ESAE

ESAE Magazine

ESAE Bi-Annual magazine, Vol. 1, Issue 1, June, 2026

Ethiopian Society of Agricultural Engineers

Engineering Ethiopia's Agricultural Transformation



About The Magazine

The ESAE Bi-Annual Magazine is the official publication of the Ethiopian Society of Agricultural Engineers, published every April and October. It serves as a vital link connecting researchers, field engineers, academics, and policymakers across Ethiopia. Inside, you will find technical updates, member spotlights, and practical insights dedicated to advancing Ethiopia's agricultural transformation

Welcome To Our First Issue

Connecting Engineers, Transforming Agriculture: When we first established ESAE, we promised more than a membership card and an annual meeting. We promised connection–a platform where the agricultural engineer in a remote woreda feels as informed and valued as the university professor.

Inside this edition, we move beyond dense academic papers to share stories of members solving real-world challenges, updates on precision agriculture, soil conservation policies, and post-harvest technology. Years ago we planted a seed–this magazine is one of its first leaves. Let us water it together

Understanding Our Profession

What is Agricultural Engineering?

Agricultural engineering applies engineering, science, and technology to improve agricultural production, food processing, and natural resource management. It bridges engineering innovation and ecological science to promote efficient and sustainable agriculture.

The discipline covers four main areas: farm power and mechanization, soil and water conservation, post-harvest technology and agro-processing, and agricultural infrastructure. Agricultural engineers design and adapt farm machinery, develop irrigation and watershed systems, and implement technologies that protect soil and improve water-use efficiency.

They also develop post-harvest solutions, such as cold chains, solar drying, and food-processing facilities, to reduce losses, preserve quality, and increase the value of agricultural products. Today, the field increasingly incorporates digital technologies, including GIS, sensors, smart irrigation, drones, and precision farming.

Ultimately, agricultural engineering is a driver of productivity, economic resilience, environmental sustainability, and rural development. In Ethiopia, it plays a vital role in modernizing agriculture by adapting technologies to local conditions, strengthening food security, and conserving natural resources.

Table of Contenets

President's Message 2
Editor's Note..... 2
Cultivating Unity, Engineering Progress: 4
Historical perspectives and Merits of Agricultural Engineering 6
Adapting Precision: How 7
Aligning Ethiopia's Mechanization Policy with Soil Health 9
Reducing Loss and Adding Value...10

Addis Ababa, Ethiopia *Phone: +251 923317398* *Email: admin@esae.org.et* website: https://esae.org.et/

PRESIDENT'S MESSAGE

Dear Members and Partners



Welcome to this edition of our bi-annual magazine. Since our establishment in 2021, the Ethiopian Society of Agricultural Engineers has worked to build a unified platform bridging research with real-world farming solutions. As we expand our technical committees and regional partnerships, our commitment remains clear: driving sustainable practices, technological innovation, and professional development across Ethiopia.

Achieving food security and climate resilience requires our collective expertise—from mechanization in the field to post-harvest value addition. I invite every member to actively contribute to our technical working groups, share field insights, and help shape the future of Ethiopian agriculture.

Editior's Notes

Dear Fellow Members of the ESAE,

When we first imagined this Society three years ago, we promised more than a membership card and an annual meeting. We promised connection. We promised a platform where the agricultural engineer working in a remote woreda could feel as informed and valued as the professor lecturing. We promised to document our work, share our failures as openly as our successes, and build a collective memory for our profession.

This magazine is that promise delivered.

Welcome to the very first edition of the ESAE Bi-Annual Magazine. It arrives in your hands every April and October. Inside, you will find no dense academic papers—those belong in our journal. Instead, you will find what makes a society live: stories of members solving real problems, updates from our student chapters, technical highlights you can actually use, and invitations to shape where we go next.

I am writing this note as both an editor and a fellow engineer. I know you are busy. I know your days are filled with field visits, reports, maintenance schedules, and deadlines. That is precisely why this magazine exists—to bring the work of our Society to you, so you do not have to chase it.

I need your help.

A magazine is only as strong as its contributors. If you have a project worth sharing, a lesson learned the hard way, a photograph that tells a story, or even a question you want to pose to fellow members—send it to me. Our next issue will be better because of you.

A magazine is only as strong as its contributors.

Three years ago, we planted a seed. This magazine is one of its first leaves. Let us water it together.



ESAE Excutive Committee

- President: Debele Debela (MSc)
- Vice President: Bisrat Getnet (PhD)
- Secretary: Workneh Abebe (PhD)
- Chief Editor: Girma Moges (PhD)
- Editor: Cherinet Gossaye (PhD Cand.)
- Editor: Yonas Mulatu (PhD Cand.)
- Cashiers: Wondiiye Gezahegne (MSc)
- Accountant: Mubarek Mohammed (MSc)
- Auditor: Yohannis Mekonen (MSc)-Not in EC

CORE ENGINEERING PILLARS

- Farm Mechanization
  - Accelerating adoption of modern, locally adapted farm implements and CA planters.
- Soil & Water Engineering
  - Climate-smart irrigation structures and watershed soil conservation.
- Post-Harvest & Processing
  - Hermetic storage, solar drying, and cold-chain value addition.
- Sustainable Rural Energy
  - Solar and biogas solutions empowering rural communities.

SOCIETY CONTACTS Web:
www.esae.org.et
Email: esae.add@gmail.com
Phone: +251 923317398
Location: Addis Ababa, Ethiopi

BY GIRMA MOGES

Cultivating Unity, Engineering Progress: A Look Back at Four Years of the Ethiopian Society of Agricultural Engineering



As I sit down to pen this piece for our biannual magazine, I find myself reflecting on the concept of roots. In agricultural engineering, we understand roots as the foundation of stability, the mechanism for nutrient uptake, and the anchor that allows a plant to weather the storm. Four years ago, ESAE planted its roots. Today, I am proud to say that those roots have grown deep, and the first shoots of our collective potential are breaking new ground.

When we first established this Society, our vision was clear yet ambitious: to create a unified platform where the often-siloed disciplines of mechanization, water resources, post-harvest technology, and agricultural infrastructure could converge. We recognized that Ethiopia's agricultural transformation cannot be achieved by individuals working in isolation.

It requires a collective—a body of professionals dedicated to the science and art of engineering solutions tailored to our highlands, lowlands, and the unique rhythm of our seasons.

The Foundation

Our inaugural year was dedicated to assembly. We focused on bringing together a critical mass of professionals from across the country. From the seasoned experts at the Ministry of Agriculture and our agricultural universities to the young, dynamic graduates entering the private sector, we worked to create a registry of talent. We established our bylaws, secured our secretariat, and, most importantly, began the crucial work of defining our identity. We asked ourselves: what does it mean to be an agricultural engineer in 21st-century Ethiopia? The answer we arrived at was simple yet profound: it means being the bridge between research and the farmer, between imported technology and local innovation.

From Establishment to Professional Engagement

Having laid this foundation, our attention gradually shifted from establishing the Society to strengthening its professional role. We began to recognize that a professional society must be more than a membership organization; it must be a platform for sharing knowledge, stimulating innovation, shaping professional practice, and influencing the direction of agricultural development.

Over the past four years or so, we have continued to promote interaction among agricultural engineering professionals working in research, academia, government institutions, development organizations, and the private sector. These interactions have reinforced an important realization: although we may work in different institutions, we share a common responsibility—to make engineering an effective instrument of agricultural transformation in Ethiopia.

Though limited, knowledge exchange has remained central to this mission. Through professional discussions, technical engagements, and conference-related activities, we have sought to create opportunities for members to share experiences, present research findings, discuss emerging technologies, and learn from one another.

Building a Stronger Professional Voice

One of ESAE's key aspirations was to establish a stronger, coordinated professional voice for agricultural engineering in Ethiopia. Despite its central role in addressing agricultural challenges, the profession remains insufficiently recognized in national development discussions.

Mechanization, irrigation, post-harvest management, agricultural energy, infrastructure, and digital technologies are interconnected pillars of agricultural transformation. ESAE must therefore champion their integration through evidence-based contributions, appropriate engineering solutions, professional standards, and active engagement in national policies, programmes, and investment decisions.



Cultivating Unity, Engineering Progress: A Look Back .....

The Challenges Along the Way

Our journey has not been without challenges. Establishing a professional society is one thing; sustaining an active, influential, and financially viable organization is another. Like many professional associations, ESAE has faced challenges related to member engagement, institutional capacity, financial resources, communication, and the coordination of activities among professionals spread across different institutions and regions.

We have also learned that a society cannot depend on the commitment of a few individuals. Its strength must come from active membership, shared responsibility, institutional support, and a clear sense of collective ownership. The enthusiasm that brought us together at the beginning must be translated into sustained participation and tangible contributions.

These challenges should not be viewed as signs of failure. Rather, they are important lessons from our formative years. They remind us that building a professional institution is a continuous process that requires patience, commitment, and collective effort.

Looking Ahead: From Roots to Results

As we reflect on the first three years, we should also look beyond the achievements and challenges of our establishment. The next phase must be about translating our collective potential into measurable professional and national contributions.

First, we must strengthen our membership base and ensure that ESAE becomes a home for agricultural engineering professionals at all stages of their careers. Young graduates and early-career engineers should find opportunities for mentorship, professional development, and meaningful participation. Experienced professionals should be encouraged to share their knowledge and help shape the next generation.

Second, we must make knowledge generation and dissemination a stronger pillar of our work. Our conferences, technical publications, magazines, and professional discussions should become effective channels for sharing research, documenting practical experiences, and promoting home-grown engineering solutions. We should also strengthen collaboration with universities, research institutions, industry, and development partners.

Third, ESAE must increasingly serve as a credible professional voice in national agricultural development. We should contribute to policy discussions, promote engineering standards, support technology assessment and adaptation, and advocate for the effective integration of engineering solutions into agricultural programmes.

Finally, we must strengthen the Society institutionally. Clear strategic priorities, effective governance, transparent management, sustainable financing, and active participation of members will be essential to achieving our ambitions.

> The roots have been planted. The foundation has been laid. Now is the time to cultivate unity, strengthen our professional identity, and engineer progress together.

A Collective Responsibility

The years may seem like a short period in the life of an institution, but it is long enough to establish a foundation, learn valuable lessons, and begin defining a meaningful direction. ESAE has taken its first steps. The responsibility now rests with all of us to nurture what we have planted.

As agricultural engineers, we understand that successful cultivation requires more than planting seeds. It demands continuous care, appropriate inputs, sound management, and the patience to allow growth to take place. The same principles apply to our Society. Its future will not be determined by its name, constitution, or founding history alone, but by what its members collectively contribute.

I therefore invite every member, partner, institution, and stakeholder to take an active role in shaping the next chapter of ESAE. Let us bring our knowledge, experience, creativity, and professional commitment together. Let us build bridges across disciplines, institutions, and generations, and ensure that agricultural engineering becomes an increasingly powerful force in Ethiopia's agricultural transformation.



By Friew Kelemu (MSc)

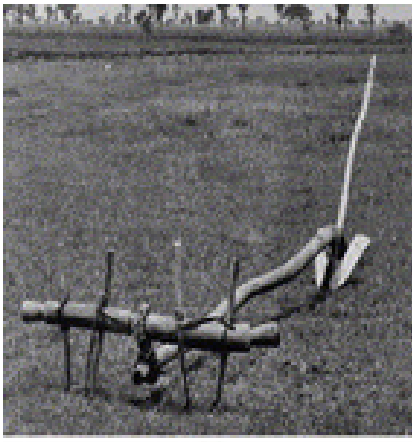
Historical perspectives and Merits of Agricultural Engineering in the Ethiopian Agricultural production system

Early Agricultural Practices and Draught Animal Power (Pre-1950s)

Ethiopia has varied agro ecology; ranging from a growing period of less than 45 days in the arid and semi-arid zones to more than 250 days in the humid and per humid zones. Irrigated crop production is the choice in the semi-arid and arid zones, whereas only one crop will be the choice in the sub moist zones, two or three crops are possible in the moist and humid zones. This is possible with a wise mix of the direct inputs like seeds and fertilizer assisted with the proper choice of the land preparation, crop establishment, harvesting and postharvest handling schemes which enhance quality and timeliness of operation .

All the above are possible with the proper selection of power units, tools, implements and proper farm management schemes. In the previous periods, Ethiopia was one of the pioneers in the draught animal powered based mechanization, which very well served the purpose as the population then, was less than 30,000,000 and the major part of the country was predominantly agricultural land.

Then, land was not a limitation and shifting cultivation was practiced, which gave the land time to rehabilitate.



(a)

Introduction of Mechanical Power Technology (Mid-1950s-1970s)

With the march of time increasing population and the introduction of commercial farms like the Tendaho Cotton Plantation the Wonji and Metahara sugar estates in the mid-1950s and 1960s (Kline 1969)necessitated the introduction of tractors and mechanical power technology beyond the border of the plantations and sugar estates. This was further expanded to the wheat fields of Arisi, Bale supplemented with the haricot bean growing areas of Sodo and Shashemne areas..



With the coming of the military government (derg) in the 1970s, though the private farms were nationalized and most were replaced with state farms the change in the level of mechanization was growing by the day, where the mechanical power based mechanization was increasing by the day. Especially, during the time of the dreg, most of the power units were introduced from the Eastern European Countries where standardization, compatibility were not seriously studied and as the results frequent failures and down times were recorded.

Tractors such as ZT and Belarus models assembled in Adama contributed significantly to Ethiopia's mechanization efforts and helped address food deficits (Friew and Shilema, 2001). Mechanized operations included land preparation, fertilization, row planting, and harvesting, while planting, weeding, and crop protection largely remained dependent on oxen and manual labour. Institutions such as the Agricultural Mechanization Service Enterprise and Agricultural Equipment and Technical Service Corporation provided mechanization services to cooperatives and private farmers, particularly for land preparation and harvesting. The use of tractors and combine harvesters gradually expanded over time.

Modern Era Mechanization Trends (1990s-Present)

Today, mechanization is expanding across Ethiopia, particularly in the wheat- and barley-growing areas of Arsi and Bale, maize-producing areas around Hawassa, and commercial farms in Benishangul-Gumuz and Gambella. Aging farming populations and growing youth engagement further highlight the need for mechanization to make agriculture more attractive and productive. However, higher education curricula have not adequately kept pace with these needs. Meanwhile, inappropriate land management contributes to soil compaction, acidification, and declining fertility. Sustainable mechanization must therefore follow the principles of prescription tillage, matching machinery and field operations to crop and soil requirements while protecting the natural resource base and environment.

Although precision farming is increasingly adopted worldwide, its focus remains largely on biological and chemical inputs, with insufficient attention to the physical effects of machinery–soil interactions. Agricultural engineering must ensure that power and implements meet crop requirements while preserving soil health and regenerating natural resources. This calls for stronger agricultural engineering education, supported by research, machinery design, testing, evaluation, and the development of appropriate technologies. Strengthening the sector is essential for sustainable agricultural production amid growing pressure on Ethiopia's shrinking agricultural land.



Friew Kelemu (MSc)
friewkelemu@gmail.com

By Girma Moges (PhD)

Adapting Precision: How Ethiopian Engineers Are Redefining Data-Driven Farming



The Ethiopian agricultural landscape is undergoing a profound, albeit silent, transformation. For decades, progress in our sector has been closely associated with the gradual introduction of mechanization—moving, in limited but important ways, from the traditional ox-plow toward tractors—alongside the expansion of irrigation. While these efforts remain uneven and, in many areas, still at an early stage, their importance cannot be overstated. I recall hearing these same discussions as a young researcher twenty years ago, and they remain highly relevant today. Yet, as agricultural engineers, we recognize that the next frontier extends beyond horsepower and hardware. It lies in precision.

While mechanization and irrigation remain critical pillars, the Ethiopian Society of Agricultural Engineers (ESAE) is now championing a new imperative: Precision Agriculture (PA). To ignore PA at this juncture would be to willingly cede our competitive edge and leave our national agricultural potential unfulfilled.

> To ignore PA at this juncture would be to willingly cede our competitive edge.



Redefining Precision for the Ethiopian Context

When we hear "Precision Agriculture," it is easy to conjure images of GPS-guided combines cruising across the Developed world such as vast American cornfields or autonomous drones hovering in Dutch greenhouses. Too often, PA is mischaracterized as a luxury exclusive to large-scale commercial operations. However, in the Ethiopian context—where smallholder efficiency is the very backbone of our economy and food security—PA is not a luxury; it is a strategic tool for survival and resilience. By embracing the principle of "Right Input, Right Time, Right Place," we are directly confronting our twin adversaries: resource scarcity and climate volatility.

I strongly believe that it would be a narrow, hardware-centric mistake to dismiss these technologies as irrelevant to our rugged highlands and fragmented small plots. PA in Ethiopia is not about importing expensive satellite receivers or expensive machinery. It is about engineering efficiency into **the last meter of the furrow.**



With the recent launch of the Digital Agriculture Roadmap, Ethiopia has formally signaled its departure from traditional "blanket" farming methods toward site-specific management. As engineers, our role is no longer only confined to designing the plow and other Mechanization technologies; it now demands that we calibrate the sensor and interpret the data streaming from the field. We cannot afford to observe this transformation from the sidelines. As a professional society, we must be the engine of its success.

Engineering Solutions: Three Pillars of Impact

Our mandate as Ethiopian engineers is to translate the global principles of PA into locally appropriate, actionable solutions. There are three critical areas where our impact is immediate and measurable:

1. Mechanical Precision: Variable Rate Fertilizer Without the Tractor

The Ethiopian Soil Information System (EthioSIS) has provided a high-resolution map of our soil's specific nutritional needs. We now know with certainty that a hectare in Gojjam is starved of Boron while another in Arsi struggles with acidity. The engineering challenge is clear: we cannot rely on $100,000 tractors with variable-rate spreaders to address this disparity.

The Engineer's Role: We must design and fabricate low-cost, manual or animal-drawn seed-cum-fertilizer drills equipped with interchangeable, 3D-printed metering plates. Instead of a digital sensor altering the flow rate, the farmer simply swaps a plastic disk calibrated for a specific GPS coordinate, guided by the soil map card for that kebele. This is mechanical precision. It is affordable, repairable in any local welding shop, and elegantly bridges the gap between laboratory data and the smallholder's field.

Adapting Precision: How Ethiopian...



2. Intuitive Automation: Sensor-Based Irrigation for High-Value Crops

Ethiopia's Rift Valley and Amhara region are seeing rapid expansion in irrigated horticulture and avocado production. Yet, over-irrigation leaches precious urea into the groundwater and drains reservoirs, while under-irrigation stresses the crop.

The Engineer's Role: The adoption of simple soil moisture tension sensors (such as Watermark or Irrometer gauges) and locally fabricated venturi injectors for drip lines represents a significant engineering win. This is not about complex computer dashboards; it is about a physical gauge that provides a clear directive: "The soil is wet at 30cm; do not turn on the pump today." As ESAE, we should be actively promoting the calibration and local manufacturing of these low-pressure, gravity-fed precision drip kits.



3. Scaled Scouting: Drone-Assisted Pest Management

We cannot place a drone on every farm, but we can equip every Woreda Agriculture Office with one.

The Engineer's Role: Agricultural engineers serve as the critical link between the drone pilot and the agronomist. A twenty-minute flight over a maize cluster in the Jimma zone can generate an NDVI map revealing a 0.2-hectare hotspot of Maize Lethal Necrosis Disease weeks before it is visible to the human eye. This capability enables spot spraying of a specific area rather than blanket pesticide application across twenty hectares. The result is significant cost savings, protection of beneficial insects, and a drastic reduction in the chemical load entering our watersheds.

Addressing the limited Ðata availability

Our most pressing engineering bottleneck is not the generation of data, but its delivery across the last mile. We possess detailed soil maps, satellite rainfall estimates, and pest forecasts. Yet the critical question remains: How does this data reach the Development Agent (DA) on a feature phone in a valley with no network?

We must champion Edge Computing for Extension. This involves designing simple, robust applications that pre-load data at the Woreda office WiFi in the morning and remain functional offline throughout the day in the field, synchronizing only upon return in the evening. While less glamorous than AI or robotics, solving this connectivity riddle will unlock the potential of millions of farmers.

We cannot afford to observe this transformation from the sidelines. As a professional society, we must be the engine of its success

The Status and Opportunity

Although still nascent, PA is gaining steady traction among Ethiopian universities, research centers, and development partners. Pilot projects are already integrating GIS, remote sensing, and crop modeling for yield prediction and irrigation scheduling.

The benefits are substantial and align perfectly with our national goals: Enhanced Productivity, Cost Efficiency, Environmental Stewardship and Climate Resilience



A Call to the ESAE Membership

PA in Ethiopia will not grow by chance. it will be driven by deliberate action from us, the engineers. This is not a distant vision; it is an immediate responsibility.

Our responsibility is clear. We must move beyond ideas and focus on practical solutions that farmers can use every day. This means designing tools that are affordable, easy to use, and easy to repair. It means turning complex data into simple advice that farmers and development agents can understand and trust.

ESAE members have the skills to lead this change. Whether in universities, workshops, or the field, each of us has a role to play—testing, building, improving, and sharing solutions that fit Ethiopia.

The future of Ethiopian agriculture will not be shaped only by new technologies, but by how well we adapt them. That work starts with us.

The Road Ahead: Scale and Security

The goal for the coming years and beyond is unequivocally Scale. We must transition from isolated pilot projects in the Rift Valley to nationwide adoption. By leveraging Artificial Intelligence to analyze historical yield data against shifting climatic patterns, we can develop predictive models that fortify our national food security.

The future of Ethiopian farming is not a driverless tractor. It is a farmer equipped with a basic smartphone, a precisely calibrated backpack sprayer, and an engineering support system that guides exactly where to walk and what to do. That is precision. That is our work.



Girma Moges (PhÐ)
barichogirma@gmail.com

By Bisrat Getnet (PhD)

Aligning Ethiopia's Mechanization Policy with Soil Health and Climate Resilience: Addressing the Full Adoption Challenge



Ethiopia loses an estimated USD 4.3 billion every year which is roughly equivalent to the country's total annual export earnings due to land degradation. The newly launched Fertilizer and Soil Health Roadmap confirms that 41% of cultivated land is affected by soil acidity alone, while nutrient depletion, erosion and declining organic matter continue to undermine the productive base of the agricultural sector. Repeated conventional tillage largely driven by the widespread use of the traditional maresha plough, mouldboard and disc ploughs is a primary cause. This is compounded by the widespread practice of free grazing, where livestock remove crop residues and vegetation that would otherwise protect and regenerate the soil. In the context of increasingly frequent dry spells and erratic rainfall, continuing with these practices threatens long-term food security, farmer livelihoods and the resilience of Ethiopia's entire agricultural system.

According to recent reports, Ethiopia currently sits at 70 th out of 102 countries in the world and 13th place out of the 24 African countries with 7500 ha of CA area coverage. Thus, increasing the area under CA would be the expected intervention to address the long-term sustainability of agricultural production.

41% of cultivated land is affected by soil acidity alone

The Policy Disconnect

Three recent policy actions have positive impacts on mechanization development and agricultural production. However, unintendedly, the actions created a contradictory environment that inadvertently perpetuates conventional tillage:

1. Tax Waiver (2019) without Differentiation – The blanket tax exemption on all agricultural mechanisation, irrigation and animal feed technologies removes import duties on every type of farm machinery. No distinction is made between implements that support conservation agriculture (CA) (e.g., rippers, direct seeders, no-till planters) and those that promote intensive tillage (e.g., mouldboard and disc ploughs). Consequently, the tax waiver subsidises the very practices that accelerate soil degradation.
2. Mechanisation Development that Promotes Intensive Tillage – Current mechanisation promotion programmes continue to favour heavy conventional ploughs. Extension system in Ethiopia "focuses mainly on intensive tillage whereas CA calls for zero or minimum tillage" and that "despite current policy advocating the reduction of land degradation and enhancing soil fertility, the current agricultural practices seem to favour productivity over sustainability".
3. Unrealised Target of the New Mechanisation Strategy – The national mechanisation strategy rightly asserts that 40% of land degradation can be curbed by introducing CA technologies. However, without a clear regulatory and financial distinction between conventional and conservation tillage and seeding implements, the strategy's target will remain aspirational.



Two Critical Barriers to CA Adoption

1. Free Grazing and the Loss of Soil Cover

Conservation agriculture depends on permanent soil cover in which crop residues left on the field to protect against erosion, retain moisture and build organic matter. In Ethiopia, the culture of free grazing means that livestock are allowed to roam and consume these residues, effectively stripping the soil of its protective blanket. This not only negates the benefits of reduced tillage but also actively contributes to land degradation, deforestation and nutrient depletion. The solution is a systemic shift to stall feeding (zero grazing). Community-based enclosures and "cut-and-carry" systems, where fodder is harvested and brought to confined animals, have proven effective. In areas where these systems have been implemented, the reduction in trampling and overgrazing has allowed soil seed banks to re-establish, springs to regenerate, and fodder availability to increase, thereby enhancing livelihoods. For this to work at scale, farmers need reliable access to affordable animal feed. The government should therefore fully implement and expand tax exemptions on all animal feed ingredients and processing machinery, as previously proposed by the Ministry of Agriculture. Complementing this with incentives for commercial feed producers such as tax holidays on new feed manufacturing investments would ensure a stable, affordable feed supply, making it economically viable for farmers to keep their animals off communal and harvested croplands.

Aligning Ethiopia's Mechanization Policy with Soil Health...



2- The High Cost of CA Machinery

A second major barrier is the upfront cost of CA implements. Imported direct seeders and no-till planters remain significantly more expensive than the traditional conventional disc and mold board plough, placing them out of reach for many smallholder farmers. This is compounded by supply-side constraints such as limited access to credit and a lack of machinery in local markets. While simpler, locally adapted tools like such as rippers demonstrate that affordable, locally manufactured alternatives are feasible, these innovations have not yet reached mass adoption via custom hiring service via mechanization service providers.

Addressing this requires a multi-pronged strategy:

- A differentiated tax waiver that exempts all CA-certified machinery (both imported and locally manufactured) from duties and VAT, while progressively taxing conventional tillage implements.
- Targeted subsidies and credit facilities for the purchase of CA equipment by smallholder cooperatives and private hire-service providers.
- Investment in local manufacturing of low-cost CA implements. Prototypes like the rippers show that Ethiopia has the capacity to develop affordable, context-specific solutions that can be supported through public procurement.

Recent research confirms that mechanized ripping using a ripper as an entry-level CA practice can significantly increase maize yields and gross margins compared to conventional tillage, while reducing total variable costs in moisture stressed and humid agro ecologies. This makes the economic case for supporting a shift even stronger.



In conclusions

Ethiopia's soil health crisis demands a holistic and decisive shift in mechanisation and livestock management policy. The current tax waiver and extension system unintentionally subsidise both intensive tillage and the free grazing that strips protective soil cover. By differentiating CA machinery from conventional implements, by actively incentivising stall feeding and local feed production, and by investing in affordable, locally adapted CA technologies, Ethiopia can turn its mechanisation drive into a powerful engine for sustainable intensification, climate resilience and long-term national food security.

Policy Recommendations

1. Revise the Tax Waiver List: Issue a revised list that clearly separates "CA-compliant" implements (rippers, direct seeders, no-till planters, jab planters) from "conventional tillage" implements, with full exemption retained only for the former.
2. Incentivise Stall Feeding: Fully exempt all animal feed ingredients, supplements and feed-processing machinery from duties and VAT. Pair this with investment incentives for domestic feed manufacturers to ensure a reliable, affordable supply of stall-feeding inputs.
3. Align Public Procurement: Mandate that all government-funded mechanisation service centres and cooperative hire schemes preferentially procure CA-compliant machinery. Establish a subsidy-matching scheme for private service providers who invest in rippers and no-till planters locally.
4. Integrate CA into Extension and Training: Update the curriculum of Agricultural TVET institutions and farmer training centres to include both conservation tillage principles and stall-feeding management. Launch a certification programme for "CA-ready" service providers.
5. Embed CA and Stall-Feeding Targets in the Mechanisation Strategy: Operationalise the 40% land-degradation reduction target with annual milestones for: (a) the share of imported machinery that is CA-compliant, (b) the area under zero grazing and stall-feeding systems, and (c) the number of farmers trained.
6. Leverage Climate Finance: Present a portfolio of bankable projects linking CA mechanisation, local implement manufacturing and community-based stall-feeding systems to climate funds such as the Green Climate Fund, highlighting the dual benefits of mitigation and adaptation.

Leverage Climate Finance: Present a portfolio of bankable projects linking CA mechanisation, local implement manufacturing



Bisrat Getnet (PhD)
bisrat.get@gmail.com

By Workineh Abebe (PhD)

Reducing Loss and Adding Value: ESAE's Strategic Role in Ethiopia's Food Systems Transformation

The Challenge

Ethiopia has made major investments to boost agricultural production. However, increased harvests alone cannot guarantee food security. A significant portion of what is produced is lost between harvest and consumption.

National assessments estimate average annual postharvest crop losses at 25.8%–cereals at 34%, pulses and oilseeds at 23.3%, and fruits and vegetables exceeding 33%. These losses mean less food, lower farmer incomes, wasted resources, and unnecessary greenhouse gas emissions. Major causes include poor handling, inadequate storage, weak transport, limited processing, and lack of cold chains.

The Opportunity

Ethiopia is among Africa's leading producers of cereals, pulses, oilseeds, coffee, fruits, and vegetables. Yet most agricultural products are marketed raw, with limited value addition. This constrains farmer income, export competitiveness, and industrial growth.

The government has made agro-processing a strategic priority. Key initiatives include Integrated Agro-Industrial Parks (IAIPs) at Yirgalem, Bulbula, and Bure, linked with Rural Transformation Centers for aggregation, storage, and primary processing. Recent national strategies – the Postharvest Management Strategy, Food Safety and Quality Strategy, and Food System Transformation roadmap–all emphasize that efficient postharvest systems are essential for sustainable food systems.



Over a quarter of Ethiopia's harvested food never reaches a plate. Can agricultural engineers change this?

What Postharvest Engineering Delivers

Agricultural engineers are central to this transformation. Postharvest engineering includes:

- Harvesting and threshing systems
- Drying and storage technologies (e.g., hermetic bags, metal silos)
- Packaging, cold chains, and transport engineering
- Food processing and waste valorization
- Renewable energy and digital monitoring (sensors, traceability)

Improved storage alone can drastically reduce losses from insects, rodents, and fungi. Solar-assisted dryers and renewable-powered cold storage preserve perishables while lowering energy costs. Mechanized handling reduces physical damage. Digital tools improve supply chain efficiency and food safety.

Postharvest engineering also supports nutrition security. Many nutrient-dense foods, like fruits, vegetables, and animal products, are highly perishable. Improved drying, hygienic processing, cold preservation, and nutrient-protective packaging help maintain quality and extend shelf life.

Furthermore, reducing losses is climate action. Food lost postharvest represents wasted land, water, fertilizer, labor, and energy, plus avoidable emissions. Renewable energy, circular bioeconomy approaches, and waste-to-energy technologies support climate-smart, resource-efficient systems.

ESAE's Strategic Role

Within Ethiopia's evolving national landscape, ESAE has a historic opportunity to become a leading professional force in advancing postharvest engineering, agro-processing innovation, and climate-smart food systems transformation.

ESAE can contribute by:

- Promoting research and innovation in postharvest engineering and agro-processing
- Supporting technology incubation and commercialization
- Facilitating university-industry partnerships
- Organizing technical conferences and professional forums
- Leading policy dialogue with evidence-based technical recommendations
- Advocating for increased investment in postharvest infrastructure
- Strengthening professional training and human capacity
- Promoting digital agriculture and climate-smart technologies

This year, ESAE could:

- Launch a technical working group on postharvest engineering
- Host a national innovation contest for low-cost postharvest technologies
- Develop a position paper on cold chain investment priorities

Ethiopia requires suitable, scalable technologies that are affordable and accessible to smallholder farming systems across diverse agroecological conditions. ESAE is uniquely positioned to bridge the gap between research, industry, technology development, and on-farm implementation.

Concluding Remarks

Reducing postharvest losses and promoting agro-processing are central pillars of Ethiopia's food systems transformation. Success requires efficient systems that preserve quality, minimize losses, improve nutrition, ensure food safety, create jobs, and enhance climate resilience.

Agricultural engineers provide the technologies and innovations needed to achieve these goals. Through engineering innovation, mechanization, renewable energy, digital tools, and systems thinking, ESAE can help build resilient, market-oriented, climate-smart, and sustainable food systems – improving the livelihoods of millions of Ethiopians.

Call to Action:

ESAE invites members to submit postharvest innovation case studies, technical challenges, or ideas for the next magazine issue. Join a technical working group or contribute to our policy dialogue – together, we engineer Ethiopia's food future.



Workneh Abebe (PhD)
workineh09@gmail.com