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# **Intensification and Agricultural Mechanization in Ghana: Searching for Proper Supply Models for Mechanized Services**

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# Key Research Questions

- A fundamental reason to explain the failure in 1970s and 1980s for an early push of mechanization in Africa is lack of demand from small farmers for mechanized farming, when their farming systems were not intensive, labor was abundant, and labor cost was low
  - **Question 1: Is lack of demand for mechanized services still an issue today?**
- It is argued in the literature that when such demand is present and high enough, supply from the private sector will automatically follow (Pingali, Bigot & Binswanger 1984)
  - **Question 2: Whether this is the case in Africa and what is the role of the government?**
- Literature for mechanization after 1990s is almost empty and relatively little attention was paid to the supply side of mechanization
  - **Question 3: Are there stylized supply models in which the private sector has developed the mechanization supply chain and whether such models are adaptable to African countries?**

# Q1: Is lack of demand for mechanized services still an issue today?

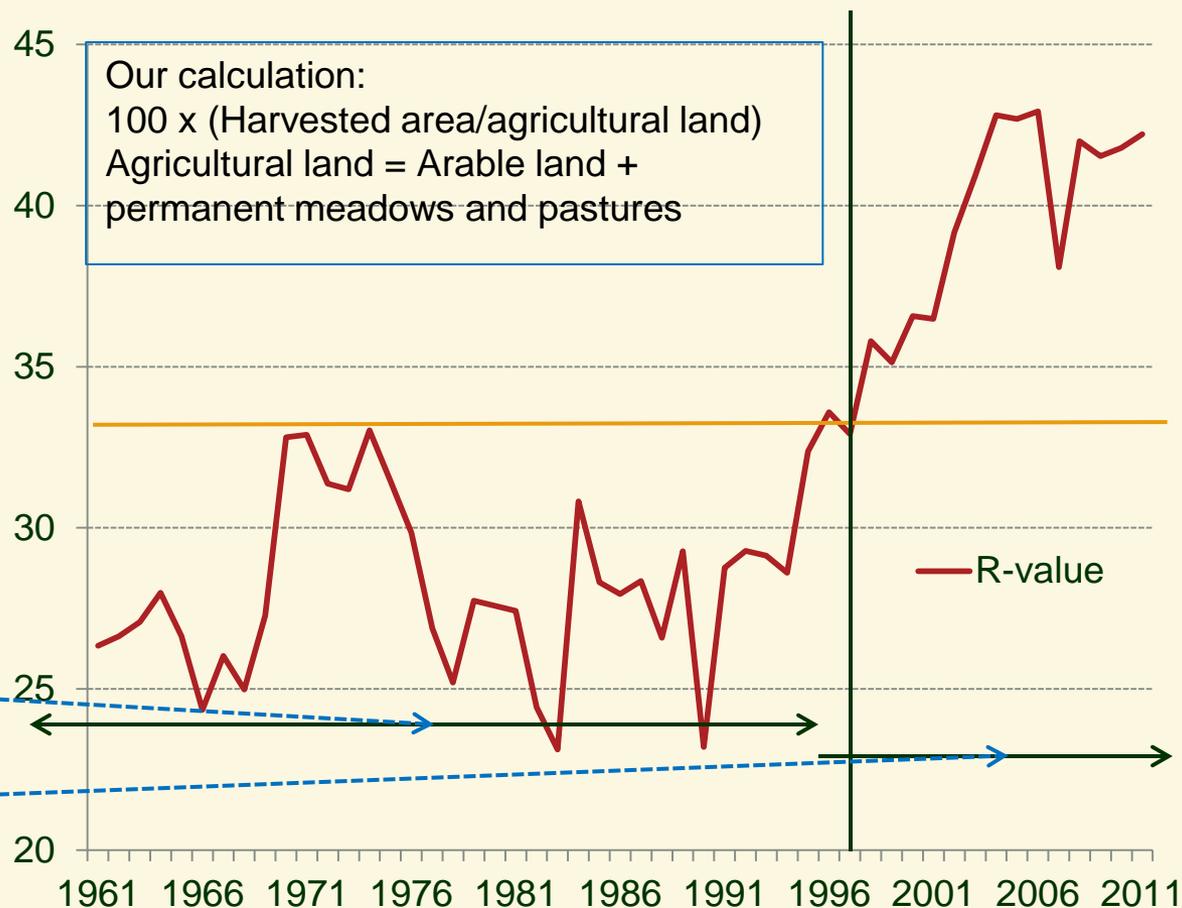
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- *Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa* published in 1984 by Pingali, Bigot & Binswanger is the first book in the literature to analyze the failure of government-sponsored mechanization against a framework of the evolution of farming systems – “transition from hand hoe to the plow is closely associated with the intensification of farming systems.”
- Two important drivers identified for the evolution of farming systems or intensification: population density and market access (Boserup, 1965; Ruthenberg, 1980)
- The same framework is used to first justify:
  - **Has intensification reached a level such that demand for mechanized services is emerging in Africa?**

# An Indicator of Intensification – *R*-Value

*R*-Value is an indicator of evolution of farming systems in Ruthenberg (1980), defined as the ratio of the number of years of cultivation and the length of the cycle of land utilization (the sum of the number of years of arable farming and the number of fallow years) multiplied by 100.

- Shifting (long-fallow) systems:  $R\text{-value} < 33$
- short fallow systems:  $33 < R\text{-value} < 66$
- Permanent systems:  $R\text{-value} > 66$



Source: FAO

# Labor Demand, Labor Cost, and Demand for Mechanization

## Labor demand and cost, Northern Ghana

	Ngeleza et al. (2011)		Akramov and Malek (2012)	
	Labor use (man-day/ha)	Labor cost (cedi/ha)	Labor use (man-day/ha)	Labor cost (cedi/ha)
Labor demand and cost	130.0	520.9	88.9	323.9
Share of labor cost in gross revenue (%)			48.3	50.4
Gross revenue per unit of labor (cedi/man-day)			8.3	7.2

## Cost comparison with and without tractor plowing, Northern Ghana

	Ngeleza et al. (2011)		Akramov and Malek (2012)	
	Manual	Tractor	Manual	Tractor
Cost, cedit/ha				
Plowing	<b>74.1</b>	<b>54.3</b>	35.2	67.9
Other labor cost	446.8	446.8	288.7	268.2
Total labor and tractor service cost	520.9	501.2	323.9	336.1
Input cost			260.7	260.5
Yield (mt/ha)	1.54	1.54	1.61	1.68
Gross revenue	1,079.2	1,079.2	642.1	656.8
Net revenue			<b>57.5</b>	<b>60.2</b>

# Labor Hiring and Demand for Mechanization

## % of rural households that reported labor hiring by landholding size

	GLSS3 (1991/92)	GLSS4 (1998/99)	GLSS5 (2005/06)
Less than 2 ha	58	64	45
2 to 5 ha	68	74	51
5 to 10 ha	76	82	64
More than 10 ha	84	88	64

## % of households that reported equipment use

	GLSS3 (1991/92)	GLSS4 (1998/99)	GLSS5 (2005/06)
National	0.9	6.4	7.7
North	0.8	6.2	12.8

A rising trend of demand for mechanization in the recent years:

- WFP survey 2008: **44%** of farmers in Northern Region reported to rent tractor services for plowing
- Ngeleza et al. (2011): **35%** of interviewed maize farmers (219) nationwide (including farmers in forest zones) reported to hire tractor services for plowing in 2009
  - **77%** in the north
- Akramov and Malek (2012): **95%** of interviewed maize farmers (174) in the north reported to hire tractor service in 2010

# Conclusion for Q1: Demand for mechanized services is high and rising in Ghana

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- Rising labor demand in agriculture due to population growth, urbanization and access to international markets
  - Intensification in agricultural land use characterized by more frequent use of agricultural land and expanding cultivated areas through reducing fallow area and time, which causes more labor needed per unit of land
  - Intensification in labor use also due to change in crop patterns led by meeting urban and export demand
- Plowing has become necessary in many places under the current farming systems when animal traction is not an option
- Rising labor cost and increased use of hired labor made certain mechanized services – land preparation and threshing – more attractive than hiring labor
- Tractor service market has quietly started to develop and tractors owners are often medium and larger farmers that also provide hiring services

## Q2-Q3: What are stylized supply models adaptable to Africa? What are the roles of the government in these models?

- A supply chain approach used to develop three stylized models based on the experiences of some Asian countries in which smallholders dominate
- Focus on the private sector's role in mechanization supply
- Identify proper roles for the government in mechanization
- Skip it in the presentation due to the time limit

# Analyzing the recent mechanization in Ghana: A supply chain approach

Three key components of the supply chain:

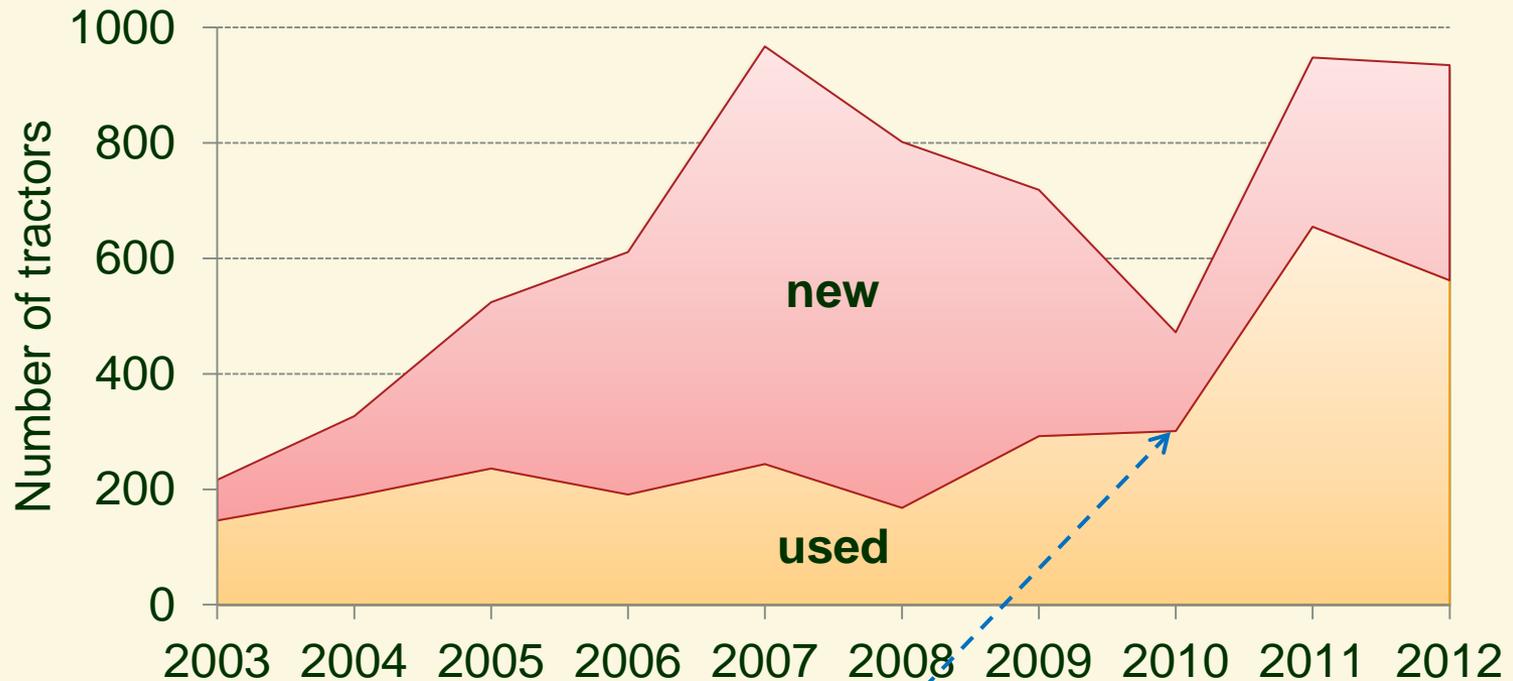
- End product: mechanization provision in agriculture
  - Machinery supply: tractor imports and distribution
  - Maintenance and repairing
- The end product – a competitive market for tractor service provision:
    - Government withdrew from this market in the early 1990s
    - Service prices determined by market supply and demand
      - Subsidy to AMSECs did not trick down to farmers
      - A rising trend in service prices after the establishment of AMSECs

# Machinery supply: Dual systems in tractor imports and distribution

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- The secondhand tractor imports and distribution fully led by private sector
  - The market existed for more than two decades
  - Operated through small businesses that have built stable import channels from exporting countries through long-term business networks
  - Most of them have a diversified business portfolio in which tractor imports are just one component
  - Buyers are mostly larger farmers
  - Prices in 2012 comparable to the subsidized price for the new tractors imported by the government
  - Tractor price negotiable and transactions in cash only (no credit and loan offered)

# Tractor Importation



Used tractor imports are steadily increasing in the recent years, an indication of increased demand for tractor

Source: Customs, Excise and Preventive Service, Government of Ghana

Note: Data for 2012 are to July 2012

# New machinery supply: Direct importation and distribution by the government

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- Financed mostly by concessional loans on an ad hoc basis: switching from one country's government to the other one (China, India, or Brazil, for example)
  - Tractors must be imported from the lender countries
  - Different brands of tractors have been brought in from different lender countries under different loan agreements
  - The choice of manufacturers and brands of tractor determined without an open tender process
- Ghanaian companies as agents to handle imports
  - Local firms in competition to become dealers for the government, because it is a riskless business, at least initially
  - Lack of transparency in the selection process
  - Future risk can be high to the selected agent company when the government switched to a different local agent under a new concessional loan arrangement, if the early agent company built up stocks of spare parts with an expectation to be continuously as the government's agent

# The establishment of AMSECs: Private entities but selected by the government

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- Each center received a package of 5-7 tractors with basic implements (plow, harrow) and a trailer
- Initial payment equivalent to 20% of the subsidized prices and remaining 80% paid in next 4 years (without interests)
- The subsidized price equivalent to two-third of the import price actually paid by the government
- Unsurprisingly, application demand for becoming an AMSEC far outpaces the available tractors
  - Difficulty to ensure transparency in the selection process

# The design of AMSEC operation: Professional service provision without economies of scale

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- Plowing as a typical power-intensive operation has natural limitation in tractor utilization
  - Hiring services unlikely become the sole business for tractor owners
- Based on the recent surveys for selected AMSECs our analysis shows that tractor utilization rate is far below the threshold level for tractors to be a profitable investment even after the government subsidizes more than one-third of the tractor price
- only 38 of 136 surveyed providers provided other types of services such as threshing, boom spraying, or harvesting
  - 80–90 percent of their service revenue from plowing
- Few AMSECs own harvesters, threshers, dryers, and other machinery, as these machines are not included in the subsidized package
  - There is little incentive for an AMSEC to invest its own money in other equipment

# Conclusion: What are viable supply models in Africa?

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- Asian experience shows that a successful mechanization process begins with ownership of machinery by farmers that are also the main providers of hiring services – Establishment of AMSECs follows an old “service center” idea that did not work in the past
- The Bangladesh model shows that when the private sector fully handles imports, affordable and suitable machinery for farmers is brought in – It is unlikely for the government to bring in the right tractors at the right prices for farmers
- The India model shows that a subsidy policy can be used to encourage private investment – When subsidy applied to machinery imported by the government, the policy can only encourage a rent-seeking behavior
- The China and India models show that interventions related to overcoming market failure in financial/credit market can be helpful in creating private investment incentives – It is impossible to do so when the financial source depends on concessional loans only