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Research Report

Successful agricultural mechanisation in sub-Saharan Africa and the significance of agricultural financing

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Briefing Paper 11/2017

Successful Agricultural Mechanisation in Sub-Saharan Africa and the Significance of Agricultural Financing

Summary

The majority of the population in sub-Saharan Africa (SSA) lives in rural areas and is directly or indirectly dependent on agriculture. As land is usually tilled by smallholders manually with a hand hoe, or mattock, the worker's output and productivity (and with it, their income) is low, and the actual workload high. Similar conditions apply in downstream sectors, ranging from processing and transport to marketing. This frequently results in negative health implications for the workers, many of them women, and makes the agricultural sector less appealing. Particularly in the event that they have achieved good levels of schooling or training, young people prefer to take up employment in the cities and choose to leave rural areas. In addition to the heavy workload, further consequences of manual cultivation include high harvest and post-harvest losses, lack of competitiveness, low agricultural exports and high imports.

Agricultural mechanisation can help to improve this situation. Its significance is demonstrated in the declaration contained in the African Union's "Agenda 2063: The Africa We Want" to abolish the mattock by 2025. This is at the very core of a more systematic agricultural modernisation strategy. If implemented sensibly and gradually for particularly appropriate processes and in the case of labour shortages, a frequent criticism associated with this approach, namely that mechanisation causes job losses, does not necessarily apply. Indeed, the job ratio created via mechanisation can be thoroughly positive.

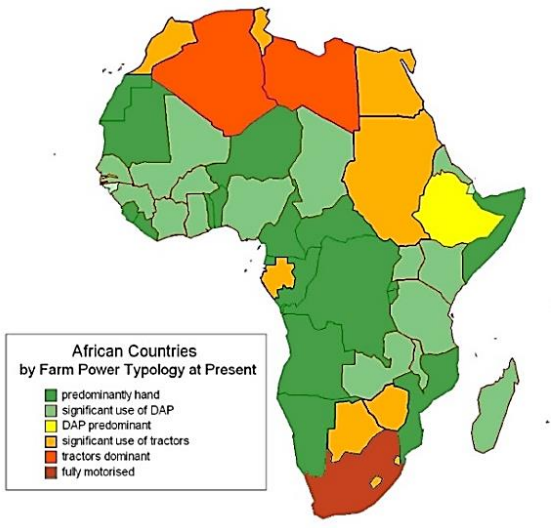
However, a number of aspects must be taken into account in order to ensure agricultural mechanisation is successful:

- Not every viable stage of mechanisation makes economic sense for all small enterprises. That said, alternative exploitation models (machinery rings, larger agricultural enterprises, specialist service enterprises, contract cultivation) and appropriate technologies (e.g. two-wheel tractors) may make mechanisation accessible to these as well. Additional cultivation and marketing measures are often required.
- The fast and reliable provision of spare parts, repair services, operating materials and fuel or energy must be guaranteed.
- Specific financial products, including combined loans for customers and suppliers, savings and loan products and leasing models can make mechanisation more accessible.
- Mechanisation processes should be promoted in a market-driven manner; the state's role should be limited to supportive measures. In the process, subsidies should be "smart", i.e. not cause market distortion, of limited duration and conducive to the economic sustainability of the stakeholders and systems involved.
- Along the value chains, professional competence should be boosted via training courses, either via the private or public sector.
- The financial and agricultural sectors must collaborate to find solutions for specific mechanisation requirements, and receive support in this joint endeavour.

Why promote mechanisation in sub-Saharan Africa?

Directly or indirectly, agriculture forms the basis of the livelihood of a large majority of the population in sub-Saharan Africa (SSA). The smallholders comprising the larger part of the rural population usually plough, weed, harvest and transport their crops manually (see Fig. 1). Similar conditions apply in downstream sectors, ranging from processing and transport to marketing, particularly from field to primary market.

Fig. 1: Prevalence of various degrees of mechanisation within the context of land use in Africa



Source: Clarke & Bishop (2002)

All this frequently results in lower labour productivity and crop failure and losses (inefficient and delayed harvesting, post-harvest treatment and storage), which in turn increases food insecurity. Simultaneously, the workload is very heavy, particularly during peak periods such as soil cultivation or harvesting. In addition, the hard physical work, frequently in a bent position, has negative health consequences for the workers. In the process, women, who number over half of the rural workers, are usually responsible for time-consuming and heavy tasks. As a result, they lack time to care for their families and dependent family members ("time poverty").

All things considered, manual labour not only makes the agricultural sector ineffective, but also unattractive. Young people, particularly those with formal schooling or training, leave their rural surroundings and move to urban areas in search of less strenuous working conditions. The innovation potential and productivity advances in the food sector suffer as a result. Further consequences of insufficient mechanisation include a lack of competitiveness, low agricultural exports, and high imports as well as low added value.

Under these conditions, the mechanisation of production stages in an agricultural context can help increase land and, above all, labour productivity, reduce crop and post-harvest losses, reduce poverty, improve food security and decrease the overall workload. This is not synonymous with the purchase of large tractors, but also includes the use of smaller tools, such as two-wheel tractors and equipment and machinery for transport, further processing and storage.

Although its critics argue that mechanisation inevitably results in higher unemployment, this is not necessarily the case; in balance, it is frequently more than able to compensate for the loss of manual labour. Typically, only the mechanisation of processes during workload peaks (high labour opportunity costs), and of particularly suitable working sequences, is economically justifiable. As a result, labour force is freed up which can be used to perform other activities such as increasing farmland, or wage labour. Such workload shifts along the value chain and higher production volumes allow labour demand to increase in other operational areas, and across the value chain as a whole.

That said, mechanisation can certainly have negative consequences for individual target groups. The mechanisation of individual cultivation processes can increase the women's "time poverty" in the case of gender-specific labour division, when they are subsequently required to weed larger areas for instance. Excessive mechanisation (substitution of large enterprises for small ones) can result in net job destruction. Inappropriate mechanisation can also cause ecological damage, such as erosion or soil compaction, with negative effects for enterprises and possibly also abutting landowners. In consequence, the more popular mechanisation strategies must be analysed for target group-specific effects, and adjusted as necessary.

Principles of adapted mechanisation

International experience has shown that mechanisation is only successful when implemented on a market-driven basis, and not via government targets. In recent decades, precisely the latter situation arose in many places: heavily-subsidised tractors, for instance, were sold to African countries within the context of government programmes, without, however, guaranteeing the supply of spare parts. The many tractor and equipment cemeteries in SSA-countries testify to the failures of top-down mechanisation. The most frequent causes of failure in this area can be attributed to erroneous (political) requirements as regards the type and manner of mechanisation, the incorrect selection of target groups and enterprises, corruption, insufficient involvement of complementary measures and inadequate (follow-up) funding by the existing financing system.

Both the choice of machines and equipment and the exploitation models must be adapted to the specific needs and facilities of the agricultural enterprises/buyers. The OECD's Five Rural Worlds model as modified by the DIE (Brüntrup, 2016) provides an excellent starting point for this process: as far as agricultural households are concerned, it distinguishes between large enterprises (Rural World 1, RW1), market-oriented enterprises (RW 2) and subsistence-oriented enterprises (RW 3). The larger and more affluent an enterprise, the more likely existing solutions are available.

In the process, the purchase of machinery by individual farmers is not the only option. Farmers can also bundle their resources informally with their neighbours, or formally within the framework of a machinery ring, thus improving their access to loans and machines. Another model involves specialist service providers who not only supply the machinery, but also the entire tillage service against payment. As part of a further model, smallholders receive machinery or the service this performs via a contractual buyer/outgrower, frequently a large agricultural or processing enterprise from RW 1 (Table 1).

The major advantage of such alternative exploitation or ownership models is the machines' availability without high investment costs. Smaller sums (machinery ring and service provider) or the assignment of a specific share of the harvest (contract cultivation) are sufficient. In the light of what are usually lower capital reserves, income and poor access to borrowed capital, these prerequisites are usually easier for farmers from RW 2 and RW 3 to fulfil than to generate the capital required to purchase machinery privately. Moreover, this approach ensures that the equipment's professional use and maintenance are guaranteed. One disadvantage of these models is the competition which results between farmers for the machinery during the most auspicious cultivation and harvesting periods. Management problems and other transaction costs are another frequent bane of shared property.

All forms of mechanisation invariably require increased commercialisation in order to be economically viable. The frequently prevailing subsistence production must be replaced or complemented by production for sales, at least in part, in order to meet the costs of mechanisation. The progressive mechanisation also has an impact on business organisation – as a result of similar machinery requirements of specific crops, for instance. As a rule, an increase in mechanisation and commercialisation leads to farmers specialising in fewer products, which carries a higher risk as a result of factors including price volatility, pests and weather conditions. The diversity of self-cultivated foodstuffs may also decline in consequence. Mechanisation strategies should take account of all these determinants, which may require analysis and accompanying measures.

How can mechanisation be financed?

One of the major challenges associated with mechanisation lies in its financing, as the purchase and maintenance of the necessary equipment constitutes a huge investment and financial burden for rural enterprises in developing countries, even in the context of alternative mechanisation models. On the one hand, classic microloans fail to apply in terms of amount and maturity. On the other, traditional investment loans are usually unsuitable as a result of insufficient collateral and high costs.

In consequence, adapted financial products and strategies may be able to effectively facilitate mechanisation. One example is contract-based securities, such as those in the form of delivery contracts. These should be of several years' duration in order to guarantee mechanisation loans. Furthermore, a proven supplier track record of several years' standing provides financing organisations with important information as far as evaluating the farmer's creditworthiness is concerned.

In addition, a donor-supplied loan and guarantee fund may underwrite the repayment of a loan against payment of a fee, with the result that the risk is spread between financial institution and fund. One financing model which is now becoming increasingly popular is leasing. In this case, the agricultural machinery acts as its own security, only becoming the farmer's property in the wake of full payment. Savings products, where at least part of the capital for the intended object of mechanisation is saved up with a financial organisation in advance, are another option. To lower the risks of increased commercialisation associated with mechanisation, supplementary insurance products may be useful, such as weather-index- or satellite-based harvest insurance policies which at least guarantee credit repayment. In general, machinery rings are advantageous for financing, as they bundle the resources of several farmers, thus lowering the risk from the lender's perspective.

In the case of financing models which use contract farming in order to provide smallholders with services, the market and contractual conditions constitute important financing factors in addition to the loan conditions themselves. These

Table 1: Business models for access to mechanisation

	Private	Shared property or machinery ring	Service providers	Contract cultivation
Principle	Purchase of own machinery	Bundling resources to purchase machinery	Use of a service provided	Loan of a machine/ use of a service provided by the aggregator
Advantages	No competition for machinery	Access to loans and machinery	No need to purchase and maintain machinery	Availability of adapted machines
Disadvantages	High costs, only advisable in the case of small, versatile machines	Competition for machines during short cultivation periods		Reliance on aggregator

Source: Authors

should not place the farmers at an unfair disadvantage, and must react flexibly to changes in circumstance. The availability of machinery appropriate to the respective challenges and problems, farmers' willingness to pay, financing of the services and contracts with buyers all determine the success or failure of this model.

The role of the state and of development cooperation

Institutions in partner countries, as well as those involved in financial and technical development cooperation, can support mechanisation processes by systematically addressing the aforementioned bottlenecks.

Experience shows that direct subsidies for mechanisation fail to result in the sustainable use of appropriate machinery, or to its long-term distribution. In consequence, funding programmes should focus on "smart" subsidies, i.e. those which are consistent with market dynamics and do not have a distorting effect. It may often prove advisable to finance alternative models based on the shared use of collectively owned machinery as opposed to funding smallholders individually. This results in transaction and learning costs which may be covered for some time.

It is almost impossible for adapted technologies, local distribution and repair enterprises or networks and the necessary know-how to emerge without external support. The public authorities can provide support in this context, even though the services should be provided via the private sector as far as possible. Leasing should be facilitated and simplified via legal measures, e.g. in terms of the taxation and enforceability of the contracts. A secondary market for used machines can be promoted by innovative market platforms which frequently also require official impetus.

Smallholders must be informed of the opportunities and risks of financial products in order to be able to use these to their advantage. In addition, the increased commercialisation means that training measures in business management are advisable. Nutritional awareness and related training sessions may also prove helpful. The financial institutions may also need to expand their know-how: many lack knowledge of the agricultural sector, leading them to exaggerate the actual risks this area entails. The public provision of information regarding the production, profitability and financial track records, as well as relevant training courses, can reduce misgivings on both sides and lead to a fruitful exchange.

In the context of food insecurity and the exodus of the young population from rural areas, there is no real alternative to the promotion and funding of sustainable mechanisation, despite all challenges and risks – but the form this takes holds the key to its success.

References

Brüntrup, M. (2016). *Erweiterung des OECD-Modells der fünf ländlichen Welten für die sektorübergreifende armutsorientierte Analyse, Kommunikation und Planung* (Analysen und Stellungnahmen 10/2016). Bonn: Deutsches Institut für Entwicklungspolitik (DIE).

Clarke, L. J., & Bishop, C. (2002). Farm power – present and future availability in developing countries. *Agricultural Engineering International: CIGR Journal*, (4), 1–19.

Ströh de Martínez, C., Feddersen, M., & Speicher, A. (2016). *Food security in sub-Saharan Africa: A fresh look on agricultural mechanisation; How adapted financial solutions can make a difference* (Studies 91). Bonn: Deutsches Institut für Entwicklungspolitik (DIE).

African Union. (2014). Agenda 2063. *The Africa we want*. Addis Ababa.

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