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Big tractors, but small farms: Tractor hiring services as a farmer-owner's response to an under-developed agricultural machinery market

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ABSTRACT

The debate about agricultural mechanization in Africa south of the Sahara (SSA) has largely ignored the role of the capital service market in spreading the use of mechanical technologies. Yet, custom machinery hiring services have been essential for the widespread use and ownership of tractors and other agricultural machines in many countries where small farms are dominant. Using survey data collected in 2013, this paper suggests that tractor services can play a key role in the adoption of tractor use among Ghanaian farming households. Medium and large-scale farmers own tractors in the survey districts, while most small-scale farmers access tractors through hire services. Farmers expand their farm size when they acquire a tractor, but not to such an extent as to fully utilize the capacity of the machine. They engage in hiring-out tractor services to increase the scale of tractor use and make profits. Medium-scale farmers offer the bulk of tractor services. These farmers will be key for spreading agricultural mechanization in Ghana.

Key words: service hiring market, farm size, tractor service provision, Ghana

1. INTRODUCTION

1.1 Tractor Hire Services in Agriculture

The debate about agricultural mechanization in developing countries has largely neglected the role of the capital service market. Small farm size and seasonality have often been seen as a major limitation to the use and ownership of agricultural machines (Pingali et al. 1987; Pingali 2007; FAO 2006; Ji et al. 2012). Yet, custom hiring services have been essential for the widespread use and ownership of tractors and other agricultural machines in many countries where small farms are dominant. For example, draft animals and manual labor were unable to cope with the work load of intensive agriculture on the small farms of India, but the use of tractors on these single farms was not economically viable (Sharma et al. 1998). It was only through hiring that tractor service charges could be reduced sufficiently to enable most farmers to adopt mechanized technologies, encouraging many to invest in private tractor service provision.

Markets for hiring out mechanization services have developed in smallholder farming systems all over Asia. In the Punjab of India, for example, only about 40 percent of farmers own a tractor, but every farmer uses a tractor on their fields (Singh et al. 2013). Custom agricultural machinery hiring services have transformed machine work in farming into an almost infinitely divisible input through which even small-scale farmers cultivating as little as 0.1 ha or producing only 100 kg of grain can mechanize their operations (Chancellor 1986). In spite of unfavorable factors, such as high tractor prices, capital constraints, widespread smallholdings, and lack of well-trained mechanics, tractor hiring services similarly rapidly developed in Thailand and Malaysia (Chancellor 1971). Many of these services were initiated by government programs that did not survive (Rijk 1986), but the programs often served to stimulate demand for mechanization services which the private sector increasingly supplied.

Agricultural mechanization service providers tend to be medium and large-scale farmers who invest in tractors both for their own use and to provide hiring services. For example, in Thailand, Malaysia, and Pakistan, the majority of the tractor service providers were farmers with landholdings about twice that of tractor-hiring farmers (Chancellor 1971; FAO 2009). Moreover, medium-scale farmers in India and Pakistan were found to hire out their tractors for about 700 tractor hours per year, more than 50 percent of the annual economic utilization rates of their tractors (Misra 1991; Byerlee and Husain 1993). Providing tractor hire services can be an effective way for tractor-owning farmers to spread fixed costs over more land, reduce per unit costs, and increase cash flow.

Past government attempts in SSA to supply agricultural mechanization services were made when there was no demand for such services (Pingali et al. 1987). As a result, private ownership of tractors did not accelerate in the sub-region nor did private agricultural mechanization service provision. In consequence, we find that mechanization services have not developed in SSA to the extent they have done in other continents – only 10 percent of SSA farm power comes from powered machinery (FAO 2003), indicating that there is a potential for the development of tractor services in the sub-region. We can expect that rental markets for privately owned and operated tractors may increase in SSA in the future (FAO 2006).

With the recent rise in demand for mechanization in Ghana as a result of increasing labor bottlenecks due to economy-wide labor constraints, urbanization, rural urban migration, and non-agricultural sector growth (Diao et al. 2014), the tractor-hiring market has started to grow in the country. Smallholders' use of these services is quite high (World Food Programme 2009; Akramov and Malek 2012). A recent survey by the International Food Policy Research Institute and Savannah Agricultural Research Institute (IFPRI/SARI 2013) indicates that two-thirds of tractor users among farmers in Ghana hired tractor services. Similar hiring patterns have been reported in other countries in SSA. In Botswana, Panin (1995) found that 72 percent of farm households hired a tractor for plowing. Similarly, Cunguara and Darhofer (2011) observed that most tractor users in Mozambique do not own tractors, but hire them.

1.2 Objectives and Hypotheses

This paper documents the behavior of tractor service providers in the survey districts in Ghana. It assesses the key features of the service market and the role played by farm size in tractor use. Specifically, the objectives of the paper are to answer the following questions:

- Who are the major participants in the tractor service market?
- Is farm size a determinant of the spread of agricultural mechanization in the survey districts?
- What is the correlation pattern between farm size, service provision, and service profitability?

To guide the design of this research, we propose the two following hypotheses:

- How much plowing service is provided through tractor hire is strongly influenced by the farm size of service provider. The larger the farm, the less providers offer plowing services, and vice versa. It follows, then, that the majority of tractor service providers are medium-scale farmers, cultivating between two and 30 hectares of land. These farmers are likely to lead the future development of tractor-based mechanization in Ghana.
- The proportion of overall tractor use made up by hiring-out tractor services is essential to achieving tractor service profitability for the tractor owner. Providers who hire-out their tractor more make more profits. Widespread use of mechanization in Ghana will occur essentially through agricultural mechanization service provision by medium-scale farmers.

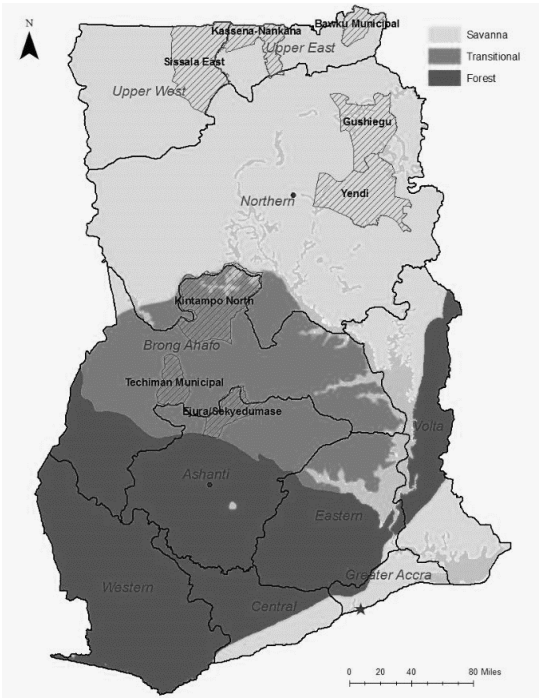
The remainder of the paper is organized as follows. Section 2 describes the data and methodology, whereas Section 3 presents the state of farm mechanization in the survey districts. Section 4 discusses farm size dynamics and tractor use among market participants. Section 5 presents the performances of the service market. Section 6 provides some concluding remarks.

2. DATA AND METHODOLOGY

This paper uses data from the 2013 IFPRI/SARI survey. The survey was conducted in eight districts in the transition and savannah agro-ecological zones of Ghana – Kassena-Nankana East, Sissala East, Bawku Municipal, Kintampo North, Ejura-Sekyedumase, Techiman, Gushiegu, and Yendi (Figure 1). These districts were selected

because they were identified through exploratory fieldwork as areas with relatively large numbers of medium and large-scale farmers and tractor owners – the target population of the survey. Farm size information was obtained from farmer listings provided by district agricultural officers. Data on tractor ownership were taken from the tractor owner census data collected by the USAID Agricultural Development and Value Chain Enhancement project (USAID/ADVANCE 2013). Consistent with the survey objective, medium and large-scale farmers cultivating more than 5 hectares of lands and tractor owners were oversampled for the IFPRI/SARI survey, while only 50 small-scale farmers (less than 5 hectares) were interviewed per district. In total, 1,843 farmers, including 408 tractor owners, were interviewed. The survey covered about 60 percent of the tractor population in the selected districts (see Chapoto et al. 2014 for further details on the survey methodology).

Figure 1—Map of 2013 IFPRI/SARI survey districts in Ghana



Source: HarvestChoice and GADM (2014)

This paper focuses on the tractor service providers who participated in the survey, but we include tractor-hiring farmers and non-tractor users in our comparisons[1]. We use a combination of descriptive methods and statistical tests to analyze key characteristics of participants in the tractor service market. Cross tabulations, graphical displays, and correlation analyses were employed to analyze the dynamics of farm size, the relationship between farm size and service provision, and other key patterns of the tractor service market. Finally, the research assesses the profitability of tractor service among service providers, taking into account the revenue from the services provided (including own use), tractor depreciation and interest on capital, maintenance and repair costs, and variable costs. The net profit is estimated as follows:

$$N = R_p + R_s - (F + L) - M - (r + \delta)I$$

where R_p is the revenue from plowing, R_s is the revenue from shelling, F is the fuel and lubricant costs, L is the labor costs, M is the maintenance and repair costs, r is the interest rate, δ is the depreciation rate and I represents the initial cost of investment in a tractor, plow, or maize sheller (see Houssou et al. 2014 for further details on profitability analysis).

[1] Given the oversampling of medium and large-scale farmers during the survey, such farmers are over-represented among tractor-hiring farmers and non-tractor users. Comparisons of tractor service providers, tractor-hiring farmers, and non-tractor users should be interpreted with this limitation in mind.

3. AGRICULTURAL MECHANIZATION AND FARM SIZE IN SURVEY DISTRICTS

Table 1 provides key statistics on farm mechanization in the survey districts. Tractor ownership is very low across the districts (2 percent or less). Animal traction is used in districts with fewer tractors, especially in the Upper West and Upper East regions, where the shallow and stony nature of the soils is suitable for the use of draft animals (Houssou et al. 2013). Most tractor owners across the study districts hired out services. Overall, 88 percent of tractor-owning farms provided various mechanization services in 2012. This service rate is comparable to observed trends in some Asian countries in the mid-1990s (Chancellor 1986). From the demand side, of the 1,145 farmers in the sample in 2012 who used tractors for plowing, 66 percent hired tractor services to do so. This rate compares well with India's, but is lower than rates observed in Taiwan and the Philippines (Chancellor 1986). Accessibility to tractor farm power primarily is through service hiring, since most farmers do not own tractors in the study districts.

Table 1—State of farm mechanization in the survey districts

		District-level data		Sample data		
Region	District	Number of tractor owners (2013)	Tractor ownership rate (% of population)	Number of draft animal users	Tractor service hiring out rate (% of owners)	Tractor service hiring in rate (% of users)
Ashanti	Ejura-Sekyedumase	172	2.1	0	47.6	84.0
Brong-Ahafo	Techiman	6	0.0	0	93.3	100.0
	Kintampo North	50	0.6	0	86.6	33.3
Northern	Gushiegu	178	2.1	6	65.4	87.5
	Yendi	180	1.2	1	54.7	94.3
Upper East	Bawku Municipal	13	0.1	133	87.8	100.0
	Kassena-Nankana East	27	0.2	42	90.8	100.0
Upper West	Sissala East	85	1.2	36	74.4	94.7
Total		**711**	**0.9**	**218**	**88.3**	**65.8**

Sources: USAID/ADVANCE census (2013), IFPRI/SARI survey data (2013).

Table 2 shows the relationship between farm size and tractor ownership, which indicates an increasing tractor ownership rate as farm size increases. Only about one percent of tractor owners cultivate two hectares or less, while 70 percent of owners cultivate between five and 30 hectares. Tractor owners are not the typical smallholder farmers in Ghana; they are mostly medium-scale farmers. Although Ghanaian agriculture is still dominated by smallholders, the number of these medium-scale farmers has increased significantly between 1991 and 2006 (Diao et al. 2014).

Table 2—Tractor ownership by farm size

Farm size	Owners, no.	Percent owning	Cumulative
less than 2 ha	3	1	1
2-5 ha	26	7	8
5-10 ha	80	20	28
10-20 ha	133	33	61
20-30 ha	74	18	79
more than 30 ha	86	21	100
Total	**402**	**100**	**100**

Source: IFPRI/SARI survey data (2013)

4. FARM SIZE DYNAMICS AMONG TRACTOR USERS

Both the landholding size and the land area cultivated by tractor service providers are significantly higher than for tractor-hiring farmers and non-tractor users (Table 3). Likewise, tractor-hiring farmers cultivate significantly larger farmlands than non-tractor users. Singh et al. (2013) and Chancellor (1971) observed similar patterns in India, Thailand, and Malaysia, where tractor service providers hold two to four times more land than tractor-hiring farmers.

Table 3—Dynamics of farm size among tractor service providers, tractor-hiring farmers, and non-users

		Service providers	Tractor-hiring farmers	Non-tractor users
Number of farmers		*300*	*750*	*611*
Average landholding size (ha)		91.0**	30.4	24.0
Farm size dynamics (ha)	current	22.5**	7.5**	5.7**
	initial	3.4	2.2	2.6
	5 years	6.8**	4.0	3.1
	10 years	13.4**	6.0	4.4
	15 years	21.5**	7.6	5.5

Source: Authors' estimations based on IFPRI/SARI Survey data (2013).
Note: ** denotes significantly different at 95% level of confidence.

With regard to farm size dynamics, Table 3 shows that both tractor users and non-users started farming with a relatively small landholding, which has grown steadily over time. However, service providers expanded their landholdings at much higher rates than tractor-hiring farmers and non-tractor users. This trend suggests the presence of a tractor ownership and tractor use effects on farm size.

5. PERFORMANCE OF THE TRACTOR SERVICE MARKET

5.1 Selected Patterns of Demand and Supply

Most farmers seek tractor services due to the fear of delays in operations on their fields adversely affecting crop production or marketing (Nakamura 2013). Plowing, shelling, and carting are the major services hired by farmers. Consistent with this demand pattern, plowing is the main service offered to tractor-hiring farmers, followed by carting and shelling (Table 4).

Table 4—Main services provided and experience with service provision

			Provider category		
		Overall	Small	Medium	Large
	Number of providers	*375*	*27*	*194*	*154*
Main services provided (%)	First plowing	83.2	85.2	82.0	84.4
	Shelling	19.5	18.5	18.0	21.4
	Carting	35.5	40.7	37.6	31.8
Ratio of farmers to providers - plowing		1:100	1:137	1:92	1:104
Ratio of farmers to providers - shelling		1:78	1:115	1:69	1:84
Experience with service provision (years)	First plowing	5.0	4.5	4.5	5.7
	Shelling	4.0	2.6	4.0	4.1

Source: Authors' estimations based on IFPRI/SARI Survey data (2013).
Notes: Farm size category: small-scale = 5 ha or less; Medium-scale = 5 to 20 ha; and large-scale farmers > than 20ha.

Primary tillage operations, such as plowing, have been reported as the dominant service offered in tractor service market in studies in Indonesia, Thailand, and Malaysia (Chancellor 1971; Kolawole 1974; Panin 1995; Paman et al. 2010). Maize shelling is also becoming an important service because it allows providers to extend tractor utilization outside of the limited plowing period and earn more revenue, albeit with a supplemental investment in the sheller equipment. On average, providers who offer only plowing services serve 100 farmers per tractor, while those who offer both plowing and maize shelling services cover 78 farmers. Kolawole (1974) reported a similar pattern of supply in the Western Savannah of Nigeria where each tractor owner served 112 farmers.

Mechanization has not proceeded far in Ghana, as demand exceeds supply: only 55 percent of the providers indicated that they were able to supply all the farmers seeking tractor services from them. Moreover, most tractor service providers have only four to five years of experience, indicating that the tractor service market in the survey districts has only developed quite recently. High demand and limited tractor numbers explain providers' inability to meet demand for their services.

5.2 Pattern of Correlation between Farm Size and Service Provision

Tractor utilization rates measured by the number of hectares plowed are considerably higher among service providers compared with tractor owners who do not offer services. While providers annually plow about 185 hectares in total, including the fields of those requesting their services, non-providers only plow 21 hectares on average (IFPRI/SARI survey data 2013). With regard to tractor use on own farm, providers plow 20 hectares which amounts to about 10 percent of total tractor utilization for plowing (Table 5). Maamun and Duff (1983) observed a similar pattern in south Sulawesi, Indonesia where tractors were utilized on owners' farms for only 13 percent of their total use annually.

Table 5—Utilization rate per tractor among service providers

	Provider type	Overall	Provider category		
			Small	Medium	Large
Plowing only	*Number of providers*	*242*	*18*	*124*	*100*
	Number of hectares plowed - own farm	19.5	4.7	11.3	32.4
	Number of hectares plowed - services	164.5	175.7	158.0	171.7
	Total number of hectares plowed	184.5	180.3	169.2	204.1
	Intensity of service provision[a]	82.4	93.1	86.1	75.9
Plowing and shelling	*Number of providers*	*53*	*3*	*25*	*25*
	Number of hectares plowed - own farm	19.4	1.8	9.9	31.0
	Number of hectares plowed - services	171.7	282.1	185.3	144.9
	Total number of hectares plowed	191.1	283.8	195.1	175.9
	Number of maxi bags shelled - own farm	387	49	364	450
	Number of maxi bags shelled - services	1,207	1,517	1,185	1,193
	Total number of maxi bags shelled	1,608	1,691	1,559	1,647
	Intensity of service provision[b]	83.5	98.8	88.5	76.7

Source: Authors' estimations based on IFPRI/SARI Survey data (2013).
Notes: Farm size category: Farm size category: small-scale: < 5 ha; medium-scale: 5 to 20 ha; and large-scale farmers: > 20 ha.
One maxi bag is equivalent to 100 kilograms of shelled maize.
[a] Intensity of service provision is measured by the number of hectares plowed as services as a percentage of total hectares plowed.
[b] For plowing and shelling services combined, we value the use in Ghana Cedi to estimate the intensity of service provision.

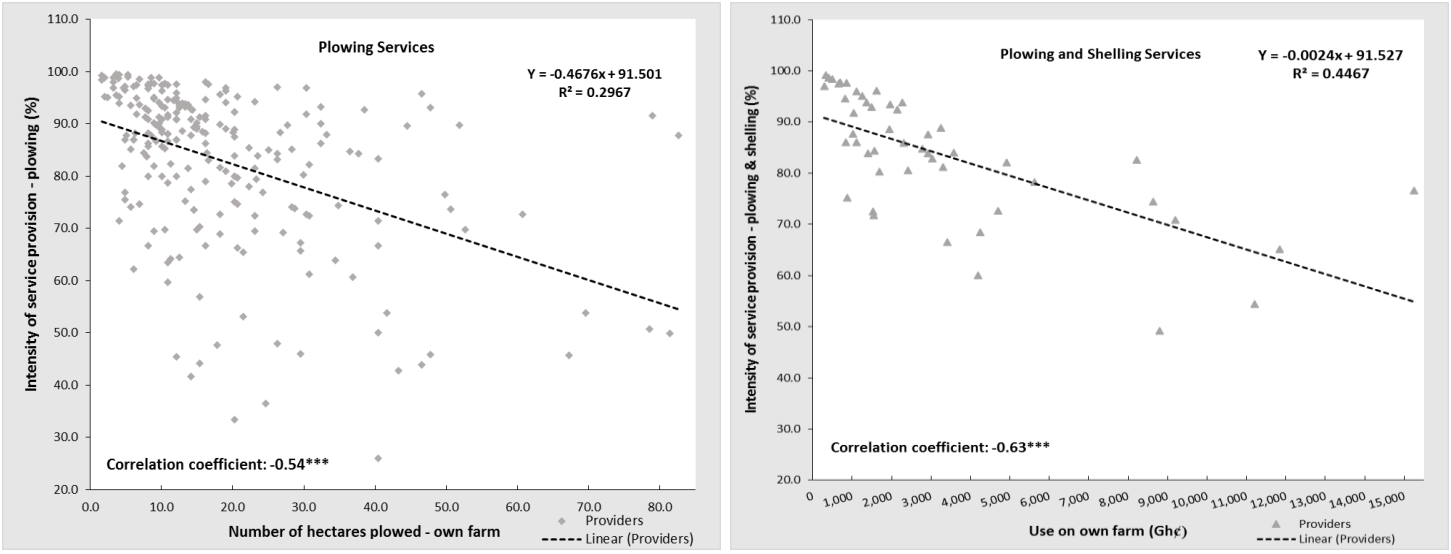
Higher tractor utilization rates are achieved through hiring out. This enables providers to operate their tractors nine times more than if they used them only on their own farms. Service provision has been possible because of excess capacity. Tractors are not manufactured for the Ghanaian market: most of the tractors acquired

by farmers are 50 to 80 horsepower machines, while the farm size of most tractor owners does not require tractors with such power. Using Chancellor's assessment of optimal tractor size (Chancellor 1986), we estimate that an average provider can cover his needs in terms of plowing (20 hectares of farmlands) with a 16-horsepower tractor. Tractors currently owned and operated by these providers in Ghana are three to five times the required capacity for mechanizing field and harvest operations on the average farm of tractor owners.

Furthermore, while the plowing seasons extends over 45 days in the north and 60 days in the south of Ghana, providers need only five days to complete plowing on their own farms (20 hectares) with their tractors.[2] This leaves the tractor available for hiring-out to other farmers for the rest of the plowing season. In addition, with a supplementary investment in a locally manufactured tractor-mounted maize sheller, offering maize shelling service has allowed some providers to extend the utilization of their tractor outside of the limited plowing period. On average, these providers shell 1,600 maxi bags of maize, in addition to providing plowing services.

The intensity of service provision, measured as the number of hectares plowed for other farmers as a percentage of the total number of hectares plowed by a tractor annually, is fairly high among tractor service providers (Table 5). The results in Table 5 also suggest that the scale of service provision is associated with farm size. To put this in perspective, we plot the intensity of service provision against the number of hectares plowed on own farm (Figure 2, left chart). The resultant scatterplot shows an inverse relationship between both variables – providers who plow more land on their own farm offer less services, whereas those who plow less land on their own farm offer more services. A similar pattern is seen for plowing and shelling operations combined (Figure 2, right chart). The exact patterns of the observed trade-offs between tractor use on own farm and service provision depend on the excess capacity available. This can be influenced by several factors, including tractor capacity, own farm use, length of plowing period, breakdowns and delays in repairs, time use to travel between farms, and others.

Figure 2—Relationship between farm size and intensity of tractor service provision



Source: Authors' estimations based on IFPRI/SARI survey data (2013). For plowing and shelling services combined, we value the use in Ghana Cedi to estimate the intensity of service provision.

Based on the above results, it seems fair to say that medium-scale farmers, in particular, will be important for spreading the use of tractors among Ghanaian farmers. Smallholder farmers are unlikely to play this role because only a few of them own tractors (even though this category of farmers provided more services in terms of intensity). The supply and adoption of mechanization services will depend on the rate at which medium-scale

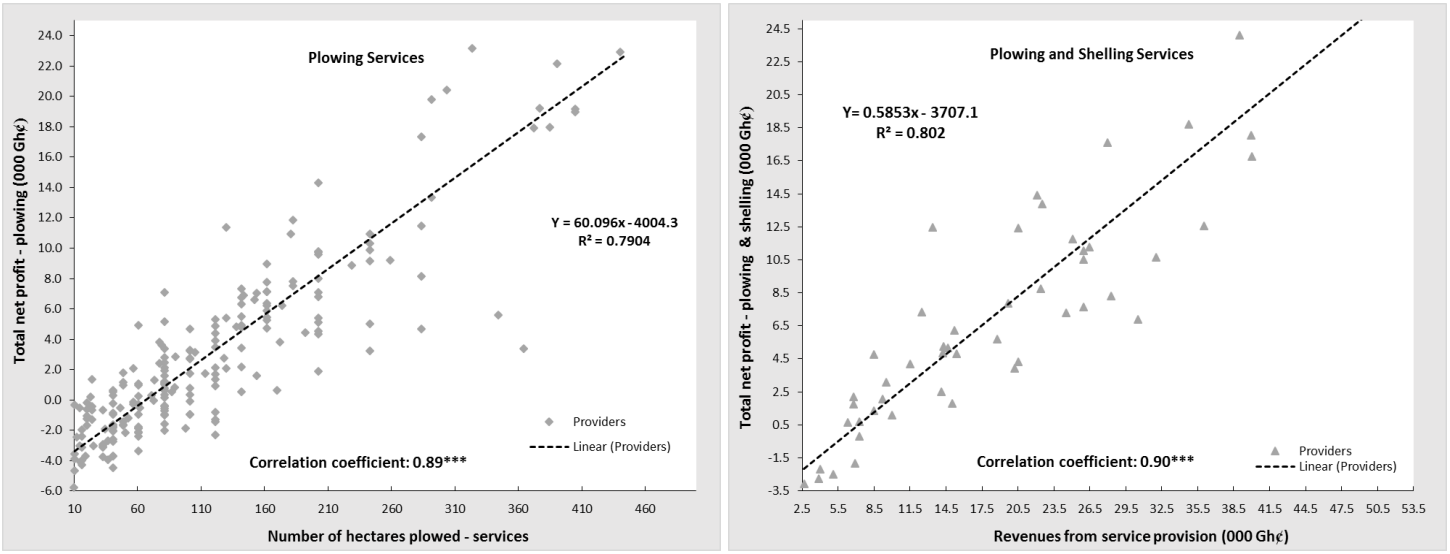
[2] The plowing capacity of the typical tractor used in Ghana is four hectares per day (Agricultural Engineering Service Directorate, 2003).

farmers invest in agricultural machines and the dynamics of transition from small to medium-scale farming in the country.

5.3 Pattern of Correlation between Profitability and Scale of Service Provision

The financial profitability of tractor services is essential for scaling up the use of mechanical technologies among farmers. In order to assess the relationship between profitability and service provision, we plot the net profit from offering tractor services against the number of hectares plowed as services (Figure 3). The scatterplot shows that total net profits increase with the scale of services provided, suggesting that providers who offer more services make more profits. Based on Figure 3, we determined that providers can achieve profitability if they plow at least 70 hectares as services, in addition to plowing 20 hectares on their own farm – 90 hectares in total or five times their current farm size.

Figure 3—Relationship between profitability and tractor service provision (utilization)



Source: Authors' estimations based on IFPRI/SARI Survey data (2013).
Note: For plowing and shelling, we use the revenues from services on the x-axis in order to be consistent.
Gh¢ denotes Ghanaian Cedi. Gh¢ 1.9 = US$1.00 in June 2012.

The summary of profitability estimates in Table 6 indicates that overall 70 percent of service providers made positive net profits. Offering shelling services in addition to plowing allows providers to extend tractor utilization into post-harvest operations. On average, investment costs increased by 42 percent with the acquisition of a tractor-mounted sheller, while annual revenues and profit levels increased by 40 percent among providers offering shelling services, relative to those providing only plowing services.

Essentially, the low operational scale of 30 percent of the providers explain the negative net profits that they realized from tractor service provision. On average, this group of providers operated at only one-third of the scale at which their profitable counterparts had operated, but incurred comparable costs. However, all of the providers made positive operational profits, i.e. if we exclude the fixed costs (interests, tractor, and implement depreciation) from the balance sheet. Indeed, some of the providers may consider their operational profits only, ignoring the depreciation of their machines. On this point, Chancellor (1971) reported that in Thailand and Malaysia, depreciation and the wearing-out of tractors was not considered a cost by farmers, as they felt their tractors still had a high resale value. Furthermore, other tractor uses and benefits not valued here, such as timeliness, a reduction in labor management issues, and transportation services, among others, may compensate for the negative net profitability realized by some providers for their plowing and shelling services, a view that is supported by Binswanger (1978) and Chancellor (1971).

Table 6—Profitability of tractor hire service provision, per tractor

Services	Efficiency indicators	Overall	Profit groups	
			Positive	Negative (loss)
	% making net profits overall (n=264)	*70*		
Plowing only	% making net profits (n=214)	63	100 *(n=149)*	0 *(n=65)*
	Revenue, Gh¢	12,977	17,640	5,165
	Interests and depreciation (tractor and plow), Gh¢ *	2,918	2,921	2,912
	Maintenance costs, Gh¢	1,654	1,607	1,734
	Average operational profit, Gh¢	7,775	10,778	2,746
	Average net profit, Gh¢	3,203	6,250	-1,900
	Land plowed, ha	138.3	183.6	62.6
	Tractor and plow costs, Gh¢	*17,163*	*17,182*	*17,132*
Plowing and shelling	% making net profits (n=50)	86	100 *(n=43)*	0 *(n=7)*
	Revenue, Gh¢	21,709	24,264	6,017
	Interests and depreciation (tractor, plow, and sheller), Gh¢	3,895	3,968	3,446
	Maintenance costs, Gh¢	1,908	1,864	2,174
	Average operational profit, Gh¢	12,896	14,451	3,341
	Average net profit, Gh¢	7,093	8,619	-2,280
	Land plowed, ha	163.4	181.1	54.2
	Maxi bags of maize shelled, no.	1,408	1,580	349
	Tractor, plow, and sheller costs, Gh¢	*24,004*	*24,483*	*21,065*

Source: Authors' estimations based on IFPRI/SARI Survey data (2013). Gh¢ denotes Ghanaian Cedi. Gh¢ 1.9 = US$1.00 in June 2012.
One maxi bag is equivalent to 100 kilograms of shelled maize.
* Following Houssou et al. (2014), a depreciation of 10 % was used for a tractor and a plow, 20 % for a sheller.
A saving interest rate of 7 % was used on fixed costs.

In sum, high returns to investment in a tractor is not achieved when the machine is operated solely for own use, given the current farm size of an average tractor owner in the survey districts. Moreover, increasing tractor usage through own farm expansion may be constrained by several factors, including access to farm inputs, production risks, managerial difficulties, as well as individual's preferences. In these conditions, tractor service provision to other farmers becomes an essential and rational choice to increase the operational scale and earn more revenues from tractor investment. This extends the benefits of mechanization to other farmers and lowers the unit cost of tractor investment for owners. Through hiring-in tractor services, small farmers in Ghana are able to mechanize some elements of their farming system without investing in the high cost machinery.

6. CONCLUDING REMARKS

This paper assesses the role played by farm size of tractor owners in the spread of tractor service provision in selected districts of Ghana using survey data collected in 2013. Medium and large-scale farmers own tractors in the survey districts. More importantly, of these two categories of farmers, medium-scale farmers hire out services more intensively to smaller farmers. The number of medium-scale farmers has increased recently in Ghana, but there is still a significant number of farms with small size in the country. Most of these small farmers access tractor through hire services from medium and large-scale farmers.

Farmers expand their farm size once they acquire a tractor, but not to fully utilize the capacity of their machines on their own farms. They provide tractor services to other farmers without tractors in order to increase the scale of tractor use and to make profits. Through tractor service provision, providers have been able to spread

the benefits of mechanization. Tractor hiring-out by medium-scale farmers will be essential to achieving increased mechanization of agricultural production in Ghana, one aspect of a structural transformation of Ghanaian agriculture.

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