furthermore, the complex nature of some programs and different operational and implementation modalities, coupled with different local organizational structures and internal processes, posed a challenge to coordination and synergy (Hando et al. 2018). The joint

implementation on the ground to promote women's access to services, opportunities, and resources were challenging because of the cultural context, workload, and complex land issues and norms.

5.7 Intervention approaches, achievements, and shortcomings

The analyzed documents show that interventions mostly follow similar program design and implementation approaches. Some approaches occur across most interventions in the different clusters, while different approaches were observed within clusters. Interventions often apply top-down approaches in, for example, several clusters 1 and 4. Participatory approaches are applied in most interventions in the different clusters to varying degrees. That is, diverse stakeholder groups such as government and public institutions, NGOs, local civil societies, the private sector, rural enterprises, service providers, beneficiaries and communities were involved in the interventions. The levels of participation, coordination, and synergy of implementers, as well as the roles of stakeholders, differed from intervention to intervention. Government and non-government stakeholders often planned and implemented interventions jointly, but, in most cases, active community and beneficiary participation was limited to implementation (Clusters 3, 4, 5). Interventions attempted to follow fully participatory approaches and involve stakeholders in program design, implementation, and evaluation (Clusters 1, 2, 4, 5, 6). However, there were challenges in attaining active participation to the desired level and outcomes (Clusters 2, 4). Few interventions demonstrated active stakeholder engagement from the project design phase (Cluster 2, 6).

Various interventions employ partnership-based approaches across the different clusters to technical and/or financial support and/or implementation. For instance, joint national programs are either planned in collaboration between government and international development partners, or the development partners support the already formulated and government-initiated policies and programs. In such cases, the partnership is formed first at the federal level and then with local implementers (Clusters 1, 2, 6). Interventions across the clusters usually partnered with one or more development organizations, government institutions at various levels, the private sector (SMEs, agribusiness, technology, and service suppliers), financial institutions, research and academic institutions, and civil society organizations (Cluster 2, 3).

To varying degrees and success, gender-sensitive approaches with provisions for gender equality and women's empowerment were reported in all clusters. At the same time, however, only a few interventions included a well-planned gender strategy in the program design (Cluster 4). There were also significant challenges in achieving the desired gender-sensitive outcomes, and women's participation was usually lower than intended.

Approaches unique to specific interventions were also reported in a few of the clusters. For example, Cluster 5 uses M4P and PPP approaches in which partnerships with the private sector, financial institutions, and smallholders exist. Cluster 2 applies community-based approaches in the environment, land and NRM. Here, many beneficiaries were mobilized for watershed management, soil water conservation and other community development activities.

The intervention documents also show various achievements and shortcomings across clusters. Achievements in agricultural and rural development are seen in all six clusters. Contributions toward increased agricultural production, productivity and food security are good examples of this. Value chain and market development (Cluster 1, 2, 3), improved livelihoods and income for beneficiaries, including women, are reported in every cluster except 3. The real value of marketed agricultural products (including livestock) per household increased by 25% (Cluster 1), access to irrigation improved for over 1,000 ha, improved seed production was adopted, and over 500 home gardens were developed (Cluster 2). By the completion of AGP (Cluster 1), a total of 537,335 farmers, 84,903 of whom were women and 62,870 were youth, had adopted best practices for managing crops, livestock, and natural resources. These practices included row planting, using chemical fertilizers, adopting inorganic fertilizers, and using improved seeds. Many other contributions were also reported. Some improved the management and use of land and water resources in watersheds,

communities, and farms (clusters 1, 4, 5), while others strengthened resilience against climate change (clusters 1, 4) and improved land and tenure security practices (cluster 5).

Capacity-building achievements enhanced various actors' and beneficiaries' institutional and human capacities at different levels. For instance, interventions in Clusters 1, 2, 4 and 5 provided direct support for developing irrigation, such as training and technical support on agricultural water management, irrigation practices, organizing and supporting water users, and soil water conservation works. There was also support provided for building the individual capacity of private and public stakeholders in planning, constructing, and managing gender-sensitive SSI (Cluster 2), and enhancing institutional capacity for climate-sensitive planning (Cluster 4). Gender-specific achievements that contribute toward gender equality and women's empowerment are explicitly reported in Clusters 2, 3, 5 and 6. Improved NRM and rural resilience against climate change are reported in all but clusters 3 and 6.

There were contributions to strengthen and enhance the enabling environment across the clusters by working on policy and institutions. For example, policy and regulatory improvements were made in agriculture/rural development and the financial sector (Cluster 1, 3), in policy analysis and influencing, and reform (Cluster 1), while support was provided to develop gender-responsive policy and create an institutional environment for the economic empowerment of women (Cluster 6). Increased access to key services and inputs, such as finance, market, technologies, extension services and technical support, are reported in all clusters.

However, there are still shortcomings in achieving objectives and meeting goals. One issue is a lack of solid understanding of the local context. This has led to shortcomings and failures in meeting objectives. For instance, interventions often fail to involve and benefit communities in SSI cost-sharing schemes because of misconceptions about beneficiaries' financial capacity and willingness (Cluster 2). Ineffective capacity building and low beneficiary participation because of a mismatch between the activities and the actual needs and priorities of beneficiaries is reported in Cluster 6. Additional shortcomings relate to inclusiveness and participation (Clusters 1, 2, 4, 5, 6). Women's participation was low because of external/systemic factors and the absence of a gender strategy in program designs (Clusters 1, 2). In other cases, there were limitations in applying and implementing participatory approaches to the desired levels. In Clusters 1 and 4, for example, evaluation reports revealed that stakeholders had limited involvement in program design. There was also a low adoption of innovations, best practices, and technologies. For instance, in Cluster 5, the adoption of water harvesting and irrigation technologies were low because of the high cost of building water harvesting structures. Another possible reason for the low level of adoption is land tenure and security, which also affect the adoption of certain practices and technologies as well as choices of investments into the land.

6. INFORMAL INSTITUTIONS ANALYSIS

Various informal institutions influence the development and management of irrigation and water resources and the scaling of irrigation technologies and services. The types of informal institutions, their characteristics, influences on water/irrigation development and key actors are summarized in Table 3.

TABLE 3. Overview of informal institutional environment and influences.

Areas and key actors	Informal institution	Influences on water/irrigation development
Customs, beliefs, and traditions		
- Areas: water and irrigation, agriculture, land, gender inclusion and equality, conflict resolution	**Collective action traditions** - Collective action through prohibition and enforcement mechanisms - Some customary clan-based institutions **Gender-related norms and traditions**	- Significant contribution toward collective management of natural resources, including water, developing, and enforcing common bylaws - Gender exclusion from decision-making and significant limits on women's participation and leadership at different levels

- Actors: individuals and collective community members, clan leaders	- Belief that irrigation is for men - Notion that women cannot be plot/landowners, and that some crops are for male - Assumptions that women are only agricultural helpers, and their primary role is as mothers - Restrictive gender norms and inequalities relating to male-female relations, behaviour, innovation, technology and agency	- Women farming is restricted to backyard gardening, while males dominate in managing larger fields (usually irrigated) - Limited gender control and access to productive resources and participation in training and meetings, as well as cooperatives and WUAs - Limited mobility and communication by women with male-dominated traders and brokers, as well as a lack of capital to engage in large-scale trading - Gendered power relations, including traditional roles in the division of labour, unequal education opportunities, differentiated benefit-sharing mechanisms and incentive structures, and limited participation in land preparation, irrigation, and agricultural value chain activities - Marginalization of other clans from accessing and benefiting from productive resources
Political and developmental norms		
- Areas: agriculture and rural development, finance, gender, water and irrigation, adoption of technologies and practices - Actors: policy/decision-makers, government institutions, extension system, non-governmental development actors, service, and technology suppliers	**Traditional development approaches** - Bureaucratic culture and linear, top-down approaches to development; continuing focus on traditional, linear technology transfer and production quantities - Approaching bylaws as a tool to compel democratic governance by governments and donor agencies, the politicization of cooperatives **Context misunderstanding and overlooking** - Failure to understand the local context, including the power distribution among actors and local institutional arrangements; the role of informal institutions and an assumption that existing practices are backward, assumptions that 'one size fits all' - Dictating WUA bylaws in line with own interests	- Limited success with the adoption of intended practices and technologies - Strengthened hierarchical and paternalistic forms of relationships, limited informal and interactive learning and discouraged flow of innovations through informal networks, promoted organizational cultures that are averse to change - Focus on linear science and driven by unchanging sets of shared beliefs - Overlooking heterogeneity among groups and hence negative influences on equity and inclusion, additional challenges faced by women in accessing agricultural technologies and financial services because of gaps in policy and services of rural financial institutions - Undermining of cooperation and enforcement mechanisms of irrigation scheme rules and bylaws, disruption of established ways of controlled resource use, environmental degradation, and increased vulnerability of communities - Underestimating the persistence of traditional institutions and the power of local elites and entrenched interests, oversimplification of complex processes
Individual cognition		
- Areas: gender inclusion, finance, technology adoption - Actors: individuals, government agencies, private sector, practitioners	- Attitudes toward risk, as well as new practices and technologies - Understanding the concept of gender and social inclusion	- Reluctance to adopt new technologies, risk aversion - Lack of confidence by women to take loans and invest in agriculture - Challenges in mainstreaming gender at various levels, designing gender-sensitive interventions and effectively implementing gender-sensitive interventions - Gaps in effectively engaging, involving, and benefiting women and other marginalized groups in irrigation and agriculture programs
Incentive structures		
- Areas: finance, and social networks - Actors: traditional platforms, individuals, and influencers and community members	- Memberships in informal socioeconomic networks and related benefits	- Enabling different community members, including farmers, to get financial services from the group - Providing 'social security funds' during the challenging times - Providing alternative sources of credit and helps fill the gaps and complex requirements of formal institutions - Facilitating knowledge and information sharing about new practices - Relating to higher social capital and positive effects on the probability of adopting improved practices

Source: Authors' creation.

6.1 Customs, beliefs, and traditions

Customs, beliefs, and traditions can be generally grouped into collective action traditions and gender-related norms and traditions (Table 3). Collective action traditions are a concerted group effort to achieve a shared goal through local social institutions, traditional beliefs and bylaws that are used to implement prohibition and enforcement mechanisms. Effective implementation of such traditions has contributed significantly toward sustainable environmental management, including biodiversity conservation and protection. Additional contributions include mobilizing resources and resolving conflicts (Ratner et al. 2017; Yeboah-Assiamah et al. 2017; Dejene et al. 2008). Clan-based informal institutions provide a framework for collective NRM within local norms and traditions. In such cases, informal tenure is one by which land boundaries and rules of resource use and administration are traditionally defined based on clan-based social organization (Reda 2014). However, collective action institutions can be highly inegalitarian; groups can act collectively to exclude others, and the outcome of their action can be negative (Ratner et al. 2017). Clan-based social institutions can negatively influence situations where irrigation is proposed as a food security intervention. People who live in the same administrative unit (or neighboring areas) but belong to other clans might be denied access to land under customary rules (Reda 2014).

Gender-related norms and traditions include, for example, the belief that irrigation is an activity for men, the notion that women cannot owns plots or land, widespread traditional practices that consider some crops as male products, and male-female relations. These lead to inequalities in behavior, innovation, and technology, the agency and ability of women to plough their plots, mobility, and communication with male traders and brokers (FAO 2019). Gender-related norms and male-female relations have resulted in gender inequality in water governance, including exclusion from decision-making and significantly limiting participation and leadership in water institutions (Nigussie et al. 2018). Some consider farming men's business in which women only take part as caretakers and helpers for men, who do the real farming activities. As such, these norms and traditions fail to recognize women as farmers, their roles, importance, entitlements, and rights in agriculture and NRM (Gella and Tadele 2015). Gendered divisions of labour enforced similar influences, where women are assumed to be helpers in agriculture, making them less able to access agricultural information, extension services, etc.

Restrictive gender norms limit women’s freedom to choose when and how much of the crops to sell or what to do with the money. Men usually keep and control the savings from selling larger volumes of produce – which they keep at banks, and then they use the savings to make large investments, such as buying farm inputs and technologies. Women are implicitly assumed to be mothers, so their sphere of influence is limited to activities carried out near home (Nigussie et al. 2021). Division of labor also overburdens women with domestic and productive tasks leaving them with limited time to participate in meetings and training and constrains their participation in cooperatives. In most cases, men farmers are responsible for cultivating big farms, especially for irrigation, while women are mostly responsible for managing backyard cultivation (ibid).

Female household heads face greater obstacles than their male counterparts, and inequitable resource allocation within households affects food security at both the household and national levels (Drucza 2018). Such norms contribute to inequality in endowments and agriculture productivity, including limited leadership, participation in certain value chains, and decision-making regarding productive assets (Springer and Drucza 2018). Gender bias against women is reflected in decision-making and accessing productive resources, in additional complications with accessing financial services and in adopting irrigation technologies (Merrey and Lefore 2018).

Gender differences remain evident in participating in irrigation scheme management and representing water users in local irrigation governance structures, where male leadership dominates (Imburgia 2019). Informal and formal rules and practices discourage women from equal participation in WUAs, or even from being members and participating in any form of decision-making. Women may be

discouraged from taking part in discussions at WUA meetings by customary norms, such as rules that prohibit women from sitting next to or speaking in front of an older male relative or in-laws (Aarnoudse 2018).

Gender inequality resulting from such informal institutions is also reflected in how water and irrigation are governed. Furthermore, gender relations are revealed in water governance for environmental stewardship, sustainable management, and groundwater use. There is a multitude of gendered social relations and power convergence in irrigation governance, including control and access to water, roles in the division of labour, unequal education opportunities, differentiated benefit-sharing mechanisms and incentive structures, and uneven gender participation. Customs and traditions also have a role in land tenure and access (Reda 2014). In many places, women continue to be deprived of secure tenure rights to land, while access to agricultural water rights from common water sources usually depends on such land entitlements (Imburgia 2019).

6.2 Political and development norms

Political and development norms contribute positively to NRM, agriculture and irrigation development as well as equity and inclusion whenever social institutions are actively engaged and involved, wherever a conducive environment recognizes and supports social institutions to function effectively, and in instances where a framework strengthens both statutory and traditional institutions and complementarity between the two systems (Ratner et al. 2017). These can be seen under traditional approaches to development and context misunderstanding.

Bureaucratic culture and linear, top-down approaches to development; continuing focus on traditional, linear technology transfer and production quantities; and assumptions that 'one size fits all' are examples of approaches to development. Bureaucratic culture enforces more hierarchical and paternalistic relationships, limits informal and interactive learning, and discourages the flow of agricultural innovations through informal networks (Hailu 2009). Linear thinking often leads to a top-down approach by which external funding agents or national government agencies prescribe WUA bylaws based on their interests rather than WUA members developing the bylaws themselves (Aarnoudse et al. 2018). Linear and top-down approaches to disseminating technologies and innovations are also part of development norms. Scaling agricultural innovations is more complex than a linear rolling out of innovations toward diffusion. It requires an appreciation of the social dynamics of target beneficiaries, actors involved, and their social relations (Gebreyes 2021). The politicization of local water and irrigation institutions is also evident in the top-down approach where WUAs are officially registered as cooperatives, and yet the public agency responsible for cooperatives management has a history of politicization (Yemi 2013). As a result, this undermines cooperation and enforcement of scheme rules and encourages water users to revert to traditional water distribution practices. It also fails to recognize the role of informal institutions, disrupting established ways of controlled resource use.

Limitations in gender-sensitive and transformative financial services can be reflections of gender-related policy and development norms, leading to women facing additional challenges in accessing technologies and services because of gaps in policy and services of rural financial institutions

Context misunderstanding and/or overlooking relates to, for instance, failure to understand the influences, roles and arrangements of informal institutions, power distributions and dynamics, assumption that existing practices are all backward, the politicization of cooperatives, dictating WUA bylaws in line with own interests, and approaching bylaws as a tool to compel governance by governments and donors. Context miscomprehension occurs when governments and donor agencies approach bylaws as a tool to compel democratic governance mechanisms. This ignores that forced participation has a limited impact, given the persistence of traditional institutions and the power of local elites and entrenched interests (Aarnoudse et al. 2018). Interventions that do not properly understand the local context have also affected outcomes in developing irrigation. For instance, there is growing evidence that programs intended to give women better access to financial services,

irrigation equipment, and markets have differential impacts. Women sometimes take on additional burdens without benefitting proportionally (Merrey and Lefore 2018). There are assumptions among technology suppliers that 'one size fits all' and that a given technology model can serve everyone. This overlooks the diversity and interest among groups and negatively influences equity, inclusion, and adoption. When development practitioners and private sector actors have a limited understanding of gender and inclusion concepts, this can negatively influence the engagement of women and other marginalized groups in irrigation programs (Nigussie et al. 2021).

Neglecting the roles of informal institutions and power dynamics leads to assumptions that existing practices are obsolete. Limited understanding and recognition of traditional institutions has had several negative effects, including diminished efficacy and relevance of the institutions in conflict resolution, interference with established ways of controlled resource use, increased environmental degradation, and weakened resilience of communities to drought (Yeboah-Assiamah et al. 2017). A lack of understanding of power distribution among different actors and local institutional arrangements has reduced the effectiveness of the participatory approaches used in developing irrigation interventions and planning and implementing projects (Yami 2013). In the political and development norms, gender-equitable financial products are lacking, and women face additional challenges in accessing technologies and financial services (Merrey and Lefore 2018).

6.3 Individual cognition

Individual attitudes and perceptions toward risks, new practices and technologies and understanding of various development actors about the concept of gender and social inclusion make up this informal institution category (Table 3). A social environment where individuals interact with others and feel connectedness, competence and autonomy could be an effective context for motivating farmers to learn and make changes (Lundström 2016). Farmers are continually comparing external knowledge with what they have experienced over many years. A range of individual and social learning situations is very important for farmers. Some aspects of social capital, such as relying on first-degree relatives, positively affect risk aversion, affecting how social links and networks are formed (Wossen et al. 2015). Relying on networks with first-degree relatives also positively impacts risk aversion (Nielsen et al. 2013). Among close social networks, individuals with similar risk attitudes are more likely to group together (Attanasio et al. 2012). Hence, risk aversion and social capital could have either synergetic or antagonistic effects for adopting technology, re-enforcing each other, or the adoption decision depends on how strong the effects of social capital and norms are relative to the risk aversion of individual households toward adoption (Wossen et al. 2015).

Individual cognition can also shape attitudes and decision-making negatively. For example, social norms may prescribe cognitive behaviours that affect an individual's attitudes toward risk and the person's decisions on adopting technologies. Because of gender-related social norms, women might lack the confidence to take risks, like loans and credit, thinking that they would lose if something went wrong and might not be able to pay back the loan (Nigussie et al. 2021). Unfavorable attitudes or limited perceptions toward gender equity and social inclusion can be challenging for governmental and non-governmental development actors and the private sector, leading to ineffective considerations of women and youth issues and engaging and involving women and other marginalized groups in interventions, products, and services.

6.4 Incentive structures

Informal incentive structures have to do with social capital, networks and informal socioeconomic platforms. *Social capital* is "*the aggregate of the actual or potential resources which are linked to the possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition*" (Yeboah-Assiamah et al. 2017). It is a significant determinant of adopting improved practices by helping address barriers related to credit, labour, and information (Wossen et al. 2015). Social capital influences other informal institutions, such as individual attitudes toward risk, benefit,

participation and roles in establishing and managing other informal institutions to a different degree. The presence of high social capital developed through family lineages and neighborhood networks can be an important asset in establishing informal institutions (Yami et al. 2011).

Social networks are incentive structures that refer to connections and interactions among community members. They share knowledge and information among communities and members and can be of different sizes and types. Such networks allow farmers to exchange information and resources with other farmers and organizations, and the shared information often promotes sustainable agricultural and land use practices (Albizua et al. 2021). Farmers with larger social networks are more likely to have better opportunities to gain experience from other community members and to know extension agents, which could be an outcome of an agent's stated strategy of targeting locally influential individuals (Matouš et al. 2013). The influence of adopting NRM practices and improved farming techniques depends on the size and type of social networks (Wossen et al. 2013). Informal information sources, social networks, community structures and social ties are all important to encourage the use of modern technologies. Memberships in labour-sharing arrangements (known as *Debo* and *Wonfel*), informal local savings and credit associations and connection to local authorities have a positive and significant effect on the probability of adopting improved land management practices (bid).

Informal socioeconomic platforms include local community-based organizations like *Idir*, *Irtiban, Debo* and *Equib*, directly and indirectly influencing access to finance, extension, and information as well as the flow of knowledge and innovations in agriculture, irrigation and NRM (Table 3). Informal socioeconomic platforms have several benefits for agricultural and rural development, among others. Traditional, socioeconomic organizations like *Idir* encourage neighbours and relatives to save money regularly to be used during times of challenge. *Irtiban* is another locally organized social arrangement devised to mitigate economic distress during, for example, livestock deaths or crop failures (Gebre-Selassie and Bekele 2012). Such network-based arrangements driven by motives of reciprocity and altruism provide smallholder farmers with effective ways of managing the numerous risks they encounter in their daily lives through risk-pooling and risk-sharing mechanisms (Aredo 2010). The benefit of such institutions is beyond just insurance against shocks and stresses. Membership in informal village savings and credit groups allows different community members to get financial services (Merrey and Lefore 2018) and help farmers relax their cash constraints (Wossen et al. 2015). It also supplements any gaps in accessing credit from formal institutions, where irrigators face complex bureaucracy, short repayment periods, high interest rates and a lack of collateral to get credit for various inputs (Kassie 2019). Memberships in informal socioeconomic platforms like *Idir* and *Iquib* also create opportunities for social learning among members in an efficient way. In addition to reducing asymmetric information and transaction costs, such platforms are crucial, especially for smallholder and resource-poor farmers, whose information needs are usually not addressed by formal extension services (Wossen et al. 2015).

Despite the numerous benefits of incentive structures in terms of resilience against shocks and stress, financial access and social learning, the extent to which these benefits enable the access and adoption of irrigation technologies is unclear. Lack of social capital can hinder the adoption of profitable technologies when individuals have limited access to formal labour, capital, and information. Information flow through social networks might not reach men and women equally and, in some cases, can enforce existing inequalities (Beaman and Dillon 2018). Meanwhile, social networks could potentially depress adoption rates by imposing an obligation to share benefits from adoption (Wossen et al. 2015).

6.5 Interactions between informal institutional categories

There are dynamics, interplays, and interconnections between various aspects of local institutions. Interconnectedness within a given group of informal institutions happens when some aspects or characters enforce or strengthen others. For instance, in customs, beliefs and traditions, the existing restrictive gender norms and gender inequalities enforce traditions that limit women's access and

agency to productive resources like land and water. In political and development norms, linear thinking and top-down approaches to development can lead to a lack of understanding of the local context. These include missing the power distribution and arrangements of informal institutions, undermining and failing to recognize the role of informal institutions, imposing bylaws, continued focus on linear technology dissemination and increasing quantity without considering other local gender and socioeconomic dynamics. Collective action traditions through probation and enforcement mechanisms may enforce clan-based customary institutions that can exclude groups outside of the clan from accessing communal natural resources.

Interconnections among separate groups of informal institutions determine their overlapping roles and functions. For instance, customs, beliefs, and traditions can affect development norms and incentive structures. Gender-restrictive customs, beliefs and traditions are reflected in development norms, for instance, as seen in the gaps regarding gender-equitable financial policies and services in rural financial institutions. Such customs also influence participation in and benefits from incentive structures, which occur in limited memberships and decision-making, accessing productive resources, financial services, markets, and information. Incentive structures can also affect individual cognition and vice versa, as social capital and membership in social networks may affect the mentality and attitude of individuals toward risks and the decisions to adopt improved practices and technologies. Attitudes toward risk can, in turn, affect membership and formations of social ties and networks, as people with closer ties and relationships prefer to group together and minimize risks. Sometimes, some aspects of customs, development norms, incentive structures and cognition collectively influence the adoption and scaling of irrigation technologies and improved practices. For example, where irrigation is believed to be an activity for men, a top-down approach does not understand gender dynamics, creating gaps in social capital, informal network membership, access to services and resources, and risk aversion.

Interplays between formal and informal institutions involved in managing communal resources, including water and irrigation, can happen at various stages and levels. Informal institutions shape formal institutions' outcomes less visibly by reinforcing the enabling and constraining roles widely attributed to formal institutions (Yeboah-Assiamah et al. 2017). In water and irrigation governance, informal institutions overlap and exert their influence even in formal public schemes. They impact the access, use and benefit, acceptability and enforcement of formal rules within communities in the water resource development. Informal rules, agreements, and social networks interplay with formally established WUAs and influence the rule enforcement and the benefit and participation of women and men based on their existing social networks (Imburgia 2019).

The interaction between formal and informal institutions can be beneficial if complementary. This depends on the extent to which the local values and norms of people in the target community support formal rules. Institutional complementarity is crucial to effectively enforce rules, as it requires some form of local politics and alliances with local powerbrokers (Yeboah-Assiamah et al. 2017). Understanding the local context, involving influencers, and allowing local autonomy makes formal institutions more effective by gaining community buy-in and enhancing participatory implementation and monitoring of NRM at the local level. A range of socially embedded institutions interacting with bureaucratic institutions affects how rules and regulations are enforced. Formal institutions can benefit by using existing social networks to mobilize and allocate resources necessary to implement and enforce rules and regulations and manage conflict (ibid). There can also be cases where there are gaps between formal and informal institutions in a way that negatively affects how natural resources are governed, as discussed in this section.

Although formal government institutions have initially dominated in a centralized bureaucratic form and later in community-based forms, informal institutions still play significant roles alongside formal ones. There are different situations in which both forms interact. Understanding the complex interactions between formal and informal institutions is one of the persisting challenges facing sustainable NRM, policy and governance (Rahman et al. 2017). These interactions influence the

effectiveness of the institutions and development interventions, as well as the participation and contribution of communities in NRM.

7. SCALING IRRIGATION IN ETHIOPIA

7.1 Actors and stakeholder landscape in scaling irrigation technologies and services

The governance of water resources is primarily based on the adopted principles of IWRM, basin-level approaches, and decentralized and user-based management. Key actors and stakeholders involved in planning, implementing and governing water and irrigation development are presented in Table 4.

TABLE 4. Key actors and their roles in developing water resources, irrigation, and agriculture[1].

Key actor categories	Key roles
Key governmental actors	
Ministry of Water Irrigation and Energy	- Plan, monitor and evaluate water resources and irrigation development - Provide financial resources and technical support to regional institutions - Formulate and revise policies and legislative frameworks
Ministry of Agriculture	- Plan, monitor and evaluate small-scale irrigation development - Provide financial resources and technical support to regional institutions
Environmental Protection Authority	- Protect water bodies and other natural resources - Implement and follow up EIAs and SIAs for major development projects
River basin high council; River basin authorities	- Develop basin development plans - Conduct policy research and provide policy guidance - Implement and monitor IWRM, and coordinate water resource development - Examine and decide on water allocation, water works and regional water disputes
Key support institutions	
Agricultural Transformation Agency; Ethiopian Institute of Agricultural Research; Policy Research Institute; National Water Resources Information Centre; Water and Land Resource Centre	- Conducting policy research and reviews - Conducting research and pilots on technologies and innovations, as well as best practices for agriculture, water and NRM - Managing knowledge and information, including generating and disseminating data, research outputs, information on water resources, climate, and hydrology - Promoting water and land management and governance, secure environmental services, and conflict resolutions in national and transnational basins
Regional offices and community-level organizations	
Regional and local bureaus of water, irrigation, agriculture, and NRM; WUAs	- Implementing policies, strategies, and programs for irrigation development - Developing localized proclamations, directives, and guidelines - Preparing budget requirements, managing the development and use of water resources and irrigation in respective regions - Organizing user groups and managing community-based irrigation/water schemes
Private sector actors	
Irrigation supply chain actors; Irrigation value chain actors; Rural microfinance providers	- Providing irrigation technology supply and related services - Building water and irrigation infrastructure - Providing loans and credit services, agronomic inputs
Non-governmental actors	
International organizations; Donors and development partners; Local and international NGOs; Civil society organizations	- Providing technical and financial support - Supporting policy development and implementation - Mobilizing resources, developing, and implementing projects - Enhancing the capacities of actors and beneficiaries, increasing access to key services technologies and inputs, and promoting the adoption of best practices

Source: Authors

[1] At the time of this research water and irrigation policies are being updated and revised. Key institutions and institutional arrangements for water and irrigation development are being restructured and the Ministry of Water, Irrigation and Energy is being split into two (Ministry of Irrigation and Lowlands and Ministry of Water and Energy). Arrangements for basin institutions is also under revision. Therefore, this section presents actors and roles based on the latest Water Policy and Strategy of 2020 and the Smallholder Irrigation and Drainage Strategy of 2018.

Key governmental actors. The Ministry of Water, Irrigation and Energy (MoWIE) is a federal institution established by law and mandated to design policies and legal frameworks for developing water resources. It is also responsible for following up on the progress of policy implementation, interpreting and elaborating water policy, supporting the implementing institutions, capturing learning, and proposing revisions. The MOA is responsible for planning and guiding small-scale irrigation development, while MoWIE is responsible for medium- and large-scale irrigation schemes. There are national and regional steering committees, secretariats, and technical committees for governing and implementing SSI, as shown in Figure 3.

FIGURE 3. Structure for governing and implementing SSI. Source*: National Strategy for Small Scale Irrigation and Drainage 2018.*

Basin institutions are the Basin High Councils and Basin Authorities, established to improve and decentralize water resources' governance and use them equitably. Basin institutions play a key role in preparing basin development plans, providing policy guidance, conducting policy research, implementing IWRM and coordinating water resource development with regional water bureaus. Examining the appropriateness and prioritization of water allocation and major water construction works is a mandate of these institutions. In these basins, the regional state water bureaus are the authorities conducting water resource management activities. The Environmental Protection Authority is responsible for protecting and conserving water bodies and for implementing and following up EIAs and SIAs for major development projects and investments, including water and irrigation.

Key support institutions. Some institutions provide direct and indirect support for scaling irrigation technologies and services. These include the Agricultural Transformation Agency, Ethiopian Institute of Agricultural Research, Water and Land Resource Centre, Policy Research Institute, and National Water Resources Information Centre (to be established).[2] These institutions conduct policy research and reviews, and play a key role in introducing, testing, and promoting best practices, technologies and innovations for agriculture, water, irrigation and NRM. Producing and communicating knowledge is another role, including generating and disseminating data, research outputs and information on groundwater and surface water resources, climate, and hydrology. Additionally, the Water and Land Resources Centre participates in strengthening sustainable land and water governance mechanisms.

Regional offices and community organizations. Regional water, agriculture, irrigation, and natural resource bureaus are primarily responsible for implementing policies, strategies, and programs, accompanied by technical and financial support and supervision from federal institutions. Regional offices sometimes develop localized regulations, guidelines, and manuals. At the community level, WUAs

[2] National Water Policy and Strategy 2020. Federal Democratic Republic of Ethiopia.

are mandated to manage water/irrigation effectively and sustainably in their defined areas, including operation and maintenance, water fees, equitable water allocation and efficient water use.

Private sector. Many actors in the private sector play a role in scaling irrigation technologies and services. Among them are water and irrigation technology supply chain actors, irrigated value chain actors, contractors, and rural financial service providers, such as MFIs and RuSACCOs. The roles of these actors include supplying several types of technologies and equipment for water abstraction, conveyance and application, maintenance services, constructing water and irrigation infrastructure, and providing loans, credit services and agronomic inputs.

Non-governmental actors. These include international organizations, donors, local and international NGOs, and civil society organizations. Development partners and donors such as USAID, World Bank and IFAD, and international organizations like UN bodies, as well as various local and international NGOs, are actively involved in developing irrigation and water resources. They support policy development and implementation, provide technical support, arrange and allocate resources, and develop and implement joint/partnership projects (Table 4). In addition, these actors have roles in enhancing the capacities of actors and beneficiaries, increasing access to key services and inputs among beneficiaries, and introducing and promoting the adoption of best practices, approaches, and technologies for inclusive and sustainable irrigation development.

Institutional structures that are appropriately structured and functional are indispensable for carrying out policies and strategies in the water sector (Zeleke and Awulachew 2014). It is commendable that such organizations are established, and there are also efforts to address some of the challenges in coordination, minimize overlaps, and clarify roles and mandates. The ongoing restructuring of water and irrigation institutions and their arrangements and the recent developments in policy and legislative framework inducing the Water Policy and Strategy of 2020 are examples. However, the current institutional arrangement for developing SSI is inadequate. There is a gap in water resources administration at the basin level, especially in transferring and using water between different regions (Nigatu et al. 2016; Tekle 2019). Inefficiency, lack of appropriate institutional arrangement, and ineffective service delivery are the key reasons for SSI's inferior technical performance and management challenges (Weldesilassie and Bekele 2020). As presently constituted, the current institutional arrangement cannot enhance the roles of the private sector in establishing the right irrigation technology supply chain with an effective incentive structure (ibid). Neither can it improve the effectiveness of service delivery by the state nor regulate the proper implementation and efficient use of irrigation water to minimize the negative externalities (ibid). There is limited coordination between ministries in their day-to-day work and a lack of matching institutional setup for effectively implementing IWRM and providing a regular multistakeholder review to monitor policy implementation, learn lessons and take action (Tekle 2019). There are unclear and overlapping competencies and mandates of implementing institutions, especially at the basin level. Insufficient management instruments and tools affect water governance and IWRM implementation (Nigatu et al. 2016).

7.2 Irrigation development focus on policies and interventions

This section presents an overview of the focus and typologies of irrigation development across policy and interventions. Specific aspects, such as target groups, approach, technologies, services, actors involved and roles, gender and social inclusion, opportunities, and gaps, are presented in Table 5.

TABLE 5. Overview of irrigation development focus across policy and interventions.

Indicators	Promoted by policy	Promoted by intervention
Small-scale irrigation		
Target group	- Smallholders, subsistence farmers and food insecure households that are vulnerable to climate change, WUAs, farmers in high potential	- Smallholder farmers, women and youth, productive Safety Net Program beneficiaries, WUAs, irrigation user associations, relevant government staff and

	AGP areas, women and youth, extension and development agents, SMEs	institutions involved in irrigation development, private sector
Approach	- Community-based, participatory, and decentralized approach - Partnership and collaboration, including with the private sector - Irrigation-plus/multipurpose approach	- Partnership and collaboration - Participatory and inclusive approached - Decentralized and community-based approach - Focus on pro-poor, small-scale, low-cost irrigation schemes
Technology	- Different types of surface water collection and rainwater harvesting structures for communities and households, different types of wells - Manual and motorized pumps, energy-efficient technologies - Structures and technologies for water diversion, conveyance, and application	- Different types of surface water collection and rainwater harvesting structures for communities and households, shallow/hand-dug wells, boreholes - Manual, motorized, and solar pumps - Structures and technologies for water diversion, conveyance, and application
Service	- Market development and irrigated agriculture commercialization, research and extension, and capacity building - Access to water, agronomic inputs, and extension services - Establish and strengthen WUAs - Develop operation and maintenance guidelines and cost-recovery mechanisms, construct and rehabilitate schemes - Supporting the local technology supply chain and developing a technology transfer system	- Demonstration, and exchange visits to introduce and promote irrigation and water technologies - Construct, upgrade and improve schemes - Facilitate access to water and improved inputs, loans, and credit services - Strengthen business development services, extension and advisory services, value chain and market development - Capacity building on irrigated agriculture, water management, O&M, organizing and WUAs
Actor and role	- Primarily the MoA lays out national strategies and plans for developing the subsector - Regional governments oversee infrastructure development, and local WUAs oversee managing and delivering irrigation services to farmers	- SSI planning and implementation by regional offices and local government - The financial and technical support from development partners, and non-governmental actors as initiators of interventions
Gender and social inclusion	- Gender mainstreaming guides to strategically address the participation and benefit of lower-income and female farmers - Target highly vulnerable and food insecure households as well as farmers in AGP areas	- Promotes gender-sensitive SSI development to varying degrees - Target women, youth, vulnerable communities
Opportunity	- Orienting policy toward CRGE and recognizing SSI as a key adaptation/resilience strategy - Supporting appropriate and energy-efficient irrigation technologies Facilitating user access to key services and inputs	- Creating and supporting WUAs, building local capacity in planning, construction, and SSI management, - Creating access to finance, market, inputs and other critical services in SSI interventions, MFIs and rural saving and lending cooperatives
Gap	- Institutional and policy gaps, coordination and synergy, research, and extension - Capacity and procedural gaps in scheme planning, design, construction and management, monitoring - Challenges in technology supply chains, user access to key services and inputs - Limited capacity and performance of WUAs in scheme management	- Limited planning, design, infrastructure delivery and performance of schemes - Limited capacity of WUAs, public institutions and contractors to enforce contract management - Synergy and coordination between actors and stakeholders across sectors - Socioeconomic, technical and practical mismatches between promoted technologies and services and user needs
Medium- and large-scale irrigation		
Target group	- Large-scale commercial farms, other private sector actors, organized producers, WUAs, smallholders, pastoralists, agropastoralists, extension and development agents	- Farmers, smallholders, WUAs, organized producers, relevant government staff and institutions, including development and extension agents, private sector, rural enterprises
Approach	- Top-down and partnership-based approach in planning and implementation - Decentralized management and operation	- Partnership and collaboration - Resource mobilization and investment
Technology	- Several types of affordable and improved technologies for collecting surface water, reducing seepage losses, water control systems and measurement and different types of wells	- Different types of surface water collection structures at community levels - Different types of diversion and conveyance structures, pumping stations

	- Motorized pumps, different types of diversion and conveyance structures, sprinkler systems	
Service	- Build capacity, extension and outreach, research, and access to agronomic inputs and finance - Expand and rehabilitate schemes, mobilize resources, strengthen technology supply chain - Conduct EIAs, feasibility studies and design, scheme construction	- Conduct feasibility studies and design, train extension agents, and farmers - Construct facilities and schemes - Establish and strengthen WUAs - Provide grants for agro-enterprises, cooperatives, market, and value chain development - Review irrigation legislation and policy support
Actor and role	- Planning and implementation are commissioned and supported by federal and regional governments and subsidiary public institutions, while MoWIE is responsible for mobilizing and coordinating resources	- Federal and regional governments lead interventions, with development partners and NGOs supporting the planning and implementation of schemes financially and technically, and schemes can also be developed as part of joint programs
Gender and social inclusion	- Mainstreams gender in water resources planning, development and management at different levels	- Targets gender-sensitive irrigation development and inclusion of organized smallholder farmers and youth
Opportunity	- Recognition of this typology for expanding commercial agriculture and efforts to enhance mechanisms for the planning, design, construction, and management of schemes	- Enormous potential for the development of medium- and large-scale schemes in the context of commercial agriculture and support to strengthen the capacity of involved public institutions
Gap	- Gaps in institutional arrangements, policy mechanisms and procedures in scheme planning, design, construction, management, and M&E - Technical, environmental, and financial sustainability - Weak capacity and performance of WUAs	- Delayed delivery and inferior quality of infrastructure - Limited capacity in project management, scheme design, scheme O&M, contract enforcement, and environmental and social safeguards - Limited cooperation, coordination, and ownership between local, regional, and federal bodies - Uncertainties in structuring PPPs
Micro and household irrigation		
Target group	- Smallholder farmers, resource-poor farmers with small land sizes, academic and research institutions, rural enterprises, and private sector actors in the technology supply chain	- Smallholder farmers, youth and women, public and private institutions involved in the supply chain and development of micro and small-scale irrigation, entrepreneurs
Approach	- Pro-poor, demand-driven, decentralized approach - Irrigation-plus/multipurpose approach - Private sector engagement	- Partnerships and collaborations - Decentralized and user-based approach targeting households/individuals - Pro-poor, low-cost, low-tech schemes that consist of households' backyard gardens
Technology	- Microstructures for rainwater harvesting at a household level, shallow wells, water tanks, motorized and different manual pumps - Stream diversion structures, low-cost and low-tech drip systems, micro-sprinklers, and micro-jet systems for conveyance and application	- Different types of microstructures for rainwater harvesting at the household level - Low-cost, simple to operate and locally available manual pumps, buckets, micro-drip, and sprinklers
Service	- Developing surface and shallow groundwater, establishing micro/household irrigation schemes - Supporting the local production, demonstration, and supply chain of technologies - Building the capacity of users, increasing access to finance and key services and inputs,	- Introduce and establish micro/household irrigation schemes and practices - Develop institutional, human, and technical capacity in public and private institutions - Institutionalize capacity building in regional government structures - Increase access to key services and inputs
Actor and role	- MoA sets the national strategy, while mainly *woredas* are responsible for implementation with the close support of federal and regional agencies and development partners on resource allocation and technical support	- Demonstrations and interventions are planned and implemented by multiple actors, including local government, NGOs and development partners in collaboration with private sector tech suppliers
Gender and social inclusion	- Reaches resource-poor farmers to improve their benefits from relatively 'larger' SSI - Mainstreams gender in strategic interventions	- Emphasizes gender-equitable planning, designing and management of micro-irrigation schemes - Targets resource-poor farmers
Opportunity	- High suitability on resource-poor smallholders, including those with small land sizes	- Recognition and inclusion of micro and household irrigation schemes in SSI irrigation development

	- Recent policy recognition of this typology for smallholder irrigation and its benefits for resilience and income among households - Efforts to address policy, research, extension, irrigation, service access and supply chain gaps	- Low-cost and low-tech schemes that can be developed and managed locally by smallholders - Presence of successful self-financing and micro-loans for poor farmers to adopt technologies
Gap	- Policy, research, and extension gaps - Technology supply chain - Access to key services and inputs	- Technology supply chain - User access to key services and inputs
Multipurpose water resource development		
Target group	- Rural communities, smallholders, agropastoralists and pastoralists, WUAs, supervisory bodies, service providers, industries and municipalities, other private sector actors	- Rural communities, smallholder farmers, agro-pastoralists and pastoralists, government staff and institutions, cooperatives, PSNP beneficiaries, women, youth, WUAs
Approach	- Decentralized, community- or user-based approach for management of schemes - Multisectoral, IWRM and basin-level approach to water resource development and management	- Resource and community mobilization, co-investment in infrastructure development - Decentralized, partnership-based and participatory approaches in development and management - Multisectoral approach to water supply
Technology	- Multipurpose infrastructures - Water lifting and conveyance technologies and diversion schemes	- Multipurpose infrastructures like traditional and community-based water management schemes - Flood capture infrastructure - Diversion schemes, motorized and manual pumps
Service	- Building capacity, mobilizing resources, and providing technical support - Draft guidelines and frameworks for protecting, developing, operating, and maintaining infrastructures and the scheme construction and rehabilitation - Integrate and institutionalize meteorological and hydrological services, research, EIAs, watershed management - Regulate water use permits and charges - Strengthen the technological supply, transfer, and standardization	- Developing water resources, markets, and value chains - Increasing access to financial services, weather information and insurance - Building capacity to enhance the resilience of communities against climate shocks - Documenting and mainstreaming best practices - Establishing and supporting water users - Constructing and rehabilitating schemes
Actors involved and roles	- MoWIE and basin authorities plan, assess, allocate resources, and provide technical support on major water works constructions, while regional water offices, municipalities and state enterprises design and implement schemes	- NGOs, local communities, CSOs and government offices actively participate in the implementation of smaller projects directly or as partners by supporting them technically and financially
Gender and social inclusion	- Mainstreams gender in all aspects of water resource development and at various levels - Targets vulnerable communities, including pastoralists, youth, and women	- Targets vulnerable communities, including pastoralists, youth, and women - Mainstreams gender in intervention designs and implementation
Opportunity	- Increased support for private sector involvement in infrastructure development and management - Prioritizing this typology for multiple purposes, including irrigation, WASH, livestock, and domestic use	- Strengthening the multisectoral approach to water resource development to leverage resources and maximize impacts of WASH, livestock, irrigation - High involvement of non-government actors in developing water resources for multiple uses
Gap	- Possible overlaps in mandate between states, and between regional and federal states, and overlap of water regulation tasks between MoWIE and the EPA	- Program design issues, including considering and understanding the local context and beneficiary needs, gender considerations - Delays in infrastructure delivery, - Gaps in performance, contract enforcement mechanisms, coordination, implementation capacity, and intersectoral coordination

Source: Authors' creation

7.2.1 Small scale irrigation

Small scale irrigation (SSI) refers to schemes that cover less than 200 ha of land and are managed locally by a group of users (Haile and Kasa 2015). Both in policy and interventions, SSI may include

what are considered micro and household irrigation schemes (MHIS). However, in fewer cases, MHIS are distinguished as a separate type of irrigation system.

Key actors in developing SSI are the MoA, respective regional governments, and local administration units. The MoA leads in developing national SSI policies and strategies and leading joint programs and bilateral agreements with international development partners. The regional offices plan, mobilize resources and implement. WUAs oversee delivering irrigation services to farmers and O&M. However, there are potential uncertainties surrounding the roles and responsibilities of O&M. Local and international NGOs and development partners are also key actors who either lead or initiate SSI projects or support government offices to implement their projects.

SSI-related policies target different beneficiary groups. These include subsistence farmers and food insecure households vulnerable to climate change, farmers in (high potential) AGP areas, women and youth, extension, development agents, WUAs, and small and micro enterprises. SSI development and interventions target diverse groups of community beneficiaries, associations and cooperatives, government institutions and staff at various levels, the private sector and academia. Youth, women, and communities vulnerable to food insecurity and climate shocks are also targeted.

The SSI-related policy approaches include decentralized, partnership-based, participatory, and inclusive, as well as community/user-based development approaches (Policy clusters 1, 2, 4) by engaging with and involving user communities and private sector actors in planning, developing and managing SSI infrastructure. Intervention approaches toward SSI have attempted to be participatory, partnership-based, bottom-up and inclusive to varying degrees. There were a few cases where various stakeholders were fully involved throughout project design and implementation (Intervention Clusters 1, 2). Some interventions followed pro-poor approaches that aim for SSI development based on low-cost and simple technologies (Intervention clusters 1, 2, 4).

The policy documents and interventions promote several types of SSI irrigation technologies that allow users to access water. For example, water harvesting and collecting technologies are prioritized in policy clusters 1, 2, and 4). Technologies for lifting and carrying water include different diversion structures, manual and motorized pumps, and water application systems like drip and sprinklers (policy clusters 1, 2, and 4). Constructing new SSI schemes and other community infrastructure and rehabilitating underperforming schemes are also promoted in the same Clusters. To meet their objectives, interventions with SSI components have also promoted irrigation technologies and water solutions like those prioritized in policies, as listed in Table 5.

Various direct and indirect services necessary for successful SSI development are key aspects of policies and interventions. These can be divided into two groups: 1) market development, including access, links, information, and market infrastructure, and 2) access to inputs, including improved seeds, different facilities, and credit access for community-based irrigation management (Cluster 1). Policies also aim to facilitate credit and bank loans for developing schemes (Clusters 1, 2, 4). Another key service is strengthening the supply chain of technologies. In policy in Clusters 2 and 4, there is support for local SMEs and the local supply chain for manual pumps and a comprehensive technology transfer system. Research and extension on irrigated agriculture are given in Clusters 2, 3 and 4 to support the planning and implementation of schemes on an economically viable, socially equitable, technically efficient, and environmentally sound basis.

Capacity-building services include enhancing human and institutional capacity for managing irrigation water and making it efficient through technical and material support and training users and service providers, like extension agents and WUAs (Clusters 1, 2).

They also facilitate gender mainstreaming in irrigated agriculture via guidelines to empower women and support their participation at various levels. In addition, policies help develop a framework or guidelines for managing schemes, such as rehabilitation and revitalization guidelines, quality assurance and control guidelines, and O&M guidelines, including cost-recovery mechanisms (Clusters

2, 3, 4). Supporting and strengthening an integrated approach to developing and managing water resources (Clusters 1, 3) and integrating appropriate drainage facilities in all irrigated agriculture schemes (Cluster 4) are also mentioned.

Interventions also have components to increase access to direct and indirect support services, such as increasing beneficiary access to financial services, market and value chain development, access to crucial agronomic inputs and capacity building. Although not exclusively for SSI, examples of services include creating links between financial service providers and producers to help smallholders access loans and credit (Clusters 1, 3, 4, 6), financial access for rural financial institutions (Cluster 3), offering business development and related services (Clusters 3, 6) and providing weather information. Organizing and supporting WUAs is additional means to help increase beneficiary access to important services and inputs. Interventions in Clusters 1, 2 and 5 have activities to support such associations. The same three clusters also have training in place for capacity building. These include training and creating awareness for WUAs on operating and managing schemes, cost recovery, and managing irrigation water. They also feature training for regional and woreda-level staff at water bureaus and agriculture bureaus, communities and beneficiaries, and farmer research groups on watershed management irrigated agriculture and organizing WUAs.

Gender and social inclusion in SSI are emphasized in agriculture and irrigation policies (Clusters 2, 4) and gender and social inclusion policies (Cluster 6). Cluster 4 aims to ensure that lower-income and female farmers and their specific needs are included and well-addressed in SSI development. Cluster 6 specifically addresses the lack of women's participation and benefits from SSI schemes and water harvesting. In addition, gender policies state that irrigation technology should be appropriate for women to operate and maintain. They also carve out a quota for increasing women's participation in watershed management and irrigation development interventions and promote equal participation and benefits for women. There are also certain guidelines in Cluster 6 that identify and introduce feasible and accessible irrigation technologies and offer women training and demonstrations on these technologies and water management. Moreover, the policies aim to mainstream gender in SSI by using sex- and gender-disaggregated data across all aspects of project/program beneficiaries (Cluster 6).

Interventions also targeted women and youth and aimed for inclusive SSI development. Some of them also recognized the limitations of resource-poor smallholders. They followed a pro-poor approach that promotes low-cost technologies and schemes that communities and farmers can own and operate themselves (Clusters 1, 2, 4). There are also developments in gender-sensitive water/irrigation technologies and extension services (Clusters 2 and 6, respectively).

Policy opportunities for developing SSI include moving toward a CRGE, recognizing SSI as a key strategy for adaptation/resilience, improving agricultural production and productivity, food and nutrition security, and bettering livelihoods (Clusters 1, 2, 4). The policies also provide support for direct and indirect services critical for SSI development and support for adopting and local manufacturing of different irrigation technologies, including energy-efficient ones.

Intervention opportunities include governmental and non-governmental actors recognizing SSI to improve agricultural production, productivity, food and nutrition security, and climate change adaptation while focusing on smallholders, women, and youth. Another opportunity is support for WUAs and a concentration on building local capacity in planning, constructing, and managing SSIs, including O&M. Introducing and promoting innovative irrigation practices and technologies, as well as enhancing access to services and inputs crucial foundations for SSI development. An additional opportunity is the growing rural financial sector and increasing institutions' reach and financial capacities, including MFIs and RuSACCOs.

Main policy gaps and challenges for SSI development include limited implementation of policies and an absence of mechanisms and institutional arrangements. These gaps are reflected in SSI interventions, i.e., infrastructure development, quality assurance, M&E, and unclear roles and responsibilities for community-level SSI schemes. There is also a lack of technical standards in the

regulatory framework and many gaps in the implementing policy on water rights and fees, land issues and cost recovery. In addition, there are limitations in extension support, the capacity of WUAs and beneficiary access to key services and inputs.

Gaps are also observed across interventions with SSI components. These mainly relate to the ability of different actors and stakeholders to scheme studies, design, implementation, and management. This has negatively influenced schemes' technical, financial, and social sustainability. Additional gaps are in program design, stakeholder participation and those relating to cooperation and coordination among implementing institutions.

7.2.2 Micro and household irrigation schemes

There are different terminologies used to describe irrigation systems within SSI, but that operate at a smaller scale. In the AGP II 2015, there are household irrigation systems (HIS) and micro irrigation systems (MIS). These cover an area of less than 5 ha for plots of fewer than 10 households and an area of less than 20 ha for plots with 10 or more households, respectively. Other literature describes MIS as "irrigation schemes that are individualized, that target smallholders with a land size of often <1 ha, which use low-cost and simple technologies" (Awulachew et al. 2005). In most policies and interventions, MHIS are considered under SSI, but sometimes they are differentiated. As a result, limited information is available, specifically on MHIS. Such schemes are built in locations where larger forms of SSI water supply systems (diversions, lifting, storage) cannot be constructed because of technical factors, such as water availability and topographic unsuitability (policy Cluster 2).

Primarily, local administrations (at *zone* and *woreda* levels) are key actors in planning and implementing MHIS, with the close support of federal agencies such as the MoA. Specifically, they develop strategies that can solve localized problems and identify the required resources for implementation. They also implement in partnership and cooperation with government offices at various regional levels, public agencies, NGOs, development partners, private sector actors, and academic and research institutions. MHIS interventions assessed in this study are implemented to support the MoA's national SSI strategy, specifically the SSI Capacity Building Strategy. MHIS are relatively new to Ethiopia compared to other types of schemes. The literature shows that they were introduced and evaluated over the past two decades, mostly by NGOs and academic institutions (Awulachew et al. 2005).

Policy on MHIS targets smallholder farmers, resource-poor farmers with small land sizes, academic and research institutions, and private sector actors, with a focus on those involved in the technology supply chain. MHIS interventions targeted smallholder farmers, youth and women, and public and private institutions involved in the supply chain and the development of micro and small-scale irrigation technologies and entrepreneurs (Table 5).

Policy approaches to MHIS development appear pro-poor, bottom-up/demand-driven, and decentralized. Also, the irrigation-plus approach is observed where irrigation development considers multipurpose water use for domestic needs, WASH, and livestock. The intervention approaches are similar to SSI, where there are partnerships and collaborations and decentralized and user-based approaches. MHIS interventions usually target households and individuals. They also follow a pro-poor approach that promotes low-cost schemes that consist of simple technologies, usually backyard gardens owned and operated by households (Cluster 2).

Technologies promoted for MHIS are for water harvesting, lifting and application. For both policies and interventions, these are characterized as low-cost, low-tech, and ideally suited for poor smallholders to acquire and use. Policy Clusters 1 and 2 promote equipment and techniques such as micro-water harvesting and collection structures. These include small stream diversions, ponds, small check dams, surface and subsurface water tanks, and groundwater recharge structures (percolation tanks). Hand-dug and tube-dug shallow wells, manual and motorized pumps, low-cost drip irrigation, micro sprinklers, bubblers, and micro jet irrigation systems are also promoted. MHIS interventions

also involve relatively simple and usually manual technologies and micro infrastructure for households, including low-cost manual pumps, buckets, micro-drip irrigation and sprinklers (Table 5).

Regarding the necessary services for developing MHIS, policy Cluster 2 mentions establishing new MHIS schemes by developing shallow groundwater under 30 meters, supporting the supply chain, and demonstrating water-lifting technologies. The cluster also supports developing policies and regulations that influence the manufacture, importation, promotion, and servicing of irrigation equipment, as well as technical support (through training and awareness creation programs) to private and public sector institutions to manufacture these technologies domestically. Policies also encourage testing and demonstrating equipment at universities, research centres and demonstration centres.

In addition to introducing and promoting schemes and technologies, MHIS interventions also built capacity. This attempted to address the institutional, human, and technical capacity gaps of the public and private institutions involved in irrigated value chains, strengthen the technology supply chain and institutionalize the capacity-building interventions in regional government structures (Cluster 2).

Regarding gender and social inclusion, policies on MHIS try to mainstream gender in strategic interventions and promote MHIS to include and empower women and smallholders with little land. Interventions also play crucial roles in developing MHIS irrigation inclusively, as they plan for gender-equitable planning, designing and management and target resource-poor farmers who do not have a lot of land.

Policy opportunities for developing MHIS include recognizing this typology as a suitable approach to reach resource-poor smallholders and women. Even though earlier policies generally set provisions for developing SSI (less than 200 ha), recent developments like the Smallholder Irrigation and Drainage Strategy of 2018 recognize HIS and MIS as distinct approaches (in addition to SSI) and their benefits for resilience and income among smallholders. The policy support of low-tech and low-cost technologies that can be supplied, operated, and maintained locally is another opportunity. There are also ongoing efforts to address policy, research, and extension gaps, to strengthen and standardize scheme development and the technology supply chain, and to give beneficiaries better access to key services and inputs.

In interventions, development opportunities include facilitating access and adoption of MHIS technologies via financing and following inclusive irrigation development approaches. The equipment needed is relatively simple and can be produced locally, promoting off-farm employment. Meanwhile, there are examples of successful financing methods for poor farmers to adopt MHIS technologies, including self-financing and micro-loans (Awulachew et al. 2005). MHIS and the types of technologies they use present a good opportunity and potential as they can be adopted and used by individual farmers because they do not depend on collective action by groups. They are of relatively low cost in terms of their capital and operating costs per farm; and, therefore, are potentially affordable by small farmers. They are often highly efficient in water use with high water productivity, improving crop quality and reducing labour costs. Private firms can distribute them through markets that are not dependent on being provided for by government institutions (Ibid). MHIS interventions can also hold potential for inclusive irrigation development as they can supplement SSI in contexts where larger schemes might not be suitable and, therefore, reach groups of smallholders outside of SSI schemes.

Gaps in this typology are like those observed in SSI. Policy gaps include an absence of standards for irrigation technologies, including drip kits, sprinklers, and pipes. There is also limited research and extension support on MHIS technologies and best irrigation practices, and the technology supply chain is weak. The reviewed documents provided scant information on challenges specific to MHIS interventions, except for the weak technology supply chain and limited beneficiary access to key services and inputs. However, some of the gaps seen in SSI likely apply to MHIS.

7.2.3 Medium- and large-scale irrigation schemes

In this study, medium- and large-scale irrigation (MLSI) refers to schemes that cover more than 200 ha of land. Medium-scale irrigation systems cover between 200 and 3,000 ha, while large-scale irrigation systems cover more than 3,000 ha (Haile and Kasa 2015). **Key actors** in MLSI management include organized user associations, commercial farms, or state/public enterprises. Unlike SSI, which is primarily led at the regional level, MoWIE leads MLSI development in collaboration with regional offices. The MoWIE is responsible for planning, resource mobilization, technical support and coordinating all national and local government actors to implement projects smoothly. In MLSI interventions, the role of government (with the support of development partners) and commercial enterprises dominate in initiating and implementing medium and large-scale schemes.

Policies and interventions on MLSI primarily target smallholder farmers, large-scale private and state commercial enterprises, and organized producers in high-potential locations. Additional target groups include private sector actors in irrigated value chains, pastoralists, agropastoralists, WUAs, and extension and development agents.

Policy and intervention approaches toward MLSI are mostly decentralized and partnership-based, especially with the private sector and development partners. Government-led development of large-scale schemes may follow relatively top-down approaches compared to SSI and MHIS. Partnership mainly mobilizes resources and provides technical support for developing and managing infrastructure (e.g., policy Cluster 4). Approaches in MLSI interventions are also based on partnership and collaboration with different government and non-government stakeholders, such as international development partners and different local stakeholders, as well as in coordination between MoWIE and its regional and local representatives (Cluster 2). Compared to MLSI development approaches decades ago, which were predominantly top-down and centralized, recent interventions aim to be more decentralized in the management and operation of schemes.

MLSI-related policies promote several types of technologies and infrastructure at the community level and higher. For instance, water harvesting and collection structures like dams, reservoirs, different types of wells, and improved storage facilities and technologies to prevent over-abstraction (Cluster 1). Such policies also promote water lifting technologies like motorized and manual pumps and support for promoting appropriate and affordable technologies and tools used for water abstraction, reducing seepage losses in canals, water control systems and measurement (Clusters 1, 4). MLSI interventions involve building irrigation infrastructure and providing similar technologies to collect and store water and convey and apply it (Table 5).

There are provisions for services critical for MLSI development across policy clusters 1, 4, 6 and 7. These include upgrading existing schemes, modernizing and enhancing traditional ones to improve efficiency and abstraction, developing O&M guides, and integrating drainage services (cluster 4). The policies also support strengthening and creating greater access, improving meteorology and hydrology information services, supplying the required quantity and quality of fertilizer, improved seeds and small farm machinery (Cluster 1). Additional services for developing MLSI schemes are mobilizing resources, promoting credit facilities and bank loans, and developing cost-recovery mechanisms (Cluster 4). Moreover, there is support for EIAs for major schemes (Clusters 1, 4, 6, 7) and enhancing feasibility studies, designs and implementation capacities (Clusters 1, 4, 6). Capacity building targets multi-level actors to enhance human and institutional capacity for managing water resources for MLSI schemes (Clusters 1, 3, 4, 6, 7).

Providing critical services and inputs is also part of the MLSI interventions. These include technical support in research, feasibility and other studies and design development, as well as social and environmental assessments (Cluster 2). In addition, interventions facilitated finance and investment solutions such as grants for the private sector and cooperative beneficiaries and planning the establishment of the National Irrigation Maintenance Fund. Also included are capacity building for WUAs and extension agents in terms of O&M and cost recovery, market and value chain development,

and enhancing the enabling environment through, among others, reviewing irrigation legislation and irrigation strategies.

There is little difference in social inclusion and gender policies, specifically for MLSI. The aim is to benefit smallholders (including women and youth) in addition to large-scale enterprises, private sector actors, WUAs and (agro)-pastoralists. The interventions consider smallholder farmers and aim for gender-sensitive irrigation development in addition to organized producers and water user groups.

Opportunities for developing MLSI include policy support to exploit the potential of this typology for expanding collective production and commercializing agriculture in Ethiopia. There are also policy efforts to address challenges, including mechanisms to enhance policy implementation and scheme project management. These are developing standards and guidelines for irrigation equipment, procuring services, enforcing contracts, and effectively and efficiently planning, designing, constructing and managing schemes. Policy provisions also enhance scheme management and M&E capacity, including performance evaluation, inspection, and safety checks. These policy opportunities will help address most of the gaps in MLSI development interventions.

Intervention opportunities are the enormous potential for developing medium- and large-scale schemes in the context of commercial agriculture and support to strengthen the capacity of involved public institutions in the development and O&M of these schemes.

The main gaps and challenges in MLSI policy include limited implementation, institutional arrangements, and limitations in mechanisms for implementation and management. Some of the reasons behind this are a lack of standards and guidelines for technologies and infrastructure development, limited capacity and regulation in scheme planning, design, construction and management and M&E. There is also weak capacity and performance of institutions at various levels, including WUAs, and limited institutional arrangements. These gaps are reflected on the ground as several factors affected MLSI interventions and their expected outcomes. These include a lack of synergy and coordination, actors' technical and financial capacity, underperforming schemes, and low sustainability. Gaps in intervention design were also observed regarding participatory approaches, gender and social inclusion, and context understanding.

7.2.4 Multipurpose water resources development

Multi-purpose water resources development (MWRD) refers to developing and building infrastructure for multiple purposes and sectors, such as rural water supply, industries, domestic use, WASH, irrigation, and livestock. Key actors in MWRD schemes include MoWIE, whose primary mandate is to design an appropriate policy and legal framework for the development and administration of water resources. It also leads the planning, implementation, resource allocation, coordination, and technical support for the major government led MWRDs. Basin institutions support the studies and prioritization of major water works, environmental offices in EIAs, and the private sector and local governments participate in implementation. Non-governmental actors are also involved in MWRD interventions. Community-based organizations, development partners and NGOs may initiate, fund, or participate as project implementation partners.

Policies on multipurpose water resource development (MWRD) target a range of beneficiaries and stakeholders. These include the general rural and urban population, smallholders, agro-pastoralists and pastoralists, communities vulnerable to climate shocks and stress, and WUAs. Water policies also target government offices at various levels, including supervisory and service-providing bodies, and different water user categories capable of paying water charges, such as the private sector (including industries) and municipalities. In addition to the above, MWRD interventions targeted organized women and youth groups, producer cooperatives and PSNP beneficiaries.

MWRD policies follow decentralized, participatory, and community-based approaches by establishing and supporting local institutions. They use a partnership-based approach to encourage the private sector and communities to get more involved in MWRD (Clusters 1, 4). Integrated and multisectoral

approaches to water resource development interventions are adopted in these policies. These approaches are also followed by interventions on the ground, to varying degrees, including mobilizing resources and communities, co-investing in infrastructure development, and community involvement in managing watersheds near MWRD schemes.

Policies on developing and managing water resources promote modern and traditional technologies for multiple purposes. Clusters 1 and 3 promote multipurpose infrastructure for using surface water and groundwater resources to expand access to a potable water supply for people, crops, and livestock. Different-sized dams and ponds, water points, various types of wells, water conservation practices and infrastructure, like check dams, are mentioned for accessing and protecting water resources. MWRD interventions in Clusters 1, 4, and 5 also promoted similar technologies, practices, and infrastructure.

Services promoted in policies are focused on capacity building, research, and improving the policy framework for sustainable and effective development and management of MWRD. These target a range of actors, beneficiaries, supervisory institutions, local water bureaus, user groups and the private sector. Clusters 1 and 3 promote increasing the water construction capacity of the public and private sectors and using structural reforms and resources to strengthen capacity in terms of institutions, legislation, facilities, and human resources. Clusters 2 and 3 provide technical backstopping and supervision of infrastructure, ways to successfully transfer technology and promote local supply chains, and developing standards and procedures for technologies, water use, water work permits, quality control, fees, and charges. Prioritized services include formulating and adapting national guidelines, standards, and criteria for planning, studying, designing, constructing, supervising, operating, and maintaining the development and management of water resources. Subjecting major water projects to the EIA process, enhancing cost and benefit assessments, integrating, and institutionalizing meteorological and hydrological services at all levels, and assessing water resources are all highlighted in the policies.

Services in MWRD interventions are more development-focused with input provision, water resources and value chain development, access to financial services, weather information and insurance for users. Capacity building aimed to enhance the resilience of communities against climate shocks, establish and support cooperatives and user groups, and promote the documentation and mainstreaming of best practices.

The policies plan for and aim to secure gender mainstreaming in all aspects of planning, developing, and managing water resources. The policies also adopted integrated and participatory approaches, including principles and norms of social equity and active community involvement (Cluster 3). Interventions also aim to benefit diverse groups of beneficiaries, such as communities vulnerable to climate shocks, youth, and women.

Opportunities for this typology are the priorities in policies as a key strategy for achieving national goals and SDGs. Policies have also recognized the benefits of MWRD across various sectors, including agriculture and livestock, climate change resilience, domestic use, WASH and GEWE. Improvements in the policy framework to enhance PPP and the planning and management of schemes and to build the capacity of actors create opportunities for developing MWRD. In the interventions, there is increasing interest, support, and involvement from non-governmental actors toward integrated and multisectoral approaches to water resource development (Cluster 1, 2, 4). This can leverage resources among actors and maximize impacts across multiple interests such as irrigation, livestock, and domestic water use.

The main MWRD policy gaps are policy implementation, shared water resource governance, and institutional arrangements challenging the IWRM implementation. The literature also confirms this, as it is common to have overlaps and tensions about water resource management and benefits in a multilevel federal system of government (Chelkeba 2018). Even though the federal government is responsible for administering the shared water resources among the regional states, it is difficult to

determine whether a given water resource is within the exclusive jurisdiction of a regional state (Tekle 2019). This is especially problematic as the water resources are public property, and it is necessary to transfer water from one basin to another or within different regions in the same basin. Ambiguity exists in the respective roles of different levels of government on how to manage and use water resources, and the lack of elaborating regulations and weak organizational structure of institutions, like river basin authorities, further complicates the situation (ibid). As with the other typologies, the policy framework is inadequate for effectively designing, implementing, and managing schemes. These policy gaps are reflected in MWRD interventions, where challenges are reported regarding institutional and human capacity, institutional synergy and coordination, program design gaps, and low financial and technical sustainability of schemes are observed.

7.3. Different policy and intervention strategies for scaling irrigation technologies and services

The analyzed policies and interventions have various strategies that either aim at (or contribute to) scaling directly and indirectly. These strategies for scaling, respective clusters, technologies and services and key characteristics are summarized in Table 6.

7.3.1 Scheme development for irrigation and multiple uses

This strategy refers to developing SSI, MHIS, MLSI and MWRD infrastructure for various purposes, including rural water supply, domestic use, irrigation, livestock, and WASH. These focus on developing and rehabilitating schemes, improving policy and governance framework, mainstreaming gender, and promoting appropriate technologies and infrastructure for developing and using water resources. General development, irrigation, and water resource policies highlight important services to ensure a dependable and sustainable water supply based on demand and efficiency measures, accelerate the delivery of sustainable and inclusive irrigation and water resource development, and enhance the management and operation of facilities. Policies also lay out key services to improve the performance and sustainability of schemes and water allocation by strengthening policy and governance frameworks and promoting best practices.

There are five services to improve the technical performance of schemes: 1) establishing national standards for irrigation equipment, as well as the design, construction, O&M and performance assessment of schemes, 2) developing standard criteria and guidelines for prioritizing new schemes while also ensuring that existing ones are maintained, 3) strengthening the joint planning and execution of scheme development and management between agricultural and water institutions, 4) including relevant costs, such as handover, O&M, rehabilitation, monitoring and information dissemination, in funding for schemes, and 5) strengthening contract management, scheme design, construction and maintenance capacity of public institutions.

To sustain the environment, the policies promote the inclusion of drainage systems, EIAs for major irrigation development works, watershed management and soil and water conservation, and the adoption of sustainable agricultural practices, including on-farm soil and water management. Controlling environmental health hazards is necessary for the design, construction and use of dams and irrigation systems, as is using water equitably between upstream and downstream users. These are both promoted in environmental and land use and ownership policies. Meanwhile, policies on agriculture, water, gender, and irrigation also promote multipurpose and gender-sensitive planning, design, implementation and M&E. Across all policies, provisions have been made for building the human and institutional capacity of public, private and water user institutions in the above areas.

TABLE 6. Overview of strategies for scaling irrigation technologies and services across policy and interventions.

Strategy	Promoted by		Technology/service to scale		Key activities
	Policy cluster	Intervention cluster	Policy	Intervention	
Scheme Development for irrigation and multiple uses	- General development - Agricultural development - Irrigation development - Water resource development - Gender and social inclusion	- General development - Environment, land, and water resources development - Irrigation development - Agricultural finance - Gender and social inclusion	- Enhance mechanisms and capacities to plan, design, deliver and manage schemes - Increase access to water and technologies for developing and using surface and groundwater - Improve policy environment for the governance of water resources, private sector engagement, and financing of schemes	- Expand and accelerate the delivery of schemes and support their quality and sustainability - Facilitate and finance surface and groundwater development and use - Mainstream climate and gender in water and irrigation	- Construct, rehabilitate and strengthen the management of irrigation schemes - Test and promote appropriate water storage, lifting, and conveyance technologies, and enhance water infrastructure for climate change resilience - Create a demand-based and efficient water supply, decentralized and inclusive water resources development and management - Develop standards and specifications for technologies; develop and enhance guidelines for scheme construction, supervision, operation, and maintenance - Build implementation and management capacity, technical backstopping, and supervision to improve the sustainability of schemes
Strengthening the technology supply chain and adoption	- General development - Agricultural development - Irrigation development - Water resource development - Gender and social inclusion	- General development - Irrigation development - Agricultural development	- Support energy-efficient and appropriate technologies for water storage, lifting, and conveyance - Enhance policy support and operating environment for the supply of local and imported technologies, public-private partnerships - Enhance user capacity and access to key services	- Support the introduction and dissemination of improved technologies for different irrigation typologies - Enhance user access to key services, build capacity - Develop partnerships, inclusive and participatory approaches, financing mechanisms	- Pilots and demonstrations, co-financing mechanisms to test and promote appropriate technologies - Utilize indigenous and localized innovations and techniques to strengthen the local technology supply - Form partnerships with the private sector for the development, supply, and financing of technologies - Prioritize import forex for agricultural technologies, and roll out tax exemption incentives - Develop and enforce technical specifications, criteria, and guidelines for technologies, and develop a technology transfer system - Packaged approaches - value chain development, facilitate user access to finance, input, market, information, and extension support to increase technology adoption
Developing and implementing scaling strategies	- General development - Agricultural development - Water resource development - Irrigation development - Gender and social inclusion	- Agricultural Development - General development - Gender and social inclusion - Environmental, land and water resource development	- Enhance policy framework allocate resources, - Adopt innovative and inclusive approaches, validated technologies, and practices, - Support research, extension, and outreach; identify and address barriers	- Strengthen research and extension - Identify and scale best practices, technologies, and approaches - Develop inclusive value chains and market-based solutions - Build capacity to form partnerships	- Test and support the promotion of technologies; document and institutionalize sustainable irrigation practices, climate-smart agriculture, water and soil management, and community-based approaches - Plan and implement gender and youth inclusion strategies - Apply scaling principles - identify and target 'scaling stakeholders' and improve the capacity of local governance institutions to implement scaling up and out, establish scaling partnerships, allocate the required resources, leverage existing networks and platforms

			- Build capacity, support partnerships, facilitate user access to key services and inputs	- Allocate resources to construct and expand schemes - Enhance women's and youth's access to services and inputs	- Packaged approaches - link irrigation with inclusive and sustainable value chain development and enhance users' access to market and finance, business development services
Enhancing policy and the operating environment for scaling	- Water resource development - Irrigation development - Agricultural development - Gender and social inclusion - General development	- General development - Agricultural development - Agricultural finance - Gender and social inclusion	- Advance research, extension, information, and knowledge management, build actor capacity - Improve coordination, form partnerships, and support private engagement business environment - Facilitate enabling conditions for wider access and adoption of technologies and services	- Enhance capacity, policy, and the operating environment for private and public actors - Create enabling conditions for wider access and adoption of technologies and services	- Develop appropriate policies and the wider institutional environment, allocate resources for scaling - Conduct (and build capacity) on research, extension and information systems, technical and advisory support for project implementation; facilitate learning, awareness creation, and experience sharing on best practices, innovations, and approaches - Enhance user capacity and access to markets, finance, agronomic inputs, and extension, strengthen the technology supply chain and O&M services - Adopt inclusive and gender-sensitive planning - Strengthen coordination and multi-actor partnerships to leverage resources, technologies, and expertise for scaling
Investment, resource allocation and financing irrigation development	- General development - Agricultural development - Water resource development - Irrigation development - Agricultural finance	- Environmental, land and water resource development - Agricultural development - Agricultural finance - Gender and social inclusion	- Develop and implement scheme financing mechanisms - Prioritize, mobilize, and allocate resources - Use market-based approaches to enhance access to services and inputs - Encourage private sector investment	- Allocate and mobilize resources - Test sustainable scheme financing mechanisms - Support and engage financial institutions	- Use collaborations, grants, and co-financing mechanisms to finance schemes, support, and link MFIs with producer cooperatives - Enhance the input supply and credit for irrigated agriculture and market development - From partnerships with private sector and development partners to finance irrigation development, provide financial incentives for private sector investment in SSI - Build capacity of actors and users on scheme financial management, sustainability, and cost-recovery mechanisms
Partnership, collaboration, coordination	- General development - Irrigation development - Environment - Water resource management - Agricultural development	- General development - Agricultural development - Water resource development - Gender and social inclusion - Agricultural finance	- Support partnerships and participatory approaches - Leverage and mobilize resources - Encourage coordination, collaboration, integration and synergy in irrigation and water resources development	- Enhance partnerships and participatory approach - Leverage and mobilize resources, knowledge, and experience - Strengthen coordination, collaboration, and synergy to enhance policy implementation	- From the synergy between water and irrigation institutions, stakeholders, and interventions to increase the effectiveness of interventions and the implementation of integrated water resources management - Promote cross-sectoral integration, collaboration, and learning to leverage finance, knowledge, and experience and maximize impacts - Form multi-actor partnerships to mobilize resources, implement market-based solutions and strengthen the technology supply chain

Source: Authors' creation.

Sustainable and attainable technologies to improve water access for rural communities are among the technologies to scale. Policies aim for wider adoption and use of improved and affordable systems and tools for reducing seepage losses in canals, water control, storage and retention systems, and measurement structures. In addition, they also promote technologies for collecting, lifting, conveying, and applying water. These focus on developing schemes, mainstreaming climate and gender in the water sector, improving the governance framework, building capacity, and appropriate technologies for developing and using water resources.

Constructing different-sized irrigation schemes and infrastructure for households and communities is a common approach in interventions to reach more beneficiaries and increase access to water. Developing technically and financially sustainable, gender-sensitive and resilient irrigation systems that are technically and financially resilient to climate change is also stressed in agricultural finance, irrigation, and water interventions along with the necessary technologies for capturing, lifting, conveying, and applying water. Irrigation- and water-related interventions have services to enhance capacity and gender inclusion by establishing and strengthening WUAs and promoting memberships that include youth and women. Among other services to scale are enhancing the capacity of government, communities, and private actors in IWRM, project implementation, and scheme operation and management.

Services and technologies for developing schemes are generally similar in policy and interventions. For scaling, policies provide several mechanisms, tools, and services to improve scheme planning, design, construction, and management. Still, implementations are often criticized for having weak EIAs, environmental and technical sustainability issues and unsustainable practices. Delayed infrastructure delivery and low quality, poor contract enforcement, low technical performance, weak O&M of irrigation and water infrastructure, and low adoption of technologies and practices frequently happen in interventions. Also, women's participation in irrigated agricultural value chains, local water institutions and decision-making often remains lower than interventions usually try to achieve. The extent to which the private sector engages in developing and managing schemes and how new scheme developments are climate resilient requires further investigation.

7.3.2 Strengthening supply chain and technology adoption strategies

These strategies attempt to strengthen the supply chain and support farmers' access to and adoption of technologies and services for water and irrigation development (Table 6). They focus on improving the policy and operating environment, user access to key services, mainstreaming gender, forming partnerships, and capacity building for supplying and adopting technologies and services. Irrigation, general development, and agricultural and environmental policies have laid out services to strengthen the supply chain and facilitate the wider adoption of technologies by addressing priority barriers. Gender and social inclusion policies and sectorial guidelines have components to ensure that irrigation technologies and services are scaled inclusively and that more women and youth adopt them.

Key technologies promoted in these policies include prioritizing forex for importing agricultural technologies and setting optimal import tariffs for technology and related equipment, supporting SMEs to encourage the local supply of technologies and parts, and testing and producing energy-efficient prototypes through PPPs. Technologies that use renewable or alternative energies, which are affordable and accessible, as well as indigenous and localized innovations and water harvesting techniques, are all targeted for scaling. Establishing joint-venture and technology transfer programs in combination with countries, private firms, NGOs, and development actors are particularly highlighted for developing and adopting technology in SSI. Additional services are ICT-based support services, building the capacity of actors at various levels and expanding user access to irrigation extension and O&M services.

Key services are finding better ways to develop and manage gender-sensitive irrigation and water resources. One such example is using guides, checklists, and indicators to, among other uses, identify and introduce feasible and accessible irrigation technologies, as well as provide training and

demonstrations on these technologies and water management for women. Establishing and strengthening WUAs, women, and youth groups is also important to improve access to services, including credit and technologies. These focus on technologies for developing and using water resources, granting users better access to key services and inputs, mainstreaming gender, and building partnerships and capacity.

Agricultural development and irrigation interventions help deliver improved technologies, make field visits, and set up events to share the experience. They also help expand different supports and services to communities at a large scale so that they are adopted more widely. This usually follows piloting to evaluate and demonstrate appropriate technologies to capture, harvest, lift, convey and apply water. Other services for scaling are capacity building and empowerment to allow more youth and women to try out innovative technologies and using irrigation, agriculture, and gender and social inclusion interventions to establish strategic alliances to advance this on a large scale. Increasing farmer and SME access to financial services, markets, and information and supporting the adoption of technical, organizational, and institutional innovations are critical to encouraging the adoption of technologies and services.

Generally, similar approaches are followed between policies and interventions. Interventions by non-governmental actors also focused on making users and service providers more technically and financially capable so that more of them can adopt and use technologies and innovations. Lower levels of technology adoption than planned are reported across interventions, including by women users. Information is limited on how technologies being scaled are intended to be inclusive and gender-sensitive to meet the varied demands of women and other user groups.

Structuring and establishing effective PPP for testing, developing, and supplying technology has been a challenge, and access to finance for buying equipment is still not possible for most smallholders. None of the assessed interventions reports the scale to which policy support for local manufacturing of irrigation technologies, equipment and related materials has expanded the local technology supply chain and whether SMEs are actively involved. How policy strategies to address widespread adoption barriers contribute to scaling on the ground needs further investigation.

7.3.3 Developing and implementing specific scaling strategies

These strategies refer to policies and interventions that have set up clear strategies for scaling irrigation technologies and services, with detailed plans to address certain barriers (Table 6). These scaling strategies focus on policies that impact many areas: policy framework, resource allocation, scheme development, gender mainstreaming, best approaches, technologies and practices, research and extension, partnerships, access to services and inputs, and capacity building.

The scaling strategies in policies for irrigation technologies and services are based on sound analysis and documented constraints. The irrigation policies have identified priority strategies to address bottlenecks regarding enhancing policy and institutions, research and extension, developing and managing schemes, and technology supply chains.

Key services include making professionals and users more technically capable, supporting active community participation and involvement to manage irrigation schemes efficiently, and improving institutional links and effective coordination between key stakeholders. Improving current schemes and constructing new ones, establishing, and strengthening WUAs, promoting sustainable NRM, and research and extension on irrigated agriculture are also given. Establishing partnerships, adopting participatory and integrated approaches, and encouraging the private sector to supply technologies and develop and manage irrigation is other important part of scaling strategies across agriculture, irrigation, and water resource policies. Such strategies support knowledge and information management, as well as market, credit, extension, and financial access.

Interventions' scaling strategies promote a variety of different measures. These include best practices, technologies and approaches, research and extension, inclusive value chain development and market-

based solutions, capacity building, partnerships, resource allocation and scheme development. Although technology diffusion and scaling out to reach more people seem to dominate scaling efforts, a mix of different methods also support them. One strategy is developing ways to institutionalize best practices, innovations, and technologies by testing, documenting, and consolidating them into program designs. Supporting extension and adaptive research is also proposed to facilitate mainstreaming into policies and extension systems and to reach more beneficiaries, mainly through general development, agriculture and NRM interventions.

Aligning interventions with government programs, resource allocation and multisectoral approaches to addressing barriers among individuals, institutions and communities is highlighted in gender and social inclusion interventions. Partnerships and collaborations to leverage existing development program networks and infrastructure, and to use mechanisms that can be integrated into social protection systems (like PSNP), are proposed so that results can be applied at a much larger scale by governments and international organizations (general development and agriculture interventions) can apply results on a much larger scale. Collaboration among stakeholders is also targeted to improve learning and the operating environment. Continued community engagement, creating awareness among early adopter beneficiaries, sharing experiences, and training actors on best approaches and practices are all included across various intervention clusters.

Expanding strategically placed water resource developments, implementing gender and youth inclusion strategies, and organizing smallholders for wider access to key services and inputs are reported in water resource and agricultural interventions. To make scaling efforts more sustainable, interventions try to increase the capabilities of local water governance institutions, link irrigation with inclusive and sustainable value chain development and enhance user access to market and finance and business development services. Moreover, also listed are designing gender-specific programs or integrating specific activities, requirements or targets that focus on environmental and gender issues in irrigation development along with allocating financial and human resources.

A good step-by-step scaling strategy has three main elements. The first is identifying key 'scaling stakeholders,' finding credible and relevant evidence and knowledge, and then actively promoting them to be used. The second is motivating, enabling, and equipping a critical mass of development actors to either support or directly implement evidenced options. The third is scaling out programmed outcomes and impacts to other dryland areas. Interventions with good strategy often apply seven scaling principles: 1) co-learning, 2) contextually appropriate, 3) cost-effective, 4) potentially scalable, inclusive for vulnerable households, 5) environmentally and socially sound, 6) climate-smart, and 7) socially, institutionally, and financially sustainable.

There are minor differences in the scaling strategies in the policies and interventions. Interventions have produced a lot of information, inputs and lessons learned that can be used to develop an evidence-based scaling strategy in programs and policies. Interventions by non-governmental actors apply regional and international experiences and best practices regarding scaling strategies and principles. Policy strategies seem to focus strongly on spreading technology and improving institutional frameworks for scaling. Interventions have also prioritized linking and creating synergy in programs across sectors to leverage resources, finance, networks, and current development structures as a key scaling strategy.

7.3.4 Enhancing policy and operating environment strategy

This strategy is based on enhancing policy and regulatory frameworks, institutions, governance mechanisms, business and operational environment, and user access to key services and inputs. Services and technologies to scale in policy focus on research, extension, information and knowledge management, the policy and regulatory framework, capacity building, coordination and collaboration, gender mainstreaming, and access to technology and key services and inputs. General development and water resource policies aim to create a conducive enabling environment, including policies, technologies, practices, and services, as well as capacity and resources for the sustainable

management and use of water resources at scale. In the areas of irrigation and gender and social inclusion, policies develop the policy and regulatory frameworks and enhance input supply, credit, marketing, and technologies for inclusive and gender-sensitive SSI. They also develop and apply appropriate tools for improving irrigation schemes' design, performance, and technical, financial, and environmental sustainability. Among environmental policies, these lists establish and strengthen institutional frameworks for effective and coordinated environmental management and NRM, including appropriate institutional arrangements and assigning clear roles and responsibilities for managing water resources at all levels.

Additional services are strengthening collaboration and coordination, institutional and human capacity building for managing water resources at the federal, regional and community levels, and providing technical and credit support to the private sector and smallholders. Research and extension focus on knowledge and information systems for water resources, irrigation water management, and technology development and diffusion.

Services and technologies to scale center on capacity building, enhancing the policy, institutional and operating environment, gender mainstreaming, and access to technology, key services, and inputs. In agricultural irrigation interventions, the capacity building includes providing business development services, extension and advisory services, value chain and market development and links, organizing and strengthening WUAs, training extension and development agents on irrigated agriculture, water management, and scheme O&M. Agricultural finance interventions feature mobilizing and allocating resources and technical support for rural financial service providers and borrowers. Meanwhile, agricultural, gender, and social inclusion interventions focus on market development, increasing access to finance, information, services and inputs, and business development services for smallholders, rural enterprises, youth and women. Moreover, partnerships among stakeholders to leverage resources, technologies and expertise, mainstream gender in water and irrigation sectors and strengthen access to technology and O&M services are critical to creating better conditions for wider access and adoption. Improving land administration, certification and tenure security for smallholders is also important to strengthen the policy and operating environment, specifically regarding environmental, land and water resource interventions. Also included is support for reviewing and/or developing policies and governance procedures to enhance the implementation of relevant policies and to mainstream best practices and approaches in programs and policies.

Enhancing the enabling environment, including policy, institutions, governance and business operations, is a key strategy in policy and interventions. There were few distinctions between policy and interventions. Interventions by non-governmental actors include improving land tenure and security regulations and practices for encouraging on-farm, long-term investments and adopting technologies and practices by farmers. There are also critical services in terms of technical and financial support for policy implementation, policy review and development, and private sector partnerships and business development.

Still, key aspects of the enabling environment challenge the large-scale adoption and use of irrigation technologies and services. Public and private actors have limited implementation capacity, inappropriate institutional arrangements, and weak coordination, integration, and synergy across interventions. There are gaps in access to finance, water, irrigation extension, market, technologies, O&M services, and policy impacts that address these gaps that must be investigated further.

7.3.5 Investment, resource allocation and financing irrigation development strategy

This strategy refers to mobilizing and allocating financial resources for developing irrigation, enhancing financial management of schemes, and scaling technologies and services via different means and actors**.** Services and technologies to scale in policy focus on resource mobilization and allocation, PPP, market-based approaches to enhance user access to key services and inputs, partnerships and collaborations, and sustainable financing mechanisms. Policies on the green economy, agricultural finance, irrigation, and water resources promote several measures to ensure

that financial resources are available for investments. These include credit facilities and bank loans for developing irrigation schemes, sectorial financing strategies, implementing the appropriate cost-recovery systems and mechanisms, and establishing a national fund. Irrigation policies incentivize private sector investment in irrigation for more than 50 ha of land. They do so by providing an exemption for water use charges, making available projects that have finalized feasibility studies and designs, and making major infrastructure available, such as dams, main canals, and access roads, at government cost. In addition, there are many services to scale: partnerships and collaborations to mobilize finance and budgets from various sources, linking microfinance institutions with cooperative societies and farmers, increasing the supply of inputs for irrigated agriculture, and developing markets.

Services and technologies to scale in interventions center around resource allocation and mobilization, sustainable financing mechanisms, and partnerships and collaborations. Agricultural finance policies support partnerships and co-financing arrangements with stakeholders to expand the program's outreach across locations and increase investment and access to financial services for irrigation. They also assist in developing a constraints database and then documenting, assessing, and addressing financial restrictions to scaling innovations. Gender and social inclusion policies target increased financing and resource mobilization for gender mainstreaming in irrigated agriculture development. Moreover, to increase access to and leverage finance, interventions promote the provision of grants, market development, and partnerships and collaborations between the private sector, government, non-governmental actors, and financial institutions. Interventions also support local government and community actors to strengthen the financial management of SSI schemes.

Although the characteristics of most of the services toward investment and financing are similar in policy and interventions, there are slight differences. Co-financing mechanisms with stakeholders and users, grants, and developing a financial constraints database and addressing it are among the services that interventions target. Policy strategies focus on developing a national financing strategy for the sector, supporting direct, on-farm investment by the private sector, and establishing national funds. Developing and strengthening scheme cost-recovery instruments and mechanisms is among policy priorities. At the same time, interventions support rural financial institutions and enhance the financial management capacities of local government and user groups. Key challenges among interventions include scheme cost recovery and financial management, such as covering O&M expenses.

8. BARRIERS AND OPPORTUNITIES FOR SCALING

This section reflects the opportunities and barriers for scaling irrigation technologies and services observed across policy, institutions, interventions, and irrigation typologies, as summarized in Table 7.

TABLE 7. Barriers and opportunities for scaling irrigation technologies and services.

Category	Barriers for scaling	Opportunities for scaling
Policy and governance	- Gaps in policy implementation - Inadequate policy framework on land use and groundwater - Inadequate regulatory frameworks and mechanisms for water use, fees, scheme development and governance - Institutional instabilities, unconducive arrangements, weak or ineffective inter and intra-sectorial coordination and collaborations, overlaps and conflicts - Collateral-based and highly formal lending policy and practices - Challenges related to land tenure security and ownership and its implementation	- Recognize irrigation as a key strategy for food and nutrition security, resilience against climate change and agricultural transformation - Adopt IWRM and a decentralized and inclusive approach to water resource development and management - Strengthen sustainable scheme development and management - Enhance policy and governance frameworks, and capacities for developing and managing irrigation and water resources - Support greater private sector involvement in irrigation and water resource development and management

Interventions and scaling strategies	- Limitations in data, knowledge and information management in water and irrigation sectors - Limited capacity of both the public and private sectors in irrigation development - Limited coordination and synergy of actors and interventions - Gaps in intervention design and implementation	- Employ inclusive and participatory approaches to developing and managing schemes that target smallholders, pastoralists, youth, women, WUAs - Support access to key services and inputs and uptake of technologies and services - Enhance the policy and governance framework, the capacity of actors - Ensure the continued commitment of governmental and non-governmental actors toward irrigation and water resources
Informal institutions	- Limited performance and effectiveness in attaining intended objectives - Underlying restrictive customs, beliefs and traditions, political and developmental norms, and individual cognition that they are based on - Gaps between informal and formal institutions	- Create a grassroots presence and positive contributions to managing common natural resources, including water - Facilitate social learning, access to resources, services, and inputs - Tap into the potential for complementarity with formal institutions at the local level
Irrigation typologies	- Limited capacity and performance of public, private and community institutions (WUAs) - Low technical, environmental, and financial sustainability of schemes (SSI, MLSI, MWRD) - Lack of institutional and cross-sectorial coordination and collaborations, unconducive arrangements, overlaps and conflicts (SSI, MLSI, MWRD) - Challenges in implementing gender-sensitive and inclusive irrigation development	- Prioritize and contribute to SSI and MHIS, particularly for climate change adaptation, food and nutrition security, poverty reduction - Support market-oriented agricultural development and commercialization (MLSI) - Prioritize and contribute to MWRD for attaining multiple development goals across sectors - Adopt gender-sensitive and inclusive approaches across all typologies
Agriculture value chain and technology supply chains	- Limited knowledge, water resource management and irrigated agriculture research and extension - Barriers affecting access to key services, inputs, productive resources, as well as participation and uptake of innovations and technologies - Weak technology supply chain, O&M services, and standards for irrigation technologies - Inadequate integration of key services, inputs, value chain and market in irrigation development	- Increase support for organizing and empowering farmers (including women and youth) to create access to services, inputs, and infrastructure - Strengthen the technology supply chain and PPPs - Make efforts toward inclusive value chain and market development

Source: Authors' creation.

8.1. Barriers

8.1.1 Policy and governance barriers

Gaps in implementation and enforcement of policies: Although there are ample policies to guide water and irrigation development and management, there are significant limitations in the implementation on the ground. There is a lack of synchronization between available resources, investment and development needs, weak alignment of federal, regional and district-level investment plans with the national development goals, and disparities in infrastructural development and access to services necessary for implementation (Welteji 2018). Policy inconsistencies and a lack of complementarities are between, for example, environmental and investment policies and proclamations affecting implementation (Gubena 2016). Lack of implementation mechanisms, unconducive institutional arrangements, weak institutional and cross-sectorial coordination, and low human and institutional capacities for implementation also contribute to limited policy implementation, as observed in the interventions.

Inadequate policy framework on land use and groundwater: This refers to gaps in the policy and regulatory framework for planning and developing land use and monitoring and using groundwater. For example, a national integrated land use plan is still needed. Proclamations on land use and administration have poorly considered incentives for sustainably managing land resources. There is also a noticeable absence of a legal framework to enforce the proclamations, the major gap being no national institution to coordinate, lead and follow up on the implementation of land use policies

(Gebeyehu et al. 2017). Regarding groundwater, water policies support assessment, development, and operation, but legislations, standards and guidelines for sustainable management are all still missing. On top of this, policies on land use, groundwater development and watershed management are poorly integrated.

Inadequate regulatory frameworks and mechanisms: Gaps are related to issues surrounding irrigation development, including water fees, water rights, conflict resolution, quality control, and O&M of water and irrigation infrastructure. There is also an absence of methods for planning, designing, constructing, and managing schemes sustainably and efficiently. There is a lack of instruments like regulations, directives, guidelines, and technical specifications to guide contract enforcement and quality assurance for infrastructure, technologies, and related equipment. Moreover, mechanisms to enforce water protection measures and provide incentives are missing.

It is expected that the current policy developments, including the 2020 Water Policy and Strategy, Draft Regulation on Water Use Charges (2019) and the Draft Guideline for Setting Water Abstraction/ Use and Treated Wastewater Discharge Charge, will address some of these challenges. They will provide the legal framework and guidance for tariff setting and payment for water abstraction, including irrigation. The Draft proclamation on Payment for Ecosystem Services (2019) is expected to address some gaps by providing sustainable ecosystem development and generating ecosystem services through an environmental fee/tax for rehabilitating watersheds.

Institutional and sectorial coordination and collaborations, unconducive arrangements, overlaps and conflicts: There is a lack of institutional coordination and monitoring mechanisms (Mosello et al. 2015) and difficulties with regards to transferring water from one basin to another or within different regions in the same basin (Nigatu et al. 2016; Tekle 2019). There is a potential regulatory task-related conflict between the Environmental Protection Authority and the Ministry of Water Energy and Irrigation regarding the protection and development of water resources (Tekle 2019). There are also potential overlaps and conflicts in mandates, duties, and responsibilities between key actors of water governance at different levels. Mandates and responsibilities are not delineated between federal ministries and agencies, basin authorities and regional bureaus. This is particularly true in water transfer, quality management, dispute settlement and water governance at the basin level and across different regions. Nigatu et al. 2016 also argue that implementing institutions have unclear and overlapping competencies and mandates, especially at the basin level.

These historic overlaps, unconducive institutional arrangements, and the lack of coordination across sectors and institutions have affected the implementation of IWRM, balancing upstream and downstream uses and interests, shared management of water resources across administrative boundaries, and environmental considerations (Hagos et al. 2009). The lack of complementarities and synergy between key actors and intersectoral collaboration impacts joint actions and outcomes of interventions (Gubena 2016; JICA 2016). There are also insufficient modalities to solve conflicts of interest across sectors (agriculture, energy, irrigation, environment) and between water institutions.

Collateral-based and highly formal lending practice and policy: In the agricultural financing policies, there are systemic gaps in the provision of microfinancing services that restrict farmers' access to loans and credit services. Collateral-based lending policies and highly formal lending practices have severely constrained credit services to the agricultural sector. Banks are barely involved in microfinancing for the sector because they consider it high-risk. These and the fact that land cannot be used as collateral are major barriers that have excluded significant portions of Ethiopian smallholder farmers from accessing finance.

Land tenure and ownership: Different land tenure and ownership policies have influenced agricultural land management and maintenance and the use of technologies and tenure security (Zerga 2016). The policies have not realized that maintaining land transcends individual users and that there is a larger obligation and motivation to properly maintain, improve and transfer land. Farmers have title deeds for user rights only and cannot transfer land through sale or use, as land in Ethiopia is officially

government-owned. The policies are sometimes criticized for discouraging farmers from making long-term investments in their farms and adopting best practices. Such regulatory frameworks affect farmers' investment and access to finance as well. Land ownership issues, together with unclear property rights and the absence of a registry system for movable assets, undermine the ability to identify appropriate collateral for lending (Amha et al. 2017). Implementing land use and ownership policies is also challenging for women accessing and using the land. Although the current laws adequately recognize a woman's right to equality concerning access and control of property (including land), certain customs and gender biases against women that are prevalent in some communities hinder them from possessing and controlling land (Tura 2014).

8.1.2 Barriers to interventions

Limitations in data, knowledge and information management in water and irrigation sectors: Nationally and locally, knowledge and information management systems on water resources and irrigation (availability, access, use) and meteorological and hydrological data are weak. Availability and access to robust disaggregated data, including for gender, is also limited. Such services are not well institutionalized and are often inadequate for policymakers, water institutions, the private sector and development actors to make informed decisions. Research and critical information on socioeconomic aspects, impacts of investments and interventions, sectorial water demand and supply, and integration with other sectors are also inadequate. Lack of satellite rainfall data, information on groundwater resources, and technological means of communicating weather data to users are mentioned in climate change and irrigation interventions.

Lack of capacity of public, private and community institutions in irrigation development: There are human, institutional, technical, and financial limitations that affect the implementation of policies and interventions. Capacity gaps concern different actors, including implementing partners, public and community institutions, the private sector, and beneficiaries. Reported capacity challenges on implementation from public institutions include gaps in technical know-how, safeguards, procurement, contract enforcement, project management and supervision in irrigation development. On the private sector side, significant capacity gaps resulted in delays in the quality and timely delivery of critical water/irrigation infrastructure and services. Low performance and functionality of WUAs in O&M and water and financial management are additional issues that affected irrigation development. There was also a lack of technical capacity among implementing stakeholders.

Limited coordination and synergy of actors and interventions: Lack of coordination among implementers and between implementers and private contractors has led to delays in scheme delivery. The lack of synergy between producers and credit providers has hindered value chain development interventions, and inappropriate institutional arrangements have constrained infrastructure ownership. Overlapping mandates and challenges in establishing cross-sectorial collaboration and joint action among key government stakeholders also occurred in water and irrigation interventions, resulting in ineffective implementation, facilitation, and M&E. Another gap reported in intervention evaluations is that there is not enough synergy between programs and projects within and across sectors, which limits efficiency and the scale of impact of interventions. This stems from unconducive institutional arrangements and the complex operational mechanisms required for integration, coordination, and synergy in developing, using and protecting water resources.

Gaps in intervention design and implementation: Contexts are misunderstood, packaged approaches and a clear scaling strategy are nowhere to be found, and the implementation of participatory and gender-inclusive approaches has proven ineffective. Often, interventions do not actively and meaningfully have stakeholders and beneficiaries, including women, participate in program design, implementation, and M&E. Other barriers abound. Communication and awareness creation is inadequate, strategies for scaling and gender inclusion are absent, M&E is weak, and there are no incentives for people to participate. Insufficient needs assessment and understanding of local context

is a major intervention design gap. Missing local gender dynamics and power relations and underestimating the role and influences of stakeholders and informal institutions are related challenges.

Moreover, there is a mismatch between promoted technologies, practices and services and user needs in irrigation and water interventions. For example, there are cases where beneficiaries expressed their need for a different technology instead of the ones introduced. Price, local availability of parts and O&M services, and labour were the main factors that affected the acceptability and suitability of diesel and rope pumps. At the same time, smallholders mentioned high prices and a lack of power storage for solar pumps. There are also gendered technology preferences that were not considered in interventions. Yet another program design gap categorises all smallholders as a homogeneous group, even though not all have equal capacities to benefit from investment efforts to transform agriculture, raise productivity, and commercialize the sector.

A lack of holistic and packaged approaches can also limit adoption and scaling. Considerations of comprehensive access to agronomic inputs, credit, extension, market, O&M services, water, and irrigable land are often missed in interventions. These are critical factors, especially for smallholders, in investing in and adopting technologies and practices and the financial feasibility of such decisions. Only a few interventions successfully linked irrigation with inclusive market and value chain development.

8.1.3 Barriers from informal institutions

Limited performance and effectiveness: The challenges in how informal institutions perform relate to how they operate and their technical, financial and enforcement abilities. The effectiveness of informal institutions in communal resource management has been investigated based on their design principles (Yami et al. 2011). However, there is little concrete evidence on the specific roles of such institutions to address the challenges of how natural resources are managed communally and to what level technologies are adopted. There are many incidences of conflicts in traditional irrigation schemes because of how unwritten regulations govern water distribution and O&M, creating members' ambiguity in enforcement and understanding (Hailesellase et al. 2016).

Capacity and resources are key factors in how effective institutions are. When institutions do not perform well in these areas, gaps can result, with implications for how productive natural resources are governed. Personnel, finance, tools and equipment, technology, legal arrangements, and autonomy are all critical. When these are lacking, rules for managing natural resources will barely be enforced and cannot produce the preferred behaviour and compliance (Yeboah-Assiamah et al. 2017). Farmers are the ones who most often establish and operate traditional irrigation schemes in Ethiopia. Still, they do so with limited external support and financial and technical capacities, which leads to poor performance (Yami 2013). Traditional irrigation schemes are based on a rotational schedule with limited knowledge and skills on the water required for different crops. Furthermore, water distribution failures in the studied schemes resulted from limited technical support, abuse of irrigating schedules or quotas by illegal users, weakness of water distributors, and rent-seeking behaviour of committee members.

Another gap of informal institutions is in traditional savings and credit groups, despite their many benefits. Even though these groups have a major role in filling the gaps left by formal financial institutions, they are no substitute for formal credit institutions because they do not provide cost-effective credit to micro- and small businesses and rarely develop into formal institutions (Merry and Lefore 2018).

Underlying customs, norms, and incentive structures: Informal institutions are based on socially embedded customs, norms and incentive structures that influence their performance. Although informal agreements between farmers and WUAs are useful for addressing water shortages and maintaining sufficient access by planning water distribution, in some cases, those informal rules allow for abuses of power, favouring friends and relatives and excluding people who are not well-connected

to WUA leaders (Imburgia 2019). Friendship, kinship, and relations can challenge rule enforcement on members of community-based management institutions with a relationship with the offender. Socioeconomically powerful groups resist the actions of WUA committees to enforce the existing bylaws (Bedeke 2011). Memberships in formal and informal associations can significantly negatively affect whether the best NRM practices are adopted. The effect of membership in informal associations can lead to the free-riding problems of common natural resources (Wossen et al. 2013).

Political norms are also reflected in the policy and organizational cultures through top-down, hierarchical, and linear approaches to development interventions. These negatively affect the effectiveness, natural resources, community participation and the adoption and scaling of technologies and best practices. In addition, underlying gender, land tenure and ownership customs, and traditions influence institutions and how they operate to improve women's access to land and agricultural water (Imburgia 2019). For instance, the lower status given to women because of restrictive gender norms on decision-making hinders the benefits of having women on WUA committees. There is a need to intervene and change perceptions to sustain positive outcomes for irrigation development (Yami 2013). Land rights receiving formal approval for the water allocation in communal irrigation schemes can lead to the exclusion of marginalized groups, including women (Bedeke 2011).

Another barrier relates to customs and traditions that form the basis of clan-based social institutions. These can marginalize communities outside of the clan and exclude them from accessing land, water resources and benefits (Reda 2014). When such factionalism prevails, certain groups can exploit communal resources for a short period. However, formal rules can also exclude certain groups of communities. Formal or de facto rules can prevent women from joining a WUA by requiring literacy, formal land ownership for plots within a scheme, or holding elections or meetings when women have other responsibilities (Aarnoudse and Lefore 2018).

Gaps in interinstitutional dynamics with formal institutions: Complementarity between formal and informal institutions creates an enabling environment for sustainably managing water and other natural resources. However, gaps in dynamics between the two types of institutions can create a hindering environment. Institutional gaps tend to exist when there are unintended, unforeseen, or hidden challenges between the different rule levels operating among formal and informal institutions involved in governing a single resource system (Rahman et al. 2017). This interaction can be competitive instead of complementary, sometimes resulting in attempts to bypass or substitute the formal institutions subtly (Yeboah-Assiamah et al. 2017). When traditional methods have been dismissed without making appropriate formal institutional arrangements, it can lead to adverse effects on people and natural resource governance. Conflicts resulting from the unwritten and undefined roles of informal and formal institutions can block sustainable management and the use of common natural resources. Such conflicts and gaps can hinder user participation, obscure how WUA leaders allocate funds and constrain cost-recovery objectives (Lefore et al. 2018).

8.1.4 Barriers from irrigation typologies and scaling strategies

Limited capacity and performance of public, private and community institutions: There is a significant capacity gap in how water resources and irrigations are managed and developed and how scheme projects are managed, including in planning, designing, construction, contract enforcement, O&M and financial management. Several interventions have reported on this barrier, which affects the timely delivery, quality, and sustainability of schemes. This gap is seen across public institutions at different levels, in extension systems, among private contractors and community-based institutions (WUAs). It is most evident in developing and managing SSI, MLSI and MWRD typologies.

Low technical, environmental, and financial sustainability of schemes: This barrier is closely related to the capacity and performance gaps of key actors discussed above and in policy and governance barriers. Several factors impact the development of SSI, MLSI and MWRD infrastructure: low quality and underperformance, inadequate integration of drainage services, negative environmental impacts,

and gaps in financial management for schemes. Even though EIAs are mandatory for major water development and irrigation schemes, implementation and follow-up are often criticized as unsatisfactory. In some cases, fisheries and wetlands are degraded, water is used inefficiently, soil fertility declines, and erosion and sedimentation occur (Mequanent and Mingist 2019). Integration of drainage, watershed management, and sustainable agricultural practices, including on-farm soil and water management - are recommended in policies to make the environment more sustainable. Yet how much this is integrated on the ground needs further investigation. Efficient cost-recovery mechanisms are mostly missing, and WUAs have limited financial management capacity, making schemes' financial sustainability more challenging. A dearth of business cases and cost-recovery mechanisms for irrigation schemes is one constraint that makes it difficult for the sustainable development and management of SSI (Tolera 2017).

Synergy, coordination, and ownership between institutions and across sectors: This barrier reflects the institutional challenges discussed under the policy and governance barriers, as exhibited across SSI, MLSI and MWRD developments. In interventions, there is often limited collaboration and coordination between water institutions—at all levels. There are also ineffective institutional arrangements, instability, and weak links between research and extension in irrigation water management (Tolera 2017). Moreover, maximizing the investment impacts of programs is difficult because of a lack of synergy between stakeholders across sectors, such as irrigation, agriculture, water, NRM and WASH. Unclear institutional mandates and overlaps have led to governance issues between water institutions, particularly among MLSI and MWRD interventions. Although policies provide an overall framework for PPP in agriculture and irrigation, implementation modalities still need to be developed and clarified. Uncertainties in establishing and structuring effective PPPs are reported in MLSI and MWRD interventions, but this also likely applies to SSI and MHIS.

Challenges in implementing gender-sensitive and inclusive irrigation development: Although policies aim for inclusive and gender-sensitive irrigation development that involves and benefits different groups of users, interventions show significant gaps in implementation. This results from capacity gaps and mechanisms for implementation, awareness, program design, and the influence of informal institutions, particularly beliefs and norms relating to gender and development approaches. This is reflected in low participation in water governance and irrigated value chains. It is also shown in challenges in accessing services, land, and irrigation water and unbalanced benefit sharing— especially for women, youth and other marginalized groups, like resource-poor farmers. Targeting in the policies and practices on the ground may be different, and often women and poor smallholders are excluded from participation and benefiting from irrigation due to various reasons like collateral, capacity, and access to services (Fikirie et al. 2016)

8.1.5 Barriers from agriculture value chain and technology supply chains

Limited knowledge, research and extension on water resource management and irrigated agriculture: These are among the existing barriers to developing and scaling irrigated value chains. The technical know-how of users and extension services on irrigated agriculture is limited, including agriculture water management, water efficiency and allocation, technologies, and O&M services. Research-extension-farmer links are also weak, and packaged approaches are lacking in extension services. Recent developments in extension policies aim for client- and market-oriented services and packaged approaches that include market and value chain development, gender and youth mainstreaming, nutrition, and environmental sustainability.

Barriers affecting access to key services, inputs, productive resources, as well as participation and uptake of innovations and technologies: Many barriers affect user access to finance, technical and advisory services, improved seeds and other agronomic inputs, and markets. Financial service provisions to the agricultural sector face access gaps, product quality, and quantity (Zewdie 2015). Accessing loans and credit for irrigation equipment is among the biggest hurdles for smallholders and even more for women. Highly formal requirements and procedures to access loans and credit, as well

as payment mechanisms, might not be suitable for many. Collateral-based lending systems of rural financial service providers have limited financial access and participation of the landless, resource-poor smallholders, young men and women entrepreneurs, and SMEs. Another challenge is that most service providers consider agriculture high risk, mainly because climate variability is high and the market for agricultural products is so uncertain.

Another barrier is the low financial capacity of many smallholders and the relatively high upfront costs of buying irrigation technologies. High input and investment costs are bottlenecks to large-scale use of technologies (Fikirie 2016; Meja et al. 2020). Limited financial access, high technology costs and the lack of financial capacity of many Ethiopian smallholders make finance a major barrier to scaling. Barriers also result from the influence of informal institutions on gender, risk perceptions, social networks, and information access, among others. Restrictive beliefs, customs and gender norms, capacity, and awareness gaps on GEWE and social inclusion all influence two main areas: 1) access to inputs, services, land, and water resources and 2) the participation and decision-making of women and youth in value chains, water management institutions and beneficial opportunities, among others.

Weak supply chain of technologies and O&M services, standards and specifications for irrigation technologies, and technology suitability: Challenges in technology import, local manufacture and supply, and availability of O&M services and spare parts are the main constraints in the supply chain. A forex shortage and the lengthy import process also challenge the relatively undeveloped market and supply chain for irrigation technologies and services. Regulatory and enforcement gaps exist in standards and technical specifications for irrigation technologies and related equipment and materials. Drip kits, sprinklers and pipes are examples. As discussed in the intervention barriers, some of the technologies that different governmental and non-governmental actors promote might not be technically, financially, or socially suitable for the local context and different user groups.

Inadequate integration of irrigation development with key services and inputs, value chains and markets: Irrigation development interventions rarely consider the local context. This includes markets and value chains, technology supply chains, timely user access to improved agronomic inputs (including high-value crops), finance and advisory services. Without these integrations, developing infrastructure for schemes and providing technology puts the economic feasibility of investments into question and significantly limits the impact on the ground. Many scaling efforts have overemphasized technical replications and reaching a specific number of end-user beneficiaries to the neglect of "softer elements" that create the enabling environment for successful scaling (Minh et al. 2021). The lack of complementary services, like extension and technical support, and provision of inputs to maximize irrigation output and return from investments are among the factors influencing the adoption of irrigation technologies at scale.

8.2. Opportunities

This section provides an in-depth analysis of opportunities for scaling embedded across policy and governance, interventions, informal institutions, irrigation typologies and scaling strategies, and agriculture value chain and technology supply chains (Table 7).

8.2.1 Policy and governance opportunities

Recognizing irrigation as a key strategy for food and nutrition security and resilience against climate change: Policies recognize the huge potential for developing irrigation in Ethiopia and that it could become a key driver of agricultural and socioeconomic development. Contributions to food and nutrition security, climate change resilience and rural development are also well recognized. Establishing a new ministry for irrigation and low-land development could indicate that policy is paying attention to this area. SSI is now considered one of the best alternatives for improving, transforming, and growing sustainable livelihoods and alleviating rural poverty in the country. MLSI schemes have been prioritized for expanding commercial agriculture, and MWRD ones for increasing multiple

benefits across sectors. Policies also support allocating more finances from various sources and establishing a national fund to meet development needs.

Adoption of IWRM and a decentralized and inclusive approach to water resource development and management: Policies have adopted IWRM principles that are critical to guide water resource development and management in an integrated and sustainable manner for different sectors, including irrigation. Basin-level, decentralized, and user-based approaches and the setup of corresponding institutional arrangements at different levels are key to efficient and participatory water resource management. Policies support an inclusive and gender-sensitive approach to planning and implementing irrigation development. Smallholder farmers, pastoralists, rural women and youth, vulnerable communities (food insecure households), water user groups, cooperatives, the private sector (contractors, investors, commercial farms, rural enterprises, agribusinesses, and agroindustry) and rural landholders are all targeted in policies. There is also specific support for equal participation and benefits for women from different agricultural development activities and participation in water use/management institutions.

Support for strengthening sustainable scheme development and management: To address technical, financial, and environmental sustainability issues, policies have provisions to enhance and enforce mechanisms for developing and managing schemes. These include developing guidelines, procedures and technical specifications for planning, designing, construction, O&M and M&E so that schemes perform better and are technically sustainable. Guidelines for rehabilitating and revitalizing schemes, as well as quality assurance and control, are also proposed. Cost-recovery mechanisms are important to ensure sustainable financing of scheme management and O&M costs. Including drainage systems and EIAs in major irrigation development works, watershed management, soil and water conservation, sustainable agricultural and NRM practices and tools to control abstraction are all priorities to ensure environmental sustainability. Water resource policies also promote allocating water based on comprehensive and integrated plans and optimal allocation principles that incorporate the efficiency of use, equity of access and sustainability of the resource.

Support for enhancing policy and governance frameworks and capacities for developing and managing irrigation and water resources: Continuous efforts are being made to address policy and institutional challenges. These include policy development and reviews, establishing institutes to support IWRM and decentralization, and restructuring relevant institutions and their federal, basin and regional arrangements. Legal frameworks for WUAs are also vital for decentralized and user-based institutional arrangements among communities. Another policy opportunity is to make private actors and public institutions for water and irrigation development, management, and supervision better planning and implementation at all levels and among community institutions.

Support for greater private sector involvement in irrigation and water resource development and management: The policies also envision getting the private sector more involved in developing water and irrigation. These attempt to attract investment and active participation in the testing, development and supply of irrigation technologies and services. More specifically, policies on incentives for PPPs and irrigation investment present a great opportunity explicitly for harnessing private capital and resources. Examples include tax subsidies for importing technologies and service provisions to attract private sector investment in irrigating plots of land larger than 50 ha.

8.2.2 Intervention opportunities

Inclusive and participatory approaches to developing and managing schemes: Focusing on interventions toward smallholders, pastoralists and pastoralists, youth, and women creates opportunities for inclusive SSI development and increases outreach. Developing different types of pro-poor, small-scale, low-cost irrigation schemes that farmers own and operate themselves are important opportunities for including resource-poor segments of farming communities. Interventions also aim for more community engagement at the grassroots level and the active involvement of WUAs, and women and youth in managing water and irrigation.

Support user access to key services, inputs, land, and water, and facilitate uptake of technologies: Organizing smallholders and making them more able to access agronomic inputs, loans and credit, and infrastructure is the most common approach. Innovative and ICT-supported opportunities that bundle technology with credit services and mobile payment mechanisms are appearing on the scene. Addressing barriers women and youth face in accessing land and irrigation water is another area to speed up the pace of scaling. It is also necessary to improve land tenure and certification practices and promote GEWE in the land and water sectors. Promoting proven technologies, best practices, and innovations should be done together with creating the necessary capacities for technical support and O&M services. In addition, inputs from piloting and testing should inform (gendered) technology preferences and suitability for local contexts and needs.

Support to enhance the policy and governance framework and the capacity of actors: These include financial and technical support for policy review, development, and mainstreaming best practices and approaches to enhance the policy and governance framework. Supports to scale out and up improved land tenure security policies and practices, gender-sensitive irrigation and water resource development, and sustainable agricultural, water and NRM practices are all examples of intervention opportunities. Support to improve implementing policy is directed toward public institutions at all levels. Smallholders, organized producers, WUAs and other stakeholders receive support on sustainable practices, scheme management and O&M.

Continued commitment of governmental and non-governmental actors toward irrigation and water resource development: Both the Ethiopian government and non-governmental actors are committed to developing the water and irrigation sectors**.** Mutual interests and aligning interventions and outcomes with national policies, priorities, and multiple SDGs present opportunities for scaling. This is done through partnerships and joint programs to leverage and mobilize financial resources and technical expertise. Learnings from interventions indicate that such alignments also allow development actors to use existing government structures, infrastructure, and mechanisms, to increase efficiency and outreach.

8.2.3 Opportunities from informal institutions

Presence at the grassroots level and positive contributions in managing common natural resources, including water*:* Informal institutions have played a significant role in managing natural resources and continue to exert their influence in rural Ethiopia. At the grassroots level, the role of informal arrangements is very important, and many even dominate resource management (Mowo et al. 2013). These institutions operate by mobilizing social capital, collective investment, and collective actions toward managing land, water and irrigation, among others. Social capital and networks can positively influence irrigation governance, as institutional arrangements seem more successful and operate smoothly when the users are a socially cohesive group. Irrigation systems are not stand-alone physical entities but require the active involvement of the community to operate them sustainably (Haileslassie et al. 2016). Because they are based on the interests and knowledge of communities, informal institutions can create a platform to actively engage communities in irrigation governance and create a sense of commitment and ownership. Traditional knowledge, positive influences, networks, and resources of informal institutions present great scaling opportunities so long as they are recognized, supported, and leveraged.

Facilitation of social learning and access to resources and services: Local socioeconomic platforms like *Iquib* and *Idir* have significant roles in allowing information to flow horizontally between group members and communities. Such platforms could potentially create effective and low-cost awareness and spread information on technologies, best practices, and innovations. Social networks, village savings, and credit groups facilitate alternative finance sources suitable to their contexts and without the complex requirements of formal institutions. Although these may not be enough for big technological investments, they still provide cash for acquiring other critical inputs. Other social platforms facilitate access to shared labour for farm activities to cover high demand.

Complementarity with formal institutions*:* Even with sufficient laws and institutions, the formal framework is often ineffective without informal institutions "filling in the vacuum" (Yeboah-Assiamah et al. 2017). Positive interplays between the two types of institutions are critical to sustainably managing and using water resources, potentially narrowing conflicts between formal and informal rules and strengthening collaborations for effective local governance. This helps fill the gaps that both types of institutions have without one undermining the other and their respective rules. Interventions also show that complementarity makes programs more effective and rules easier to enforce, raising community acceptance and participation. However, it requires adaptive management, mediation, and compromise to manage the challenges that arrived from the interplay. Mediation between formal and informal institutions is necessary, and there needs to be mutual understanding, shared rules and common expectations to bridge the gaps between the two (Rahman et al. 2017). Therefore, enhancing and leveraging complementarity between formal and informal institutions creates an opportunity for greater community acceptance of best irrigation and water governance practices at the grassroots level.

8.2.4 Opportunities from irrigation typologies and scaling strategies

Prioritization of SSI and MHIS for climate change adaptation, food and nutrition security, and poverty reduction: This is an opportunity for scaling SSI and MHIS technologies and services by synergizing with interventions that are aimed at agricultural production and productivity, value chain development, nutrition, and income, as well as strengthening resilience against weather variability, among households and communities. Such prospects can be used to leverage finance, networks and expertise and maximize impacts from investment. MHIS, especially, presents opportunities as they empower entrepreneurship in smallholder farmers and micro-businesses, rely less on community coordination and infrastructure, and use cost-effective, existing technologies.

Support for market-oriented agricultural development and commercialization (MLSI): This is among the priorities to transform the agriculture sector by targeting potential areas**.** The government has recently developed Agriculture Commercialization Clusters specific to priority crops and geographic regions.[3] This can be used for planning how to scale technologies and services by matching them with the identified production and market factors of given value chains. Also, MLSI development can reach more groups of users as rural enterprises, SMEs, state farms, business development providers, commercial farms and cooperatives are actively involved. This typology seems to have greater potential for leveraging PPPs and investment from private commercial actors. This can be supported by promoting MLSI for industrial and high-value crops and links with agribusiness clusters, agroindustry zones, exporters, and other offtake market actors.

Prioritization of MWRD for attaining multiple development goals across multiple sectors: Policies and interventions prioritize expanding multipurpose water infrastructure for rural water supply, domestic use, livestock, crop, WASH, and other uses. MWRD contributes directly and indirectly to the SDGs, including 2 and 6. All of this has created strong commitment, increased the allocation of resources, and created a need for an integrated approach to developing the typology. Finance, technical support and other resources, and infrastructure for collecting, abstracting, and conveying water to increase access to supply can be leveraged for scaling irrigation technologies and services by integrating irrigation development along with MWRD, whenever applicable.

Adoption of gender-sensitive and inclusive approaches (across all typologies): SSI, MHIS, MLSI and MWRD all have provisions for mainstreaming gender and enhancing participation and benefits of rural women in planning, implementation, and M&E. MHIS presents an opportunity for scaling by following a pro-poor approach and including and empowering women and smallholders, particularly those with small plots of land. Using low-cost and simple technologies and micro infrastructure to collect, carry and apply water presents a unique opportunity for scaling technologies. It is due to these technologies and infrastructure are likely appealing to smallholders with small plot sizes, limited financial capacity

[3] http://www.ata.gov.et/our-approach/agricultural-commercialization-clusters-2/

and minimum technical requirements for O&M. With the right support, such technologies can be relatively easier for SMEs to manufacture and supply locally and for users to operate and maintain themselves.

8.2.5. Opportunities from agriculture value chain and technology supply chains

Increased support for organizing and empowering farmers, women, and youth to create access to services, inputs, and infrastructure: In policies and interventions, there is strong support and incentives for forming different types of cooperatives, such as producer, water user, input supply and savings and credit cooperatives. Smallholders, youth, and women are highly encouraged to organize themselves in such ways. Another approach is the Farmer Production Clusters (FPCs), where 30–200 farmers group together on adjacent land to farm as one and are supported to adopt the latest full-package farm recommendations.[4] Such organization of smallholders gives many users access to seeds, fertilizers, agrochemicals, loans, credit, and extension services through established structures. Furthermore, producers will have stronger bargaining power and a better chance for collective access to land, markets, transportation, and improved storage. The potential for such arrangements to stimulate collective investment in technology and services by farmers should be looked at closely. Policies strongly recommend membership and active participation of rural women in WUAs or irrigation associations to improve access to services, including credit for buying irrigation equipment, among others. However, despite the many benefits of organizing, it is important to consider that certain segments that are unable to organize/join for different socioeconomic reasons could be further marginalized.

Support to strengthen the technology supply chain: Developing, testing, adopting, and spreading appropriate water and irrigation technologies, including energy efficient and renewable ones, are all actions supported in policy and interventions. Implementing policies that support SMEs in manufacturing equipment and parts domestically is crucial. To this end, it is necessary to investigate and further strengthen the extent to which SMEs are supported and involved in the technology supply chain. The recently approved import tax and duty exemption for pumps (including solar) and related parts aim to stimulate private sector investment in the supply chain and reduce user costs. Preliminary studies show a cost reduction of up to 40% (compared to the cost before the tax exemption law) for motor and solar pumps with a full exemption (Bizimana et al. 2021).

Efforts toward inclusive value chain and market development: Compared to previous times, government and development actors are making greater efforts to adopt packaged, and value chain-based approaches in agriculture extension and interventions. In addition to the traditional focus on inputs and production, interventions are forming links between input and technology suppliers, financial service providers, producers, and markets. Providing facilities, credit, and technologies for improving agricultural production, productivity, and value addition is observed. Whenever applicable and feasible, irrigation development should be linked with the value chain and market development to exploit these opportunities. Collaboration with non-governmental actors will be beneficial, as they are actively involved in the value chain and market development in partnership with the private sector.

Value chain and market developments aim to include and benefit women, youth, and smallholders. As mentioned in interventions analysis Section 5, successfully implementing this has been a challenge to varying degrees. Not all smallholders can participate and benefit in irrigated value chains, and it is still difficult to involve women to the desired extent. The extent to which pro-poor value chain developments must be looked at further. It is necessary to empower youth and women through technical training tailored to improve their skills and competencies, promoting women's membership and participation in decision-making positions in WUAs and cooperatives, and enhancing the gender mainstreaming capacity of public and private actors along value chains. For this, technical support

[4] http://www.ata.gov.et/farmer-production-clusters-fpc/

tailored to the different actors and their needs is crucial to make value chains more efficient, organized, and competitive.

9. Recommendations

Based on the barriers and opportunities discussed above, this section lays out a vision for irrigation and the key objectives to achieve it. To achieve visions of "*sustainable irrigation development that benefits smallholders including men, women and youth in terms of food and nutrition security, income, and resilience against climate change through the scaling of technologies and services,*" the following objectives are critical:

- Enhance the enabling environment for scaling irrigation technologies and services.
- Enhance the credibility and efficiency of irrigation development and interventions.
- Strengthen technology supply chains and partnerships.

9.1 Enhance the enabling environment for scaling irrigation technologies and services

Improve the institutional environment and implementation capacities: A conducive arrangement of water and irrigation institutions should be developed that makes coordination, collaboration, and synergy effective at the federal, basin, regional, local and community levels. Platforms should be formed and strengthened to involve institutions continually and actively for agriculture, water, irrigation, environment/natural resources, energy, and women and youth to ensure multisectoral planning, coordination, and integration at all levels. To minimize potential overlaps and conflicts of interest within water institutions across the levels of governance and between sectors, the respective roles, mandates, and authorities of institutions should be clarified, defined, and enforced through legal instruments.

Institutional and human capacities and allocating corresponding resources are critical for implementing policy. IWRM and participatory and inclusive irrigation development have proven challenging to implement successfully. For public institutions, technical skills, and financial support for mainstreaming GEWE and social inclusion, institutionalizing best practices and innovations, multilevel water governance, project management and M&E should be among their priorities.

The relevant informal institutions should also be strengthened and empowered to make governing the development of community-based water resources and irrigation more effective—especially for SSI, MLSI, MWRD and Water-Energy-Food-Ecosystem (WEFE) Nexus to increase food systems' resilience to climate change and conflict's cascading effects in Ethiopia. Development actors should help address the underlying norms and traditions that negatively impact the performance and achievements of these institutions and then devise mechanisms for synergetic interplays between formal and informal institutions.

Review, improve and update policies: Policy frameworks on using, recharging, and protecting groundwater and land use must be further developed and linked**.** Finance and land administration policies, procedures and practices need to be reviewed to accommodate the needs of smallholders, women, and youth. Missing proclamations, regulations, directives, and guidelines for the water, irrigation and NRM/environment sectors should be developed and applied to enhance policy implementation.

Policy implementation and practices relating to land tenure security, ownership and certifications must be improved to positively influence a sense of ownership, adoption of best NRM practices and long-term investments by farmers. Even though the constitution and policies on women give them equal rights concerning access to and control of property, prevailing gender-restrictive norms and beliefs make this challenging to implement. Identifying best practices and approaches gained from land tenure and administration interventions is necessary and revising current practices is necessary. Tenure security and certifications should also encourage women's access and right to land. Giving women more access and control of land needs to create awareness about women's rights at the

grassroots level among women, men, influencers, law enforcement and development actors and providing legal services to rural women.

Address gaps in research, extension, and information management: Robust research and extension should inform understanding and decision-making on challenges and opportunities, feasible solutions, and innovations from the highest policy to the household level. Enhancing research and knowledge on irrigation should emphasize the sector's potential, practices, uses development and performance, gender and social inclusion, technology, and service bundles. Education, research, and extension institutions should integrate and enhance their involvement and commitment toward generating, institutionalizing, and disseminating research outputs in their curricula, programs, and activities. Stakeholder platforms are important for facilitating dialogues, exchanging knowledge and information, networking, and influencing policy and practices by bringing multiple stakeholders together. Continued testing and demonstration of improved irrigation technologies and practices are critical to advance the perception and understanding of producers and practitioners alike.

Enhancing data and information systems should focus on strengthening and institutionalizing data and information for land use and hydrological, meteorological and gender-disaggregated data. Databases and monitoring systems on the availability, use and quality of surface water and groundwater should be enhanced. Policy efforts to establish the Water Resources Information Centre and Irrigation Management Information System[5] should link and partner with key local and international organizations with the experience, data, and resources to support the systems.

Strengthening irrigation mainstreaming in extension manuals and services should prioritize using farmer research groups and farmer training centres as networking platforms to create and enhance irrigation research-extension-farmer links. It also recommends updating and improving the SSI component in crop extension manuals, training extension agents on water use efficiency and quality, scheduling, managing and operating schemes, and irrigation technologies and applications.

9.2 Enhance the credibility and efficiency of irrigation development and interventions

Improve the technical, financial, and environmental sustainability of irrigation schemes: Developing and using mechanisms, such as directives, guidelines, manuals, and standards for designing public irrigation and procuring services, construction, and evaluation, is a priority measure to improve technical performance. Measures to ensure environmental and social sustainability should include effective implementation of EIAs and SIAs for major irrigation developments, installing proper drainage facilities and managing water salinity. Applying gender mainstreaming guidelines in the planning, implementation, and M&E of schemes is also necessary. In addition, ensuring women are represented and actively participate in WUA management committees is critical to give them better access to land and irrigation water and for inclusive scaling. Rolling out practical cost-recovery mechanisms, water fees, allocation of public funds, and partnerships with the private sector to drive greater investment in SSI development should improve the financial sustainability of schemes.

Bureaus for water, irrigation and agriculture, private consultants, and contractors should improve their skills, mechanisms, and procedures. Technical support and supervision are necessary for effective, gender-sensitive, sustainable planning, implementation, O&M, and quality assurance. Extension agents, water experts and WUAs should all receive well-planned support on scheme management, such as O&M, water use efficiency, water allocation and distribution, and financial management, including water charges, fee collection and cost recovery methods. Knowledge and implementation capacity regarding IWRM, improved irrigation and soil water conservation, recent innovations and technology developments, technology specifications and applications, gender technology preferences and scaling approaches need to be advanced.

Strategically plan communication, stakeholder participation, and gender mainstreaming: While it can be costly and challenging, implementing participatory approaches and communication strategies

[5] National Water Policy and Strategy 2020. Federal Democratic Republic of Ethiopia

from the intervention design to evaluation stages improves coordination, commitment and collaboration among actors and beneficiaries. Meaningful and active stakeholder participation in intervention designs, including women and youth, is one way to address the reported context misunderstanding in interventions.

An effective communication strategy on the aim and expected outcomes of interventions and irrigation technologies and services is essential. It should be tailored to different groups, such as beneficiaries, implementing partners and other system actors. Appropriate communication channels and suitable platforms are required for informing, consulting, and collaborating with stakeholders. Even in cases where there are strategies for engaging stakeholders and mainstreaming gender, ensuring that stakeholders actively participate from design to M&E has been difficult. In most cases, the participation of women has been below target. Skills in project planning and management, coordination, and awareness of gender and social inclusion are necessary to implement these strategies in programs.

Comprehensively assess local context*:* A solid understanding of local challenges, technology and service needs and preferences, priorities, the socioeconomic context, and access to inputs and services is mandatory. Scaling efforts should investigate the heterogeneity among smallholders, gendered differences in technology preferences, availability and access to irrigable land and water, and local availability of O&M services and spare parts. Access to agronomic inputs, suitable financial services and payment modalities, and market and technical support is also crucial. Another factor critical for success is considering the local power and gender dynamics and the role and influence of informal institutions.

Adopt integrated and bundled approaches to ensure the relevance and credibility of irrigation development: Traditional agriculture and irrigation development approaches that focus on inputs, production, and linear technology diffusion should be enhanced. Intervention designs should adopt packaged approaches, integrate with the value chain, and market development, and synergize with other interventions. Packaged and value chain-based interventions that include components on agronomic inputs, advisory and business development services, technology, finance, markets, and infrastructure are likely to succeed.

It is also important to create links between actors in irrigated value chains, such as agronomic inputs, irrigation technology and services, financial services, ICT and digital services, production, value addition and offtake markets. Access to improved storage, transportation, and facilities for value addition for perishable irrigated products are among the priorities to make value chains more competitive and efficient. How much value chains are inclusive, gender-sensitive and pro-poor should also be investigated.

As irrigation requires significant investment, inadequate feasibility considerations in selecting high-value crops and high-end markets can put farmers at risk. Whenever possible, SSI and particularly MLSI planning should integrate with the identified agricultural commercialization clusters and agro-industry zones to access markets and infrastructure. Synergizing irrigation interventions with agriculture and rural development, water supply, watershed management, transportation and other developments could maximize the impact of investments.

Ensure comprehensive strategies for sustainable and inclusive scaling of irrigation technologies and services: Although addressing all systemic barriers to access services, inputs and resources might not be realistic at the program level, it should be an integral part of long-term intervention strategies. Integrated scaling pathways should be developed based on a comprehensive understanding of farmers' demands, needs and preferences, and priorities for irrigation investment, as well as the socioeconomic context and systemic barriers to scaling irrigation development. The pathways should also address challenges along the irrigated agricultural value chain, such as specialized knowledge and technical support, on-farm water management, access to irrigable land and water, different

technology options for accessing, conveying, and applying water, the cost of labour and technology acquisition and maintenance, and technology preferences.

Co-developing scaling strategies with farmers and other food system actors and stakeholders is necessary to ensure the suitability of promoted technologies and services with localized and differentiated needs. Considering the dynamics and influences of local power structures and informal institutions is crucial. A scaling strategy for proven technologies and services should be realistic and based on demand, local context, scaling principles, and establishing partnerships with development partners, cooperatives, financial institutions, technology and service providers, and market actors. Allocating corresponding human, financial and technical resources is also necessary.

Restrictive informal institutions that exclude certain groups, often women and youth, from accessing land and water resources can be addressed by improving community awareness, mainstreaming GEWE and social inclusion in land and water sectors. Enhancing policy implementation and practices on the ground regarding land ownership and tenure security is also necessary. In WUAs, land ownership can be a criterion for accessing irrigation water, and such rules can have unintended consequences and limit participation (including women) in irrigated value chains. Organizing and empowering smallholders, women, and youth is one of the main ways to grant them better access to agronomic inputs, infrastructure, extension, finance, and markets.

Increasing user access to financial services is among the top priorities for scaling irrigation technologies and services. Linking smallholders and organized producer groups, including women and youth, SMEs and other value chain actors, with MFIs and RuSACCOs is critical. Partnerships with development partners, financial institutions and ICT providers are necessary to help strengthen risk management mechanisms for weather, markets, and loan repayment uncertainties in financing agriculture and to develop products and services tailored to smallholders and SMEs. They are also necessary to mainstream gender and youth in financial products and services. In addition, innovative approaches like Pay-As-You-Go systems that link irrigation technology suppliers, users and financial institutions via digital and mobile platforms present a great opportunity to create better access to credit and technology via a suitable payment method.

9.3 Strengthen technology supply chains and partnerships

Strengthening the processes, actors involved and operating environment for supply chains is most important for scaling. Without a strong supply chain and active participation from the private sector, it will be very difficult to increase the availability, affordability, and accessibility of technologies for water abstraction and application and O&M and maintenance services.

Stimulate private sector-led supply of irrigation technologies and services: Forming partnerships with SMEs, development actors, and users is critical to support and incentivize the local manufacture and assembly of pumps and irrigation equipment and provision of well digging and maintenance services. SMEs should receive technical support, training, financing, and business development services to enter the market and supply quality products. This is particularly encouraged for supplying MHIS and SSI irrigation technologies that are relatively easy to manufacture locally. How effectively the policies to support local production are being implemented, whether SMEs are getting the support they need, and how actively SMEs are engaged in the irrigation supply chain should all be investigated and further strengthened. Complications should be addressed, and incentives should be implemented to attract the private sector to import technologies. The main challenge here is the forex shortage and the lengthy import processes. Most important are prioritizing forex for the sector and ensuring that the tax and duty exemption for agriculture and irrigation equipment ratified in 2019 is implemented effectively. Furthermore, it is necessary to form partnerships to improve coordination and synergy between importers, agriculture, irrigation, and customs authorities.

Development and enforcement of quality standards: It is important to set national standards and technical specifications to apply for both locally manufactured and imported irrigation technologies,

including different types of pumps and related parts, as well as conveyance and application technologies, like sprinklers and drip kits. This can reduce losses due to substandard and cheap technologies and unhealthy market competition.

Encourage private sector investment and financing: Innovative mechanisms to de-risk agricultural lending should be devised by actively involving development partners, MFIs and RuSACCOs. Practices like providing loan guarantees for financial institutions and modalities to distribute risk among other actors should be further investigated and scaled. Changes should be made to collateral-based lending policies and highly formal lending practices. Ongoing policy reforms and lending practices to land certification and moveable assets as collateral should be finalized and implemented effectively. Policies' impacts on attracting private sector investment in irrigated agriculture and scheme management should be investigated and strengthened. Uncertainties in structuring PPPs should be addressed by developing sector-specific implementation tools, including regulations and directives. Partnerships between irrigation technology suppliers, financial institutions (RuSACCOs and MFIs) and ICT providers are necessary. It is also critical to help financial institutions minimize and distribute risks from lack of collateral and uncertainties and to develop financial services and payment modalities tailored to male and female smallholders.

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