

# Ethiopian National Agricultural Mechanization Strategy

*Vision, Systemic Challenges and Strategic Interventions*

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The Federal Democratic Republic of Ethiopia  
Ministry of Agriculture

Ethiopian  **ATA**  
Agricultural Transformation Agency  
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## Content

|   |    |
|---|----|
| Content .....   | 2  |
| List of Acronyms .....  | 4  |
| Minister’s Statement.....   | 6  |
| Acknowledgment .....  | 6  |
| Executive Summary.....  | 8  |
| Chapter 1: Introduction .....   | 16 |
| 1.1. Purpose and Scope.....   | 16 |
| 1.2. Strategy Development Approach .....  | 17 |
| 1.3. Definition and Value Chain of Agricultural Mechanization .....                     | 19 |
| 1.4. Major Stakeholders .....   | 20 |
| Chapter 2: Current Context for Agricultural Mechanization and Opportunities .....       | 22 |
| 2.1. Overview of Ethiopian Agriculture .....  | 22 |
| 2.2. Background and Current Status of Agricultural Mechanization.....                   | 25 |
| 2.3. Value Addition from Agricultural Mechanization.....                                | 29 |
| 2.4. Major Constraints to Agricultural Mechanization.....                               | 31 |
| 2.5. Policy Motivation .....  | 32 |
| 2.6. Gender Implications.....   | 34 |
| 2.7. Ensuring Sustainable Mechanization .....   | 35 |
| 2.8. Availability of Financial Services to Smallholder Farmers.....                     | 36 |
| Chapter 3: Strategic Vision and Business Models.....                                    | 37 |
| 3.1. Context for the Vision and Strategic Choices.....                                  | 37 |
| 3.2. Vision and Strategic Objectives.....   | 40 |
| 3.3. Vision of Stakeholder Collaboration .....  | 41 |
| 3.4. Vision for the Ideal Business Model.....   | 44 |
| 3.5. Vision for Collaboration among Stakeholders in the Ideal Business Model .....      | 47 |
| Chapter 4: Systemic Bottlenecks and Strategic Interventions to Achieve the Vision ..... | 54 |
| 4.1. Research and Technology Development .....  | 56 |
| 4.2. Domestic Manufacturing and Imports .....   | 67 |



|            |  |     |
|------------|--|-----|
| 4.3.       | Distribution .....                                 | 78  |
| 4.4.       | Promotion, Purchase, and Usage .....               | 83  |
| 4.5.       | After-sales Service .....                          | 91  |
| Chapter 5: | Implementation Priorities .....                    | 96  |
| 5.1.       | Priority Interventions .....                       | 97  |
| 5.2.       | Medium- and Long-term Interventions .....          | 101 |
| 5.3.       | Implementation and Ongoing Review.....             | 102 |
| Chapter 6: | Annexes .....                                      | 103 |
| 6.1.       | Steering Committee .....                           | 103 |
| 6.2.       | Prioritization Methodology for interventions ..... | 104 |
| Chapter 7: | Reference .....                                    | 106 |



## List of Acronyms

|              |  |
|--------------|--|
| <b>ATA</b>   | <b>Ethiopian Agricultural Transformation Agency</b>          |
| <b>ATVET</b> | Agricultural, Technical, Vocational and Educational Training |
| <b>BBM</b>   | Broad Bed Maker  |
| <b>CBU</b>   | Complete Build Unit  |
| <b>CKD</b>   | Complete Knocked Down  |
| <b>CSA</b>   | Central Statistical Agency                                   |
| <b>CRGE</b>  | Climate Resilient Green Economy                              |
| <b>DAs</b>   | Development Agents   |
| <b>EIAR</b>  | Ethiopian Institute of Agricultural Research                 |
| <b>ESA</b>   | Ethiopian Standards Agency                                   |
| <b>GDP</b>   | Gross Domestic Product                                       |
| <b>GoE</b>   | Government of Ethiopia                                       |
| <b>GTP</b>   | Growth and Transformation Plan                               |
| <b>FAO</b>   | Food and Agriculture Organization of the United Nations      |
| <b>FHHs</b>  | Female Headed Households                                     |
| <b>FTCs</b>  | Farmer Training Centers                                      |
| <b>HIMI</b>  | High and Intermediate Mechanization Implement                |
| <b>JV</b>    | Joint Venture  |
| <b>LMI</b>   | Low Mechanization Implement                                  |
| <b>MFIs</b>  | Microfinance Institutions                                    |
| <b>MoA</b>   | Ministry of Agriculture                                      |
| <b>SMEs</b>  | Small and Medium Enterprises                                 |
| <b>NARS</b>  | National Agricultural Research System                        |



|              |  |
|--------------|--|
| <b>NGO</b>   | Non-Governmental Organization            |
| <b>RARI</b>  | Regional Agricultural Research Institute |
| <b>RBoA</b>  | Regional Bureau of Agriculture           |
| <b>SKD</b>   | Semi Knocked Down                        |
| <b>SACCO</b> | Savings And Credit Cooperative           |
| <b>SHFs</b>  | Small Holder Farmers                     |
| <b>USD</b>   | United States Dollar                     |



## Minister's Statement

Agriculture is a vital component of Ethiopia's economy and provides a livelihood for millions of our citizens. Unfortunately, the majority of agricultural practices that are used in this country have not always kept up with modern technologies, significantly constraining the output and productivity of our smallholder farmers. To overcome these challenges modern practices in mechanization must be made accessible to Ethiopian farmers. While some progress has been made in recent years of introducing these types of technologies to farmers, a national strategy that provides direction and unifies these efforts is vital to successfully institutionalize agricultural mechanization.

Agricultural mechanization has the ability to significantly increase crop yields, decrease post-harvest losses and reduce the labor needed across multiple crops and in multiple components of the mechanization value chain. Much of these practices are currently performed by draught animal power, which are not only inefficient but also emit harmful greenhouse gas into our environment. By introducing mechanized technologies, the reliance on draught animal power can be reduced, agricultural productivity can be increased, and labor can be channeled towards to other high-value adding activities and sectors. This supports Ethiopia's ambition to become a middle income country by 2025 as well as building a more diversified, climate resilient economy.

Thus, this sector strategy clearly outlines the most constraining bottlenecks across the value chain and recommends interventions to arrive at the desired outcome. It is also aligned with other Government policies to support sustainable socio-economic growth and industrialization.

The Federal Government of the Democratic Republic of Ethiopia has made a strong commitment to agricultural and rural development by allocating over 10% of the national budget. The next Growth and Transformation Plan, for the years of 2015-2020, will emphasize improved practices, including mechanization, to bring about value addition to agricultural output. The Government will also work further to ensure that farmers are given sufficient access and support to utilize these practices, and that domestic industries are supported through an effective enabling environment to enhance their operation and ability to develop and supply such mechanized technologies for farmers. To do this, the Government is prepared to undergo several interventions, starting with improving and empowering our institutions to execute these tasks effectively and efficiently.

Given the potential impact of increased agricultural mechanization to Ethiopia's economy and to the livelihoods of Ethiopia's farmers, I challenge and encourage all relevant stakeholders to utilize this strategy and implement the recommendations contained therein.

State Minister

Ministry of Agriculture



## Acknowledgment

This National Agricultural Mechanization Strategy was developed with the support and contribution of many partners. The Ethiopian Agricultural Transformation Agency (ATA) and the Ministry of Agriculture (MoA) would like to express appreciation for the continuous engagement with, and the insight, guidance, and information provided by partner organizations from government, research and education institutions, industry, and non-governmental organizations. The ATA and MoA are appreciative of all the generous support received and look forward to continued collaboration in the implementation of the Strategy and pursuit of the transformation of the Ethiopian agriculture.



## Executive Summary

### *Purpose and approach*

This strategy outlines the most significant constraints to agricultural mechanization and proposes interventions that lay the foundations for a more value-adding, efficient and inclusive agricultural landscape in the next five years. Specifically, the vision for the sector is to **“Increase national food production and security through enhanced and sustainable use of agricultural mechanization technologies in order to support Ethiopia’s middle-income status by 2025”**.

The stimulus behind this strategy is the increasingly urgent need to address long-standing trends that are now reaching a critical point: low crop productivity (especially in comparison to comparable African countries) leading to enhanced food security concerns among a growing population, lack of access to and usage of mechanized technologies among female and male farmers due to a varying amalgamation of structural, financial and policy related constraints, as well as inadequate capacity to manufacture and/or import machinery.

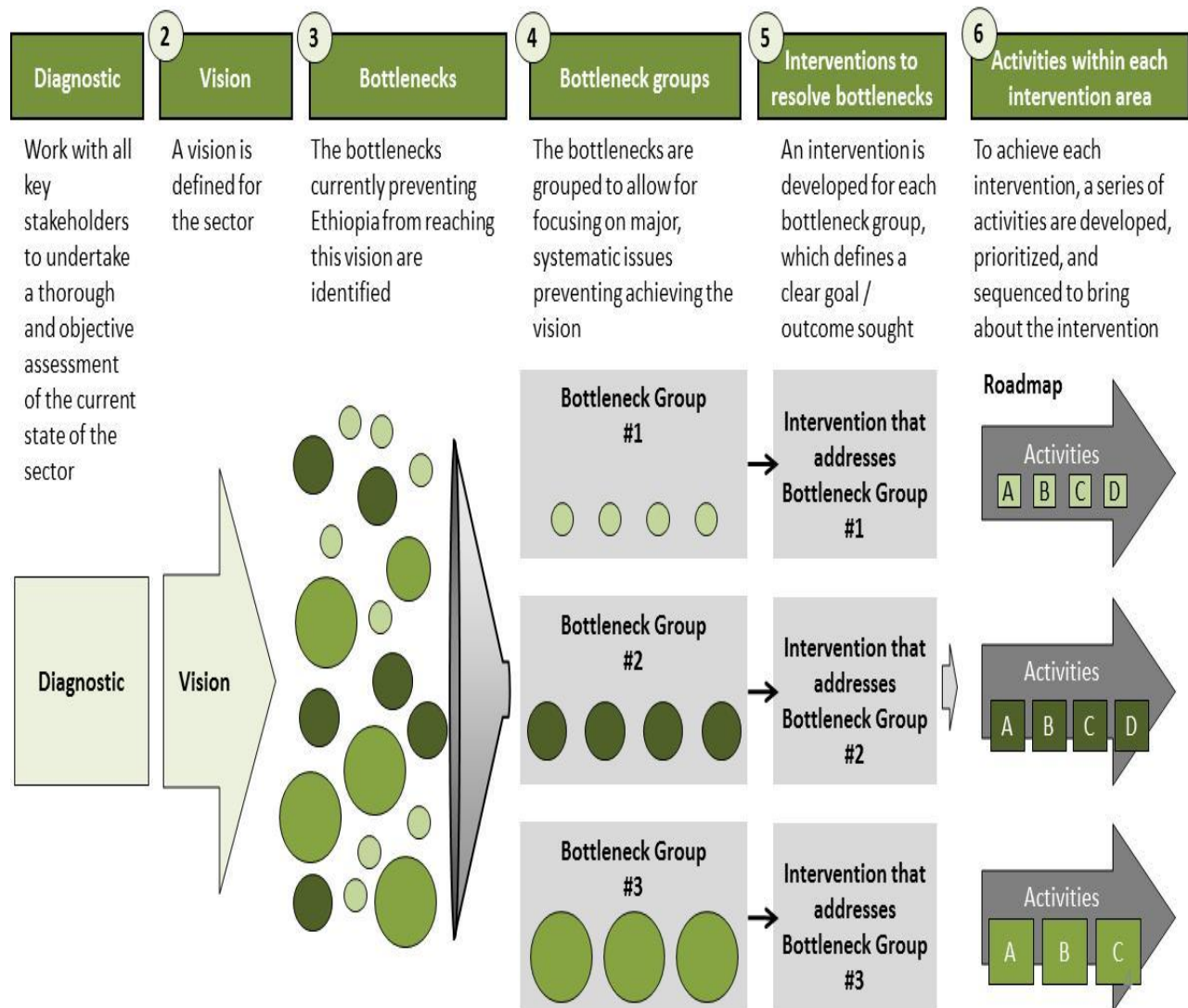
These set of challenges are not new to the country; indeed, many initiatives have been undertaken to address some of them in various forms. However, this strategy not only represents the first comprehensive outline of mechanization’s status and potential in the country but also clearly outlines a set of activities that articulate the roles of key stakeholders and aligns their initiatives. Therefore, **the engagement of partners in the strategy formulation process is important in ensuring the successful execution of this strategy.**

### *Approach*

The strategy formulation process has sought to test the full array of the mechanization value chain, from research and technology development all the way to after-sales services. It drew on a highly rigorous process that is systemic and hypothesis driven (see Exhibit I).



**Exhibit I: Strategy formulation process**



To ensure that the ideas and analyses are wholly captured and reflect accurate data, a variety of qualitative and quantitative tools were utilized (see Exhibit II).

**Exhibit II: Key tools and inputs utilized for the strategy**

|                           |   |   |
|---------------------------|---|---|
| Stakeholder workshops     | Participatory process across public and private sector          | <ul style="list-style-type: none"> <li>Invited stakeholders to discuss a variety of issues across the value chain</li> <li>Held a series of sessions and involved leaders from MoA and BoA, the extension system, leading private sector companies, technical and vocational training institutions</li> </ul> |
| China-Brazil case studies | Data-driven assessment directly linked to policy prioritization | <ul style="list-style-type: none"> <li>Commissioned a world leading consulting firm to conduct best practice study of mechanization’s trajectory in China and Brazil, with deep emphasis on policy interventions</li> <li>Adapted best practices to Ethiopian context</li> </ul>                              |
| TAA experience            | Applied knowledge and experience                                | <ul style="list-style-type: none"> <li>Utilized wealth of experience and knowledge of TAA &amp; ATA program team</li> <li>Integrated analyses and findings from previous and current deliverables within TAA into document</li> </ul>   |
| On-the-ground research    | Generation of new data  | <ul style="list-style-type: none"> <li>Circulated questionnaires and collected data from most relevant actors in the value chain including machinery importers, manufacturers, MoA, Agricultural Research Institutions</li> </ul>   |
| Expert engagements        | Applied knowledge and experience                                | <ul style="list-style-type: none"> <li>Ensured deep involvement of mechanization experts throughout the process</li> </ul>  |

The intersection of each of these tools and resources has allowed for a comprehensive picture to emerge in the sector that is built on the basis of quality data.

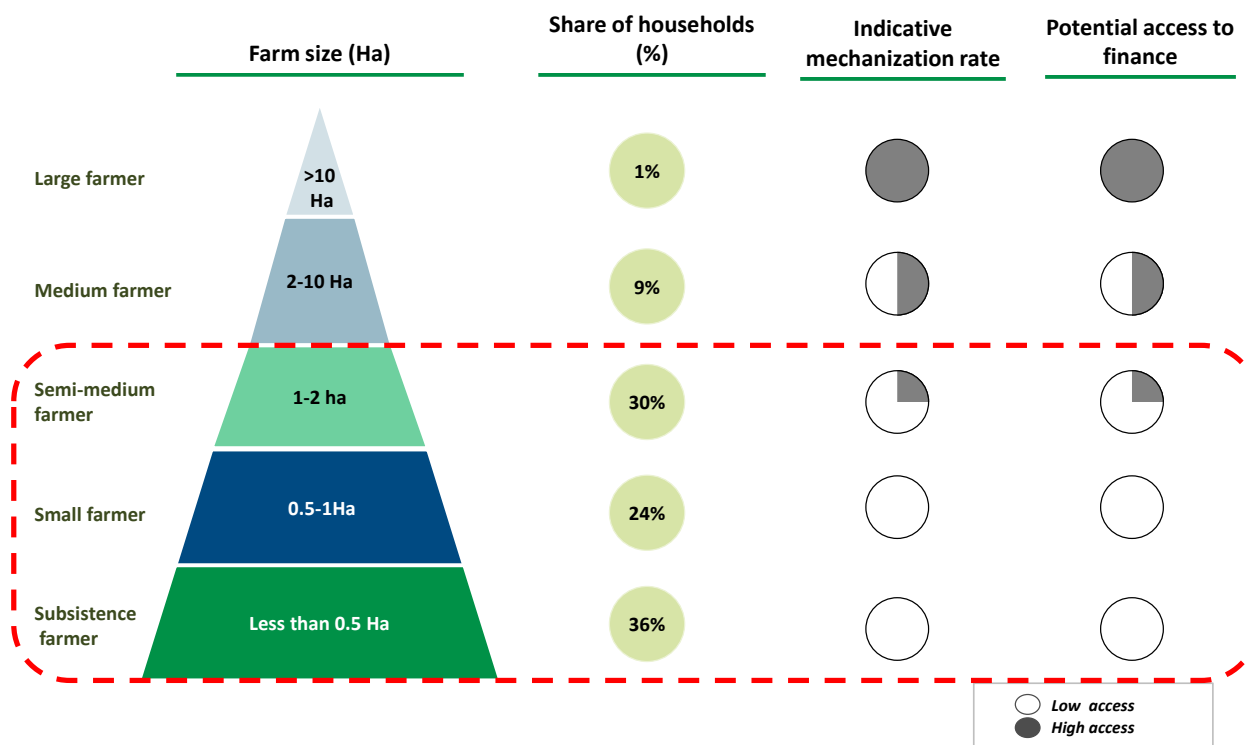
*Context of and vision for agricultural mechanization in Ethiopia*



Agriculture represents approximately 43% of Ethiopia’s GDP, and is accountable for providing livelihoods to roughly 80% of the population. Traditionally, Ethiopian agriculture is low-input and low-output, leading to crop productivity levels that are significantly below regional and international standards. For example, wheat yields in 2008 were approximately 77% of the African average and 56% of world average yields<sup>1</sup>. While agricultural mechanization has shown to be an effective way of increasing production, it so far has not experienced significant application or use in the Ethiopian smallholder context. The set of challenges facing the widespread adoption of mechanized technologies is spread across the value chain, from research and development of new implements all the way through to after-sales service.

This level of discrepancy can be partly explained by the level of mechanization among Ethiopia’s farmer households (see Exhibit III). Nearly 85% of the population resides in rural Ethiopia and smallholder farmers account for 90% of farmer households. Smallholder farmers have very limited to no access to mechanized technologies making it difficult to produce at a scale that is comparable to African and international averages.

**Exhibit III: Ethiopian farmers by segment, level of mechanization and access to finance**



<sup>1</sup> Yield Gap and Productivity Potential in Ethiopian Agriculture: Staple Grains & Pulses, 2010 (Data from FAOSTAT)



The vision of this strategy is to “Increase national food production and security through enhanced and sustainable use of agricultural mechanization technologies in order to support Ethiopia’s middle-income status by 2025”.

An informed mechanization strategy will not simply contribute to the enhanced livelihoods of smallholder farmers, but it could also potentially set the foundation for greater sustainable development and industrialization. Stimulating the productivity of agriculture will not simply resolve food constraints and allow farmers greater purchasing power, but it has the potential to contribute to the development of downstream agricultural activities such as processing and create value-adding jobs in manufacturing. In turn, these initiatives will serve as key enablers for Ethiopia to reach middle-income status by 2025 and will help the country (and its most vulnerable citizens) dependency away from Agriculture.

At a high-level the strategy aims to fulfill the following objectives:

- Raise the level of Ethiopian agricultural mechanization from 0.1 kW/ha to 1 kW/ha, with at least 50% derived from mechanical /electrical power
- Reduce the use of animal power for agricultural operations by 50%
- Promote the usage of agricultural mechanizations technologies that can be used by female farmers making up at least 30% of the user population, and that mitigate environmental degradation
- Address at least 50% of the needs of pastoralists and agro-pastoralists for mechanization inputs

However in order to achieve these objectives, systemic bottlenecks in the system will need to be overcome, or at the very least, mitigated to allow for transformation to take place.

*Key systemic bottlenecks and strategic interventions*



The key bottlenecks and interventions identified in the strategy were plotted against each aspect of the value chain (see Exhibit IV).

**Exhibit IV: Key bottlenecks and interventions**



In identifying the necessary interventions needed to overcome these bottlenecks (especially among the



more downstream components of the chain), this strategy categorizes mechanized implements into two broad categories, 'low mechanization' and 'high and intermediate mechanization'. This allows for each intervention to be designed according to the level of sophistication of equipment.

For Low Mechanized Implements, a package of equipment should be identified to best service smallholder farmers that can be distributed and promoted through the existing extension system and smaller retail outlets. The rationale for the categorization of these implements is based on how they would be accessed and how much time they are used on a farm on an annual basis. This would dictate that for implements such as improved ploughs, it would be most effective for farmers or groups of farmers to own these implements directly. Initially, the design and approval of these implements should be led by the public research system and production should be undertaken by private domestic manufacturing enterprises on a local level. To support usage, the 'package' of basic implements should be supported through greater promotion and training through the extension system. In order to help facilitate usage, access to credit should be increased in line with existing input credit systems. Local blacksmiths and artisans should be encouraged to participate in after-sales support activities and be accredited in the necessary skills to perform basic repairs and maintenance.

For motorized high and intermediate machinery, joint venture partnerships (with Ethiopian controlling interests) should be formed to support research into priority opportunity areas and develop, fabricate, and ultimately distribute machinery to supplement domestic supplier capabilities. Research and development should serve to make advanced machinery more available to smallholder farmers. The public research system should provide support and also be able to leverage existing knowledge of more advanced technologies and establish more effective methods of bringing it in-country. In the long-term, importation restrictions of equipment should be eased and focus should be put on building domestic capacity for assembly and production. Efforts would also be made to improve distribution networks, on both a national and regional level; which would also allow for the provision of improved maintenance and spare parts.

Motorized high and intermediate machinery would be taken to farmers using contractors, who would operate under a 'fee-for-service' model. This will allow farmers to benefit from the machinery without having to bear the cost of purchasing the equipment. An additional advantage of this model is that many advanced implements require extensive training, and would ensure that operators of machinery have the technical skills to effectively provide services. By utilizing highly trained operators many of the current barriers to adopting high and intermediate mechanized implements in smallholder agriculture could be overcome. The private sector and the extension system should collaborate on providing agronomic demonstrations. Operators should also engage the support of Regional and Zonal staff to help assess and identify high priority areas; provide cropping information, support demonstration events and provide linkages to maintenance services.



To achieve this vision and successfully employ mechanized technologies to a significant number of smallholder farmers in the coming years, a comprehensive and coordinated effort will need to be made by a variety of public and private stakeholders. The key stakeholders identified and their current and ideal roles are represented in the exhibit below (see Exhibit V). While certain stakeholders have undertaken mechanization initiatives, most of their activities are weak and largely uncoordinated. Conversely, the mechanization strategy aligns stakeholders and ensures they are leveraged based on their competencies.

**Exhibit V: Key stakeholder and their roles (actual versus ideal)**

|                                   | Research and Technology Development | Manufacturing and Import | Distribution | Promotion, Purchase and Usage | After-sales Service |
|-----------------------------------|-------------------------------------|--------------------------|--------------|-------------------------------|---------------------|
| MoA and RBoA                      | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Foreign Companies                 | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Distributors/ Retailers           |                                     |                          | ✗            | ✗                             | ✗                   |
| Service Providers                 |                                     |                          |              | ✗                             | ✗                   |
| NGOs/ International Organizations | ✓                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Smallholder Farmers               |                                     |                          |              | ✗                             | ✗                   |
| SMEs                              | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Large Domestic Companies          | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Government Research Institutes    | ✗                                   |                          |              | ✗                             |                     |
| Artisan producers                 |                                     | ✓                        |              |                               | ✗                   |
| Ethiopian Standards Agency        |                                     | ✗                        |              | ✗                             | ✗                   |

**Key**    ✓ Presence    ✗ Weak presence    ✗ Little to no presence    Ideal role of stakeholders

To this end, and based on this strategy, the Government of Ethiopia needs to create a detailed implementation plan to achieve this vision and increase the productivity and livelihoods of smallholder farmers.



## Chapter 1: Introduction

### 1.1. Purpose and Scope

This document was created to align stakeholders across the agricultural mechanization value chain on a unified and comprehensive strategy that will improve the production and profitability of primarily smallholder farmers by facilitating and increasing their use of agricultural mechanization. In particular, it aims to achieve five specific objectives:

- Define the national **visions and strategic objectives** for agricultural mechanization until 2025, with clear interventions and key activities detailed for the next five years
- Identify the current context and primary **bottlenecks** to smallholder farmers' success in each step of the value chain
- Develop national agricultural **mechanization business models**, describing key actors and their interactions, including strategic objectives, and; design a set of comprehensive, actionable **interventions** addressing these bottlenecks and achieve the ideal states for these national business models
- Propose a series of **prioritized key activities** and appropriate owners to successfully carry out the strategy
- Outline an **implementation plan** to actualize the above components

The strategy will focus on agricultural mechanization technologies, spanning the following areas: Tillage and land preparation, sowing and planting, crop protection and maintenance (e.g. weeding fertilizers and insecticides application), harvesting, threshing and shelling and other post-harvest processes (e.g. drying, storages, transport, agro-processing and applications towards livestock mechanization).

However, it should be noted that this strategy document does not include **implementation timetables, budgets, or resourcing assessments** for the proposed interventions, which will be designed by the implementing owner and respective stakeholders after the national strategy has been finalized. Rather, it is a working document and that may be further revised based on additional findings/analyses and stakeholder feedback.

In the meantime, this strategy is the result of key stakeholder consultations, as well as full extensive discussions with the Ministry of Agriculture. As such, it represents the national vision for agricultural



mechanization for the country, and should serve as a blueprint to mobilize all relevant public, private, and public-private stakeholders towards overall sector development.

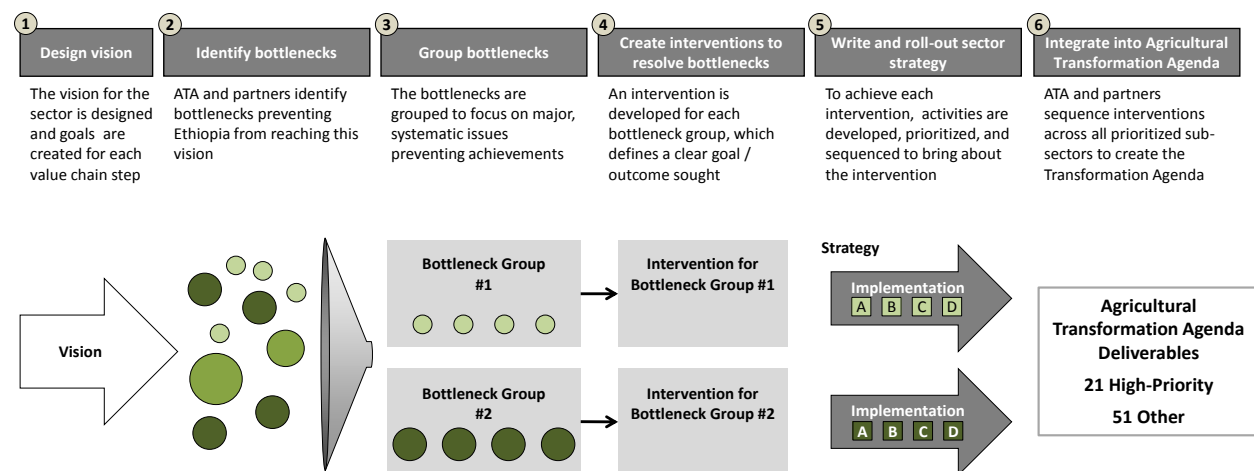
## 1.2. Strategy Development Approach

The Ministry of Agriculture (MoA) and the Ethiopian Agricultural Transformation Agency (ATA) jointly developed this national agricultural mechanization sector strategy through a series of strategic, systematic, and stakeholder-consultation processes starting in December, 2013.

First, the ATA worked closely with the MoA Mechanization Directorate and other stakeholders to discuss the **vision** and desired scope for agricultural mechanization strategy development. Given the significant challenges present today, this vision statement is aimed to be both inspirational and realistic, capturing a snapshot of what the agricultural mechanization sector should look like in the near future.

By way of processes (broadly following the steps outlined in Exhibit 1), initially a core strategy development team was established and a steering committee to guide the overall strategy process was formed. Subsequently, the core development team collected primary and secondary data to help frame the strategy scope and direction. Next, qualitative and quantitative analyses were conducted on this data to understand the key issues and constraints that form **bottlenecks** to the realization of the discussed vision – the most critical of which are detailed in this document.

**Exhibit 1: From vision to roadmap: how the ATA approaches problem-solving**



Distinctions were made between bottlenecks in order to frame solutions on discrete key issue areas that, though interrelated, engage distinct sets of stakeholders who can work independently to drive results in parallel. All bottlenecks have been identified through:



- **Systematic interviews** with experts and stakeholders, including MoA, research organizations, academia, and other development partners
- **Extensive review of relevant literature** from existing reports published by local and international experts to provide a baseline understanding of the agricultural mechanization sector
- **Original research**, including quantitative analyses on production, price, and sales trends, interviews and field visits, and case studies
- **Stakeholder workshops**, using problem-solving sessions with both industry experts (mini-workshops) and high-level officials (Steering Committee) to identify the most critical constraints and issues in the sector<sup>2</sup>

Next, interventions were designed to address these sets of bottlenecks. Collaborating closely with the relevant stakeholders, the MoA/ATA developed a set of targeted **interventions** to address and overcome the constraints posed by bottlenecks in the agricultural mechanization value chain, which in addition to the bottleneck data and analysis identification process was guided by the following:

- Historical experience in Ethiopia of successful and unsuccessful projects in the sector
- International best practices, with a strong focus on Brazil and China case studies commissioned by the ATA, with core recommendations tailored to the Ethiopian context
- Consultations with experts, using problem-solving sessions to form workable hypotheses with the many stakeholders named in this document
- Stakeholder workshops

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

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<sup>2</sup> A total of 115 people attended four workshops from MoA, RBoAs, EIAR and RARIs, higher learning institutions and TVETs, NGOs and the private sector



### 1.3. Definition and Value Chain of Agricultural Mechanization

Agricultural mechanization can be defined as the economic application of engineering technology to enhance the effectiveness and productivity of human labor.<sup>3</sup> This includes land preparation to planting, harvesting, on-farm processing, storage, and marketing of products.<sup>4</sup>

As shown in Exhibit 2, the above definition is taken through a value chain analysis to address the full array of conditions that affect smallholders' ability to engage in agricultural mechanization. A value chain approach helps to analyze and address the major constraints faced by the sector under consideration and use opportunities available at multiple levels along the chain. A value chain describes the full range of activities, which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery and support to final consumers.<sup>5</sup>

While appreciating the relevance of the value chain approach, one must also consider that all activities outlined are not necessarily linear. This strategy will detail and elaborate these exceptions wherever relevant.

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<sup>3</sup> FAO and UNIDO, 2008

<sup>4</sup> Rijk, 1999

<sup>5</sup> WBCSD, 2011

**Exhibit 2: The agricultural mechanization value chain components**



| Value chain step                    | Overall objective for the agriculture mechanization  |
|-------------------------------------|--|
| Research and Technology Development | Includes all aspects of understanding the needs of farmers and developing technologies that meet those needs.  |
| Manufacturing and Import            | Includes the supply and/or manufacturing of agricultural equipment, whether it is domestically or internationally-sourced.   |
| Distribution                        | Includes the establishment and/or functionality of the up-stream ecosystem of how technology is introduced and made accessible to the end user; as defined by the relationship between either the manufacturer/distributor/agent or operators, but not to the end recipient. |
| Promotion, Purchase and Usage       | Includes the establishment and functionality of the down-stream ecosystem of how technology is taken to farmers, including promoting benefits of the technology, physical usage, and transaction support.  |
| After-sales Service                 | Includes all services dedicated to the upkeep and ensuring optimal functionality once the technology have become operational.  |

**1.4. Major Stakeholders**

To realize the overall vision contained in this document by 2025, stakeholders across all sectors and levels of Government must be engaged. Below are some of the key direct stakeholders who have been involved in the process of formulating this sector strategy and in its implementation in the future. The successful execution of this strategy will depend on their commitment, alignment, and continued engagement over the next five years.

**Ministry of Agriculture and Regional Bureaus of Agriculture**

The **Ministry of Agriculture** is responsible for developing the overall national agricultural and rural development strategies and policies for Ethiopia, with input and support from the regions and other stakeholders. Within the MoA, the **Mechanization Directorate** oversees the agricultural mechanization program. The Mechanization Directorate will coordinate implementation of the mechanization strategy in collaboration with its regional counterparts. In addition, the MOA Mechanization Directorate will take the lead role in organizing joint planning, monitoring and evaluation sessions to align all stakeholders over the sector strategy. The MoA’s continued engagement on the agricultural mechanization value chain – both through the Mechanization Directorate and other directorates (Input, Extension) will be essential for the success of the agricultural mechanization sector. The **Extension Directorate** oversees services used to promote and popularize new technologies and practices through the public extension system. The Extension Directorate works closely with counterparts at the RBoAs, and zone and woreda levels offices of agriculture.



### Government research institutes

Agricultural mechanization research occurs through the **Ethiopian Institute of Agricultural Research** (EIAR), which is responsible for the design, implementation and coordination of federal-level agricultural research, and the **Regional Agricultural Research Institutes** (RARIs), which are expected to conduct targeted research based on the various agro-ecologies to identify region-specific needs and recommendations. EIAR and RARIs collectively form the **National Agricultural Research System** (NARS). Together, they contribute and play an important role in developing and disseminating research on agricultural best practices for Ethiopian smallholder farmers.

### Artisan producers

These are locally-based skilled individuals known as blacksmiths responsible for the production of basic implements (mainly LMIs), such as the traditional plow (*marshal*), sickles, and *wege*.<sup>6</sup> The blacksmiths are basically based on family labor and as they are also farmers the job is considered as an additional income generation. Occasionally artisans also have some informal employees.

### Small and Medium Sized Enterprises (SMEs)

Privately owned Small and Medium Enterprises (SMEs) currently supply the majority of agricultural machinery used in Ethiopia, often by producing units and then selling directly to the RBOAs or to farmers through informal channels. Examples of these implements would be sickles, ploughs or stationary threshers, going across both LMIs and some HIMIs.

### Large domestic companies

These companies are larger (based on market size, facilities and access to capital), mainly private sector entities that have, often with pre-existing relationships with foreign suppliers. These types of entities are needed to provide the scale, financing, facilities, technical resources to the development and supply of agricultural machinery at scale. Producing, or even importing, medium/large agricultural machinery into Ethiopia in significant number is capital intensive and often requires significant financing as well as assembly facilities. Currently only a limited number of entities can accommodate this type of activity.

### Foreign companies

Large foreign agricultural machinery companies are responsible for the majority of agricultural machinery used in highly developed agricultural economies. While much of the technology that has been developed by large agricultural machinery manufacturers is applicable to Ethiopia, there is relatively little direct local presence by these entities. Most are only represented by agents/distributors, and there is

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<sup>6</sup> A pair of metal made loops used to join maresha with the other plough attachments



almost no design/adaptation directly for the Ethiopian market/smallholder agriculture.

### Distributors/ Retailers

This includes those entities that purchase goods with the aim of reselling, either on a wholesale or a retail level. This could include those who act as a sole importer of agricultural machinery with the direct aim to sell to others, or those who work on a regional level and may handle multiple brands.

### Service providers

Those who provide a type of labor output for a fee, irrespective of the type of skill involved. This includes both those who operate machinery as a service to other farmers/recipients as well as those who support the operational functionality of machines, such as mechanics.

### NGOs/international organizations

A number of multi- and bi-laterals, along with some non-Governmental organizations have worked to help promote the advantages of mechanization in recent years. NGOs can also play a valuable role in promotion and dissemination of technologies, providing an alternative to the public extension system.

### Smallholder farmers

Smallholder farmers, defined as female and male farmers who own less than 2 hectares of land, make up around 90% of the farmers in Ethiopia. They are the ultimate users and beneficiaries of agricultural mechanization, and therefore a participatory approach is critical in all stages and sectors of the agricultural mechanization system, be it determining which types of technologies are produced and identifying distribution models that can more efficiently reach smallholder farmers.

## Chapter 2: Current Context for Agricultural Mechanization and Opportunities

### 2.1. Overview of Ethiopian Agriculture

Agriculture is the second largest contributor to overall economic growth and a significant contributor to reducing poverty. In 2012-13, it accounted for about 42.9% of national GDP (only slightly behind the services sector at 45.2%)<sup>7</sup>, almost 90% of foreign exchange earnings, and 85% of employment.

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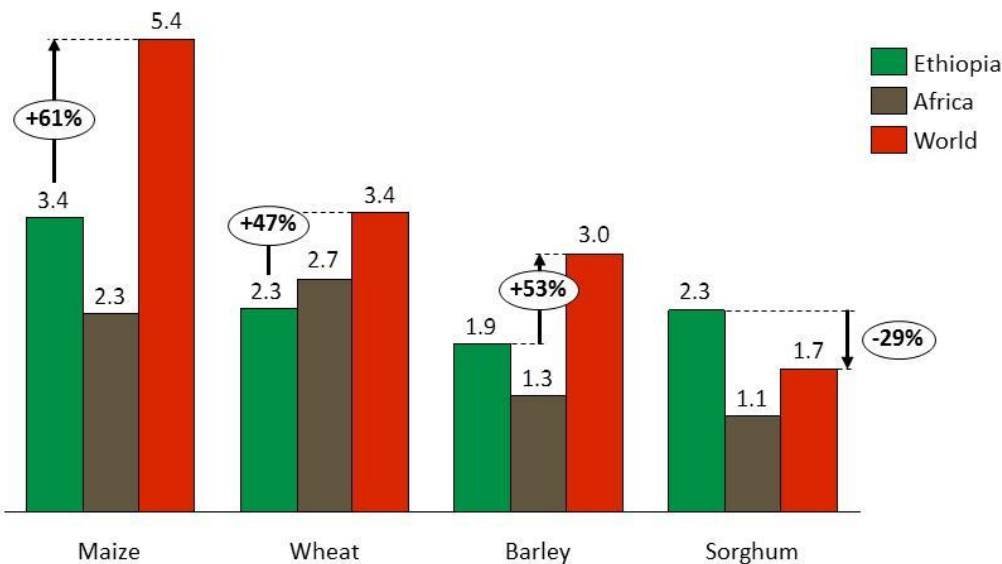
<sup>7</sup> FDRE MOFED, *Macroeconomic Indicators for 2012/13*

While agricultural productivity in Ethiopia is improving, there are still major gaps in productivity when compared with the rest of Africa in some crop areas, and almost universally, when compared with global output levels.<sup>8</sup> For example, in the African average production of wheat is approximately 10% more productive per hectare, and the global average is almost 50% higher than Ethiopia (as detailed in Exhibit 3). In countries like China, there have been significant correlations between increased use of agricultural mechanization and increased productivity.<sup>9</sup> Even with significant improvements in productivity in recent years, Ethiopia is still a net wheat importer. In addition to this, approximately only 12% of the total arable land is utilized for agriculture, with an expectation that this percentage will grow, both in relative and absolute terms.

**Exhibit 3: Comparative productivity of staple crops<sup>10</sup>**

**Productivity per crop in 2012 – Comparison with regional and world averages**

Yield (Tons/Hectare)



Ethiopia’s farmers are also diverse; agriculture is dominated by smallholder farming. There are approximately 14.7 million households, of which, approximately 60% of which operate on less than 1

<sup>8</sup> FAO, 2014

<sup>9</sup> Booz & Co. (2014)

<sup>10</sup> UN FAO Statistics, 2012



hectare<sup>11</sup> of land while only approximately 1% of farmers operate on land greater than 4 hectares<sup>12</sup>. As shown in Exhibit 4, Ethiopian farmers can be categorized generally into the following categories:

- **Marginal farmers** have an average farm size of less than 0.5 hectare and represent approximately 36% of the rural households. They primarily produce commodities exclusively for their own consumption. As a result, marginal farmers have very limited purchasing power and are less knowledgeable of appropriate agronomic practices.
- **Small farmers** have an average farm size between 0.5 and 1 hectare. These farmers primarily produce crops for their own consumption, with the remainder of their commodities marketed through cooperatives/local markets. They may have access to informal finance to support their on-farm activities. Small farmers have limited access to agricultural mechanization; they primarily rely on LMIs. They typically also leverage family labor to support on-farm activities.
- **Semi-medium farmers** have an average farm size between 1 and 2 hectares. They produce at least one cash crop and market the crop through cooperatives. While they may have access to MFIs to finance their farming, their access to mechanization is limited and still relies primarily on LMIs. Similar to marginal and small farmers, they largely depend on the family labor.
- **Medium farmers** have an average farm size between 2 and 10 hectares. They are largely commercial producers and have some market access, but do not benefit from full access to market information. They employ a combination of skilled and external labor. Medium farmers may be partly mechanized with informal access to tractors and combine-harvesters, depending on their location.
- **Large farmers** have an average farm size that is larger than 10 hectares. These are mainly commercial farmers (and some State farms) with access to the most advanced practices. They have greater market information and access to markets. Commercial farmers can employ skilled labor to support their on-farm activities. They also have access to bank loans or other external capital, privileging them to key farming benefits like improved inputs and technologies. Commercial farmers are fully mechanized with tractors and combine-harvesters.

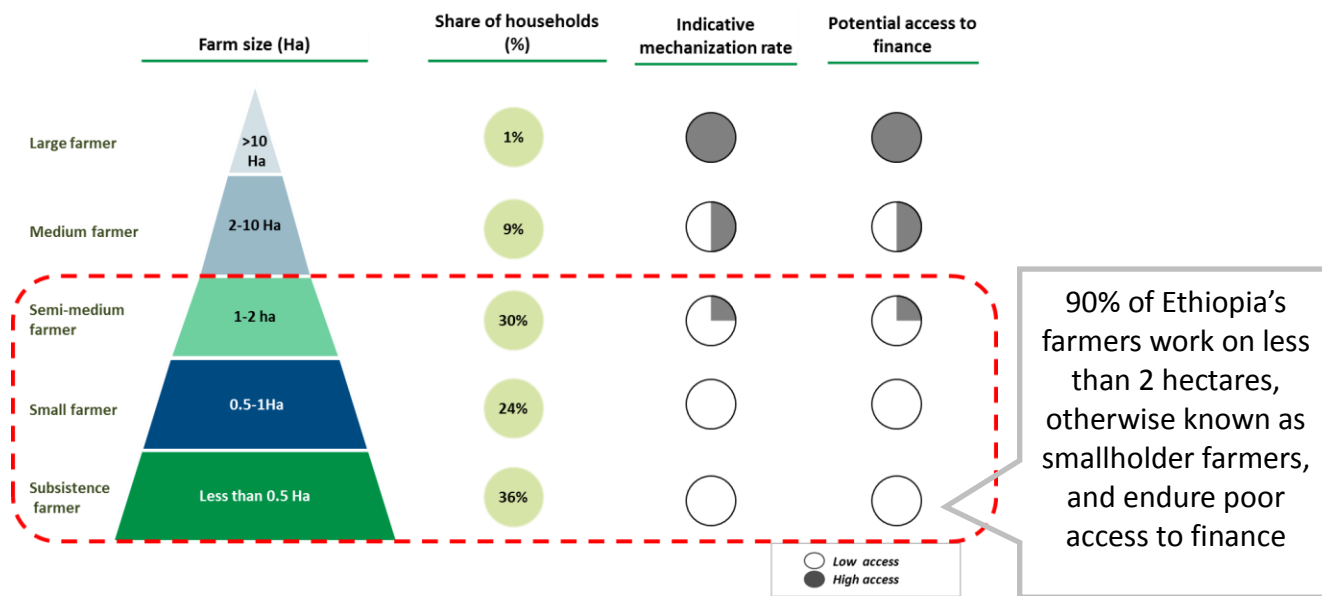
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<sup>11</sup> Sustainable Development among Rural Women, Youth and Poor Households in Ethiopia (2014), PAA-Africa (2014)

<sup>12</sup> PAA-Africa (2014)



### Exhibit 4: Segmentation of Ethiopian farmers



## 2.2. Background and Current Status of Agricultural Mechanization

There are three levels of primary power sources for agricultural mechanization:

1. **Hand tool technologies** are the most basic level of agricultural mechanization, employing only human muscle as the main power source.<sup>13</sup> Examples include: a shovel or a pick
2. **Animal draught technologies** are implements and machines that employ animal muscle as the main power source.<sup>14</sup> For example, a traditional plough is an animal draught technology
3. **Mechanical power technologies** are implements that employ mechanical power as their main power source. Examples include anything from tractor-mounted planter to an engine-driven thresher/harvester

<sup>13</sup> Rwanda Mechanization Strategy, 2010

<sup>14</sup> Rwanda Mechanization Strategy, 2010



When looking at commonalities amongst machinery types, there is more in common between small tools that could either be animal or human powered. These are most often relatively affordable (the majority falling under 10,000 birr), which will be referred to in this document as **Low Mechanization Implements (LMIs)** and then larger implements which require additional power coming from either engine or by being attached to a tractor for their energy source<sup>15</sup>; these will be referred to as **High and Intermediate Mechanization Implements (HIMIs)**. For the purpose of this strategy, they will be classified into these two categories, which closely correlate with their projected/actual use in Ethiopia and the way in which they are most readily deployed, as opposed to a specific similarity in operation, cost, function, etc.

Agricultural mechanization (as defined above) is not new to Ethiopia. The introduction of mule pulled ploughs by the Jimma Agricultural Technical School in late 1950s were followed by additional efforts made by Chilalo Agricultural Development Unit (CADU), Wolaita Agricultural Development Unit (WADU) and Ministry of Agriculture amongst others, in early and late 1960s. Many implements still in use on farms across Ethiopia demonstrate the efforts made towards developing home grown agricultural mechanization. In support of such mechanization effort, the first university program in agricultural engineering started in 1959 of what is now Haramaya University. The program linked education research with extension work in various aspects of agricultural engineering. However, the curriculum did not address fundamental subjects such as soil and tillage mechanics, engineering properties of biological materials, machine design, nor design of agricultural machinery. Consequently, graduates were not prepared to design, assess or evaluate imported and locally made agricultural machines.

In 1976, the Agricultural Mechanization Research Unit (of the then Agricultural Implements Research and Improvement Center) was hosted in Melkassa Agricultural Research Center and still serves as an apex unit in the country working on agricultural mechanization, but with little impact on smallholder farmers. In 2000, the Agricultural Mechanization Research Directorate was established within EIAR. Parallel restructuring also took place at the regional level and the major regions (with the exception of SNNPR) established their own research programs on mechanization, including:

- Bahir Dar Mechanization and Food Science research center under the Amhara Agricultural Research Institute
  
- Mekele mechanization and rural energy research center under Tigray Agricultural Research Institute

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<sup>15</sup> *Mechanizing Philippine Agriculture for Food Sufficiency*, 2011



- Assella, Bako, Jima and Fedis agricultural mechanization research centers under Oromia Agricultural Research Institute

In addition to the public research institutes, the contributions of private institutions such as Selam Vocational Training centers to the development of agricultural mechanization technologies have been significant.

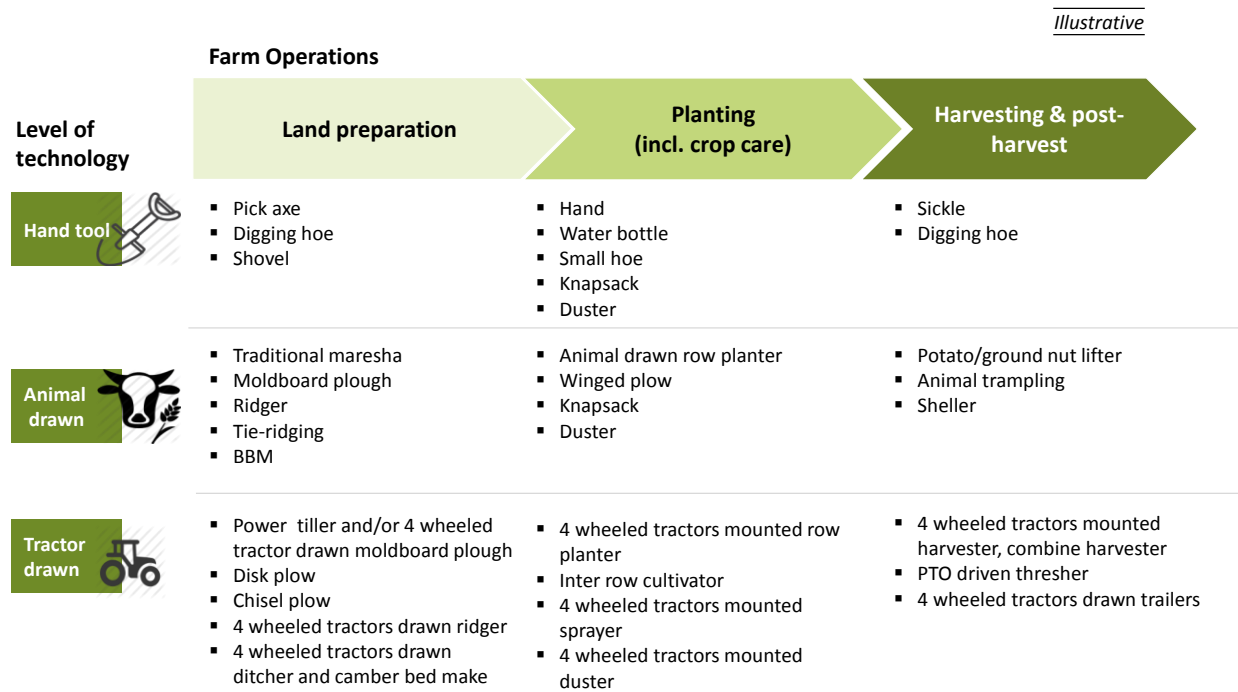
While agricultural mechanization is a valuable instrument to the growth and development of agriculture, its progress in Ethiopia has been slow. Currently, there is approximately only 0.1 kW per hectare.<sup>16</sup> The farm power is calculated from current labor available from oxen at 13 million head (87%), and 12,500 tractors (13%). While this index is used to show mechanization, the primary contributing factor still remains oxen power. As detailed in Exhibit 5, the most common implements utilized in Ethiopian agriculture are still animal-drawn implements, such as ploughs.

Based on the previous stratification of farming households and their respective land size, approximately 36% of households are engaged in subsistence farming, meaning they live off less than 2 USD per day. This limited purchasing power among the majority of farmers indicates that the bottom tier will likely only have access to LMIs for purchase. The remaining 64% of farming households (small, medium and commercial), however, will have significantly greater purchasing power, allowing them greater access to more advanced machinery. This analysis serves as the basis for this strategy's structure around the target demographics for both LMIs and HIMIs.

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<sup>16</sup> internal analysis

**Exhibit 5: Common agricultural implements used in Ethiopia**



Power-driven agricultural mechanization utilization in Ethiopia is present in some large geographic areas where farms are largely single crop-based and contiguous. This allows for larger scale machinery to be applied across smallholder farmers more economically, by operating in a denser geographic area, resulting in less idle time for the operator. For example, farmers in the Arsi-Bale wheat belt region currently utilize mechanized technologies offered by contractors on a per unit cost structure. Specifically, combine harvesters are deployed through this modality. These farmers pay a similar financial fee that is comparable to traditional harvesting and threshing costs, but experience in other, well-developed agricultural economies shows that mechanization utilizing large-scale agricultural machinery significantly lowers crop losses. While these technologies are present on a small scale in Ethiopia, there is little structure or oversight on their operations or functionality.

Given that agricultural mechanization is only reaching a small subset of farmers today, significant effort will need to be made to effectively catalyze mechanization to reach a majority of farmers. This will require a concerted effort among the public and private sectors to align on the vision and approach to be implemented over coming years.



### 2.3. Value Addition from Agricultural Mechanization

The overall benefits of increasing agricultural mechanization are immense and wide-ranging, both on agricultural productivity, as well as overall livelihood development. These range from direct benefits on smallholder agriculture to the indirect economic benefits, including:

- **Increased production mainly of priority crops:** Across the value chain, mechanized devices have been shown to increase overall production in smallholder agriculture compared with traditional practices.<sup>17</sup> For example, by threshing tef with mechanized threshers, post-harvest losses can be reduced by up to 30%. The main direct benefit to smallholder farmers is improved livelihoods through increased food production and income. Indirect benefits include improved food security in the country on a macro level, reducing dependence on imports and improvements to living standards. ATA analysis shows that in utilizing tef row planters, farmers can earn an additional 2.5 billion USD in ten years if only 20% of farmers mechanize and they will support the food requirements of an additional 6 million individuals (or approximately 6% of the population).
  
- **Minimize in labor units and manual labor:** Much of the traditional agricultural practices are highly labor-intensive and inefficient. Utilizing machines can save farmers a significant amount of effort and time (time that can be invested in performing other economically and socially productive activities). For example, when a farmer plants tef by hand, planting a hectare with the correct seeding rate can take days but by utilizing a mechanized planter, this process can be reduced to a few hours. Additionally, the majority of the workforce is utilized in agricultural production, limiting the workforce available to perform other functions in the country. Reduced man-hours on the farm can provide farmers with additional opportunities with which to seek additional sources of income. The indirect impact will result in increased overall economic output for the country. The introduction of mechanized devices can additionally encourage female-headed households to participate in activities that were deemed labor intensive and difficult to perform, allowing them to increase their production.
  
- **Managing use of inputs:** Mechanized devices reduce the amount of inputs, such as seeds and chemicals, helping farmers reduce some of their variable costs. Additionally, adopting

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<sup>17</sup> ATA team analysis



mechanized practices has also been shown to achieve similar yields, but with much less labor input, or increased overall agricultural output. Reductions in chemical input usage (15-40%, depending on input and crop) can save farmers on input costs, and by reducing seed usage, they can also increase food availability (reducing seeding rates by 15-90%, depending on input and crop type).<sup>18</sup>

- **Enhanced quality of agricultural output:** Mechanized devices can also contribute to increased quality of crop output, especially when used in post-harvest activities. For example, a mechanized thresher can significantly reduce soil contamination that is often hard to avoid when performed manually. Direct benefits to farmers can include increased income, through the selling of better quality crops. One of the easiest methods to increase agricultural revenue is by increasing the quality of output, which allows for higher market price, especially through export. Indirect benefits include increased opportunities for export, and by extension an increase in foreign currency reserves.
  
- **Supporting rural employment and increasing skill diversification:** The introduction of a mechanization sector can create additional employment opportunities for rural populations. For example, machine service providers will be needed to offer operation, maintenance and repair services to a whole host of farmers who require those services. These businesses will require a number of full-time employees who can operate and provide technical assistance. These sectors will demand farmers with a more advanced skillset who can be trained to perform these activities. Moreover, the sector creates opportunities for the non-farming community. Industrial designers, engineers, and manufacturers will need to be trained to design and produce the machines. This will allow them to expand their know-how to industries outside of agriculture, and contribute to the country's industrialization agenda. By moving labor away from primary agricultural production to creating service providers to supporting agricultural productivity, mechanization can support the creation of alternative livelihood opportunities other than smallholder agriculture.
  
- **Supporting overall industrialization:** Improved practices in agriculture can accelerate the rate of Ethiopia's industrialization. Currently, Ethiopia still has a very low manufacturing/industrial base. By focusing on building skills in the areas of producing agricultural machinery, this sector could be developed and broadened past agricultural machinery to other types of manufacturing/industries.

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<sup>18</sup> ATA team analysis;



Overall, initial forays into agricultural mechanization would prioritize increasing overall agricultural productivity and increasing food security, however the additional benefits of mechanizing the sector would have a significant positive impact on livelihood creation, industrialization, and strengthening non-agriculture based sectors of the economy.

#### 2.4. Major Constraints to Agricultural Mechanization

The advancement of agricultural mechanization in Ethiopia has faced a number of distinct challenges. These have constrained both the widespread availability of such implements, and ultimately, the use of those implement in agricultural production, especially in the smallholder context. This has greatly reduced the potential impact of agricultural mechanization on production across the agricultural sector, and indeed has limited its use in Ethiopia to larger, commercial farms and to a few select areas where it has been disseminated through informal channels. The causes of this are many, but there are a few key cross-cutting constraints that have been particularly restrictive in recent years, and have limited Ethiopian farmers from benefitting from the advantages of agricultural mechanization.

The first significant constraint has been a lack of an overarching, **comprehensive agricultural mechanization policy and strategy; and institutional capacity**. Such a policy would be able to unify stakeholders and dictate focused and complementary efforts to support the increased use of mechanized implements. As a result of the lack of such a policy, the majority of previous efforts have lacked focus or overall support across the sector. This has also meant that activities are not built upon through effective prioritization or multi-stakeholder/sectorial efforts. Additionally, this has also resulted in the relevant institutions to agricultural mechanization being under-capacitated, leaving them under-funded, understaffed and unable to perform their prescribed mandate, both on a Federal-level and a Regional-level. This includes those tasked with components throughout the value chain, from research and development through to policy makers that would create effective enabling mechanisms for maintenance and after-sales service provision. It has only been within the last year where a Directorate at the national level has been formed to look at the sector as a whole.

The second overarching constraint has been purely physical, which is that the **land size and topography in Ethiopia is limiting to increase in agricultural productivity through increased mechanization**. As detailed previously, many farmers are reduced to operating on land that is smaller than one hectare, which is often sloppy and of a reduced usability. As a result of this sloppy nature, as well land in Ethiopia being highly fragmented, there is often a lack of easy/consistent access by machinery to farmers' land. This prevents machinery being used economically across multiple farms. This is further exacerbated by mixed terrain and poor road linkages to/between farmlands and urban/semi-urban areas where



machines could be maintained and spare parts easily accessed. While accessibility has improved in recent years, the vast majority of farmers still face these challenges.

The third key constraint is a **lack of physical machinery available**; both from domestic or international sources. This problem is complex, as there is both a lack of supply, but also a significant constraint in taking the small supply that is available to the farmers. Domestically, there are very limited providers that manufacture HIMIs, and those suppliers that produce smaller implements often face constraints in scaling in sufficient quality. The local industrial sector is largely nascent, and so far, has not focused on agriculture, nor have there been sufficient incentives put in place to encourage entry into the sector. For imported units, there are further constraints, including a challenging and unique operating environment and a lack of neighboring countries with strong manufacturing industries. This means that there are limited channels to bring agricultural machinery into the country and it has to compete against many other types of infrastructure and construction equipment. This is also not helped by the fact that the country lacks a system to review and release mechanization technologies.

The last major constraint is **farmer behavior and perception/lack of awareness of agricultural machinery**. Much of the agricultural practices in Ethiopia have remained constant for centuries, and Ethiopian farmers have not been exposed to newer, more effective practices, often brought by exposure to other cultures. This has meant that the mentality of readily accepting new practices is not as ingrained in the Ethiopian farmer approach as it may be in other countries. In addition to being largely risk adverse, Ethiopian farmers are not frequently exposed to modern machinery though the Government extension system. Even on the rare occasion that these types of new technologies are made more visible, a combination of the lack of an effective distribution/disbursement system and the farmers' own lack of purchasing power make access to these technologies extremely challenging.

## 2.5. Policy Motivation

As Ethiopia's most important sector, agriculture is regularly identified as a fundamental component in addressing the country's development challenges. Over the past decade, the Government of Ethiopia's (GoE) development policy has prioritized poverty reduction and gaining middle-income status by 2025. Three overarching national strategic frameworks were developed to achieve these intended objectives, focusing on different aspects of the agriculture sector:

- **The Sustainable Development and Poverty Reduction Program (SDPRP)** was implemented between 2002/03-2004/05. One of the four pillars of the strategy is the Agricultural Development-Led Industrialization (ADLI). ADLI was a long-term strategy to achieve faster growth and economic development by making use of technologies that make extensive use of the







## 2.6. Gender Implications

Women constitute half of the rural farming community in Ethiopia, and they contribute 70% of household food production.<sup>23</sup> Despite playing such a significant role, there are many challenges that hinder women from exploring their full potential. A key hindrance is the accessibility to extension services by female-headed households. While there is limited data on the rate of accessibility by women, empirical evidence shows a trend that puts women significantly behind their male counterparts. Once addressed, studies show that investments in women's access to agricultural inputs and agronomic practices can significantly improve women and greater population's livelihoods. This may contribute up to a 30% increase in production.<sup>24</sup> Similarly, addressing gender inequality at the national level can contribute up to a 1.9% increase in GDP.<sup>25</sup> Further, investment in women farmers' productivity and income has a ripple effect on improving household nutrition, children's schooling, and the ability of the household to generate savings. Realizing this, the national Growth and Transformation Plan clearly underlines the need to involve both women and men; supporting women's institutions and targeting at least 30% female-headed households (FHHs) in all extension services.<sup>26</sup>

Agricultural mechanization has many important implications for gender mainstreaming and gender relations. Women's role in agriculture is prevalent; they work in all aspects of farming operations such as seed cleaning, sowing, planting, weeding, applying fertilizer/manure and pesticides, threshing and harvesting. Agricultural mechanization can help reduce women's workload and facilitate difficult operations. However, experiences in many countries show the promotion, adoption and benefits of mechanization are not gender-neutral. Mechanized technologies that have been adapted have often addressed challenges related to men's tasks – often with negative consequences for women. For examples tractors and animal-drawn ploughs have been used by men to increase the acreage under cultivation however it has resulted in an increase in weeding and harvesting operations, a practice that is often performed by women. Moreover, of all women's tasks on the land, weeding with short-handled hoes is the most difficult and time-consuming. Additionally, trainings of mechanized devices are most often organized by extension services, a resource that is highly inaccessible by women.

To ensure a successful mechanization, this strategy has identified gender sensitivity in the design of specific interventions across the value chain.

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<sup>23</sup> Ministry of Agriculture, (1992)

<sup>24</sup> Bill and Melinda Gates 2012,

<sup>25</sup> Elissa Braunste in GEM-IWG Working Paper 07-4, March 2007: 6

<sup>26</sup> GTP I, 2011-2015



## 2.7. Ensuring Sustainable Mechanization

The Ethiopian economy is based on rain-fed agriculture. As such, increased weather events due to climate change (for example, increased rain variability/unpredictability, as well as droughts and floods) have significant productivity, economic, and social impacts throughout the sector, which are further compounded by environmental degradation (such as soil erosion due to over-tilling and/or overgrazing of cattle). In fact, climate events have reduced Ethiopian GDP by as much as 10%, and soil erosion alone is conservatively estimated to reduce agricultural GDP by 2-3% per year.<sup>27 28</sup>

In response to these issues, the GoE has developed the Climate Resilient Green Economy (CRGE) strategy to tackle climate and key environmental needs, both in terms of mitigating greenhouse gas (GHG) emissions and building adaptive resilience in each sector to withstand climate shocks. Based on the CRGE, one of the key opportunities for reducing GHG emissions intensity per hectare of agriculture is implementing mechanization activities which replace methane emissions from cattle driven ploughing and planting activities. In light of this, and the potential social implications of mechanization, this strategy seeks to address the following needs:

- To reduce agricultural GHG emissions through both replacing animal draught practices with efficient mechanized option
- To reduce agricultural mechanization GHG emissions and operational costs by sourcing high efficiency combustion engines, and where practical and sustainable, biofuel options
- To ensure that agricultural mechanization activities that maintain and/or restore natural resources key to climate resilient livelihoods under the CRGE, such as soil fertility, health and moisture content, and mitigates risks associated with soils erosion
- Where the use of agricultural mechanization risks displacing manual labor to support potentially affected parties through sustainably planned mechanization related, or alternative employment and training programs

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<sup>27</sup> Ethiopia's Climate Resilient Green Economy, 2013

<sup>28</sup> Environmental Policy of Ethiopia, 2007



## 2.8. Availability of Financial Services to Smallholder Farmers

For mechanization to become available to smallholder farmers, financing should be accessible to rural households through channels that target farmers and products and services that are tailored to their needs and requirements. At present, Ethiopia's financial system is at an early stage providing little coverage. The key institutional players making up the sector are banks, MFIs and SACCOs (Savings and Credit Cooperative). Financing is difficult to access, even more so among populations living in rural areas. Currently, only a small number of the overall population access and use the financial services system – nearly 24% of the population in 2012 have an account in a financing institution compared to 50% world average.<sup>29</sup> Additionally the majority of this group resides in urban centers, meaning that accessibility in rural areas is significantly lower than the stated average. The rate of accessibility in rural areas can be explained by limited access to distribution channels – both bricks and mortar, and through mobile technologies. In a survey conducted by the ATA in the Amhara and Oromia regions, farmers needed to travel between 6 to 9 kilometers to reach banks or MFIs. In terms of depth and breadth of financial product offerings, MFIs and RuSACCOs (institutions who target rural populations) have provided a limited size and scope of products and services that fit the needs of smallholder farmers. For example, there is limited credit for key productivity-increasing farming inputs including mechanized technologies and farmers have limited options with which to insure themselves against extenuating circumstances such as unstable weather conditions. In addition, the lack of flexible loan terms tied to incomes disincentives farmers from exploring financing options.

With respect to access to financing related to mechanization, there are a number of points along the value chain where financing is required – from purchase of machinery to financing related to the rendering of services. For example, ATA analysis shows that the estimated number of farmers that utilize mechanized services for a fee, for activities that span across land preparation all the way to threshing, have a total mechanization credit requirement of approximately 4.8 billion ETB in one year.<sup>30</sup>

Currently a number of MFIs offer a basic credit facility for the lease of both low and motorized equipment. The loan size given is arbitrary and depends on the type and quality of machinery and it is not clear what framework is used to assess this amount. The loan term is also fixed and is not based on the payback period required by the farmer; for example at Dedit Credit and Savings Institute (DECSI), it is fixed at three years. This offering cannot alone support mechanization among smallholder farmers in Ethiopia, various interventions at many points in the value chain will need to be undertaken (described in interventions section) to enable these activities to take place.

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<sup>29</sup> World Bank Financial Inclusion Data

<sup>30</sup> ATA analysis, 2014



## Chapter 3: Strategic Vision and Business Models

### 3.1. Context for the Vision and Strategic Choices

The value of agriculture to the Ethiopian economy is immense. Based on its recent performance, the Ethiopian economy is expected to grow to reach middle-income status by 2025.<sup>31</sup> The value additions of mechanization support this trajectory and the overall economic goals of the Government of Ethiopia. Agriculture is predicted to not only continue playing its traditional role of food and livelihood support, but also to contribute to value-added employment and play a more significant contribution to foreign exchange earnings through exports. Agricultural mechanization also has the ability to support the industrial development aspirations of the country through agro-processing and machinery production. While Ethiopian GDP should continue to grow as farmers' productivity levels grow, the relative share of GDP from agriculture and employment in the sector is likely to decrease as the economy diversifies more into services and manufacturing.

The mechanization of agricultural practices can also support Ethiopia's goal of building a climate-resilient green economy, through the introduction and diffusion of technologies that satisfy this goal. This includes the promotion of conservation agriculture technologies (of no or minimum tillage) and reduction in draught animal power used; both of which have significant positive environmental advantages.

In order to formulate the most effective strategy for mechanization, a set of fundamental strategic choices need to be defined. The objectives essentially need to answer the question: "*Why does Ethiopia want to mechanize? What does it wish to achieve through mechanization? Why are we targeting smallholder farmers?*"

The following sections will outline the most important of these *strategic questions*, then outline the *proposed answers* to them, and describe the *key implications* these proposed answers have on the strategy. The hypotheses' answers emerge from discussions and consultations with key stakeholders and policy makers and will help guide the overall strategy in scope and aim. It is important to note that the proposed solutions to these strategic objectives, in large part, need to fit coherently with Ethiopia's larger national development strategies and development path.

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<sup>31</sup> World Bank, 2013



The key strategic questions include:

### 1. Type of desired developmental impacts

**Question of strategic objective:** What are the high priority development goals that the strategy seeks to accomplish?

- Is the most important objective of the strategy to bring benefits to the farmers, in income and productivity?
- Or is it to ensure total food production and food security of the country?
- Or is it to help build an industry in the country and build manufacturing, research and development and distribution capabilities?

**Proposed strategic objective:** The mechanization strategy will first and foremost seek to:

- Raise farmers' productivity and income, by increasing utilization of mechanized devices
- Through that, also increase the national food production and security through increased total food production; as an additional, second priority, agricultural mechanization will be used as a demand pillar for industrialization in Ethiopia

**Key implications of the proposed answer:** The prioritization of bringing the benefits of mechanization to farmers means that in the immediate term, viability of/access to the technologies takes precedence over considerations of where they originate from – imported or local production. Wherever possible, priority should be given to strengthen domestic agricultural machinery industries and support local private companies to supplying reliable equipment. Local supply and production capabilities are valuable in the long-term, but will be considered *after* ensuring farmers can reap the optimal benefits of suitable mechanization in the immediate-term. Additionally, the emphasis on food security and reduction in food aid means that key staple domestic consumption crops – tef, wheat, and maize – will be prioritized over cash crops in the short-term.



## 2. Priority beneficiary groups

**Question of strategic objective:** Among the diverse farmer groups in Ethiopia, who are the top priority beneficiary farmers/farmer segments for the publicly driven mechanization strategy? The main sub-segments in Ethiopia include:

- Smallholder farmers – non-subsistence farmers: farmers who farm mostly by themselves or in their household units, but who have sufficient land and productivity to produce for more than just themselves, typically with 1-10ha each; they make up ~40% of Ethiopia’s farmer population
  
- Smallholder farmers – subsistence farmers: farmers who farm mostly by themselves or in their household units, but who have sufficient land and productivity only to provide for themselves and not for the markets, typically with <1 ha each; they make up ~60% of Ethiopia’s farmer population
  
- Commercial farms/state farms: farms managed and operated on significant scale (e.g. >10ha); collectively, they make up ~1% of Ethiopia’s farmer population

**Proposed answer of strategic objective:** The mechanization strategy will focus on smallholder farmers, as they represent the overwhelming majority of farmers in Ethiopia. Within the smallholder farmer segment, different approaches will be provided for non-subsistence and subsistence farmers, both will be focus of the strategy. As efficiency gains and economic benefits are realized for the relatively larger, non-subsistence farmers, the strategy will also seek to increase productivity across all segments of agricultural production. At the same time, basic support will be provided to the subsistence segments in ways that are appropriate to it, to provide pro-poor interventions – as they make up the largest number of Ethiopian farmers. It is also expected that commercial farms will benefit significantly from the initiatives undertaken that are more targeted.

The long-term objective will be to utilize the right strategies of mechanization to migrate farmers from the subsistence to the non-subsistence segment in terms of surplus production. The strategy will seek to realize maximum gains in the immediate term in areas which are easiest to impact, and then effectively leverage these gains to support more sustainable progress in the long run.



**Key implications of the proposed answer:** The proposed focus on smallholders has many implications. Among them is that the agricultural mechanization strategy and implementation model will need to enable access to machines and their benefits for individual farmers whose farm land is not more than 1-2 hectares. It also mandates that the majority of public sector resources and support should be directed toward access for smallholder farmers, more than commercial or scaled operations.

The strategy of realizing maximum efficiency gains first to create resources to support pro-poor interventions for the 'bottom farmers' will also have wide implications. An example of this is that in geographical implementation, the woreda/kebeles with the smallholder farmers who are most accessible (i.e. to support with the lowest intervention costs) will be targets for the most immediate interventions.

### 3.2. Vision and Strategic Objectives

#### Summarized Vision Statement

*“Increase national food production and security through enhanced and sustainable use of agricultural mechanization technologies in order to support Ethiopia’s middle-income status by 2025”*

In addition to providing livelihoods for Ethiopia’s farmers, agricultural mechanization will form a major demand driver for domestic industrialization. To complement the vision, there are a number of desired strategic objectives that the strategy wishes to achieve. These include:

- Increase farm power where it is currently at 0.1 kW/ha to 1 kW/ha by 2025 <sup>32 33</sup>
- Increase income through reduced post-harvest losses<sup>34</sup>
- Increase domestic supply of agricultural machinery<sup>35</sup>

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<sup>32</sup> Ethiopia’s green economy (2013)

<sup>33</sup> Internal analysis

<sup>34</sup> Proposed: To a degree of international standards

<sup>35</sup> Proposed: to 60% domestically sourced by 2025





- Increase overall productivity of land<sup>36</sup>
- Improve the timeliness and effectiveness of work
- Decrease drudgery in field operations, thereby enhancing quality of life of rural men and women
- Provide entrepreneurship opportunities to increase additional livelihoods
- Increase technical skills and knowledge to respond to the expanded needs of mechanization

The remainder of this chapter outlines a stakeholder analysis and national business model to help the sector realize the stated vision above. This analysis will serve as the foundation for a strong collaboration between public-private partnerships to ensure each stakeholder's strengths are leveraged towards achieving the vision, which is outlined in the national business model. The national business model details the interaction models for all stakeholders across the value chain with clear visions and objectives.

### 3.3. Vision of Stakeholder Collaboration

Currently, stakeholder efforts to mechanize Ethiopian agriculture have had unclear direction and have been undertaken in an unorganized fashion, with limited scope and impact. To become effective, each of these stakeholders will need to play at least one of the following functions including **setting national policies, providing market incentives, transferring technical capabilities, and enabling systemic grass-root access to the farmers** (see Exhibit 6).

While the Government should contribute across the value chain, it has largely focused its efforts in overseeing and supporting extension services to farmers, as very few private sector entities have the reach necessary to access farmers. Despite decades of experience, The Government currently lacks sufficient capacity to conduct R&D, manufacture at scale and provide after-sales services. In addition,

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<sup>36</sup> Proposed: By 50% by 2025



neither the current extension nor the cooperatives system is currently well structured for distribution and/or the provision of direct ownership of machines, based on their current activities in the sector. Moreover, there are no clear incentives for the Government or members of the extension system to take on such a role in the sector. Rather than engaging in the direct provision of agricultural machinery, the Government should play more of a regulatory role, ultimately creating an enabling environment for the sector to succeed.

Mechanized technologies are sourced from the two major domestic players, as well as a little over a dozen Small and Medium Enterprises that are domestic small scale producers. There is very little to no direct greenfield investments from foreign enterprise, with most of their products being imported and made available through a distributor. Both domestic and foreign companies will have a very important role across the value chain, and will need to build up capabilities especially in R&D, manufacturing and distribution. Foreign companies should especially be encouraged to contribute to local capacity building by setting up local offices and manufacturing facilities. Concurrently, the Government should facilitate the creation of distribution centers that are co-located with farmers to ensure distributors are not just centered in urban hubs but are accessible by its end-users.

Exhibit 6: Key players in the mechanization sector – Current and ideal role<sup>37</sup>

| Key Stakeholders                  |                                     |                          |              |                               |                     |
|-----------------------------------|-------------------------------------|--------------------------|--------------|-------------------------------|---------------------|
|                                   | Research and Technology Development | Manufacturing and Import | Distribution | Promotion, Purchase and Usage | After-sales Service |
| MoA and RBoA                      | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Foreign Companies                 | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Distributors/ Retailers           |                                     |                          | ✗            | ✗                             | ✗                   |
| Service Providers                 |                                     |                          |              | ✗                             | ✗                   |
| NGOs/ International Organizations | ✓                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Smallholder Farmers               |                                     |                          |              | ✗                             | ✗                   |
| SMEs                              | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Large Domestic Companies          | ✗                                   | ✗                        | ✗            | ✗                             | ✗                   |
| Government Research Institutes    | ✗                                   |                          |              | ✗                             |                     |
| Artisan producers                 |                                     | ✓                        |              |                               | ✗                   |
| Ethiopian Standards Agency        |                                     | ✗                        |              | ✗                             | ✗                   |

|            |            |                 |                         |                              |
|------------|------------|-----------------|-------------------------|------------------------------|
| <b>Key</b> | ✓ Presence | ✗ Weak presence | ✗ Little to no presence | □ Ideal role of stakeholders |
|------------|------------|-----------------|-------------------------|------------------------------|

Locally-based service providers can play an integral role in the helping to bring mechanization to smallholder farmers; they can provide access by purchasing mechanized equipment and providing services to farmers for a fee. While this model is practiced in some parts of Ethiopia (in Amhara for example), the volume of service providers who render mechanized services is low and it is unclear whether the quality of service meets the minimum requirement. Additionally, there have been very few service providers of after-sales services. The government should encourage the uptake of such activities especially among rural farmers.

International agencies and NGOs have thus far played an important role in researching agricultural technologies including mechanization and in developing recommendations around them. Unfortunately, they have been weak in ensuring that their policies and recommendations are implemented on the ground with a majority of their resources and efforts being invested in research and data collection. Over time, their research should be studied by the government and NGOs should focus on supporting the government in downstream activities of the value-chain.

<sup>37</sup> ATA team analysis, 2014

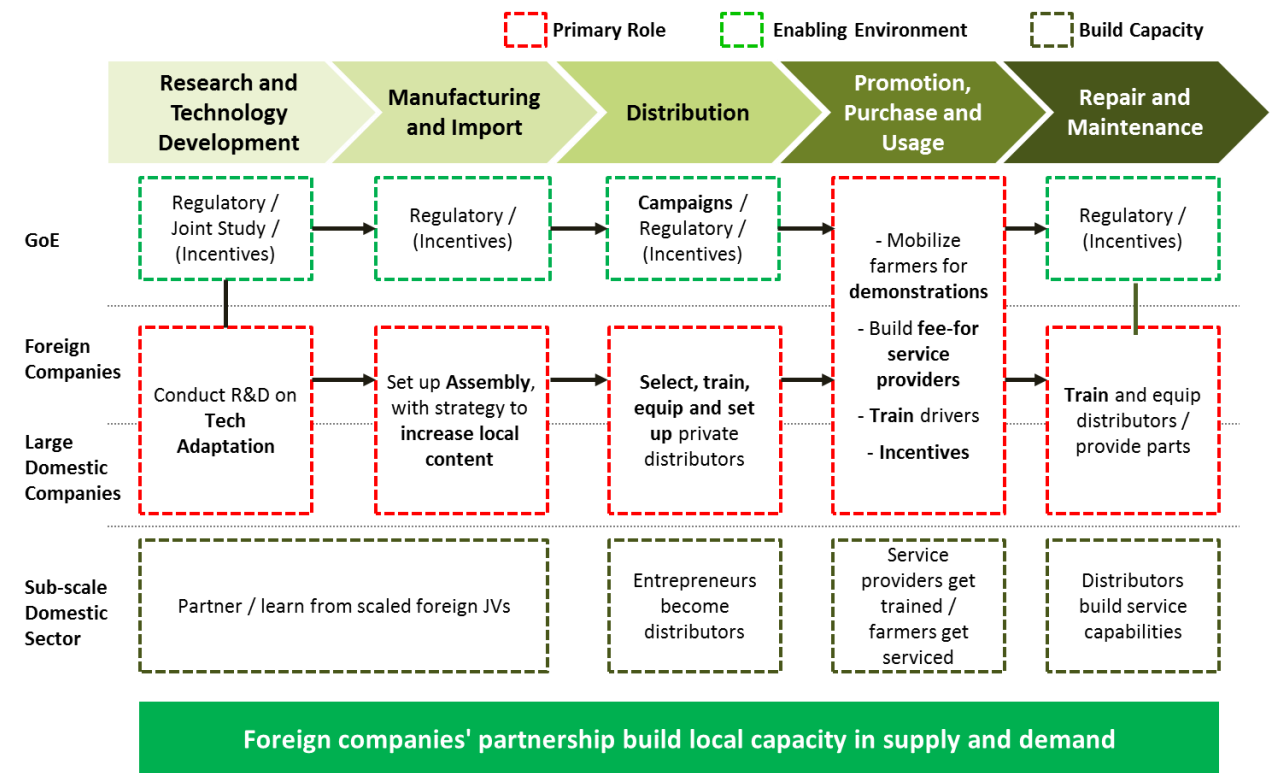


long-term. Immediate benefits also exist; the local private sector can build a strong industrial base in the short-term through imports and foreign investment. Additionally, the public sector plays a critical role in accelerating the private sector’s ability to reach farmers at scale.

In the long-term, the Ethiopian private sector should play a stronger role in driving components across the value chain. This will likely not happen until there has been sufficient capacity building on technical and business acumen issues for the local private sector. An expected timeline for this state will likely not be for another 10-15 years.<sup>39</sup>

Across the value chain, the vision and ideal state for each value chain component is listed below:

**Exhibit 7: Recommended Business Model for HIMIs**



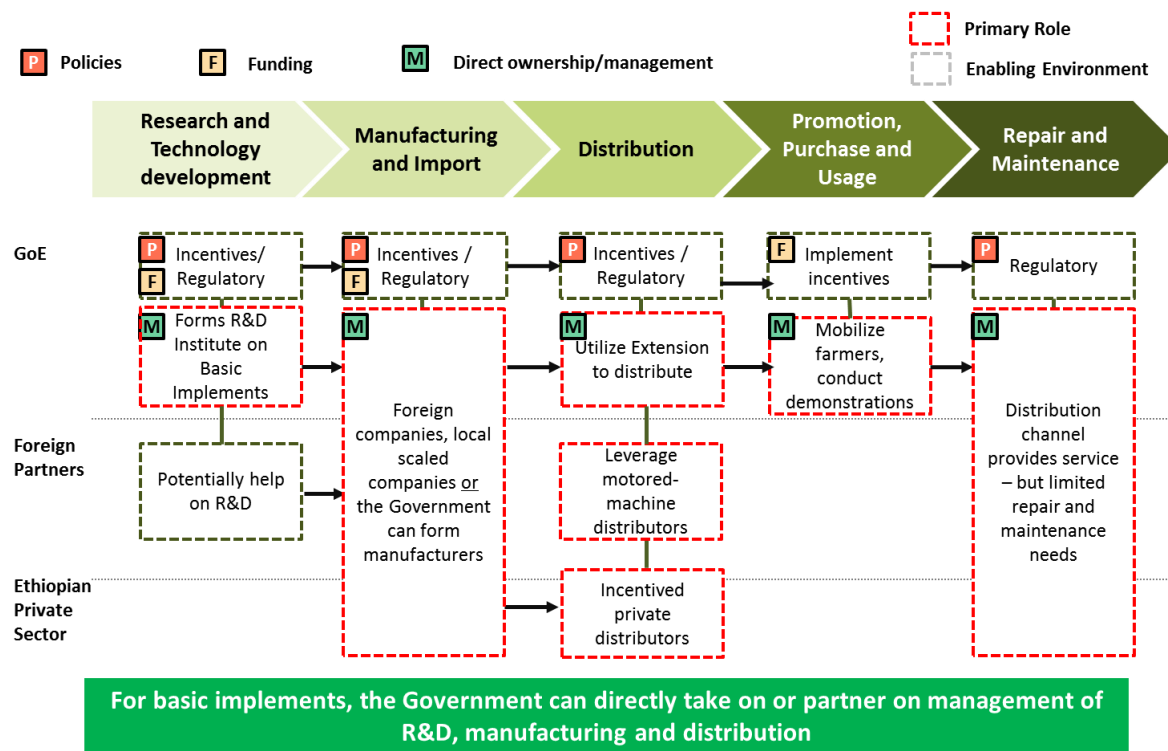
The ideal collaboration model to start Ethiopia’s **High and Intermediate Mechanization Implements** process involves several interventions across the value chain. Here is a summary of the vision:

<sup>39</sup> Boze &co.(2014)



- **Research and Technology Development:** To accelerate the rate of R&D in the sector, the Government should incentivize the private sector to enter and lead R&D for HIMIs. For example, the Government can provide joint study opportunities for foreign companies and the local private sector to conduct R&D and technology adaptation. This will allow the sector to benefit from foreign companies' deep industry know-how and build a local industrial base
  
- **Manufacturing and Imports:** The Government should similarly provide regulatory incentives for foreign companies to set up assembly sites to increase local capacity
  
- **Distribution:** The Government should host local campaigns across the country to promote a distributor class; this does not currently exist. Foreign companies and the small scale domestic sector can empower the new class; they can identify, train, and equip private distributors with the right resources
  
- **Promotion, Purchase & Usage:** The Government should play a direct management (and to a degree ownership) role. Given the strong extension system in Ethiopia today, the Government should mobilize farmers for demonstrations at existing Farmer Training Centers (FTCs) to promote agricultural mechanization. The Government should also provide clear incentives for private farmers or entrepreneurs to become fee-for-service providers, or contractors. The government should encourage suppliers of agricultural machinery and NGOs could also support in efforts to promote new technologies
  
- **Repair and Maintenance:** The Government should continue to regulate and provide incentives for repair and maintenance services. Foreign private companies should proceed with capacity building to support the growth of this function

**Exhibit 8: Recommended Business Model for LMIs**



Unlike HIMIs, the value chain for **Low Mechanization Implements** will require more direct involvement from the Government. As illustrated in Exhibit 8, the Government will continue to play a strong regulatory and financing role across the value chain. The Government will also be directly involved in supporting R&D efforts to develop basic implements, supporting local manufacturing operations, leveraging the existing extension system to distribute technologies, and mobilizing farmers to promote technologies. Foreign partners will have a minimal role. Rather, the local private sector can drive the manufacturing process.

**3.5. Vision for Collaboration among Stakeholders in the Ideal Business Model**

This section presents a detailed picture of ‘who should do what’ in the ideal mechanization model, detailing collaborations among the key stakeholders. This vision of the collaboration and mechanization model will be the basis that drives the interventions detailed in the later sections of this strategy.

**Research and Technology Development**

Based on the prioritization of the needs assessment report, Government policymakers should identify intervention areas for technology development in two broad areas:



- **High and Intermediate Mechanization Implements:** include standing threshers, multi-function tractors, and combine harvesters. Technology suppliers, both foreign and domestic, should lead the development of the R&D sector to accelerate growth for HIMIs. They can leverage priorities identified in a needs assessment of the sector to develop targeted, market-relevant products for smallholder farmers. To complement existing domestic suppliers, the foreign private sector has deep industry knowledge that makes it well-positioned to support the domestic R&D sector. Given that, the GoE should leverage the foreign private sector’s expertise by providing incentives for them to form minority partnerships with local suppliers.
- **Low Mechanization Implements:** while the National Agricultural Research System (NARS) still conducts research, and testing and adaptation works on HIMs, the LMIs should be led by it. NARS should develop a set of implements that meet demands of smallholder farmers. All implement prototypes should be tested and adapted before designs are finalized and then made publicly available.

In the short-term, as foreign enterprises possess deeper technical expertise, domestic enterprises should partner with them to gradually gain capacity in research and development of the relevant technologies and skills needed to develop and produce these types of technologies.

### Local Manufacturing and Import

The local manufacturing and import sector’s national business model is divided across LMIs and HIMIs:

#### Definition Box 1

##### DEFINITIONS: Type of import machineries

**Knocked down (KD):** Agriculture machineries supplied unassembled, but with all components and assembly instructions. To qualify as KD, an agricultural machinery must be taken apart in a manner that its overall bulk or size is reduced by at least one third of the assembled bulk or size.

**Completely knocked down (CKD):** Agriculture machineries imported fully disassembled and assembled locally in Ethiopia.

**Semi-knocked down (SKD):** Agriculture machineries imported in the form of semi-finished products, and assembled locally in Ethiopia.

**Completely Build Unit (CBU):** Agriculture machineries imported in one piece without any processing or assembly.

### High and Intermediate Mechanization Implements

The GoE should prioritize building local supply of agricultural machinery through (1) increasing initial imports to satisfy immediate demand, and (2), providing incentives for joint ventures to develop local industrial capacity.

- **Initial imports to increase local supply of agricultural machinery:** Currently, Ethiopia’s stock of agricultural machinery is very low. To fill that gap, importation is the primary means of increasing local supply of machinery to meet demand in the short-term. To minimize the time needed to





bring the benefits of motorized implements to farmers, The Government should start with incentivizing the local market to source quality units from international suppliers. It can then gradually increase local content to capture benefits on the manufacturing and industrialization side through regulatory movements and a favorable enabling environment.

Initial prioritized imports should be focused on two categories of technology, with specifics to be found in the needs assessment: 1) multi-functional implements with a high annual utilization rate and, 2) complex motorized implements where there is sufficient need throughout the year. Imports should initially be based around CBUs to build initial supply, with a gradual move towards SKDs and CKDs. This will allow local assembly companies to build the more complex skill sets required over time. Non-motorized implements should be manufactured locally, as they require less complex processes/competencies. These should rarely be manufactured overseas unless there is no technical need/component/process available.

- **Incentives for joint ventures to develop local industrial capacity.** The GoE should prioritize developing sustainable industrial capacity in the sector by providing incentives for joint ventures between international and local companies. This should support joint venture creation, where foreign enterprises provide support such as plant setup, equipment, skilled employees and managers, with local enterprises in secondment positions. Foreign manufacturers can also build the capacity of local Ethiopian operations on technical and production issues. Ultimately, the local manufacturing sector should move towards fabricating basic components without Government incentives.

### *Low Mechanization Implements*

Domestic manufacturing of low mechanization implements should include standard specifications of all LMI technologies and formed into a package and made publicly available. This would allow local certified manufacturers to easily fabricate and multiply technologies to reach farmers at scale.

For both LMIs and HIMIs, safety testing should be mandatory for all implements with additional testing for performance on a needs basis. This will provide the end user/operator with the full information prior to purchase. Standards for mechanization should be established based on an international set of evaluation criteria, for both safety and functionality and enforced by a national testing agency.

### **Distribution**

Distribution needs for both LMIs and HIMIs are different, and therefore have different proposed national



business models:

**High and Intermediate Mechanization Implements**

**Domestic and foreign manufacturers through joint ventures can collaboratively select and set up private Ethiopian distributors.** Private distributors will serve as the primary retail and wholesale sales points for implements. Secondary distributors should also be selected at the regional level as a retail

Definition Box 3

**DEFINITIONS: Key actors along the Distribution and Promotion, Purchase, and Usage chevrons**

**Distributor:** A company that buys agricultural machineries, warehouses them, and resells them to retailers or direct to the end users or customers. They also provide a range of services (e.g., product information, estimates, technical support, and repair and maintenance, credit) to their customers. There are two types of distributors: primary distributors who source directly from manufacturers or importers and secondary distributors who source from primary distributors

**Contractors:** Provides fee-for-service farm operation for farmers, such as field hauling and threshing. Contractors can either directly operate the machinery or hire operators if they are wealthier entrepreneurs

**Operators:** Drive and control farm equipment to till soil and to plant, cultivate, and harvest crops.

outlet. Manufacturers would train primary and secondary distributors on implements to support end users as needed. Manufacturers would also be part of the global supply chain for spare parts, allowing them to make full implements and spare parts/attachments readily available to farmers.

**Provide financing facilities that are conducive to private agricultural machinery distributors.** Private distributors will likely be entrepreneurs based in rural areas with limited capital to purchase large machinery. Given that, financing should be to:

- Support distributors in purchasing imported machinery, which is generally purchased in large quantities;
- Create an enabling environment for equipment leasing and make finance readily accessible to contractors.

The application focus of HIMIs should be in segments of the value chain that have more in-depth labor/usage requirements, in relation to how much time per year that device can be utilized. For example on a one hectare plot of land, even a plough may need to be used up to seven times, each of which could take approximately four days, making it more favorable for the farmer to own the implement. Alternatively, a motorized planter could plant a hectare of land in approximately one hour, greatly limiting the practicality for a farmer to own this implement directly, as it would remain idle for the rest of the season and would be highly capital intensive to own. If necessary, MFIs can provide local, small-scale financing for these implements



### *Low Mechanization Implements*

LMIs should be promoted and made available through extension agents at the woreda and kebele levels as well as being made available through local private sector distributors.

### **Promotion, Purchase & Usage**

The national business models for motorized and non-motorized implements are detailed below:

### *High and Intermediate Mechanization Implements*

For promotion, **the extension system should engage technology suppliers to conduct demonstrations across the country to build awareness of the benefits of the technologies.** Manufacturers should socialize the benefits of mechanized devices to DAs. This will involve experienced mechanics from foreign companies or contractors conducting demonstrations of agricultural machinery at field days. Demonstrations should occur throughout the year to highlight a comprehensive set of services. MFIs should also attend field days to support farmers in accessing finance to pay for the service.

For purchase and usage, **contractors should provide a fee-for-service offering to operate machinery for the smallholder farmers.** Contractors should take machinery to farmers and offer its services on a per unit fee basis. This will allow farmers to utilize an extended number of services that they currently do not have access to.

Definition Box 4

#### ***Enabling environment***

For agricultural mechanization, an enabling environment should support development of favorable conditions for business to thrive. This could include regulation, tax offsets, financial policies, infrastructure provision-in-kind, lending terms or other types of inducements to help support the growth of industries relating to mechanization.

The Government should regulate contractors to ensure that they are complying with quality and safety standards. In particular, contractors should be required to get certified every year. All contractors' machinery should also be regularly inspected for safety and functionality.

**Zonal support staff will link contractors and smallholder farmers.** Operators will be supported by a Regional employee at the zonal-level, who coordinates with Woreda Agricultural Offices, FTCs, DAs, and secondary distributors/agents to provide overall operational

support to contractors to ensure maximum application of technologies.



### *Low Mechanization Implements*

The basic, non-motorized implement package should be a key component of the extension package that is distributed and promoted across the country. Demonstrations of non-motorized technologies should also be conducted on field days. In addition, extension agents and model farmers can promote non-motorized technologies kebele to kebele to reach the most inaccessible smallholder farmer.

Youth and Small and Medium Enterprises (SMEs) should receive basic training on LMIs for demonstration purposes. The training should cover functionality and basic maintenance topics.

To increase adoption, implements from the basic implement package can be provided to model farmers free of charge.

### *After-sales Services*

High and Intermediate Mechanization implements will require a more robust repair and maintenance system, while LMIs' repair and maintenance services can easily be provided with the current existing technical capacity.

### *High and Intermediate Mechanization Implements*

Primary distributors should be the domestic supply point for spare parts. They should also maintain a consistent and sufficient stock of commonly used spare parts required for regular maintenance/service provision. Fast-moving spare parts, however, should be readily available through both primary and secondary distributors.

Contractors should also be supported by MFIs and other financial institutions to access financial liquidity to purchase major spare parts when needed.

Actors on the supply side will be trained and skilled on maintenance services.

- Primary and secondary distributors will be certified in/authorized to provide maintenance services
- Contractors will be linked to secondary distributors and supplementary maintenance providers in the local area for maintenance training



- Maintenance providers will be trained on re-certifying operators on a technical level
- Manufacturers train maintenance providers in basic maintenance

#### *Low Mechanization Implements*

Low mechanization implements require only basic levels of maintenance and support. Woreda Agricultural Offices, Zonal support staff, and DAs should link smallholder farmers to basic service providers.



## Chapter 4: Systemic Bottlenecks and Strategic Interventions to Achieve the Vision

This chapter discusses **systemic bottlenecks** that the sector must solve to realize the vision of each step along the value chain and the overall ideal national business model. Each of the bottlenecks identified limits the productivity, profitability, or sustainability of the agricultural mechanization sector. Their collective impact is felt on farmers wishing to practice agricultural mechanization, consumers who purchase their crops, private companies interacting in agriculture-associated space, and Government agencies supporting smallholder agriculture. One to three **strategic interventions** with transformative potential are then proposed for each bottleneck, along with a subset of **key activities**. By implementing these interventions, stakeholders will move closer towards achieving transformational growth for Ethiopia's agriculture sector and for the country as a whole.

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

**Exhibit 9: Summary of bottlenecks and interventions**





## 4.1. Research and Technology Development

### Vision for Research and technology development

Technology suppliers should drive R&D for High and Intermediate Technologies to better understand the needs of female and male smallholder farmers as well as other farmers and react to market conditions. The Government promotes policies and provides resources to ensure a strong enabling environment for the R&D sector for Low Mechanization Implements in public research institutions.

### Bottleneck 1.1: Limited visibility of agricultural mechanization needs in the country

The first step of the research and development process is to define current farming practices and the role agricultural mechanization can play to support overall crop production. This allows suppliers to develop the most relevant technologies for farmers' needs, in the appropriate quality and quantity. For example, suppliers are more likely to introduce an applicable tef row planter if they were aware tef productivity was low due to farmers failing to plant in rows. However, in the current Ethiopian context, this understanding is nonexistent, manufacturers most often introduce technologies upon Government request, while companies import tractors based on requests by clients.

A needs assessment process that incorporates best practices is critical for suppliers and manufacturers to effectively develop relevant products that address the needs of both female and male Ethiopian farmers. Without this process in place, suppliers and manufacturers will not be able to produce targeted technologies that address farmers' critical needs or technologies that only provide value for a small group of farmers. For example, since its inception in 1976, R&D developed approximately forty technologies across tillage, planting, harvesting, post-harvest and processing equipment.<sup>40</sup> R&D focused mainly on small implements using human and/or animal power (LMIs). Moreover, post-harvest minimizing technologies are the most developed, when compared to pre-harvest technologies, out of the 21 mechanized technologies developed by R&D 67% focus on post-harvest. In addition, R&D selection of crops lacks focus, resources equally divided between priority crops such as tef and maize grown by 44% and 64% of SHFs respectively and non-priority crops such as papaya and tomato grown by 4% and 2% of SHFs respectively. While those implements are needed, they may not necessarily produce the highest value proposition for smallholder farmers. Accordingly, farmers will likely only adopt technologies that they perceive will have a high contribution to their work.<sup>41</sup>

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<sup>40</sup> EIAR Output Catalogue, 2013

<sup>41</sup> ATA team analysis based on EIAR data, 2014





### Intervention 1.1a: Conduct a needs assessment to identify the most impactful mechanized technology opportunities for the private sector

National needs assessment process will ensure technologies are developed to generate maximum return to farmers. The current lack of a well-developed local agricultural mechanization private sector justifies the existence of a Government-driven national needs assessment process. In particular, local mechanization technology manufacturers today have limited technical expertise and capacity to conduct their own R&D and effectively assess market needs. Given this, the GoE can initially step in to play this role to ensure there is a strong understanding of farmer needs, both among women and men. Moreover, the GoE's support during the sector's infant stage will ensure agricultural machinery innovations are in alignment with the Government's development goals through a clear prioritization process.

While not comprehensive, the national needs assessment should include:

- **Current practices of farmers:** it is vital to establish an understanding of the current status of how agriculture is conducted on a smallholder level and where the key areas of improvement lie. In particular, farming practices that should be understood are use of inputs and soil preparation, sowing, crop protection, harvesting practices, and mechanization practices across the country. This will effectively serve as a quantification of demand for various services/components of mechanization so the market opportunity can be more easily understood
- **Understanding of all types of farmers:** the study should identify the needs of a wide spectrum of farmers that represent most of Ethiopia's SHFs, including female smallholder farmers, commercial farmers, and farmers that do not have sufficient access to markets. These farmers have different needs; for example, female smallholder farmers of male-headed households may benefit from labor-saving technologies while commercial farmers prefer access to motorized machines. This understanding will help suppliers develop tailored technologies to meet the needs of different farmers and expand their market reach
- **Capacity of key suppliers and actors:** The operational capacity of key stakeholders in the sector should be studied. Manufacturers and importers' decisions on which technologies to introduce to the market will depend on the availability and capacity of distributors and repair and maintenance services. If distributors are not operating, manufacturers and importers will struggle to effectively reach farmers across the country. They will need to distribute the products themselves hence incurring extra costs or will have to keep in stock their machineries and refrain from producing more until they find distributors

These criteria should be evaluated across the country, and as comprehensively as possible. The data will generate a segmentation of demand and opportunities across the country, forming the basis of



knowledge for actors along the mechanization value chain. More importantly, this knowledge should act as the initial prioritization of technology opportunity areas.

In particular, the process should classify three types of technology priority areas based on:

- **Farm operations requiring high-power inputs and low control;** for example tillage, transport, water pumping, milling, and threshing
- **Farm operations requiring medium levels of power and control;** for example seeding, spraying, and intercropping operations
- **Farm operations requiring high-degree of control and low power inputs;** for example transplanting, vegetable planting, and fruit and vegetable harvesting

Ideally implements should serve multiple functions or serve multiple crops to maximize value and applicability for smallholder farmers. As it will be difficult for LMIs to serve multiple functions, they should be functional across priority crops or have high on-farm utilization rates. For example, an improved plough can be employed for maize, tef, and wheat/barley. The improved plough can also be deployed across the country. This would familiarize smallholder farmers to improved implements more quickly and serve as a base of mechanization in preparation for more advanced implements. Additionally, these basic implements can provide immediate production benefits and solve more immediate problems for smallholder farmers today. In identifying these technologies, the Government should also be mindful of prioritizing and encouraging those technologies that are environmentally friendly and result in minimum damage to soil fertility and health.

#### **Key activities:**

- Identify detailed data required for initial assessment of farming practices and farmer types
- Conduct data collection at the kebele and woreda-level institutions across the country
- Identify and test technologies that respond to women's and men's needs
- Collate and analyze data at the national level to identify priority technology opportunities by LMIs and HIMIs
- Develop a standardized 'package' of LMIs for smallholder farmers

#### **Bottleneck 1.2: Limited resources allocated to mechanization R&D has resulted in low quality and output volumes**

Currently, Ethiopia spends 0.24% of its GDP on agriculture research, which is below the 1% target set by the African Union's Executive Council in 2006. Many other African countries are spending more than the



suggested amount – for example, Botswana, South Africa, and Kenya are spending 4.32%, 2.02%, and 1.3% respectively.<sup>42</sup>

Of the limited agricultural research budget Ethiopia does spend, it dedicates a large amount, more than 30% of its agricultural research expenditure, towards crop research.<sup>43</sup> Approximately only 2% was dedicated towards mechanization in the overall agricultural research spending budget over the past three years (Exhibit 10). Additionally within the mechanization directorate of EIAR, much of the prioritization for funding allocation does not go directly to R&D, but rather to assessment, evaluation and promotion activities. Another key constraint is a lack of current spending dedicated to mechanization R&D is not utilized effectively; the majority of the output is of relatively low quality, and is not easily produced at scale.<sup>44</sup> In addition to this, only a select few prototype designs have made it out of the research system and are produced at scale.

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<sup>42</sup> World Bank 2010; Africa Agriculture Status Report, 2013

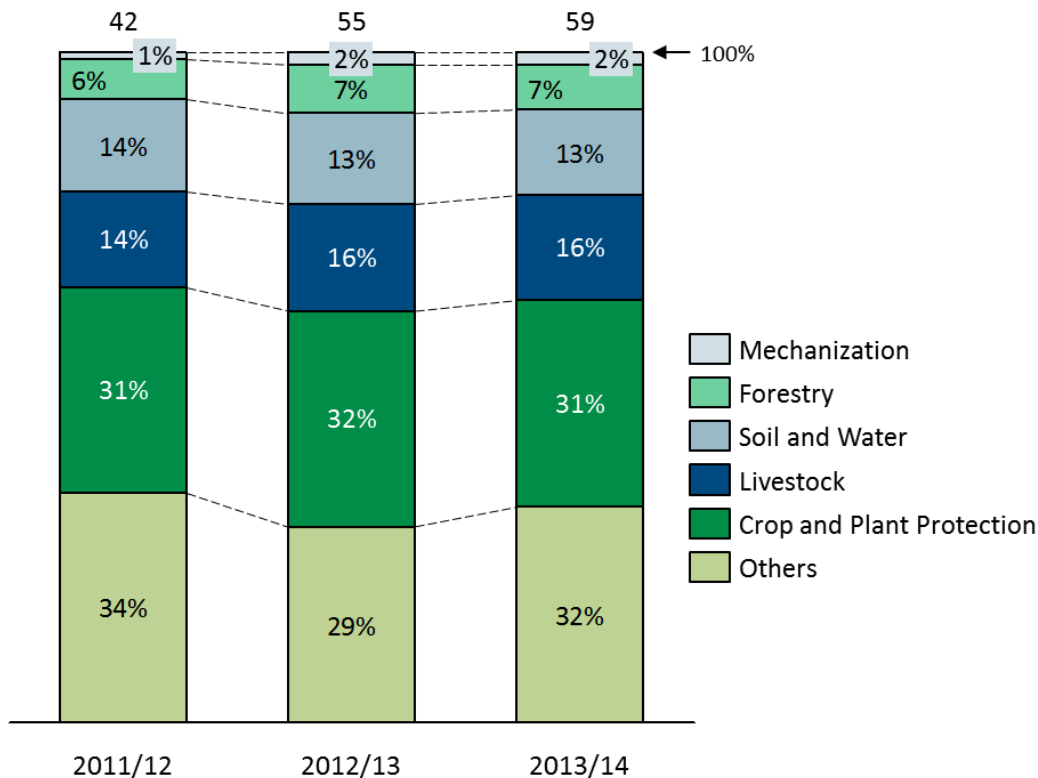
<sup>43</sup> EIAR, 2014

<sup>44</sup> ATA Team Analysis

Exhibit 10: Share of budget by directorates in EIAR

**Total amount of budget allocated to EIAR**

Millions



As a result of its low resource allocation, Ethiopia’s agriculture R&D sector suffers from limited R&D infrastructure and a lack of advanced equipment.<sup>45</sup> Specifically, Ethiopia’s mechanization R&D infrastructure landscape lacks in a number of areas including R&D facilities lack basic equipment and infrastructure such as basic field and laboratory instruments, workshop facility and related tools and machineries, field and service vehicles. Additionally, there are a limited number of testing sites which, in turn, limit technology testing across major agro-ecologies. While progress has been made in recent years to improve the overall infrastructural landscape in Ethiopia (road infrastructure for example), the country lags significantly relative to its peers. According to the World Economic Forum’s 2014 Competitiveness Index<sup>46</sup>, Ethiopia is ranked 112 out of 148 in terms of quality of overall infrastructure, lagging by a large margin behind Ghana and Côte d’Ivoire (90 and 96 respectively). When looking specifically at R&D infrastructure indicators such as the quality of scientific institutions and FDI and technology transfer,

<sup>45</sup> EIAR, 2014; ATA Team Analysis

<sup>46</sup> WEF Competitiveness Index, 2014-15



Ethiopia's ranking is not much better at 108 and 118, respectively, once again lagging behind comparable countries.

**Intervention 1.2a: Identify requirements and allocate sufficient resources to fund government research on mechanization topics that will build competencies**

Strong R&D activity is critical, among other things, to develop, test and adapt technologies suitable to Ethiopia. It is critical that the Government is made aware of the many social and economic impact of investing in R&D and also be given direction on the R&D activities that will yield the greatest impact. To undertake this, government-run mechanization institutions should first identify those technologies that should be prioritized for R&D. Second, it should identify the funding requirements and sources for these technologies.

The NARS (EAIR and RARIs) mechanization units should initiate the identification of technologies that impact the greatest numbers of farmers and that are feasible to deploy, for example through the development of an assessment framework for the identification of high value added R&D activities.

Additionally, it should only undertake research in activities where Ethiopia can build competencies and where it is unique to Ethiopia, such as with tef technologies, to avoid a re-invention of the wheel. Once these activities have been identified and prioritized, the MoA Mechanization Directorate and EIAR will need to collectively develop a budget that adequately meets the requirements of the proposed activities.

**Key activities:**

- Identify and prioritize high value adding R&D activities that most relevant to Ethiopia and will help build competencies
- Determine and provide the required amount of funding for each of the prioritized activities
- Develop long term funding plan and identify future revenues streams that would allow R&D to become, at least partly, self-sustainable

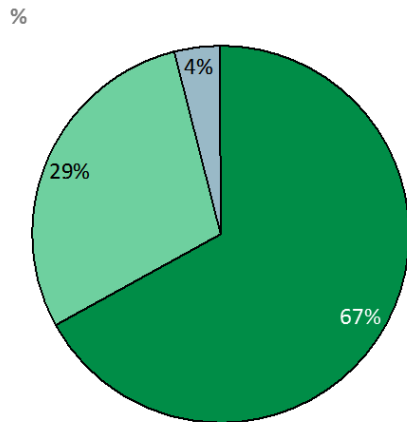
**Bottleneck 1.3: Low human capacity in agricultural mechanization**

Agricultural engineers work across the mechanization value chain to design machinery at the R&D stage and manufacture machinery at the manufacturing and assembly stages. Currently, there are a limited number of agricultural engineers in the mechanization sector in Ethiopia. For example, as shown in Exhibit 11, only 4% of EIAR's 707 research staff specializes in mechanization, while the crop and soil &

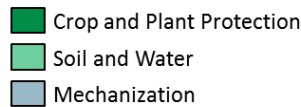
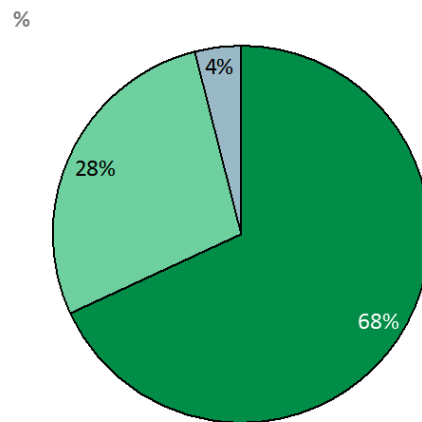
water departments have 67% and 29% of research staff respectively.<sup>47</sup> Local private sector companies also have some R&D capacity, but it is currently limited by a perceived lack of demand and difficulty in accessing farmers. The GoE is the primary driver of demand, with few companies having success at producing and distributing implements locally.

**Exhibit 11: Share of staff by directorates in EIAR**

**Share of researchers at EIAR in 2014**



**Share of technical staff at EIAR in 2014**



About half a dozen Higher Learning Institutes (HLI) offer programs in agricultural mechanization in Ethiopia; this, combined with the perceived lack of demand is the primary reason for the lack of agricultural engineering skills in the country today. Six of the thirty one public universities offer agricultural engineering and mechanization programs at the first and second degree levels.<sup>48</sup> Further, a small number of students are enrolled in these programs. In 2013, 208 undergraduates and 114 graduates were enrolled in Agricultural Engineering and Agricultural Mechanization programs in Adama Science and Technology University (ASTU) respectively. This only represents approximately 1% of the total number of students enrolled at the university and 0.04% of the total students enrolled nationally. A significantly lower number of students graduate from these programs and join the workforce. Additionally, even fewer women sign up to these programs than men, resulting in lower diversity in the R&D sector that is working to develop inclusive technologies. The low matriculation and graduate rates at the university levels could be a result of little to no explicit incentives to join the profession. These numbers are likely insufficient to meet the current and growing demands of the agricultural mechanization sector.

<sup>47</sup> EIAR, 2014

<sup>48</sup> MoE, 2010



A strong in-country base of female and male agriculture engineers is imperative for a thriving agricultural mechanization sector. Investing in building local agricultural technical capacity through enhanced investment in education will enable the sector to innovate, and may even, in the long-term, motivate foreign companies to contribute to the growth and development of a sustainable mechanization sector. In the short-term, a pool of readily available agriculture engineers will incentivize foreign private companies to enter the Ethiopian market. In particular, the barrier to entry will be significantly lower; foreign private companies will not have to bring their own manpower with them, rather they can readily hire in-country at a more economical cost. Additionally, the curricula used to train on the relevant disciplines could be more targeted towards the needs of the sector.

### **Intervention 1.3a: Build human capacity in agricultural mechanization and engineering**

Increased human capacity in mechanization is needed to attract foreign companies to invest in the sector in the long-term. The GoE should strengthen the currently available agricultural engineering and mechanization programs and incentivize students to major in such programs to support capacity building in the long-term. Additionally, it should promote the inclusion of female engineers and incentivize them to enter this field of study in an effort to produce qualified female experts on mechanization. The GoE should increase human capacity by initiating exchange programs and providing directions to improve current capacity of the agricultural mechanization and engineering.

In the short-term, the GoE should set up directives that encourage or require R&D and manufacturing JVs with foreign companies to set up secondment programs with local scientists or stipulate a minimum local employment requirement for R&D positions. Another example is to create linkage programs where academic institutes work closely with JVs to structure teaching and internship programs; where the foreign JVs can give feedback into the academic programs, and where the students and graduates from the institutes can be linked directly with the private JVs' research efforts.

Other countries have sought to build human capacity in agricultural mechanization by offering research fellowships and secondment programs.<sup>49</sup> Additionally, TVETs do not yet offer any courses directly relevant to the fabrication of basic agricultural implements. TVETs are the primary technical training arm of the vocational education system and best equipped to provide the types of additional skill-building needed to produce these types of implements. Efforts like these should be promoted and publicized to build the capacity in industrial design, engineering, metal work, production supply chains, custom prototyping, assembly line production, and other relevant disciplines.

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<sup>49</sup> Booz & Co. (2014)

**Key activities:**

- Offer grants and fellowships in R&D to agricultural mechanization and engineering undergraduate and graduate programs, and also create a grant that is targeted at female engineers
- Offer agricultural mechanization and engineering related courses (theory and practical) at TVETS
- In universities, the curriculum can be expanded to include other related engineering disciplines such as mechanical, so as to ensure engineering students have relevant work opportunities upon completion of their university degree
- Strengthen career services at the universities by linking the public universities with local and foreign private companies with R&D facilities
- Set up exchange programs with foreign public and private research institutions, universities, et al.
- Set up partnerships with top-tier educational institutions for example, offering secondments to professors and graduate students
- Encourage the hiring of additional staff that is dedicated to mechanization at EIAR

**Intervention 1.3b: Incentivize manufacturers (domestic and foreign companies) to establish joint ventures to improve current R&D capacity**

A strong R&D sector is required to supply technologies that are specific, gender-friendly and suitable in Ethiopia. The foreign private sector, based on their strong accumulated R&D experience, is best positioned to initially drive innovation and product development for R&D through the creation of joint venture partnerships in Ethiopia. These foreign companies should be incentivized to invest in new, world-class facilities that are based in Ethiopia, to help drive up the standard of how R&D is conducted in the country.

Additionally, large, multi-national agricultural machinery manufacturers have significant technical expertise and experience that is relevant and can be transferred to Ethiopia. Specifically, foreign private companies will bring expertise to: distribute already developed machinery more quickly across the country, develop new machinery (or adapt existing technology) that might not otherwise be developed in the country, and build the technical capacity of local agricultural engineers.

Some examples of government incentives for foreign private sector entry from China and Brazil that could be adapted to the Ethiopian context include:







and propagate knowledge of policies



## 4.2. Domestic Manufacturing and Imports

### Vision for Local Manufacturing/Imports

There is a readily available supply of machinery for agricultural mechanization in-country. The local manufacturing sector is building its capacity to become a strong, sustainable sector. The Government promotes policies and provides resources to support an enabling environment for the growth of the domestic private sector.

### Bottleneck 2.1: Domestic manufacturing sector is in its infant stage

A strong local manufacturing industry can afford the country numerous benefits. Some of these benefits include:

- Creating employment opportunities
- Reducing foreign currency expenditure by minimizing imports
- Attracting foreign investment in the country
- Manufacturing products that are specifically suitable for Ethiopian conditions
- Accelerating the growth of the agricultural mechanization sector

However, Ethiopia's current domestic manufacturing sector is in its infant stage. There are only two large scale machinery assembly plants. Both of these companies import semi-knock down (SKD) tractors and assemble them locally. From 2005-2010, the two companies supplied an average of 300 tractors per year. Even with tractor imports, the number of tractors in-country is low, averaging 3 tractors per 100 square kilometers of arable land in 2007, especially when compared to other countries in Africa, South Asia, and the world average ranked at 14, 129, and 200/100 square kilometers respectively.<sup>52</sup>

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<sup>52</sup> Agribusiness for Africa's Prosperity, 2011



In terms of numbers, the sector is dominated by small and medium-scale industries that produce small scale machineries, such as maize shellers and multi-crop threshers, largely for the Government, at a very limited scale. Of these smaller industrial players, approximately 12 of them currently have the capacity to copy relatively simple machines and implement and collectively, they can produce up to 2000 threshers and shellers a year, but they have little in-house R&D capabilities. In particular, they lack the technical capacity to design and manufacture complex machineries, which require more advanced engineering and manufacturing skills. These small and medium scale industries will unlikely be able to produce more sophisticated technologies at scale. In addition, even if these companies have the required technical capacity, they have limited access to financing sophisticated machineries.

Additionally, agricultural machinery manufacturers need a supply of basic metal and petrochemical materials to produce equipment locally. Currently, there are few industry players that are concerned with refining and producing raw metal products from mineral ores.<sup>53</sup> Unfortunately, there is a limited number of basic metal companies in Ethiopia, which are only able to meet 15% of the country's metal and petrochemical needs; the remaining 85% is imported.<sup>54</sup> In addition, Government infrastructure projects, like housing and schools, are competing for raw materials, resulting in an increase in the cost of metal for agricultural machinery companies.

Domestic manufacturers also face constraints when trying to sell their products alongside imported goods to those who hold investment licenses. Because an investment license allows goods to be imported tax free, this often results in imported goods being a cheaper alternative to locally-produced machinery for investors, as when a local manufacturer is building a machine, they will be taxed on the inputs needed for production (e.g. raw materials or ball bearings).

### **Intervention 2.1a: Promote domestic manufacturing efforts with the formation of joint venture partnerships with foreign manufacturers**

Joint ventures between foreign and local manufacturers are well-positioned to build a sustainable local manufacturing sector in Ethiopia. As discussed in the Stakeholder Analysis (Section 3.3), the foreign private sector has deep industry know-how that can be leveraged to build a base of agricultural machinery, initially through importation and assembly. For example, the first agricultural machinery manufacturing facility in China was built by the Russians in the early 1950's through a joint venture. Today, this company is the country's largest domestic tractor maker.

The GoE should put in place favorable regulatory incentives to encourage domestic manufacturing to initiate efforts into the fabrication of agricultural machinery, and also incentivize international players to

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<sup>53</sup> Booz & Co. (2014)

<sup>54</sup> MIDI Metal Industry Profile, 2010



enter the market and form partnerships. The latter will require the appropriate regulation pertaining to joint ventures to be formed, which can take the shape of:

- Regulation requiring all foreign manufacturing investment/ventures in Ethiopia in agricultural machinery must be partly or majority owned by Ethiopian entities in related industries
- Regulation stipulating that only the foreign manufacturing investments/ventures with partial or majority Ethiopian ownership partners would qualify for certain Government incentives
- Regulation that allows companies who invest in local R&D facilities to be given tax incentives
- Regulation that stipulates locally-manufactured goods sold to those users holding investment licenses would not be taxed on the inputs used for the production of those goods

Such regulations will help ensure Ethiopian companies are continuing to play an active role in building the local manufacturing sector with the entry of large, multi-national foreign companies and ensure that there is a level playing field. The specifics of the JV-specific regulation should be crafted according to the vision of the country's national policies for supporting Ethiopian companies. However, JV laws should include the following three parameters to ensure the development of a robust local manufacturing sector:

- **Local ownership requirements:** Local ownership can ensure that Ethiopian companies are protected and are actively brought into the development of the manufacturing sector in-country with the entry of large, multi-national companies. These requirements could include partial, 50% or 51% ownership
- **Employment/personnel requirements:** Ethiopians should be given opportunities for higher quality employment that allows them enhance their current technical and leadership capacity. GoE can set a minimum threshold for number of Ethiopians in high value-added employment such as one-third Ethiopian representation in leadership and managerial roles and 50% in technical roles. Additionally, these JVs should be encouraged to be an equal opportunity employer and ensure an adequate number of Ethiopian women are represented at all levels of the organization. The GoE should ensure this is in line with the country's overall Industrialization



## strategy

- **Local content requirements:** Local content refers to the percentage of a final product's value that is generated through the local supply chain. Foreign companies should be encouraged to procure materials and services from local Ethiopian companies. Further, this should align with the country's overall Industrialization strategy
- **Climate and environment requirements:** In setting up operations, due attention must be given to JVs operations to ensure that it is not violating gas emission thresholds that have been set by the government. Additionally in the case of manufacturing plants, mechanized products produced must also comply with environmental laws and not be hazardous towards the climate and environment

### Key activities:

- Assess capacity of domestic companies to determine attractive candidates for joint ventures – the Strategy recommends a 'select the winners' approach in the short-term, by actively screening and recommending the most capable, willing, and highest potential local companies to be partners for the foreign firms;
- Incentivize and require large-scale international players to enter the market and establish joint ventures with strong Ethiopian companies
- Establish the parameters for joint ventures to ensure the creation of local capacity
- Facilitate linkages between international and domestic companies to establish joint ventures
- Coordinate investment policies and related activities with the Ethiopian Investment Authority
- Support local domestic manufacturing enterprises to source raw material/inputs needed without paying tax for those implements that will be used by entities holding investment licenses

### **Intervention 2.1b: Create standards for the manufacturing of small and medium scale machinery and make publicly available to SMEs**

Currently, small and medium scale agricultural machinery cannot reach farmers at scale despite the availability of manufacturing capacity. This gap is the result of not having standardized designs and little private sector distribution systems to act as an access modality. Additionally, the country lacks a policy and regulatory framework for the evaluation, registry, release and quality control of agricultural



machinery including the types of mandatory evaluations mandatory, types of technologies that require evaluation, and the bodies responsible for performing these evaluations

If basic LMIs were able to reach farmers at scale, their impact could increase farmer livelihoods for many of the poorest smallholder farmers. Additionally, the deployment of the implements can serve as an initial awareness-building activity of the benefits of mechanization among the difficult to reach smallholder farmer segments.

To support quality control and ensure maximum functionality of implements, the GoE should support the creation of design standards, including blueprints for LMIs and make these publicly available to potential fabricators. Additionally, accreditation should be given to SMEs with fabrication capabilities that can make these implements on a regional-level. Thus, designs for implements would be available publicly for anyone to replicate, should they have the necessary accreditation and be able to produce at a sufficient quality and performance standard. In setting standards for these new blueprints, the GoE should also ensure that minimum thresholds are met for environmental criteria especially for soil fertility and health.

Finalizing the designs of the Implements Package should be the responsibility of the Ethiopian Institute of Agricultural Research (EIAR), with additional input from Regional Agricultural Research Institutes, who have additional content expertise in specific technologies/crop areas. Publication of blueprints and designs should be the role of Ministry of Agriculture and Ministry of Industry through Regional Governments and Federal Agency for Small and Medium Enterprises to disseminate designs and link with Microfinance Institutions (MFIs) and Financial Institutions (FIs) to provide financing support for initial start-up capital. TVETs should offer technical skills classes that train individuals to fabricate LMIs as part of their curriculum, including the certification for students who graduate.

**Key activities:**

- Finalize and publicize designs and distribute to Regional research institutes for familiarization and technical capacity building for replication of implements on a local level
- Develop accreditation program for fabricators
- Provide support to MFIs and small financial institutions to support funding to formation of SMEs to produce basic implements at scale
- Build technical skills program and offer certification; promote field to farmers and SMEs
- Develop data base of agricultural machines and implements that are certified and registered in the country so as to allow a facilitated importation process from abroad of already tested machines



- Define and develop detailed process and clear guidelines for the registration, certification and release of agricultural machinery

### **Bottleneck 2.2: Lack of machinery standards and testing**

All new and adapted agricultural technologies should undergo standards and testing processes to ensure consistency and quality control. In particular, standards and testing process will:

- Ensure customer safety
- Ensure the suitability of machines to a country's conditions
- Educate customers on the comparative performance of various machines
- Provide input to researchers on improvement of quality
- Serve as a basis for standard specification for manufacturers

Currently, there are a number of challenges in the system in Ethiopia. First, there are no national standards for agricultural machineries. Occasionally and upon request, EIAR tests machineries based on its own standards. However, the adoption of mechanization technologies in general is limited due to sub-standard machinery quality and a lack of availability. Aside from its role of driving agricultural R&D including mechanization, EIAR is also responsible for testing, review and release of machinery. This dual role can cause potential conflicts of interests, as organizations developing agricultural machinery should not be setting the standards and managing quality control for the country. Case studies from Asian countries further validate this claim, indicating that agricultural machinery testing and evaluation should be done by independent agencies (Exhibit 12). Additionally, the results of testing are only published to technology developers or importers, and not to end users who could potentially study the results across different types of equipment.



Exhibit 12: Standards and testing institutions in selected Asian countries<sup>55</sup>

|                          | Mechanization level | Adoption of testing standards | Role of R&D centers | Testing agencies  | Institutions regulating standards      |
|--------------------------|---------------------|-------------------------------|---------------------|---|--|
| <b>China</b>             | High                | OECD<br>National              | New product design  | China Agricultural Machinery Testing Center (CAMTC)   | CAMTC                                  |
| <b>India</b>             | High                | OECD<br>National              | New product design  | Bureau of India Standard (BIS), Farm Machinery Training and Testing Centers, Regional Research Laboratories, Few NGOs | BIS                                    |
| <b>Philippines</b>       | Middle              | ISO<br>National               | New product design  | Agricultural Machinery Testing and Evaluation Center (AMTEC)  | AMTEC                                  |
| <b>Republic of Korea</b> | High                | OECD<br>ISO                   | New product design  | Division of Agricultural Machinery  | N/A                                    |
| <b>Thailand</b>          | High                | ISO<br>National               | New product design  | Thai Industrial Standard Institute under MoT  | National Agricultural Machinery Center |

**Intervention 2.2a: Create testing and certification standards focused on safety and performance**

Testing and certification standards will protect customers, ensure the suitability of machines to a country’s conditions, educate customers on the comparative performance of various machines, provide input to researchers on improvement of quality, and serve as a basis for standard specification for manufacturers.

Safety and performance standards are frequently enforced in highly mechanized countries<sup>56</sup> and should similarly be included in Ethiopia’s testing process:

<sup>55</sup>China Compulsory Certificate Mark (2011);

<sup>56</sup>Booz & Co. (2014)



- **Provide performance and safety standards that are in alignment with international standards and criteria.** Across numerous highly mechanized countries, like China, India, and the Philippines, safety tests are in alignment with international standards (ISO or OECD) and are almost always mandatory. This ensures that the end user is protected and the risk of harm is mitigated (especially in cases where awareness of using these types of technologies is low). Safety standards are most important for LMIs that will be directly used by farmers who have limited hands-on training
  
- **Allow access by end-users and farmers to test results.** The purpose of performance standards is to better inform consumers about the functionality and quality of agricultural technologies. Once machinery prototypes pass the testing and certification process, the results should be communicated to both developers and the public. This helps end users, including farmers and other potential buyers, to determine which machines to buy. The outcome of performance tests should be gradual and reflect relative performance; the model should be similar to fuel economy on a car or power consumption by electronics

**Key activities:**

- Develop safety and performance standards for motorized and LMIs that are based on international standards
- Publicly release testing and certification protocols for machinery manufacturers
- Publicly release testing and certification standards for farmers

**Intervention 2.2b: Establish a national testing and certification body to conduct national and regional testing and certification**

To allow for better enforcement and consistency of standards, an independent national testing and certification body should be established to oversee the testing process. This model has been successful in countries that were at the same stage of development as Ethiopia. China for example, was successful at ensuring the functionality of equipment, and by 1980, there were forty six discrete locations for testing of equipment.<sup>57</sup>

Given the lack of a strong private sector in Ethiopia today, the public sector should support the creation of an independent national testing center. Ultimately, when the private sector is more developed, private

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<sup>57</sup> Booz & Co. (2014)



testing centers should be encouraged to develop to replace the Government's testing and certification body. The centers will have sufficient working capital to be self-sustaining through charging fees for the services rendered in the certification process.

The national testing center should be established by the MoA. In the interim, the government should study options and identify an entity that can play the role of a National Testing Agency.

**Key activities:**

- Empower a National Testing Agency to be the interim formal testing body to enforce testing and certification standards; identify existing public entities whose resources and expertise can be leveraged in forming the National Testing Agency for example, universities or existing standard agencies
- Establish an independent testing body to manage and conduct testing related to all agricultural machinery; identify national and international partners to support with the establishment
- Establish a fee structure and process for manufacturers to obtain testing and certification
- Promote the importance of testing and certification to end users across the country and promote services of National Testing Agency

**Bottleneck 2.3: Import tariffs drive up the cost of agricultural machinery**

With only two tractor assembly companies, Ethiopia relies heavily on imports for tractors to meet the country's demand. From 2005-2010, the number of imported tractors grew by 22% annually (13% when accounting for locally assembled units).<sup>58</sup> Despite this growth, Ethiopia's tractor coverage is still significantly lower than other countries (Exhibit 13). In 2010, there were only an estimated 5,090 tractors operating in the country across 126,427 square kilometers of arable land, bringing the number of tractors operating to only four per hundred square kilometers.

As of 2014, there are approximately 12,500 tractors in Ethiopia for 14.7 million smallholder farmers<sup>59</sup> a ratio of approximately 1 tractor for every 1,000 smallholders.<sup>60</sup> Given that, increasing the number of medium to large-scale machinery should be extended to smallholder farmers to help with mechanization

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<sup>58</sup> Agribusiness Indicators, 2012

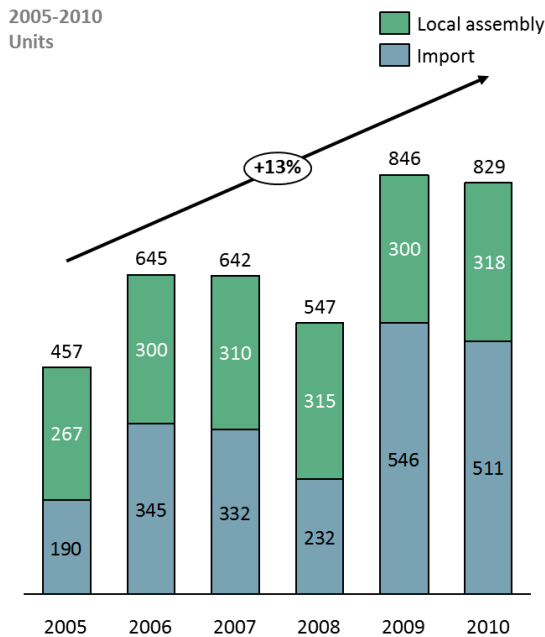
<sup>59</sup> ATA team analysis, 2014

<sup>60</sup> This number excludes commercial and state farmers that use the majority of the tractors in-country

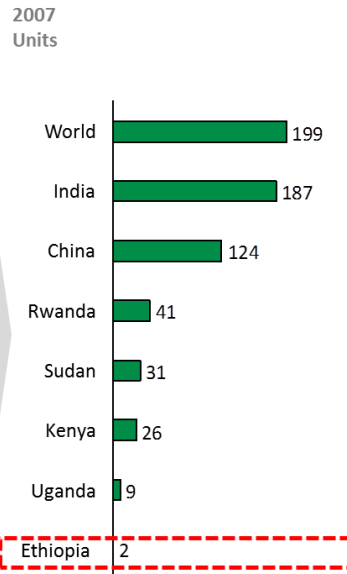
efforts in Ethiopia. The core benefit of medium and large-scale machinery is that they are able to work across multiple crops and multiple agro-ecologies.

**Exhibit 13: Number of tractors per 100 sq. km of arable land**

**Although supply of tractors has been increasing at 13% annually**



**The number of tractors per 100 sq. km of arable land ranks below world and neighboring countries**



Currently, tractors that are imported are exempted from taxes and other duties, provided they receive clearance from customs within six months. However, in many instances clearance takes longer. When importers miss the six months timeline, a 10% custom duty and 15% VAT are levied on the tractors, increasing the price by a quarter. This further limits the number of farmers that can afford tractors.<sup>61</sup>

Similarly, spare parts for tractors are tax-free only when they are imported with the tractors. Spare parts that are imported separately will be taxed at 5% custom duty, 15% VAT and 10% surtax. While adequate provision of spare parts is critical for keeping machineries operating productively, the current tariff regime makes it unattractive for suppliers to maintain an adequate supply of readily available spare parts, resulting in poor maintenance of tractors. High tariffs on tractors and spare parts deter importers from importing more machinery. Given the current state of the local manufacturing sector, importation is the most feasible short-term solution for immediately increasing the supply of tractors and other large-

<sup>61</sup> ATA team analysis, 2014





consistent supply of engines for the local market, but also protect consumers against price fluctuations. By structuring supply deals directly with manufacturers, as is now being done for common household goods, traders would be removed from the transaction. As local demand for engines increases, GoE would be able to modify supply accordingly, or should a domestic engine manufacturing/assembly facility be established, importation could be altered to stimulate demand for locally fabricated products.

**Key activities:**

- Align with the Ministry of Industry on Industrialization Strategy, ensure that mechanization is prioritized
- Coordinate with the Ministry of Trade ways to facilitate the process for importing machines, including:
  - o Remove import tariffs for CKDs
  - o Reduce import tariffs for CBUs and SKDs
- Provide centralized engine importation through government supply contracts to provide price stability and consistent supply on small horsepower engines

**4.3. Distribution****Vision for Distribution**

Female and male smallholder farmers are able to easily access agricultural mechanization technologies. Contractor and distributor classes are well established and provide farmers with agricultural machinery.

**Bottleneck 3.1: Lack of efficient and effective distribution models for agricultural mechanization technologies**

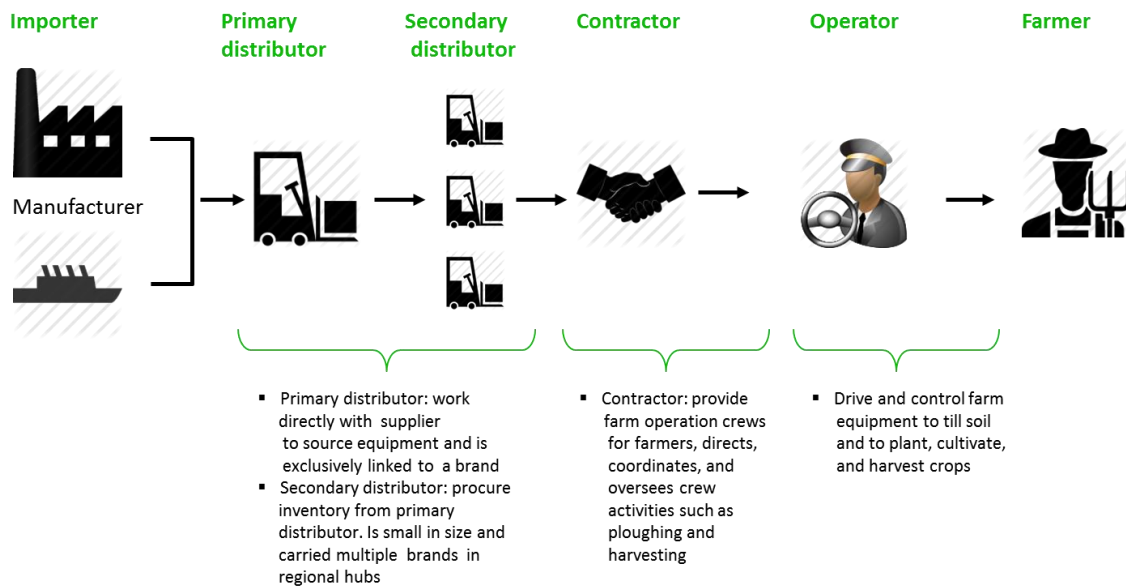
Small and medium scale technologies are typically distributed through the country's existing cooperatives system. The Regional Bureaus of Agriculture identify the types of technologies they want to promote, such in the example of the Broad Bed Maker. The Input Directorate then orders the goods and manufacturers produce the implements and sell it to cooperatives, who in return sell it to farmers. Although this system works for technologies that are highly divisible, such as seed and fertilizer, there has been limited success with mechanized implements. In addition, small and medium-scale industries will have difficulty distributing their products and accessing farmers directly. Additionally, cooperatives have a limited number female members and this has caused female farmers of female headed households difficulty in gaining access to mechanized technologies.

While distribution for small and medium scale machinery can largely be done through the country's

cooperative system to reach farmers, powered and large scale machinery require an established distribution network to effectively reach female and male farmers. Moreover, an effective distribution network requires individuals with technical knowledge, business acumen, and financial resources who can deliver; such individuals are difficult to find in country. As a result, agricultural machinery suppliers have stepped up to perform multiple roles: (1) manufacture or import technology (2) distribute technology (3) repair and maintenance technology. However, this setup ties end users exclusively to one company, allowing companies to potentially inflate the price of their services.

Current importers/distributors are not typically located within close proximity to smallholder farmers in rural areas; and instead are clustered in major cities. This is not feasible to users of farm machineries, especially women of female-headed households, who would need to travel long distance to access key support and maintenance services.

**Exhibit 14: Recommended actors across the mechanization supply chain**



**Intervention 3.1a: Promote the creation of a distribution network for agricultural machinery at the federal and regional levels**

A functional distribution and retail system will make it significantly easier for agricultural machinery to be deployed through Ethiopia. The system would sell agricultural machinery and facilitate better access to spare parts and maintenance services.



Two classes of distributors should be encouraged (Exhibit 14):

- **Primary distributors** to work directly with manufacturers and/or importers of machinery into the country. These primary distributors could come from existing import business already operating in the country and have a clear understanding of financing, import, and custom requirements
  
- **Secondary distributors** to procure inventory from primary distributors. These distributors would be smaller and likely handle multiple brands in smaller regional hubs. Secondary distributors could be organizations or people from businesses currently offering spare parts and maintenance to trucks looking to diversify

Both distributors should provide repair and maintenance services.

**Key activities:**

- Provide incentives for primary and secondary distributors to gain accreditation in service and maintenance provision from manufacturers

**Intervention 3.1b: Establish a “machine distributor” fund to provide liquidity to local distributors and support the formation of leasing companies**

One of the most constraining aspects of importing goods into Ethiopia is the lack of finance available for agents, distributors, and other relevant parties. The National Bank of Ethiopia has tight controls on foreign currency allocations that hamper importers from accessing currency liquidity in sufficient amounts and on favorable borrowing terms. Given that importing agricultural machinery would have significant long-term benefits for overall economic output and food security in the country, the GoE should prioritize it as a spending area.

To promote the purchase and import of agricultural machinery, national stakeholders can create a fund that backs local financial institutions to issue credit to distributors/agents and entities interested in





becoming leasing companies. The primary aim of the fund would be to provide short-term, foreign currency financing at attractive rates. The fund should be created with foreign currency to expedite and make the importation of machinery easier.

Such a fund could extend its purpose and should contain the following elements:

- **Accessible to authorized importers and interested leasing entities with proven ‘technical competencies’**
  
- **Available to borrowers with significant collateralization of goods** to ensure importers are not bringing in superfluous goods

**Key activities:**

- Identify and project liquidity needs for agricultural machinery
- Identify current regulation on equipment leasing and how it could be optimized for machinery leasing
- Establish oversight body to conduct technical evaluations of purchasers and ensure sufficient collateralization of goods for lending
- Establish standardized practice of borrowing and purchasing, including any conditionalities for borrowers
- Establish a “machine distributor” fund that offers flexible credit and collateral terms, leveraging international best practices, and develop framework for accessing applications and tracking borrowers’ performance

**Intervention 3.1c: Build distribution system for small and medium scale machinery in rural areas**

Small and medium scale machineries play a vital role in increasing base productivity levels and in reducing labor inputs into priority crops. These machines are needed on a larger scale, and would spread across geographic and crop zones. They are also small enough (and ideally, affordable enough) that individual farmers would own these, as opposed to being offered through a fee-based service. As such, an effective awareness building and distribution system would be vital to ensure that they can reach a sufficient number of farmers.



Currently the extension system does not conduct significant promotion of mechanization to farmers, either on small or medium and large mechanized implements. By integrating the Small and Medium Scale Machinery Package into the overall Extension Package, awareness could be created alongside the traditional package approach. This is necessary to create sufficient access to basic implements that farmers can easily purchase, and would ensure that these implements are accessible to farmers. It would also instill a basic understanding of mechanization as a concept for increasing productivity. Ideally, this would then lead to fewer obstacles when trying to introduce more advanced mechanized technologies.

More specifically, by utilizing Development Agents and operating trainings out of Farmer Training Centers, the Small and Medium Scale Machinery Package can leverage the existing extension system. Implements can then be sold through local SMEs/traders, and/or primary cooperatives to ensure that there is sufficient supply and reach.

**Key activities:**

- Create manuals for all LMIs that can be delivered through Trainings of Trainers and ultimately to DAs on how to best use implements
- Ensure sufficient supply of implements at local level, ideally through private sector, but also through Woreda Agricultural Offices
- Identify existing MSMEs/distributors and encourage the establishment of new enterprises that can deliver the implements
- Conduct analyses to identify where distributors should be located (for example zonal capitals), and the size of their operations
- Encourage MSMEs/distributors to co-locate closer to customer base, through financial and tax incentives



#### 4.4. Promotion, Purchase, and Usage

##### Vision for Promotion, purchase, and usage

Create an institutional framework for mechanization and extension services that fully supports male and female farmers in accessing agricultural mechanization, both at the Federal and Regional level. Farmers adopt best practices in agricultural mechanization based on their crop and agro-ecological needs and socio-economic ability.

##### Bottleneck 4.1: Limited awareness of agricultural mechanization among farmers

Currently, most Ethiopian smallholder farmers have a limited awareness level of agricultural machinery and the benefits that it can bring to their farming operations. This limitation is compounded by the lack of awareness and emphasis within the extension system of the benefits of agricultural mechanization. Since 98 percent of farmers list their DAs as their primary source of information and over 80 percent utilize and visit FTCs, the lack of emphasis on agricultural mechanization in the formal extension system is significant.<sup>62</sup> Additionally, farmers of female-headed households who may not wish to interact with male DAs (who make up the majority of the extension system), are left out completely.

First, the ATVET program, the primary vocational school for development agents, does not offer in its curriculum courses on agricultural mechanization. DAs are instead trained in the Animal Science, Natural Resources, and Plant Sciences. Additionally DA trainings are not offered in a way that is conducive to women. For example, the role of the DA is very much understood to be a male-dominated role. Without any training in agricultural mechanization, DAs are not capable of promoting agricultural mechanization to smallholder farmers.

Second, manufacturers and suppliers, organizations that possess the technical know-how, do not have access to smallholders. In highly mechanized countries such as China, the private sector plays a big role on technology promotion through technology and trade fairs and field trials to promote the awareness of agricultural mechanization.

Without the ability to reach farmers through demonstrations and trainings, agricultural mechanization adoption rates will remain low.

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<sup>62</sup> ATA, August 2013



#### **Intervention 4.1a: Promote awareness of agricultural machinery at the grass-roots level by facilitating linkages with private companies**

Awareness raising is the first step towards enhancing the practice of mechanization among smallholder farmers. The key to raising awareness of agricultural machinery, as repeatedly confirmed by international experiences, is to conduct grassroots level mechanization demonstrations. In Ethiopia, such promotional activities should be done through the country's existing extension system. While the Government has strong reach at the grass-roots level, it will need the support of the private sector to demonstrate the benefits of agricultural technology and to effectively promote awareness to a large number of farmers. Technology awareness promotion should be done through the extension system in collaboration with the private sector. Field days occur regularly in woreda and kebeles with the purpose of demonstrating proper agronomic practices and introducing new technologies to farmers. Private manufacturers and agent repair and maintenance service providers and financial institutions should be present at field days. LMIs should also be demonstrated at these field days, but do not need the support of private companies, as the same product could be manufactured by multiple producers, and the designs would be standardized.

##### **Key activities:**

- Encourage the extension system to work with manufacturers who have local operations to conduct grassroots mechanization demonstrations woreda by woreda through male and female DAs. In the demonstration meetings, technicians from manufacturers should operate the machines and show how the machines are used and their overall impact on productivity
- Identify and train support staff to help oversee operations and act as an information resource for operators

#### **Intervention 4.1b: Promote awareness and accessibility among female farmers including female-headed households**

To spearhead awareness raising among female-headed households a number of interventions can be used to address these challenges. Firstly, the Government should promote the DA role among women and tailor trainings and curriculum to be more gender responsive so as to allow them to reach female farmers. Secondly, demonstration and promotion can take place among key women's support groups at the kebele level, with the assistance of the female DAs and female representatives of private companies. Thirdly, identify and encourage female model farmers and their networks to attend field days.

**Key activities:**

- Promote the DA role among women through a targeted campaign and through the involvement of current female DAs
- Tailor trainings and curriculum to be more gender responsive through the inclusion of a course on how to work with female farmers
- Identify key stakeholders for female farmers to pilot the promotion of technologies through this channel and identify level of impact
- Identify and encourage female model farmers to demonstrate at field days and encourage female DAs to reach out to women to attend

**Intervention 4.1c: Promote local-level contractor class to render rent services to smallholder farmers**

One of the most significant obstacles in mechanization for smallholder farmers is that the per capita farm size of an individual smallholder can only utilize – and generate return for – a small portion of the capacity and power of mid- and large-sized motorized machinery. Additionally, service providers have not operated in a policy environment that is conducive to purchase machinery to take to farmers, with few exceptions (the Arsi-Bale region, for example). This mismatch makes it difficult for individual farmers to purchase these machineries in broad scale in Ethiopia.

To solve this mismatch, a class of fee-for-service service provider – what this Strategy terms “Contractors” – will be promoted and formulated. The fee-for-service model can solve the deep issue of the above mismatch, and be the key to enable access of scaled machinery for the vast market of smallholder farmers. The smallholder farmers no longer have to purchase the entire machines to be able to enjoy the benefits of mechanization. As this Strategy provides access to the smallholder market segment, it will also help make Ethiopia an attractive and large market for global manufacturers of machines suited to small farm sizes.

Thus, for offering these services, potential contractors need to understand the market opportunity and users need to understand the benefits of the technology and ensure that it is easily accessible. For medium and large scale machinery, the primary model of distribution could be through contractors who provide a fee-for-service. This model would offer two key benefits:

- **Quality and consistency of training** to contractors and operators to ensure all agricultural



machinery is operated by highly-trained individuals. This would protect farmers' safety and ensure that machine services were provided to farmers in the most time-efficient manner

- **Provision of access to mechanization for smallholder farmers** (while avoiding the traditional issue of individual access to finance) to help them access mechanization

The majority of operators can be local entrepreneurs or model farmers or those identified as having the potential to successfully run a business. The Government should conduct a promotional campaign to create awareness of the opportunities that exist in becoming a service provider. Those interested would be shown how they would be able to significantly improve their livelihood by offering the service, especially towards women who now will have access to services that they were not able to perform on their own. The career path would be that operators would have to provide the initial capital to finance the operations, and then would be credited back once they have shown commitment to their business.

#### **Key activities:**

- Source and engage candidates from TVETs and other educational institutions to join contractor field (e.g. develop promotional material of career path)
- Conduct activities to promote contractor formation and link-up willing farmers/entrepreneurs with manufacturers for training
- Set up a certification program for 'contractors' (can be administrated by domestic/foreign companies)
- Institute regulatory and financial incentives and supports for people who are successfully certified as contractors to support contractors in training, for example training fees, capital for purchase of equipment, etc. The Government, in coordination with the Ministry of Education, should promote the certification program to potential suitors, for example, by visiting high schools and participating in career fairs
- The Government provides linkage for the certified contractors to female and male smallholders (through, for example, the woreda/kebele demonstration events, women's gatherings, etc.)

#### **Bottleneck 4.2: Lack of financial services to facilitate the use of agricultural mechanization services**

To enable access to farmers of small mechanized implements and contractor services, a resilient and efficient financial institutional system needs to be in place. Currently, this system is wrought with a number of challenges including low accessibility, limited breadth and depth of financial products, as well



as low financial literacy.

Although, SACCOs and MFIs serve some farmers by providing input credit, most farmers still do not have access to financial services. Limited access to distribution channels both, brick and mortar as well as electronic, limits opportunity to deposit savings, purchase financial products and to access loan disbursement and make loan repayments. Additionally, many farmers that seek financing through the cooperatives network are not registered directly with MFIs (and therefore have limited exposure to their services) and carry a greater risk of default, hindering their access even further.

Moreover, MFIs have provided a limited scope of products and services that fit the needs of smallholder farmers such as limited input credit (including for mechanized technologies), rigid loan terms, and few risk mitigation mechanisms. Mechanization in particular requires its own schemes and terms.

#### **Intervention 4.2a: Increase accessibility by farmers of financing services for mechanization technologies and services**

To increase accessibility and link up farmers directly to MFIs, a tried and tested manual voucher system can be employed in coordination with rural financing stakeholders. Contrary to the current system, after a farmer applies for a loan, the MFI assesses the farmer's credit worthiness and issues a voucher and loan passbook. The farmer then exchanges the voucher for inputs from the primary cooperative and the latter further exchanges the voucher copy to the coop union. Once the coop union has consolidated the vouchers, it passes it on to the MFI who then sends cash in the amount of commission for inputs sold by union and primary cooperatives.

Additionally, financing can be further offered by service providers of mechanized services, opening up farmers to an additional distribution channel. Service providers can act as middle men between MFIs and farmers. Similar to the model above, service providers can collect vouchers from farmers and then turn in it for payment from the MFI.

#### **Key activities:**

- Perform analysis of the loan requirement for purchase and rent of machinery by region
- Develop and map financing system to involve providers of mechanized services
- Coordinate with rural financing stakeholders on the incorporation of providers of mechanized services into their voucher system framework and ensure that mechanization is a key component of their rural financing strategy for Ethiopia



- Encourage MFIs to promote their services at field days

#### **Intervention 4.2b: Increase breadth and depth of financial product offerings to serve mechanization needs**

MFIs need to expand the size and scope of their financial service offerings and ensure they cater to farmers' needs and requirements. First, MFIs should modify the terms of their existing products (such as the loan for equipment leasing) to make it more usable to farmers. Loan products should come with flexible terms and conditions that are tied to farmer incomes, repayment should be based on farmer cash flows, and loans should be adjusted based on creditworthiness.

The financial product mix offered by financial institutions should be expanded to include products targeted at encouraging the use of mechanized technologies. Specifically, loans related to the purchase of small mechanized technologies and a variety of insurance schemes should be offered. Similar to loans given to automobiles, loans for the purchase of agricultural mechanized technologies can be structured so that they can be offered up as collateral in case of default. Insurance products such as Catastrophic Risk Insurance could protect farmers against risk of unexpected events. They include the following:

- **Specific peril crop insurance:** Single, pre-defined independently declared specific event (e.g., flood)
- **Multiple peril crop insurance:** Multiple, pre-defined independently declared specific events (e.g., flood and pest infestation)
- **Area yield index insurance:** Crop yields do not attain a pre-defined, independently declared threshold
- **Weather index insurance:** Temperature, rainfall or other weather indicators exceed or fall below pre-defined independently declared thresholds (typically measured by land-based sensor technology)
- **Satellite based index insurance:** Pre-defined, independently declared changes in climatic zones as measured by data transmitted via satellites





This mechanism adds a layer of protection to farmers who are financially vulnerable and gives them the confidence to invest in mechanized devices. Additionally, a component for mechanization should be included in smallholder farmers' annual input package. Specifically, around an additional 1600 Birr should be added to cover the annual demand per farmer for providers of mechanized services.<sup>63</sup>

**Key activities:**

- Design new products including mechanization technology loan and crop insurance to support the adoption of new practices; commission the help of experts in the field to identify correct structure of package
- Assist relevant stakeholders with initiatives around the modification of existing financial products so that they cater to farmer requirements (such as around flexible loan terms, repayment periods, etc.)
- Ensure that the technical capacity exists within MFIs to accurately assess risk when it comes to agricultural output and the impact mechanization can have on smallholder agriculture
- Commission MFIs and development banks to help assess risk
- Expand technology package to include an additional 1600 Birr per farmer for the procurement of agricultural mechanization services

**Bottleneck 4.3: Weak institutional capacity for promoting mechanization among farmers and implementing the mechanization strategy**

Currently, there are multiple institutional challenges within the government system that hinder it from being able to achieve its desired outcomes on farmers.

First, mechanization is overlooked at the highest levels of planning. While Ethiopia's first Growth and Transformation Plan sets important goals and objectives that hope to elevate Ethiopia to middle-income status through industrialization (among other efforts), there are no references to the importance of incorporating mechanization in achieving development for the country.

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<sup>63</sup> ATA team analysis, 2014



Second, there has been an unclear agenda, and a de-prioritization in recent years, of mechanization at the MoA. While the MoA had previously dedicated resources to the promotion of technologies specific to mechanization (such as the Rural Technology Promotion Department), these have since been phased out. For the past twenty years, the MoA has dedicated limited resources towards mechanization and it was only in 2013 that the MoA created the Mechanization Directorate to address mechanized technologies. However, many structural challenges remain especially when accounting for the current Directorate's organization structure and access to resources. The Directorate lacks many of the organizational structures required for a unit to operate – including designated space, requisite quality and number of staff and IT infrastructure. The Directorate has insufficient resources to execute its role – as of the publication of this strategy, it houses only three employees. Finally, the Directorate struggles to secure funding and this has only compounded its inability to operate.

Third, there is limited capacity on the regional level. Similar to the challenges faced at the federal level, the regional offices lack the infrastructure and resources to operate. Additionally, with very few outlets the regional reach of the Directorate is limited, making it more difficult to diffuse knowledge and use of mechanized products among smallholder farmers.

#### **Intervention 4.3a: Establish institution of mechanization at the federal and regional level**

To address these political, organizational and funding challenges around the institutionalization of mechanization, the current system in which it functions will require a major overhaul. Much like in Nigeria and China, it is advised that an independent institution (with regional counterparts) is established to coordinate all the efforts that are employed by all actors in the value chain to develop the sector, develop guidelines and enforcement of the guidelines, capacity building, accreditation of institutions and individuals.

GTP II should ensure to capture mechanization as a key pillar for growth and transformation of Ethiopia. The significance mechanization plays in catalyzing development and in creating higher value-added jobs for the local workforce should be noted and acted upon. Additionally, policies should be developed that would enable the creation of the proposed institution including issuing a decree for its creation and dedicating expanded funding (the detailed roles and responsibilities of the institute shall be defined upon its establishment). This entity should also be promoted among relevant stakeholders in the industrial and financial sector for example.

In the interim period before the creation of the independent institution, the agricultural mechanization Directorate within MoA (and relevant units at RBoA) should be strengthened at the institutional level. It



will require both enhanced manpower and resources to carry out its role in overseeing the overall development of agricultural mechanization in the country. Additionally, it should act as a coordination body of the sector in the country and should work in close cooperation with all stakeholders and actors along the agricultural mechanization value chain. The existing agricultural mechanization Directorate within MoA will be the foundation upon which the envisaged institute will be established and should handle the tasks of the envisaged institute to the time of the establishment of the institute.

**Key activities:**

- Liaise with the highest levels of government to incorporate mechanization as a core agenda item in GTP II and promote benefits of mechanization among stakeholders
- Issue decree for the creation of an independent institution for mechanization and other accompanying policies
- Conceptualize and identify resources requirements and set up the organizational structure and processes for the federal and regional entities including for human resources, IT systems, etc.
- Focus on capacitating new independent entity through a strong campaign for the hiring of qualified personnel at the federal and regional levels
- Set up an IT data management system that can easily collect and store knowledge and data that can be accessed by at the federal, regional and woreda level
- Create a performance management unit (MLE) that sets the overall goals of the organization and the key parameters and indicators that the organization should evaluate itself against, evaluates project proposals against those goals, and monitors the progress of the chosen progress against key indicators
- Set collective targets with each of the regional offices to ensure there is alignment and conduct a periodic review to ensure targets and goals are relevant

#### 4.5. After-sales Service

**Vision for After-sales Service**

Smallholder farmers are able to easily access agricultural mechanization spare parts and after-sales services across the country. Specialized repair and maintenance providers are established and have well-stocked supply of critical spare parts and well-trained technicians. Smallholder farmers have access to avenues that allow them to solicit advice on modern farming techniques related to mechanization.



### **Bottleneck 5.1: Lack of available spare parts and after-sales services**

Maintenance helps increase the life span of agricultural machineries. Repair and maintenance services in Ethiopia are currently at an infant stage with few companies providing these services. Given the lack of specialized repair and maintenance providers, importers are currently providing the services for tractors and other motorized machineries. However, most of these service providers are located in Addis Ababa, only a few of them have mobile workshops in rural areas. Subsequently, machines are not inspected and maintained regularly resulting in increased machine malfunction and high cost for the customer.

Moreover, importers source a limited number of international brands. For example, Ries Engineering, a prominent local importer, exclusively imports Massey Ferguson tractors and MOENCO, a competitor, only imports New Holland tractors. This means machine owners are closely tied to only a few brands and service providers. With limited competition, repair and maintenance costs remain high.

### **Intervention 5.1a: Create an enabling environment to ensure availability of spare parts for imported medium and large agricultural machinery**

Keeping a ready supply of spare parts, especially those that are high use is essential to keep machinery operational. Many suppliers are forced to import spare parts with the purchase of equipment, incurring up to an additional 30% for spare parts<sup>64</sup>. Agents/distributors are also hesitant to tie-up foreign currency/capital in stocking spare parts on hand (especially those that incur high taxes on their imported goods).

The strategy proposes that machine import tariffs be reduced or eliminated on the importation of spare parts for primary agents/distributors. This will ensure a readily available supply of spare parts in the country. Additionally, a revolving foreign currency fund should be formed for use by agents/distributors in the purchase of spare parts to help in ease liquidity constraints. This fund should be accessed by suppliers who have met pre-certification standards by suppliers, limiting their ability to abuse the privileges of the fund. Additionally, orders should be made directly with manufacturers (preferably with Original Equipment Manufacturers) to ensure there is consistency over quality for the parts imported.

#### **Key activities:**

- Develop guidelines and policies that mandate all agricultural machinery imported is accompanied by complete lists of spare parts, which are publicly available to encourage importation of spare parts
- Create guidelines and policies that would require an agent/distributor within Ethiopia to ensure

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<sup>64</sup> ERCA, 2014



at least import 10% of net import value is in spare parts

- Remove importation taxes/tariffs on spare parts for medium and large agricultural machinery
- Establish foreign currency fund accessible by importers to fund spare parts purchases
- Coordinate policies with Ministry of Trade and Industry, and Ministry of Finance

**Intervention 5.1b: Support the formation of privately run regional supply centers for commonly-needed spare parts and ensure a sufficient number of trained technicians**

Spare parts and maintenance are vital for the upkeep and long-term continued usage of mechanized implements, especially larger, more complex implements. During periods of high-usage, it is vital that spare parts can be made readily accessible to where they are needed on short notice. Keeping sufficient stocks of spares with high turnover is needed, especially on a regional level. In addition, a highly-trained class of technicians will be needed to support the installation of these types of spare parts and will reduce the wait time for maintenance.

Ideally, supply of spare parts should be kept with secondary distributors. This will allow distributors to properly manage the stock count and ensure that spare parts are fitted and are sufficiently maintained. In order to ensure technicians have sufficient training for servicing these types of machines, support would be given to TVETs by machinery manufacturers to provide training at the institutions themselves, providing a clear career trajectory with mobility between employers, as those graduates would have accreditation for specific machinery types/brands.

The Ministry of Agriculture should also assist by ensuring a sufficient amount of spare parts are imported for each type of implement and to work with manufacturers to identify key locations that will host the supply centers. To ensure that there are enough trained staff, manufacturers would work directly with TVETs and Ministry of Education to ensure there was enough classes being offered to meet demand.

**Key activities:**

- Identify high-need spare parts for each type of equipment that a secondary distributor sells and monitor the supply of stock through a national inventory system
- Create the national inventory system repository
- Coordinate with TVET to prioritize training of mechanics and technicians capable of working on medium to large machinery, ensuring that there is direct connections to potential employers



through work experience/trainee programs

- Find and select high potential secondary distributors, and encourage and support these entities, for example the government can help secondary distributors identify key locations to set up service centers
- Create linkages between equipment operators and secondary distributors through the support of zonal-support staff to ensure that all operators had ready access to maintenance and service providers

#### **Intervention 5.1c: Support regular accreditation/maintenance renewal system to ensure full functionality of machines**

To ensure that maintenance services meet the quality needs of machine operators, an accreditation process should be created that is in line with international quality standards. Thus, any 'authorized maintenance provider' would need to be recertified by the manufacturer on a regular (e.g. annual or semi-annual) basis. This would work similar to the car industry, where manufacturers have 'authorized dealers/service providers that are certified to give service that meets recommended quality. In order for the distributor to continue supplying a particular brand of machinery, the manufacturer will need to conduct a regular inspection of workshop, retail facilities, and spare parts inventory system to ensure proper service provision to customers. This would be done by the manufacturers in a similar way to how they originally authorize the manufacturer to sell their equipment.

Distributors would work directly with manufacturers to receive reaccreditation, but would be supervised through the Regional Bureaus of Agriculture and Zonal support staff.

#### **Key activities:**

- Ensure that all distributors are recertified every one-two years, both on retail and distribution
- Develop/Improve the accreditation system by ensuring standards meet international guidelines

#### **Intervention 5.1d: Capacitate and support local technical staff to perform basic maintenance**

While the LMIs in the Basic Implements Package are not as technically advanced, they require basic maintenance to be performed. Additionally, some devices will have moving parts that will suffer from wear and tear and will ultimately need to be replaced.

Maintenance for LMIs will not be as complex as for engine powered machinery. To handle such an



activity local technicians can be empowered and trained to provide these types of maintenance services, such as vehicle and/or Bajaj mechanics. A simple one or two day training could be offered to technicians in maintaining these types of units, after which, the technician would be given an accreditation. Initially, the government should cover the costs of trainings to local technicians that have been selected as having high potential. Technicians would receive the training as part of training of trainers given by research-based mechanization experts.

**Key activities:**

- Modify and improve technical training curricula that build on the Basic Implements Package for maintenance and spare parts replacement
- Survey and identify geographically-relevant basic maintenance technicians that would be candidates for training
- Coordinate with TVET on curricula and funding mechanisms for program



## Chapter 5: Implementation Priorities

This chapter provides a recommendation on the key **strategic interventions and actions** that the sector should immediately consider implementing and also provides a high level outline of the implementation roadmap of this strategy. A methodological approach was utilized to formulate these recommendations (see Annex 6.2) including the use of a comprehensive prioritization matrix that examined the level of socio-economic impact and degree of feasibility of execution of each identified intervention.

This sector strategy is envisioned as a living document that provides meaningful and impactful guidance to sector participants. Achieving the sector's vision requires a structured review process to take place on a periodic basis, and improve on it based on lessons learnt and changing realities within the sector. Therefore, the recommendations proposed are provisional and should be put through a review process to reflect the priorities and development trajectory of the time of review.

Six key interventions were identified:

- Intervention 1.1a: Conduct a needs assessment to identify the most impactful mechanized technology opportunities for the private sector
- Intervention 4.1a: Promote awareness of agricultural machinery at the grass-roots level by facilitating linkages with private companies
- Intervention 4.1c: Promote local-level contractor class to render rent services to smallholder farmers
- Intervention 4.2a: Increase accessibility by farmers of financing services for mechanization technologies and services
- Intervention 4.3a: Establish institution of mechanization at the federal and regional level





- Intervention 5.1d: Capacitate and support local technical staff to perform basic maintenance

Additionally, recommendations on medium- and long-term implementation plans are outlined.

## 5.1. Priority Interventions

### **Intervention 1.1a: Conduct a needs assessment to identify the most impactful mechanized technology opportunities for the private sector**

High impact technologies should be identified that meet the needs of farmers. The strategy proposes the following key activities:

- At the federal level, identify detailed data required for initial assessment of farming practices and farmer types
- At the regional level with support from NGOs, conduct data collection at the kebele and woreda-level institutions across the country
- At the federal level, collate and analyze data to identify priority technology opportunities for Low Mechanization Implements (LMIs) and High and Intermediate Mechanization Implements (HIMIs)
- At the federal level, evaluate the current capacity to produce these technologies in-country and identify which technologies to source (and modify)
- At the federal level and in consultation with experts, identify and test technologies that respond to women's and men's needs
- At the federal level and in collaboration with the regions, develop a standardized 'package' of LMIs for smallholder farmers and distribute to regions



#### **Intervention 4.1a: Promote awareness of agricultural machinery at the grass-roots level by facilitating linkages with private companies**

The extension system should spearhead the facilitation of linkages between technology suppliers and operators with smallholder farmers. The strategy proposes the following key activities:

- At the federal level, the Government should conduct an identification of high need areas such as areas with low concentration of mechanized devices
- At the federal level, identify and connect with high potential locally-based private sector mechanization players such as manufacturers, agents, service providers of mechanization and after-sales services whose activities could benefit farmers
- At the federal level and in consultation with regional extension system, develop program for creating linkages through field days, workshops, etc.
- At the regional level, identify private sector players whose products are relevant and encourage prioritized private sector players to sign up to program and mark attendance to sessions
- At the regional level, train and hold a workshop for Development Agents (DAs) on technologies, ensuring adequate representation of female DAs
- Identify and train zonal support staff to help oversee operations and act as an information resource for operators
- At the regional level, organize and host field days and oversee joint demonstration by DAs and private sector players

#### **Intervention 4.1c: Promote local-level contractor class to render rent services to smallholder farmers**

To ensure farmers have accessibility to machinery and that they are provided with the best service, the government should focus on promoting the contractor profession to rural individuals who live in close proximity to the farmers. The strategy proposes the following key activities:

- At the federal level and with consultation from the regions, design the promotional campaign to attract individuals to the profession
- At the regional level, conduct a promotional campaign to create awareness of the opportunities that exist in becoming a service provider
- At the regional level in coordination with the Ministry of Education, should promote the certification program to potential suitors, for example, by visiting high schools and participating in career fairs
- At the regional level, source and engage candidates from public and private TVETs and other similar educational institutions to join contractor field



- At the federal level and with the assistance of international experts and TVETs, set up a certification program for ‘contractors’
- At the federal level, institute regulatory incentives for people who are successfully certified as contractors to support contractors in training, for example training fees, capital for purchase of equipment, etc.
- At the regional level, provides linkage for the certified contractors to female and male smallholders (through the woreda/kebele demonstration events, women’s gatherings for example)

#### **Intervention 4.2a: Increase accessibility by farmers of financing services for mechanization technologies and services**

This intervention should primarily support and build on the transformational efforts and initiatives undertaken by rural financing stakeholders. The primary objective is to ensure financing around the purchase and use of mechanization is identified and acted upon by these stakeholders. The strategy proposes the following key activities:

- At the federal level, perform analysis of the loan requirement for purchase and rent of equipment by region
- At the federal level, develop and map financing system to involve providers of mechanized services
- Coordinate with rural financing stakeholders on the incorporation of providers of mechanized services into their voucher system framework and ensure that mechanization is a key component of their rural financing strategy for Ethiopia
- At the regional level, encourage MFIs to promote their services at field days

#### **Intervention 4.3a: Establish institution of mechanization at the federal and regional level**

Initially this intervention should capacitate the mechanization arm of the MoA, and ultimately should lead to the creation of an entity that is able to focus on mechanization for the country. The strategy proposes the following key activities:

- At the federal level, liaise with highest levels of government to incorporate mechanization as a core agenda item in GTP II and propagate benefits of mechanization among these stakeholders
- At the federal level, issue decree for the creation of an independent entity for mechanization (similar to EIAR) and other accompanying policies



- At the federal (and with some support from the regions), conceptualize and identify resources requirements and set up the organizational structure and processes for the federal and regional entities including for human resources, accounting and finance, IT systems, locations of regional and woreda offices, etc.
- At the federal and regional level, focus on capacitating new independent entity through a strong campaign for the hiring of qualified personnel at the federal and regional levels
- At the federal (and with some support from the regions), create a performance management unit (MLE) that sets the overall goals of the organization and the key parameters and indicators that the organization should evaluate itself against, evaluates project proposals against those goals, and monitors the progress of the chosen progress against key indicators
- At the federal level, set up an IT data management system that can easily collect and store knowledge and data that can be accessed by at the federal, regional and woreda level
- At the federal and regional level, set collective targets with each of the offices to ensure there is alignment and conduct a semi-annual review to ensure targets and goals are still relevant

#### **Intervention 5.1d: Capacitate and support local technical staff to perform basic maintenance**

This intervention should serve to up-skill local-level individuals to be able to perform basic maintenance. The strategy proposes the following key activities:

- At the federal level, identify localities with high needs for basic maintenance services and perform baseline assessment of availability of these services to ensure it is meeting the needs of the population
- At the federal level and in coordination with the Ministry of Education and TVETs, modify and improve technical training curricula that build on the Basic Implements Package for maintenance and spare parts replacement
- At the regional level, survey and identify geographically-relevant basic maintenance technicians that would be candidates for training e.g. artisans
- At the regional level, conduct a promotional campaign to create awareness of the opportunities that exist in the maintenance profession (in tandem with promotional campaign for service providers)



## 5.2. Medium- and Long-term Interventions

### I. Medium-term Interventions

|      | Medium-term Interventions  | Primary Owner   |
|------|--|---|
| 1.3b | Incentivize manufacturers (domestic and foreign companies) to establish joint ventures to improve current R&D capacity                               | NARC (National Agricultural Research Council)/EIAR/MoA/EIA (Ethiopian Investment Authority) |
| 2.1a | Promote domestic manufacturing efforts with the formation of joint venture partnerships with foreign manufacturers                                   | Mol (Ministry of Industry)/MoA/EIA  |
| 2.2b | Establish a national testing and certification body to conduct national and regional testing and certification                                       | MoA/ESA(Ethiopian Standard Agency)/BoAs (Bureaus of Agriculture)                            |
| 3.1a | Promote the creation of a distribution network for agricultural machinery at the federal and regional levels   | MoA/BoAs  |
| 4.1b | Promote awareness and accessibility among women including female-headed households   | MoA/BoAs  |
| 4.2b | Increase breadth and depth of financial product offerings to serve mechanization needs   | MoA/ATA/ MFIs (DeCSI, OMO, OCSSCO, ACSI)  |
| 5.1b | Support the formation of privately run regional supply centers for commonly-needed spare parts and ensure a sufficient number of trained technicians | MoA/BoAs  |

### II. Long-term Priorities

|      | Long-term Interventions  | Primary Owner   |
|------|--|---|
| 1.3a | Build human capacity in agricultural mechanization and engineering   | NARC/EIAR/RARIs (Regional Agricultural Research Institutes) |
| 1.2a | Identify requirements and allocate sufficient resources to fund government research on mechanization topics that will build competencies | NARC/MoA/EIAR/RARIs   |
| 2.1b | Create standards for the manufacturing small and medium scale machinery and make publicly available to SMEs                              | ESA/Mol/MoA/BoAs  |
| 2.2a | Create testing and certification standards focused on safety and performance   | ESA/Mol/MoA/BoAs  |
| 2.3a | Extend the agricultural tax exemption and reduction to   | MoFED/ ERCA (Ethiopian Revenues                             |



|             |  |  |
|-------------|--|--|
|             | medium/advanced agricultural machinery   | and Customs Authority)/MOA               |
| <b>3.1b</b> | Establish a “machine distributor” fund to provide liquidity to local distributors and support the formation of leasing companies | MFIs (DeCSI, OMO, OCSSCO, ACSI)/MoA/BoAs |
| <b>3.1c</b> | Build distribution system for small and medium scale machinery in rural areas  | MoA/BoAs/ESA                             |
| <b>5.1a</b> | Create an enabling environment to ensure availability of spare parts for imported medium and large agricultural machinery        | MoA/BoAs                                 |
| <b>5.1c</b> | Support regular accreditation renewal system   | MoA/ESA/BoAs                             |

### 5.3. Implementation and Ongoing Review

The working document and suggested implementation priorities will be **owned and managed by the MoA’s Agricultural Mechanization Directorate and RBOAs**. The ATA will continue to provide ongoing problem solving and implementation support.

The review process for this sector strategy reflects the diversity of perspectives contained within. Early reviews were conducted by agricultural mechanization and agronomy experts as well as by private sector participants from December 2013 – March 2014. At the discussion and alignment workshop in June 2014, representatives from the MOA, RBOAs, EIAR, RARIs and other GoE agencies, and relevant NGOs also participated. Stakeholders at the workshop were charged with reviewing and refining the proposed activities for all interventions and identifying the most prioritized interventions to implement for 2007 E.C. the agricultural mechanization sector strategy was also reviewed by the National Agricultural Mechanization Steering Committee and other key stakeholders.

**Moving ahead, the strategy should be reviewed at periodic checkpoints and progress will be measured against targets that will be developed in the implementation stage of this sector strategy.** With the next Ethiopian Growth and Transformation Plan (GTP) for 2016-2020, this document is expected to contribute strategic thinking to the nationwide targets set, while revised national goals impact the prioritization of interventions within the agricultural mechanization sector.



## Chapter 6: Annexes

### 6.1. Steering Committee

Guiding the development of this strategy throughout the whole development process was a Steering Committee, comprised of experts in the sector and those who have the most relevant experience to forming a functional and implementable strategy. These include the following:

- **Tamiru Habte:** Director, Mechanization Directorate, Federal Democratic Republic of Ethiopia, Ministry of Agriculture
- **Dr. Heinz Loos:** Project Manager, Ethio-German Agricultural Training Center (ATC), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- **Yonas Metaferia:** Agricultural Marketing Manager, Ries Engineering PLC
- **Aliye Hussen:** Director General, Oromia Agricultural Research Institute
- **Dr. Marco Quinones:** Senior Director, Geographic Implementation Support, Ethiopian Agricultural Transformation Agency
- **Dr. Seife Ayele:** Director, Technology Access and Adoption, Ethiopian Agricultural Transformation Agency
- **Mirafe Marcos:** Chief of Staff, Ethiopian Agricultural Transformation Agency

Throughout the development of the strategy, the Steering Committee met on a regular basis to provide high-level guidance and support for strategic challenges. In turn, their contribution to the development of this document was invaluable to ensure that the ultimate document developed was functional, realistic, evidence-based, and ultimately, implementable.



It is expected that the mechanization sector strategy development process will continue through the development of the next Growth and Transformation Plan (GTP) due in 2015, with which a formal version of the strategy will be launched.

## 6.2. Prioritization Methodology for interventions

In identifying the prioritized interventions for the strategy for the five year timeframe, a thorough process was put in place that involved MoA and ATA professionals. A prioritization matrix was developed that allowed for the identification of those interventions that are high impact, and those that are feasible to pursue. A number of variables were addressed including:

### Impact and Attractiveness

- **Degree of necessity:** the level of urgency needed to address bottleneck, the more urgent, the higher the rank
- **Degree of impact:** the degree of impact on the number of farmers and level of improved farming practices
- **Degree of impact:** the extent to which it can contribute to industrialization and the involvement of the private sector





- **Degree to which in can address multiple bottlenecks, now and in the future:** the extent to which one intervention can address several systemic issues

#### Feasibility of execution

- **Level of resources needed to execute:** the human, financial and infrastructural requirements of executing the intervention
- **Availability of resources:** the extent to which the resources are readily available
- **Time needed to implement:** the time required to see the intervention fully executed
- **Level of stakeholder coordination required:** the level of complexity of stakeholder coordination e.g. the more stakeholders involved, the more difficult the alignment process

This assessment also accounted for the expert opinion of a variety of stakeholders including participants from the strategy's validation workshop that included national and international public, private and NGO sector participants.



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