Executive Summary

A Framework for Sustainable Agricultural Mechanization in Africa across Agri-food Chains

This Framework provides a menu of the priority elements to be considered by countries in Sub-Saharan Africa\(^1\) (SSA) in the process of developing their national strategies for sustainable agricultural mechanization [SAM] during the first half of the 21st Century. During the last six decades, progress in mechanization of on-farm operations has been disappointing. However, some progress was made in mechanization of off-farm post-harvest operations such as in grain milling to the relief of mostly women and children. Much more is still required to transform on-farm mechanization scenario by liberating the African farmer from the ergonomically debilitating hard labor associated with the hand hoe farming. In addition, agricultural mechanization can contribute to improving rural livelihoods by breaking labor bottlenecks that constrain productivity and growth of rural incomes and thus making farming attractive to the young and educated. At a larger level, mechanization is a necessary dimension of transformational development strategy that promotes the sustainable commercialization and modernization of small-, medium- and large-scale farms and firms in order to accelerate agricultural development and initiate sustained poverty-reducing economic growth in rural and urban areas.

Agricultural mechanization include the application of tools, implements and powered machinery and equipment to achieve agricultural production. In this regard, agricultural production includes both crop and livestock production as well as aquaculture and apiculture. Three levels of power sources are involved: manual with entire reliance on human muscle power; animal powered; and motorized [both fossil fuel and electrical] sources. The term ‘agricultural mechanization’ covers the manufacture, distribution, repair and maintenance, utilization and management of agricultural tools, implements, equipment and machines in agricultural production from land development, crop and livestock production, harvesting and storage as well as on-farm processing and rural transportation.

According to the Food and Agriculture Organization of the United Nations [FAO], agricultural mechanization in SSA has, remained at the first stage of the mechanization process – the **Power Substitution Stage**: which is the earliest developmental stage involving the substitution of use of animate power [be it from human muscles or from draft animals] with mechanical power from internal combustion engines and/or electric motors used in performing the energy intensive and often arduous and back-breaking tasks such as primary land tillage; grain milling etc. Such energy-intensive tasks require

\(^1\) North Africa is excluded in the analysis as that sub-region has advanced in terms of agricultural mechanization and the rest of Africa needs to catch up with it. Moreover, it has different agro ecological zones that are distinct from the rest of Africa.
adequately powered equipment/implements to perform them. The mechanization process at this stage, is technologically straight forward i.e. introduction of the hardware in the form of new and higher level power sources [whether animate or mechanical] especially for performing the difficult and arduous farming and/or household tasks. However, establishment of sustainable systems for the efficient and effective utilization and management of the hard ware has been the main challenge which most countries in SSA have been facing.

1. The Context for the Study

The transformation of agriculture is a key strategic pillar of the African Union’s Agenda 2063, the economic development blueprint for the continent. Therefore, in 2014, which was designated by the African Union as the Year of African Agriculture and Food Security, African Heads of State and Government renewed their commitment to agricultural transformation in the continent. This renewed commitment is contained in the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. Through this Declaration, the leaders provided the strategic direction for African agriculture for the period 2015 to 2025, by identifying specific interventions that are required to accelerate the pace of agricultural development and ensure its sustainability.

In particular, Commitment III on Ending Hunger in Africa by 2025 includes a resolve to accelerate agricultural growth by at least doubling current agricultural productivity levels, by that year. This calls for appropriate policy and institutional conditions and support systems to facilitate sustainable and reliable production and access to quality and affordable inputs; supply of appropriate knowledge, information, and skills to users; efficient and effective water management systems notably through irrigation; and suitable, reliable and affordable mechanization and energy supplies, amongst others. Therefore facilitating increases in agricultural productivity and strengthening of food and nutrition security through improvements in inputs, mechanization, and post-harvest management, remains a key priority for the AU. This entails the need to help Regional Economic Communities [RECs] and AU Member States develop and drive policies and strategies that facilitate efficient production and exchange of goods and services.

The African Union Commission (AUC) is therefore committed to providing the leadership to ensure that efforts to increase access to mechanization services in Africa are in line with the CAADP/Malabo priorities, including ensuring access to such services by smallholder farmers. Of particular interest is the specific goal, as stipulated by the AUC, of relieving the African farmer, within a set time-frame, of the hard labor and back-breaking drudgery associated with farming dominated by the hand-hoe common in many parts of SSA, hence the rallying motto by former AUC Chairperson of “sending the hand hoe to the museum”.

It is within this context that in 2016, the AUC requested technical assistance from FAO to develop a framework for sustainable agricultural mechanization for Africa. FAO accepted the request and developed a Technical Cooperation Project [TCP] on Sustainable Agricultural Mechanization {SAM} with the AUC, which has resulted in the development of the Framework for Sustainable Agricultural Mechanization in Africa (SAMA).

2. Objective and Rationale

The objective of this report is to provide a framework through which countries and sub-regions in SSA can plan and develop their own sustainable agricultural mechanization strategies in an informed manner
taking cognizance of the experience on the continent and elsewhere of the past six decades of implementing agricultural mechanization programs.

It is recognized that although mechanization strategies and policies may be country specific, national strategies are best formulated when guided by insights and parameters identified within a framework which factors in outlooks with regional and global perspectives. Experience of the past six decades of implementing agricultural mechanization programs in SSA countries and elsewhere does show that prescribing a single mechanization strategy does not capture the diversity that exists across countries in this large and diverse continent. However, several aspects related to policy formulation and strategy development could benefit from a common framework. Beyond these common areas, it would be more useful to consider policies and strategies in the context of specific situations. However, the starting point for this study was the firm long-term commitments on agricultural mechanization made by the African Heads of State and Governments at their 23rd and 24th Summits held in Malabo and Cape Town respectively.

3. **Methodology of the study**

A Team of seven persons was commissioned to develop the framework for SAMA. An Inception Workshop was convened in Addis Ababa on 30th June to 1st July 2016. It was agreed that a comprehensive study looking at mechanization holistically and carried out with due consultation of key stakeholders be done. In addition, there was agreement that the focus should be the SSA region.

An analysis of the state of agricultural mechanization in the four sub-regions of SSA [i.e. Central Africa (CA); Eastern Africa (EA); Southern Africa (SA) and Western Africa (WA)] was undertaken. The Team which worked on this report also participated in a Consultative Meeting on Mechanization Strategy convened by, among others, the World Bank; FAO; AGRA; ACT and CEMA to discuss new models for sustainable agricultural mechanization in sub-Saharan Africa on 1st and 2nd December 2016 in Nairobi, Kenya. The preparation of this document also included a review of past studies including the MSU/USAID sponsored two years study of 1967-69 [by Kline et al of 1969] and the World Bank sponsored rapid study of 1987 [by Pingali et al 1987].

4. **Lessons from past experiences**

This report notes that success in agricultural mechanization has occurred elsewhere in the World in regions/countries where there has been a long-term commitment with a clear vision and goals to be reached. The selection of priorities is crucial and the sequencing of the series of actions are important ingredients to success.

Analysis of the mechanization scenario globally shows that the key factors necessary for success in agricultural mechanization, included, among others, effective demand for the outputs of farm production; economic utilization rates of agricultural machinery and equipment including efficient supply chains and service providers who can sustainably and profitably provide agricultural machinery, implements and their spare parts.

5. **Ten priority elements for SAMA**

Key issues, which need to be factored in a framework for SAMA in SSA, include the following:

**First** is to recognize the need to tackle the farm power constraint in agriculture in the region. With land preparation on about 60% of the cultivated land being done with the hand hoe [and in some sub-regions
up to 80%] there is need, as a matter of urgency, to transform this situation. As noted by several experts, farming powered entirely by human muscles is regarded as labor supplied as a punishment as characterized by some ‘... Accursed is the ground because of you; through suffering shall you eat of it all your life. By the sweat of your brow you get bread to eat’. Other regions of the World have moved on and have long liberated their farmers from this hard labor punishment of using the antiquated hand tools in tillage. Use of the draft animal power [DAP], which has been characterized by some African leaders as being a Before Christ Technology [BCT] is possible as a transition technology in the drier regions free of the tsetse fly and with farmers who have a livestock husbandry tradition provided the other constraints to its ubiquitous use can be tackled [e.g. competing demand for livestock products; declining grazing land and labor to herd the draft animals]. There is need therefore to consider leap frogging the DAP stage of mechanization in many parts of SSA as the region progresses into the middle of the 21st Century.

Tractors [both two wheel ones [2WT or power tillers] and four-wheel ones [4WT]] therefore remain as the main farm power option especially for on-farm operations. Farmers do not necessarily have to own these tractors – all that they need is provision of tractor hire services on a timely basis and at an affordable cost.

The second issue is the implements used/hitched/driven by the power source. Past concern on agricultural mechanization in SSA was more on the sources of farm power and the socio-economic consequences and impact of their increased use by small holder farmers and less on the implements being used. These implements, especially those used for land preparation and crop husbandry, do contribute directly and significantly to the environmental impact of agricultural mechanization. There is now a global movement advocating for the adoption of conservation tillage practices and this will affect the types of implements and tillage practices which are going to be used in SSA over the coming several decades.

Third - mechanization requires farms to produce on a commercial basis to meet the elevated costs necessary for machinery services. Therefore, if farms are not profitable before mechanization, the likelihood of them becoming profitable because of mechanization alone is low. Due to the low profitability of many small farms as compared to the levels of mechanization investments required, medium and large scale commercial farmers are in most favorable position to mechanize first as it has happened in Asia and elsewhere in the world. Efforts to increase the profitability of small and medium scale commercial farming can be expected to boost the effective demand for mechanical technologies and would undoubtedly augment the supply of machinery hire services to small scale farmers. There is a need therefore to encourage the development of viable commercial farming operations which also have the potential of providing mechanization services to small scale farmers. Such commercial farmers are emerging in some countries where the right enabling policies have been enacted in the recent past – occupying up to 40% of cultivated arable land in some countries.

A fourth issue is the types of crops being cultivated. Unlike in Asia and Latin America where cereals are the dominant crops occupying 96% and 93% of cultivated land respectively [in 2000], in SSA the situation is different with cereal crops occupying 67; 70; and 83% of cultivated land respectively for Central, Western and Eastern Africa. The rest of the cultivated land for food crops is occupied by roots and tubers. It is only in Southern Africa where cereals occupy 98% of cultivated land. These statistics do demonstrate the challenges of mechanizing agriculture in SSA especially where small holders are dominant. Further, the land under cereal production in SSA has increased from 45 million hectares in 1961 to 96 million in 2000 often intercropped and in some cases poorly de-stumped while the farm power available has declined.
A fifth issue is the need to take a holistic approach to agricultural mechanization and to consider the entire agri-food chain including financing of capital investments required to support the acquisition of farm machinery and implements, as well as factor-in off-farm uses of mechanization inputs and value addition activities on the produce. Further, mechanization technologies for agri-food chains can contribute significantly to programs for reducing losses along entire food chains as well as to programs for maintaining rural infrastructure and increasing employment opportunities in rural areas especially for the youth and women. Coupled with this and as a sixth issue is the need to achieve efficient utilization rates of agricultural machinery as well as the timeliness of performing field operations. Delayed planting can lead to reduction in yields of up to 100kg/ha for each day planting is delayed beyond the optimum date in rain fed cereal systems in the semi-arid areas of SSA. Further, the number of days available for field operations in such semi-arid areas is limited to about 30 days and hence timeliness is critical in most farming systems in SSA. This limits the effective annual utilization rates, of say tractors [4WT], to 300 to 400 hours as opposed to the recommended 800 to 1200 hours. This will remain a major challenge to the viability and profitability of powered mechanization investments.

A seventh issue is one of the efficiencies of the franchises and supply chains for agricultural machinery and implements. According to the available data 26 countries in SSA have less than 1000 tractors in use, and 6 had between 1000 – 2000 tractors; with 10 having between 2,000 and 10,000 units and only 6 with between 10,000 and 30,000 units. South Africa stands out on its own class with over 67,700 tractors in use. Given that these usually represent several brands and sizes of tractors – this implies that the numbers of a particular brand and size imported each year in most countries is quite small thus raising the issue of sustainability and viability of the franchises and supply chains for agricultural machinery, implements and their spare parts. This is a critical issue related to sustainability of mechanization in many countries in SSA. Coupled with viability of franchises and supply chains for agricultural machinery and implements is the eighth issue involving manufacturing and testing in the region. Given the small size of the market for mechanization inputs in most countries this is likely to require cooperation at the sub regional level if viable manufacturing entities are to be established. A start could be made by developing sub-regional protocols for setting standards and testing of agricultural machinery and implements.

A ninth issue is one on institutions, policies including for financing of agricultural mechanization inputs and services and for research and development. This involves, in particular, the roles of the public and private sectors in these areas including which sector should take a lead and where joint action is required. The failures which occurred in the 1960s and 70s were caused by, among other reasons, the lack of clear policies and agreement on who should take a lead between the two sectors. While it is agreed that the private sector should take a lead in agricultural mechanization initiatives, it is also important to recognize that the private sector works best if there is a large enough demand for mechanization inputs and services. Some of the past public sector actions were a result of low demand in most countries which led to the sector being unattractive to private sector initiatives. At the same time, there is a lack of critical mass on an individual country basis [e.g. for R & D] and this may necessitate some cross country cooperation especially for capacity building to achieve economies of scale and scope.

Finally, the tenth issue revolves around the sustainability of agricultural mechanization in SSA. Sustainability is taken here to include environmental sustainability in particular the contribution which agricultural mechanization interventions can make to the reduction of soil erosion and compaction through the adoption of sustainable land preparation and crop husbandry techniques; commercial sustainability through using business models which offer mechanization services to farmers not only efficiently and profitably but also at competitive and affordable prices; and socio-economic sustainability through recognizing the dominance of small holder farmers in SSA agriculture as well as other groups who may be disadvantaged by higher levels of mechanization such as women, youth and the elderly.
Sustainable agricultural mechanization strategies will need to cater for all these issues so as to ensure that, to the extent possible, the interests of all these groups are catered for and they contribute effectively and efficiently to the national economy.

6. Priority areas
The main elements of SAM which have to be considered by SSA countries when developing their own national strategies include creating the supporting environment which facilitates the establishment and operation of viable and sustainable businesses which are offering timely and efficient services aimed at increasing the farm power available to farmers to enable them to perform, on a timely basis, the different tasks along the agri-food value chain. This will, among other things, include also the transformation of current conventional tillage and crop husbandry practices to sustainable practices which are more environmental friendly such as conservation agriculture and minimum tillage adapted to local conditions. In addition, agricultural mechanization strategies at national level should cover the entire agri-food value chain and include harvesting, post-harvest handling and processing issues to, among other things, reduce food losses, add value to the produce, incorporate food safety aspects and link the farmer to the market and the consumer.

Other elements of SAM include institutional issues to cater for the interests of small scale farmers and their organizations as well as those of women and youth. Also, the framework for SAM strategies should include elements related to the establishment and operation of viable entities for manufacturing of agricultural machinery and implements in the region as well as franchises and supply chains for their distribution, repair and maintenance at the national and sub-regional levels. The SAM strategies should also cover innovation systems required including for technology development and transfer at national and sub-regional levels – there is no point of continuously developing prototypes which remain on the shelf. Capacity building of the required human resources [at artisan, technician and professional levels] as well as institutional capacity will be critical to the success of SAM strategies.

Other priority elements include strengthening the capacity for use of quality machinery and implements required for SAM, including developing systems for setting standards and testing protocols; capacity building including for farmers and particularly the youth and women farmers. Financing modalities for investments in sustainable mechanization systems are also necessary elements. Also required will be the need to establish mechanisms for regional cooperation and coordination to facilitate exchange of information and technologies as well as to design and implement collaborative regional programs and projects on SAM where economies of scale and scope dictate so. Finally and most important, the long-term commitment to SAM by all key stakeholders involved in policy, strategy formulation and implementation as well as in financing will be critical elements to its success. Options for the various elements for SAM are presented and it will be up to those involved in formulating strategies at the national and sub-regional levels to select which options fit best the prevailing local situation.

7. Areas for immediate action
Areas of immediate action include developing detailed guidelines to help member countries in the design and formulation of policies and strategies for SAMA covering all three aspects of sustainability of agricultural mechanization interventions – commercial, environmental and socio-economic. Most of the currently existing guidelines were developed in the 1970s & 80s when the development paradigms emphasized public sector dominance and subsistence food security. There is also an urgent need of developing mechanisms for increasing the flow of financial resources for agricultural mechanization investments from commercial banks and other financial institutions which will provide loans to emerging
small and medium scale commercial farmers and entrepreneurs. It is only when local financial institutions get actively involved in lending for mechanization of African agriculture that it can be regarded as sustainable.

Strengthening of the national, sub-regional and regional institutional infrastructure supporting the development of agricultural mechanization is essential in, among other areas, research and innovation; standards and testing; manufacturing and trade in agricultural machinery and implements; technology transfer and extension as well as capacity building in all aspects. This may involve the establishment and/or strengthening of centers of excellence as well as coordinating mechanisms at national, sub-regional and regional levels. Given the current small size of many national markets for agricultural machinery and implements, regional cooperation will be necessary in the implementation of many activities in order to attain economies of scale and scope as well as create sustainable organizations and institutions. As it has occurred in other regions of the World, the involvement of national, regional and international organizations/institutions in this effort, such as National Governments; Farmers Organizations; AUC; RECs; AfDB; AGRA and development organizations like FAO, UNECA; UNIDO and the World Bank, will be critical to the success of SAMA in SSA.

8. Concluding remarks
Leaders in SSA understand the importance of agricultural mechanization in the future vision of agricultural development and food security for the region, however efforts to accelerate mechanization will require substantial long-term political and financial commitments while grappling with new problems. Therefore, unless commitments are made to address these problems, the prospect for African agriculture and farmers is likely to remain bleak. Fortunately, there are signs of a new cadre of farmers emerging in some countries who are likely to spearhead and catalyze the sustainable mechanization effort. The process may at times be turbulent, but governments and leaders in the agricultural sector in SSA must remain steadfast and take a longer-term perspective of mechanization, just as Asian governments and leaders did in the 1960s and 1970s. Otherwise, African agriculture may be doomed to continue using antiquated tools and implements in the twenty-first century to the detriment not only of food security, but also of agricultural development and overall economic growth. Other developing regions of the World have mechanized primary activities of their agriculture within a 3-4 decades period and are now moving on to even higher technological levels. SSA cannot afford to be left behind - Now is the time for transformative action on sustainable agricultural mechanization in this region.

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Required Actions

1. We call on the 2nd AU STC to endorse the Framework for Sustainable Agricultural Mechanization in Africa

2. We call on African Governments to prioritize agricultural mechanization and be guided by the menu of the priority elements to be considered in the process of developing their national strategies for sustainable agricultural mechanization