Reflections on Mechanization in Sub-Saharan Africa – Lessons from recent trends[1]

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This piece draws on recent findings on mechanization in Sub-Saharan Africa and reflects on how these trends can play out on farms and in the rest of the value chain over the next 20 to 30 years.

Generally and not specific to agricultural mechanization, investment in the region will be guided by economic and policy principles that are coupled with a market-led approach. This approach will be shaped by transformational trends that are currently observed in many regions in Africa. It is likely that investment will occur only in selective value-chains and within specific nodes of these value-chains. These commodities or value-chains will be characterised by their potential in terms of demand growth (either import replacement or export growth), existing investment, policy support and agro-ecological conditions. We anticipate that these investments will be facilitated through spatial targeting and business feasibility throughout the entire value-chain that conforms to business principles such as risk and return.

After decades of persistently low use of agricultural mechanization, the proportion of African farmers using tractors has increased since roughly 2005. Conventional perceptions are that tractor use in sub-Saharan Africa is confined mainly to large-scale commercial farms, however, there is mounting evidence of increasing use of tractors by smallholder farmers. To date, the drivers of the rising use of mechanization services remain poorly understood.

Hence, to anticipate the changes in mechanization in Africa over the next two to three decades we need to understand the driving forces behind the increasing mechanization trend over the past decade.

Secondly, we need to understand and interpret the implication of existing macro-economic- and demographic trends and the changing landscape of the African farmer, which in many cases is conducive for agricultural transformation, in the context of mechanization adoption. Examples include changing farm structures and the rise of the medium-scale (MS) farmer in many Sub-Saharan African countries, the pace of urbanization, dietary changes, growth in rural and urban populations, positive economic growth and changes in per capita income.

Our findings indicate:

- Tractor use has increased over the past decade in many African countries, some at a faster rate. Increasing tractor use has only occurred in selective regions within a country, often characterized by higher levels of commercialization. We anticipate that it is likely that this increasing trend will continue over the next two to three decades, however, uncertainty remains at what rate will this occur. Wide-spread mechanization in Sub-Saharan Africa, similar

[1] The ideas reflected in this summary report was discussed at a workshop session on *agro-industrial transformation as a driver for employment generation, food security and rural development in Africa* which took place at the 6th African Conference of Agricultural Economists in Abuja, Nigeria in September 2019. The session was organized by the Program of Accompanying Research on Agricultural Innovation (PARI) at the Center for Development Research (ZEF) of the University of Bonn

to Asian countries during the Green Revolution, is however unlikely and we anticipate that only specific geographic regions in Sub-Saharan Africa will drive this growth.

- Tractor use will likely continue as a result of a market-driven response to changing factor prices, especially in geographic areas that have experienced rapid economic dynamism and where there is a higher prevalence of changing farm structures such as the entrance of MS producers.
- The increased concentration of MS farmers in several African countries could stimulate demand for mechanization. In our study in Tanzania that has explored the determinants of increasing tractor use among farming households, two key empirical findings we obtained: 1) the estimation results confirmed the basic correlation between land size and tractor use and 2) we have found that in districts where there is a higher concentration of medium-scale farmers, there is also a higher adoption of tractor rental use among small-scale producers, hence confirming a positive spill-over effect that promotes capital intensive forms of farming. Therefore, based on the Hayami-Ruttan induced innovation framework, in the event that larger farms own or use tractors on their own farm but there exist times of slack use, we might anticipate that tractor owners could rent out tractor services to farms in nearby communities if the rental costs per hectare are competitive with manual or animal traction-based land preparation. Under such conditions, we might anticipate mutual synergies between large farms to small farms through the development of tractor rental markets, whereby larger farms more fully utilize the capacity of expensive capital investments, and whereby smallholder farmers gain access to cost-cutting land preparation technology that simultaneously frees up labor for reallocation to higher-return off-farm activities. The second implication is that if the MS farmer group continues to expand and control a larger area of cultivated land, we can anticipate that the demand for mechanization will be stimulated.
- Given the existing structure of land size distribution, increase tractor use was not as a result of tractor ownership, but instead as a result of the development of tractor rental markets. We need to acknowledge that it remains expensive to mechanise and key economic principles such as feasibility and mechanization thresholds are still valid.

Other factors that will guide mechanization use:

- Governments will play a crucial part in developing sustainable mechanization strategies and policy that is targeted to create a conducive investment environment for the private sector. The private sector relies on certainty, surety and clarity which promotes confidence to invest and expand. These strategies and policy frameworks should be coupled with a market-led approach. It is well documented in the literature that previous state-led efforts to actively participate in tractor supply have often failed since these efforts were rarely considered to be a market-driven response to changing factor prices. Hence, governments can guide investment through policy interventions that are targeted to address challenges such as risk, finance, ease of doing business, trade reforms, transaction costs and appropriate policy that is aligned with emerging macro-economic and demographic trends observed in many African countries.
- In order to ensure continuous use of tractors, supply chain-related aspects are crucial which include the availability of after-sales support such as parts availability, service of equipment, fuel availability, extension services and repairs and maintenance.
- It will be key to guide research and development to address localised solutions/demand.
- The profitability of farming which is highly correlated with price movements in commodity markets, remains a binding factor not only to mechanize, but to address the productivity gap

through engagement in best farm practice. The land size distribution characteristics in Sub-Saharan Africa are perhaps not conducive to own a tractor, except if services can be made available to surrounding farmers in times of slack use. The core motive of farming, hence the decision to be self-sufficient or to produce a surplus will further impact the approach towards input use, including mechanization. It is important to understand that one agricultural input, such as the use of mechanization to prepare fields within optimal planting window or the use of improved seeds, will not solve the productivity gap. Hence, mechanization, seed or fertilizer use cannot be seen in isolation, but should rather be considered in combination or supplementary to one another to promote positive rural agricultural transformation.

- In order to develop sustainable mechanization strategies for Africa which is a responsibility by public and private sectors, it is important that we leverage success stories and understand why it has been successful. We also need to understand the driving forces behind failures, not at the national level, but at the farm-level. Hence, in order to understand these drivers, we will need accurate and intelligent data, especially on the role that medium-scale producers are playing in the region and the spill-over effects of them to surrounding small-scale producers.

Mechanisation in Post-farm production segments of the value chain: Status and Projections

Although post farm mechanization fell beyond the scope of our study, it is worthwhile to consider some valid principles.

Consider for a moment the mechanization theory at farm-level, Binswanger and Pingali have identified two associated stages of agricultural mechanization, namely mechanization of power-intensive operations such as land preparation and secondly, control-intensive mechanization of which an example is weeding or seeding. The increasing trend in the use of mechanization over the past decade in many districts in African countries probably suggests that the first level of mechanization has occurred (confined to certain geographical regions and not widespread). This is typically associated with labor-intensive operations. In a scenario where labour is migrating from rural to urban areas, it can be expected based on economic theory that wages in these regions will rise up until a point where it becomes more feasible to shift to the second stage of mechanization, thus, mechanization operations such as weeding or planting.

The question is whether the same principles can be applied to post-harvest mechanization? The answer to this, in my opinion is yes, but with some nuances. My view is that other rural- and agro-industrial transformational factors will drive post-harvest mechanization. This, in turn, will primarily be driven by the private sector as a result of market response in specific value chains and regions that experience economic transformation.

MS Farmers: In our study we drew upon the changing landscape of farm structures in Sub-Saharan Africa which include important evaluations such as the increase in the number of MS farmers in many districts. As the concentration of MS farmers increases, we expect that these regions will attract investment in terms of input suppliers and off-takers. If there is a viable business-opportunity for these private sector role-players, investment will occur in storage, agro-processing, transportation, handling facilities etc.