



## Mechanization in Ghana: Emerging demand, and the search for alternative supply models



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### ABSTRACT

Influential studies in the 1980s and early 1990s drew on the Boserup–Ruthenberg theories of farming systems evolution to argue that African countries were not yet ready for widespread agricultural mechanization. Through applying the theories of farming systems evolution and of induced innovation in technical change, this paper shows that demand for certain mechanized farming operations particularly plowing has emerged even among smallholders, suggesting that supply issues may now be the main constraint to successful mechanization. We therefore adopt a supply chain approach to analyze two types of mechanization practices in Ghana, i.e., a recent state-led mechanization program and the private sector-led service hiring market, against an international perspective by drawing on three Asian supply models. We identify two major flaws in existing policies. First, the agricultural mechanization service centers that the government promotes fail to use tractors services with sufficient intensity. Second, direct importation of agricultural machinery by the government inhibits imports of appropriate and affordable machinery. In contrast, the development of mechanized service hiring market in which medium and large scale farmers who are tractor owners provide hiring-out services to small-scale farmers represents a promising model for sustainable mechanization in Ghana. This private sector-led second model is consistent with international experiences.

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### Introduction

Agricultural mechanization represents technology change through the adoption of non-human sources of power to undertake agricultural operations such as plowing, harvesting, shelling, and planting. Adoption of mechanization by farmers is an evolutionary process influenced or induced by a set of country specific agro-climatic factors, economic factors and social conditions for which the government's policy choices have impact. Because of this, the literature on mechanization in Africa that is dated to the 1970s and 1980s focuses on evaluating governments' early interventions in mechanization services. The consensus was that the early push in mechanization failed in Africa due to lack of economic demand from farmers and the fiscal burden of state-sponsored programs (Pingali et al., 1987; Mrema et al., 2008). Donors' and governments' appetite for mechanization policy fell considerably after the 1980s. However, with the recent emphasis on agricultural development and public investment in the sector, some African countries have

started to devote public resources to promote agricultural mechanization, including through direct subsidization of machinery imports. The objective of this paper is to bring the attention of researchers to the role of mechanization in agricultural transformation and the role that governments can play in the development of the machinery supply chain. Through applying the theories of farming systems evolution developed by Boserup (1965) and Ruthenberg (1980) and of induced innovation in technical change developed by Hayami and Ruttan (1970, 1985), the paper first assesses whether mechanization demand has emerged. After providing a concrete assessment on emerging demand for mechanization, the second part of the paper focuses on the alternative supply models of agricultural mechanization for addressing such emerging demand. Based on a cross-country comparative analysis and recent development of mechanization in Ghana, the paper examines the appropriateness of mechanization strategies of the government of Ghana. We find that demand for certain mechanized farming operations particularly plowing has emerged even among smallholders. The development of the mechanized service hiring market in which medium and large scale farmers who are tractor owners provide hiring-out services to small-scale farmers represents a promising model for sustainable mechanization. On

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the other hand, the specialized service provision model recently promoted by the government seems to be not viable. Continuous implementation of such model will not only increase the financial burden to the government, but also encourage more rent-seeking behaviors, a negative factor to hurt the private sector as the leader in developing mechanization supply chain.

Ghana has experienced steady economic growth since the late 1980s, and the growth is accompanied by rapid urbanization and rising nonfarm opportunities in the rural areas. During this period, the government of Ghana has adopted a market-driven agenda in which its policies and investments have been remarkably neutral with respect to the production sectors. Apart from cocoa, the “winner-picking” type of government intervention is rarely adopted in the agricultural sector. However, beginning in 2003, the Government started to reemphasize the importance of mechanization, directly engaged in tractor imports, and established subsidized agricultural mechanization service centers in the last a few years. Several African countries are considering similar mechanization policies. In Nigeria, for example, the government is the primary importer of tractors, which were sold at subsidized prices to farmers (PropCom, 2012). Similarly, the Government of Tanzania has sold more than 5000 sets of imported agricultural machinery at subsidized prices since 2009 (Lyimo, 2011). The government of Mali imported 400 tractors from India in 2006; DRC imported 920 sets of tractor and farm equipment; and Cameroon planned to import 1000 tractors from India in 2013, all at the subsidized prices (FAO, 2013a). Many of these imports and associated policies are facilitated by lines of credit from the emerging economies such as Brazil, China and India. The records of the Export-Import Bank of India show that Angola, Benin, Burkina Faso, Burundi, Chad, Guinea Bissau and Swaziland have received similar lines of credit ranging from \$4 million to \$50 million from India to purchase agricultural machinery (pipeline and operative, as of August 2013). China's exports of agricultural machinery have increased in value from \$410,000 in 1994 to nearly \$65 million in 2008, with much of the increase driven by large tractor exports and 11% of such exports going to Africa (FAO, 2013a). While exports through these credit arrangements with African countries' governments are encouraging these countries to increase agricultural machinery imports, it is a question whether it also presents potential challenges for these countries to be able to establish a private sector-led sustainable supply chain for agricultural mechanization.

Against this background in the recent development of mechanization policy among African countries, we employ a methodology that is a combination of qualitative interviews, secondary data analysis and literature review for a diagnostic analysis of demand for and supply of agricultural mechanization. We focus on Ghana and have interviewed farmers, tractor owners, government officials, importers and other stakeholders there in April 2012 – July 2013.<sup>1</sup> The hypotheses emerging from the field work were tested and refined by analyzing both aggregate and household survey data. A number of small-scale surveys or field studies conducted by IFPRI's Ghana Strategy Support Program, including a farm budget survey (Akramov and Malek, 2012), a study of animal traction use (Houssou et al., 2013a), a survey of input use for maize and rice production (Chapoto and Ragasa, 2013), a survey of government-supported mechanization service centers (Benin et al. 2012), and a study of cropping practices and labor requirements for farm operations (Ngeleza et al., 2011). Part of the data from a recent survey of tractor owners and medium and large scale farmers jointly conducted by IFPRI and Ghana's Savannah Agricultural Research Institute (SARI) in October – December 2013 is also used. The

cross-country comparison of agricultural mechanization experiences was developed through an extensive literature review.

Very little research has examined the supply side factors of mechanization (e.g., Mrema et al., 2008), and those have usually focused on provision of services alone rather than the entire supply chain with service provision at the end. This paper tries to fill the knowledge gap by analyzing the entire supply chain both in the cross-country comparison and in Ghana's case study.

The paper begins by examining the demand side of mechanization in the next section. Using the frameworks of evolution of farming systems that was used by Pingali et al. (1987) and induced innovation in technical change developed by Hayami and Ruttan (1970, 1985), the third section provides a contemporary assessment of demand for mechanization services in Ghana. Supply issues are then examined. Three stylized models of mechanization supply based on the experiences of selected Asian countries are presented in the fourth section. The penultimate section has a diagnostic case study of Ghana's current practices in mechanization supply, which covers the model promoted by the government through Agricultural Mechanization Service Enterprise Centers (AMSECs) and the practice led by the private sector. The final section concludes.

### **Agriculture since 1980s: Is demand for mechanization emerging in Ghana?**

Since the early 1970s, all over the developing world, power intensive operations of land preparation, threshing, pumping and transport have been largely motorized via tractors and stationary machines (Binswanger, 1986). However, Africa is an exception. The early push of tractorization by African governments and some donors largely failed, and animal traction was also processing very slowly in many countries. Applying the Boserup–Ruthenberg model, Pingali et al. (1987) have provided a formal analysis on the main reasons for the slow progress of agricultural mechanization in Africa. By examining the existing farming systems in Africa carefully, the authors argue that the slow transition from hand hoe to mechanized plow can be explained by lack of the evolution in farming systems. Only when the systems move from long fallow to short fallow or permanent agriculture does plowing become necessary to deal with grassy weeds and hardening soils which are difficult to remove with the hand hoe.

How have farming systems evolved in Africa in the last 30 years after the publication of Pingali et al. (1987)? Understanding such evolution is the first necessary step for better assessing possible changing situation of demand for mechanization in Africa in the recent years. In the following subsection we first investigate a measure of farming systems, commonly used by Boserup and Ruthenberg, for Ghana in the last five decades. We then apply the induced technical change framework of Hayami and Ruttan (1970, 1985) for an analysis of the changing characteristics of the economic environment to explain the emerging demand for labor-saving technology among farmers.

#### *Long term drivers of agricultural evolution*

##### *Farming system evolution*

The fundamental contribution of Boserup–Ruthenberg theory in farming system evolution is to interpret agricultural technological changes and practices as endogenous rather than exogenous to the economic system, that is, such endogenous progress is influenced by agro-ecological conditions and induced by changing characteristics of the socio-economic environment with which the farmers are confronted (Binswanger, 1986). According to Boserup and Ruthenberg, and further formalized and tested by Pingali et al.

<sup>1</sup> In April 2012, 44 interviews were conducted in Central and Northern Ghana, and in July 2013, 35 interviews were further conducted in two districts, Ejura and Savelugu Nanton.

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