

# GHANA

## Strategy Support Program



### Is Specialization in Agricultural Mechanization a Viable Business Model? The Case of Ghana

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DISCUSSION NOTE # 012

## 1. THE ISSUE

Since 2007, the Government of Ghana (GoG) embarked on a bid to transform agriculture under its Medium Term Agricultural Investment Plan (METASIP) and Accelerated Agricultural Modernization Policy. This policy has been translated into the provision of subsidized agricultural machinery to individual farmers and private enterprises established as Agricultural Mechanization Services Enterprise Centers (AMSECs) (Diao et al. 2012). These interventions have contributed to increasing farmers' access to agricultural mechanization services and reducing drudgery in farming across the country, but more work needs to be done.

Unlike in the 1980s, when the lack of demand was seen as a constraint to agricultural mechanization in many developing countries (Pingali 2007), economy-wide labor constraints such as non-agricultural sector growth and rural-urban migration have fuelled the demand for agricultural mechanization services in the country. However, the current demand pattern is primarily focused on power-intensive operations, especially plowing services. The demand for control-intensive operations, such as weeding, sowing, fertilization, and harvesting, is marginal. As a result, most of the tractors are usually placed in storage after the plowing seasons, which last 45 days in the north and 60 days in the south of the country.

This pattern of demand (and therefore supply) raises questions as to what should be a practical service provision model to promote, and whether a specialized agricultural mechanization service provision model presently pursued by GoG can be a viable business model attractive to private investors.

This brief examines the profitability of agricultural mechanization service provision at the current stage of mechanization in the country based on a recent research by Houssou et al. (2012). Many stakeholders believe strongly that the state should subsidize agricultural machinery. This is understandable, since imported tractors are unaffordable by individual firms. However, subsidies should not be a barrier to developing a sustainable supply chain in which the private sector can play a leading role in the transformation of agriculture in the country.

This brief is organized as follows. Section 2 briefly describes the theoretical framework and methodology applied, whereas section 3 presents the main results. Section 4 offers our concluding remarks.

## 2. METHODOLOGY

In April 2012, we interviewed various stakeholders along the supply chains and service beneficiaries across the country. Information gathered from these interviews was combined with the survey data collected for the evaluation of AMSECs in 2011. The survey covered a total of 48 AMSEC and 88 non-AMSEC service providers.<sup>1</sup>

Using the firm investment theory (Diao and Yeldan 1998) and field-based assumptions on various costs, revenues, and tractor efficiency, we estimated the profitability of specialized plowing service provision under a normal situation (Houssou et al. 2012). Mechanization service provision is considered a business run by a firm. The firm's goal is to maximize its inter-temporal net profit  $\pi$ , taking existing service provision technology and market price (service fee charge) as given. The firm, as an investor, decides between two different types of investments, (i) investing in service business by purchasing a tractor, or (ii) saving the same amount of money in a bank to earn interest. If the returns to investment on a tractor for offering plowing services are higher than the interest earned on saving the same money in a bank, farmers will invest in tractor service provision business; otherwise they will save their capital.

The annual tractor costs paid by the firm, assuming that the firm invests its own money and ignoring the cost of borrowing, must consider acreage plowed, fuel and lubricants used per acre, and labor costs per acre. We considered three types of tractor prices:

- a normal business model in which the tractor and plow prices are not subsidized;

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<sup>1</sup>The survey was conducted by Gerald Ahorbo and Victor Owusu. We would like to acknowledge them team for the numerous and fruitful conversations and for sharing the survey data.

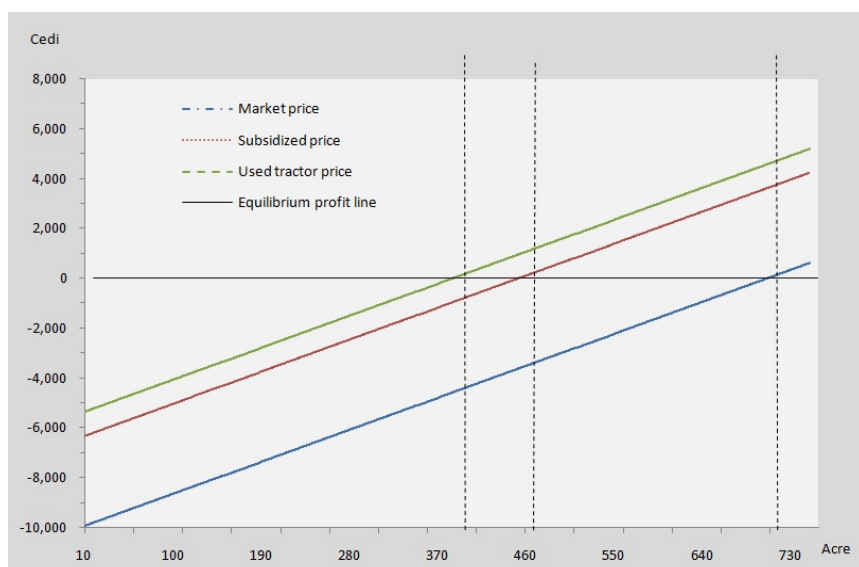
- a subsidized business model in which the tractor price is similar to the price offered by the Government; and
- a second-hand tractor business model in which a non-subsidized price on second-hand tractors found in the local market is considered.

The main reason for considering the third model in this paper lies in the fact that the used tractors business has existed in the country for a long time despite the Government's subsidy on new tractors. Moreover, information collected from our field visits shows that used tractors are comparable with new tractors in terms of field efficiency. Moreover, used tractors are much cheaper than new tractors; they are purchased on the private market and they do not enjoy any Government subsidy or financial sector support in terms of credits. Although new tractors are imported by GoG, the demand for used tractors remains high in the country, indicating both high demand for tractor services and limited Government capacity to meet such demand through its subsidized program.

### 3. PROFITABILITY OF AGRICULTURAL MECHANIZATION SERVICE PROVISION: MAIN RESULTS

Figures 1a and 1b illustrate the relationship between the numbers of acres plowed and the net profit per tractor in different locations: South and North of Ghana. In all three theoretical models, the tractor operational efficiency is assumed to be the same. Profitability monotonically increases with the number of acres plowed.

**FIGURE 1A—NET PROFIT PER TRACTOR INVESTMENT - THE MODEL (SOUTH)**



Source: Authors' estimates.

The horizontal zero-profit line represents the equilibrium in which investing in tractor yields the same returns as saving the money in a bank to earn interest. Below the equilibrium (or non-arbitrage) point, investors prefer to save their money in a bank. Beyond this point, there is an incentive to invest in tractors and mechanized services can be a rational investment. This equilibrium point shows the minimum number of acres that must be plowed for accumulated profits over 10 years (discounted by the interest rate on savings) to cover the tractor investment cost and accounting for depreciation.

Given a tractor field capacity of 10 acres per day, 60 effective plowing days in the South, and 45 days in the North, the maximum number of acres that can be plowed by a tractor in the two seasons is about 600 acres in the South and 450 acres in the North. As indicated in Figure 1a, both used and subsidized tractors are likely to be profitable as their equilibrium points are at 380 and 460 acres, respectively - below the maximum number of acres that can be plowed.

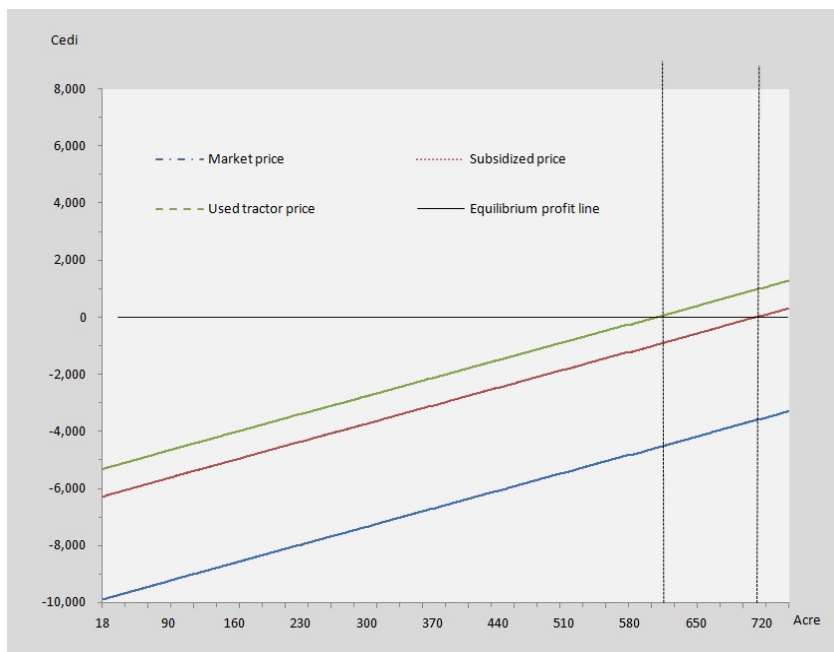
In the case of the North (Figure 1b), more than 600 acres are required to reach the equilibrium point for used tractors and 710 acres are required for subsidized tractors, while the maximum number of plowed areas is only 450 acres. This is because the service charge is about 25 percent lower in the North than the South. The difference in service charge is due to more advanced economic development in the South. As a result, the gross margin (*GM*) is lower in the North, even though labor costs are low in this region of the country, and fuel and maintenance costs are comparable between regions. Taking into consideration the differences in *GM* and effective plowing days between the North and the South, the results suggest that none of the three models in the North is profitable at the maximum number of effective plowing days (45 days with 450 acres, Figure 1b).

### 4. AGRICULTURAL MECHANIZATION SERVICE PROVISION: MODELED VERSUS ACTUAL PROFITABILITY

In order to compare the model outcomes with actual profitability, we plot the distribution of net profitability in the provider sample against the model curves. Figures 2a and 2b present the results. Table 1 shows the model costs and revenues and the summary statistics of the providers by terciles of actual profitability.

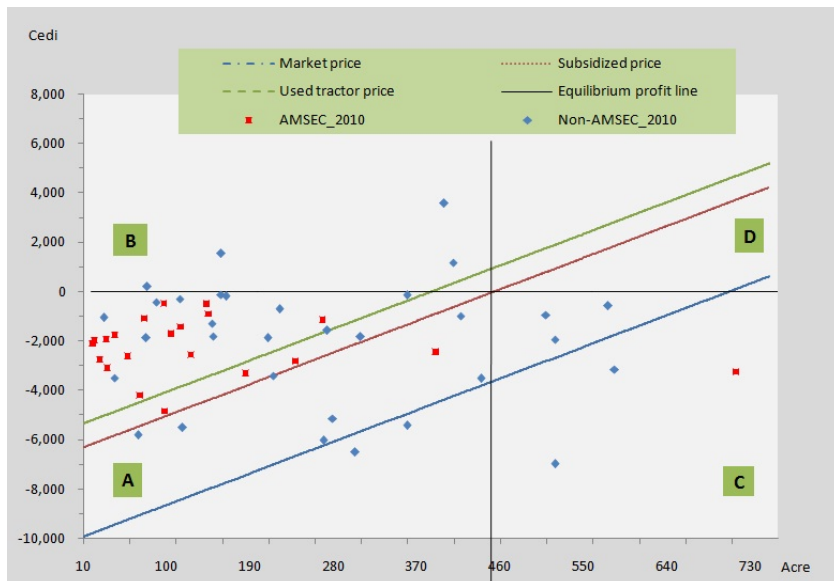
The graphs are divided into four zones: A, B, C, and D, which are delimited by the curves and the zero-profit line for the non-arbitrage condition in the firm's investment decision.

**FIGURE 1B—NET PROFIT PER TRACTOR INVESTMENT - THE MODEL (NORTH)**



Source: Authors' estimates.

**FIGURE 2A—NET PROFIT PER TRACTOR INVESTMENT - ACTUAL (SOUTH)**



Source: Authors' estimates based on survey data and field-based assumptions.

Note: AMSEC = Agricultural Mechanization Service Enterprise Center.

Zone A is characterized by low operational scale and negative investment profitability (although without considering tractor investment cost, the operational profit is positive). Most surveyed firms in both the South and North are unfortunately located in this zone (86 percent of valid observations). This pattern indicates that most firms are not able to fully operate their tractors to the

maximum 45 days (North) or 60 days (South). The fact that most providers in Zone A are located in the areas above the profitability curves of the three models indicates that it is low operational acreage rather than high operational costs that explain the non-profitability of these firms' investments.

Zone B is characterized by a low operational scale with positive investment profits. While a few firms in the South are located in this zone, in the North virtually none are located there. This result indicates that while they operate at low scale, the extremely low operational costs observed (lower than the average situation used in the models), make their investments profitable. Assuming no reporting error, two factors can explain the profitability of these firms: low maintenance costs and low tractor price. The low tractor price indicates that these are used tractors with low maintenance costs.

Enterprises in this group may represent experienced farmers as owners.

Zone C is characterized by a high operational scale but negative investment profits. A few firms in the South are located in this zone, indicating that while their operational scale is high enough to potentially yield positive returns, they still did not make any profit from their investments. Further analysis shows that the high maintenance cost incurred is the main factor behind their non-profitability. The average maintenance cost for the firms falling into zone C is estimated at 6,200 Ghana cedis (GHC), about 40 percent higher than the model assumption of GHC 4,200.

Zone D is characterized by high operational scale and high profit. Unfortunately, none of the firms in either the South or North belongs to this zone. Overall, all firms in the North and about 90 percent of firms in the South plowed fewer acres than required to break even. The average number of acres plowed by a firm was 168 in the North and 206 in the South, and both are well below the equilibrium break-even points.

In summary, the low operational scale observed for most providers is the main factor behind the non-profitability of investing in mechanization in the country. In addition, a prevailing factor is frequent breakdowns of the machines, including the new tractors. Breakdowns can be caused by poor maintenance or lack of skilled operators. Likewise, delays in repairs due to unavailability of spare parts and lack of qualified mechanics are contributory factors. While specialized agricultural mechanization is in theory a profitable investment in the South, in practice numerous constraints hamper profitability. It is therefore reasonable to conclude that a specialized service provision model

is not a realistic model that can be operated and sustained by the private sector even with the current subsidy policy.

**FIGURE 2B—NET PROFIT PER TRACTOR INVESTMENT - ACTUAL (NORTH)**



Source: Authors' estimates based on survey data and field-based assumptions.

Note: AMSEC = Agricultural Mechanization Service Enterprise Center.

#### 4. CONCLUDING REMARKS

This brief assesses whether specialization in agricultural mechanization service provision at the current stage can be a viable busi-

ness model in Ghana. The results indicate that low operational scale is the most important constraint to the profitability of investment in specialized agricultural mechanization service provision. With such a low operational scale, it is essential to consider

various options for introducing low-cost tractors into the Ghanaian market. Increased government support to the used tractor market is one such option. However, little attention has been paid to this option because the second-hand tractor market is fully operated by the private sector without the Government's promotion policy and the financial sector's support. Moreover, with heavy subsidies on costly tractors, the subsidy policy can distort supply chain development, and as a result many low-cost machines will unlikely be introduced into the Ghanaian market.

This study also shows that the current focus on specialized service provision ignores the development stage of mechanization in Ghana. While the demand for mechanization is increasing in the country, most of this demand concentrates on plowing services, with other operations powered

by manual labor. Such a demand pattern is consistent with the current level of agricultural intensification and small farm profitability. Tractors are essential for increasing cultivated areas, but are unlikely to become effective tools for inducing the process of agricultural intensification and productivity growth.

**TABLE 1 - RELATIONSHIP (AVERAGE) BETWEEN PROFITABILITY, COST-EFFICIENCY, AND OPERATIONAL SCALE AMONG PROVIDERS BY REGION**

Region/tractor price		Terciles of net profit	Tercile size	Tractor& plow price (GHC)	Maintenance costs (GHC)	No.of acres plowed	Revenue	Operational	Investment profit	
							(GHC)	profit (GHC)	(GHC)	
North	Model	Market	-	-	<b>34,222</b>				<b>-5,999</b>	
		Subsidized	-	-	<b>12,969</b>	<b>4,243</b>	<b>450</b>	<b>11,250</b>	<b>4,061</b>	<b>-2,387</b>
		Used tractor	-	-	<b>7,300</b>					<b>-1,423</b>
	Actual	1	12	<b>16,439</b>	<b>6,168</b>	<b>221</b>	<b>5,001</b>	<b>1,845</b>	<b>-7,118</b>	
			(7,000; 19,667)	(100; 19,400)	(28; 580)	(700; 11,600)	(294; 4,686)	(-21,440; -2,526)		
			<b>13,304</b>	<b>928</b>	<b>139</b>	<b>3,316</b>	<b>1,319</b>	<b>-1,871</b>		
		2	12	<b>13,304</b>	<b>928</b>	<b>139</b>	<b>3,316</b>	<b>1,319</b>	<b>-1,871</b>	
			(5,600; 18,000)	(150; 3,500)	(18; 280)	(365; 8,400)	(110; 4,200)	(-2,261; -1,078)		
			<b>9,968</b>	<b>948</b>	<b>138</b>	<b>4,153</b>	<b>2,082</b>	<b>-466</b>		
3	10	<b>9,968</b>	<b>948</b>	<b>138</b>	<b>4,153</b>	<b>2,082</b>	<b>-466</b>			
	(1,400; 18,000)	(260; 2,511)	(19; 251)	(380; 8,790)	(114; 4,897)	(-1,064; 262)				
South	Model	Market	-	-	<b>34,222</b>				<b>-1,510</b>	
		Subsidized	-	-	<b>12,969</b>	<b>4,243</b>	<b>600</b>	<b>19,800</b>	<b>8,550</b>	<b>2,103</b>
		Used tractor	-	-	<b>7,300</b>					<b>3,066</b>
	Actual	1	18	<b>15,912</b>	<b>6,222</b>	<b>245</b>	<b>7,263</b>	<b>3,235</b>	<b>-5,692</b>	
			(2,400; 30,000)	(635; 13,660)	(27; 705)	(1,060; 17,629)	(300; 7,930)	(-14,776; -2,813)		
			<b>14,096</b>	<b>1,441</b>	<b>143</b>	<b>4,181</b>	<b>1,833</b>	<b>-1,925</b>		
		2	18	<b>14,096</b>	<b>1,441</b>	<b>143</b>	<b>4,181</b>	<b>1,833</b>	<b>-1,925</b>	
			(11,000; 20,000)	(51; 5,750)	(11; 510)	(375; 15,300)	(190; 6,885)	(-2,755; -1,283)		
			<b>10,167</b>	<b>2,085</b>	<b>230</b>	<b>7,558</b>	<b>3,665</b>	<b>-148</b>		
3	18	<b>10,167</b>	<b>2,085</b>	<b>230</b>	<b>7,558</b>	<b>3,665</b>	<b>-148</b>			
	(1,300; 20,000)	(100; 5,667)	(23; 567)	(900; 17,000)	(495; 8,580)	(-1,133; 3,575)				

Source: Authors' estimations based on AMSEC surveydata (2011).

Note: Terciles of increasing net profits from 1 to 3. Tercile ranges in brackets. Only six firms (2 in the North, 4 in the South) made positive net profits in the total sample.

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