

Nigeria Agricultural Policy Project

Mechanization in Nigeria: What needs to be done to stimulate demand and support market growth?

Hiroyuki Takeshima and Adam Kennedy

Introduction

Mechanization increases the power applied to agricultural operations and is one tool among many for improving farm productivity and increasing incomes for Nigeria's farmers and processors. It alone cannot drive the transformation of agriculture (Pingali 2007). Farmers will mechanize to lower costs and ensure timeliness of operations, allowing a greater area of land to be cultivated. The demand for mechanization is therefore determined by the stage of agricultural transformation reflecting the use of complementary inputs (improved seeds, fertilizer), the intensity of farming, land holdings, and rural labor supply and thus wages. Countries across the developing world have mechanized at different rates corresponding to their level of agricultural transformation but also strongly influenced by government policies. Assessments of agricultural mechanization at the continental level have found that Nigeria has an agricultural sector characterized by both low productivity growth and low machinery growth relative to other African countries (2018, Malabo Montpellier Panel). This brief will examine some of the supply and demand side constraints that may be hindering the adoption of mechanization and outline strategies where government and donors can focus their efforts to better support farm productivity.

Stimulating demand for mechanization

Despite economic transformation and urbanization, declining shares of the workforce employed in the agricultural sector at national levels, and high food prices relative to other developing countries, the growth of agricultural mechanization has been gradual, and is probably lower than it would be under ideal market conditions. The use of mechanized equipment is higher in the North where the Trypanosomiasis does not limit the usage of animal traction as in the southern part of the country (Table 1). While the adoption of animal traction has grown at the extensive margins, adoption remains low at the intensive margin, insufficient to trigger substitutions with more powerful machines like tractors.

Key Policy Recommendations

- Rural wages are increasing due to non-farm job growth, food prices remain high, and complementary technologies are being used that should support a growing demand for mechanization, though it is currently limited.
- Investments in R&D can support farm intensification and improve demand for mechanization as will research on implements and machinery best suited for local use.
- Reducing transaction costs can make machines more readily available, but there are still market inefficiencies that should be addressed through targeted investments beyond subsidies.
- Supporting better business models that improve the efficiency of tractor hire services can help address farmer demand while stimulating private sector investment in the sector to address access in underserved areas.

Low real wages for farm labor, particularly in the North, are unlikely to be the cause for the slow spread of tractorized land preparation.

Improved seed varieties often induce farmers to adopt power-intensive husbandry practices like multiple-tillage and control-intensive husbandry practices such as weed control, row planting, and maintenance of optimal plant populations. These farming practices also generate high outputs requiring more labor inputs in harvest and post-harvest operations inducing mechanization. In Nigeria, intensification-driven demand is an important determinant of the adoption of mechanical technologies among smallholders.



Agricultural production technologies, including varietal technologies that critically affect the returns on farm power use, are often generated through public-sector agricultural R&D. Using farm household data as well as various spatial agroclimatic data, Takeshima 2017 shows that the adoption of mechanization technologies has been higher in areas with greater agroclimatic similarity to agricultural R&D stations. **Public-sector agricultural R&D aimed at raising overall productivity, including**

plant breeding, is therefore an important determinant for the adoption of agricultural mechanization. In a country like Nigeria, where production systems are diverse, adoption of mechanization has been limited in many areas, and where public investments in agricultural R&D have lagged in recent years, it is important realize these spatial variations and address them accordingly through greater investment in location-specific R&D.

Table 1: Percentage of Nigerian farmers using mechanization during the rainy seasons

Region	Share (%) of farm households using tractors or animal traction				
	Tractors	Total	Animal traction		No tractor / Animal traction
			Owened animal	Rented animal	
Total	4	24	14	10	73
North West	2	53	28	25	47
North East excluding Taraba	5	64	42	22	33
North Central + Taraba	11	5	3	2	85
South East	0	0	0	0	> 99
South South	0	0	0	0	> 99
South West	5	0	0	0	95

Source: Authors' calculations based on Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) 2010/11, 2012/13 and 2015/16.

Note: Figures are simple averages from three rounds of LSMS-ISA, adjusted for sample-weights. Figures may not add up to 100 due to rounding errors.

The potential to exploit economies of scale is also an important determinant of the spread of mechanization. Where mechanization has increased, the returns to scale in overall production have risen, even with intermediate mechanization technologies such as animal traction (Takeshima 2017). Put differently, weak land-markets as well as limited input and output markets due to poor road infrastructure limit the scope for exploiting economies of scale and consequentially the adoption mechanization. It is also noteworthy that the R&D effect described above is particularly strong among larger farms.

Facilitating Market Growth

Nigeria does not have a standalone agricultural mechanization policy, although the role of mechanization is specified as part of the country's overall agriculture and nutrition security policy. Agricultural mechanization is also supported through various government programs including subsidized distribution of tractors to individual farmers or private-sector machinery hiring service providers. The focus has gradually shifted from the former to the latter over the years, as it has increasingly

been recognized that hiring services more efficiently meet smallholder demand. The government has also put in place several regulatory measures, including testing and certifying machines and operators, although the extent of their enforcement is presently unknown. In addition, national agricultural research organizations, such as the Institute of Agricultural Research in Samaru, support the development of machinery, such as tractor-attachments.

The tractor market in Nigeria consists of relatively larger-scale, new tractor sellers, and smaller-scale, used tractor sellers. Used-tractors often provide affordable alternatives to new tractors, with spare parts and repair services available in local markets, but their supply and demand are not matched spatially. There is also an active informal-sector farmer-to-farmer hiring service market, which is recognized but not well understood by the government. These custom-hiring service providers are currently more efficient than the formal-sector hiring service providers promoted by the government that include the Agricultural Equipment Hiring Enterprises (AEHE). They use their tractors more efficiently and at

lower cost, while still obtaining comparable revenues implying that government-sourced tractors have not been allocated to the most efficient farmers. Should the government choose to maintain AEHE to complement the informal sector, it is necessary to identify practices and knowledge that might improve efficiency and invest in building capacity in skills such as machine operation,

repair and maintenance, and business management. Capitalizing on such expertise in the informal sector, while making sure not to crowd them out, is critical also in light of the government’s plans to import a large number of new tractors through arrangements with John Deere and Brazil’s More Food International Initiatives.

Table 2: Annual profitability for tractor owners in Benue State

Cost categories	Government- sourced tractor owners, median		Market- sourced tractor owners, median	
	Naira, '000s	USD	Naira, '000s	USD
Fuel/ Oil	429	1192	163*	452*
Operator	360	1000	150	417
Repair or Maintenance	13	37	37	102
Total Costs	1209	3359	440*	1222*
Total Revenues^a	1635	4543	1410	3917
Profits	283	787	558*	1551*
Observations	23		31	

Source: Authors’ calculation, Benue tractor owner survey 2018.

*10% statistically significant difference from government-sourced tractor owners based on non-parametric tests for difference of median USD figures are based on USD 1.00 = Naira 360 ^a Includes imputed value for own-farm use

It is only if there is unmet demand for mechanization and the private sector is failing to invest and meet that demand, that government should play a role in promoting mechanization. Indeed, subsidies have been successfully used by Asian governments in the past, but they were designed with clear exit strategies and rarely targeted specific equipment or firms allowing the private sector to compete assuring that machinery was tailored to local conditions. Governments can also help fill knowledge and capacity gaps, for example, by conducting soil mapping to determine the appropriateness of different machine types and providing demonstration/education on the use of new technology, equipment repair, and service provision business models. There is unlikely a single “right” formula for government involvement in mechanization beyond facilitative and coordinative roles.

Lastly, rather than emphasizing direct interventions, the Nigerian government should focus their efforts on R&D. This should include developing machinery and implements utilizing the capacity of engineering departments with active collaboration with the private sector such as local fabricators and retailers. It is also important to concentrate efforts on other types of research, such as the development of new seed varieties that makes the use of mechanization more efficiently. Technical training and extension also help

farmers familiarize themselves with different types of machinery, creating more demand for mechanization, and reducing machine downtime for repair.

Conclusion

Urbanization and non-farm job growth in Nigeria is supporting rural wage increases, food prices remain high, and complementary technologies are being used that should support a growing demand for mechanization, though it is currently limited. The Government of Nigeria has rightly targeted the reduction of transaction costs to make machines more readily available, but there are still market inefficiencies that might be addressed through a more targeted set of investments beyond subsidies. Smart investments in R&D can support farm intensification and improve demand for mechanization as will research on implements and machinery best suited for local use. Supporting better business models that improve the efficiency of tractor hire services can also help address farmer demand while stimulating private sector investment in the sector to better address access in underserved areas. Ultimately, Nigeria will need to intensify agricultural production to feed its growing population and reduce its import bills, and mechanization is an important tool among many that can help.

Key References

1. Aboagye PO, AG Abubakar, AI Adama, AO Lawal, & AA Musa (Synthesized by Hiroyuki Takeshima). (2016). *Agricultural mechanization and south-south knowledge exchange: What can Ghanaian and Nigerian policymakers learn from Bangladesh's experience?* GSSP Policy Note 6 and NSSP Policy Note 36, IFPRI.
2. Hatzenbuehler, Patrick L.; Takeshima, Hiroyuki; Edeh, Hyacinth; and Lawal, Akeem. 2018. Cost and policy determinants of features of tractor markets in Nigeria: Case studies of tractor sellers in Kaduna state and tractor owners in Benue state. [NSSP Working Paper 55](#).
3. Malabo Montpellier Panel. 2018. Mechanized: Transforming Africa's agriculture value chains. Dakar, Senegal: International Food Policy Research Institute (IFPRI) and Malabo Montpellier Panel. <http://ebrary.ifpri.org/cdm/ref/collection/p15738col12/id/132766>
4. Takeshima, Hiroyuki. 2017. The roles of agroclimatic similarity and returns on scale in the demand for mechanization: Insights from northern Nigeria. [IFPRI Discussion Paper 1692](#).
5. Takeshima, Hiroyuki; and Lawal, Akeem. 2018. Overview of the evolution of agricultural mechanization in Nigeria. [IFPRI Discussion Paper 1750](#). Washington, DC
6. Takeshima, Hiroyuki, Hyacinth Edeh, Akeem Lawal, & Moshud Isiaka. (2015). Characteristics of private-sector tractor service provisions: Insights from Nigeria. *Developing Economies* 53(3), 188-217.

About the Authors

Hiroyuki Takeshima is a Research Fellow with the Development Strategy and Governance Division (DSGD) of the International Food Policy Research Institute (IFPRI), based in Washington, DC, USA.

Adam Kennedy is a Senior Program Manager and Senior Research Analyst with DSGD of the International Food Policy Research Institute (IFPRI), based in Washington, DC, USA.

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