Investing in a no-till planter in Cambodia: A promising opportunity for certain categories of service providers

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Abstract

The use of no-till planters is a promising component of the transition towards more sustainable agricultural practices in Cambodia. One way to facilitate their large-scale use would be to involve the service providers who are hired by smallholder farmers to do most of their mechanised field operations. This study assessed the conditions under which it would be profitable for service providers to invest in no-till planters and sell services based on their use. The mode of operation and the income earned from the custom-hire business of 35 service providers in Battambang Province (Northwest Cambodia) were assessed. The profitability of no-till maize, rice and cassava planters was then analysed based on assumptions concerning costs, service fees and farmer demand, which were then discussed with service providers in workshops. Under these assumptions, for each crop, investing in a no-till planter was found to be profitable for only some of the service providers interviewed. The fact the service providers had different profiles led to varying interest in and capacity to purchase and operate a no-till planter. Some already provide services to relatively large areas and may thus be able to purchase the equipment with no policy support. Other providers underuse their own tractors. They will likely have difficulty investing in the equipment without policy support, but may be more motivated to propose a new service to make a fuller use of their tractor. Support actions to boost the supply of no-till planters in Cambodia should therefore take the diversity of service providers into account.

Keywords: Conservation agriculture, custom-hire business, economic model, ex ante analysis, no-till planter.

Introduction

No-till planters have many potential advantages for smallholder farmers in South and Southeast Asia. Their use reduces ploughing and production costs (Ngwira et al., 2013). Combined with crop rotation, management of crop residues, and the use of cover crops, no-till planters can improve soil fertility and increase soil organic carbon accumulation under conservation agriculture (Pheap, Lefèvre et al., 2019; Potma Gonçalves et al., 2019). In turn, this combination of practices can increase yields (Erenstein et al., 2012; Pittelkow et al., 2015).

However, in many developing countries, smallholder farmers do not have enough capital to purchase a planter. In some cases, farmers' organisations are sufficiently financially solid to purchase and manage agricultural machinery (Groot et al., 2019; Singh, 2018) and where this is not the case, custom-hire businesses have generally developed, thereby giving smallholder farmers access to agricultural mechanisation (Houssou et al., 2015; Yamauchi, 2016). These service providers may have the capacity to purchase no-till planters and to propose a new service to smallholder farmers (Sims and Heney, 2017).

However, for a service provider, the decision to invest in a no-till planter may not be easy. First, no-till planters cost more than conventional planters (e.g. Epplin et al., 2005) and in the early stages, farmers' demand may not be sufficient to offset their investment. Second, no-till planters may face several constraints to their use (e.g. they are often heavier than conventional planters and their maintenance is more expensive).

In Cambodia, in a general context of rural youth exodus and aging of the farmer population, the mechanisation of agricultural practices has developed rapidly in the past two decades (Chhim et al., 2015). Between 2002 and 2012, at the national level, the number of four-wheel tractors more than doubled and that of power tillers (e.g. two-wheel tractors) multiplied by 10 (Chhim et al., 2015). In Battambang Province (Northwest Cambodia), the main agroecosystems can be schematically divided into lowland and upland systems. In the lowlands, farmers mainly produce one rice crop per year, or two when complementary irrigation is available. Yields are often limited by low levels of soil nutrients, fluctuating water levels in the paddy field and related impacts on the form and availability of nutrients in the soil (Pheav et al., 2005). In the uplands, intensive mono-cropping of commodity crops such as maize and cassava replaced forests and later subsistence farming systems in just a few decades (Kong et al., 2019). However, the increase of non-conservation-oriented mechanised farming practices resulted in significant depletion of soil fertility, thereby reducing the yield and profitability of such crops (Kong, 2019; Montgomery et al., 2017a; Touch et al., 2016).

Making no-till planters available to smallholder farmers is a promising component of the transition towards more sustainable agricultural practices in both lowland and upland areas of Battambang Province. Service providers play a major role in smallholder farmers' access to tractor services and consequently in the intensification of cropping systems, while simultaneously contributing to soil fertility depletion, decreasing productivity and profits. An opportunity thus exists to engage service providers in a process that facilitates farmers' access to mechanised equipment enabling the transition towards conservation agriculture. In Battambang Province, since 2009, a research for development (R4D) team has developed approaches and innovative cropping systems directed towards the use of conservation agriculture (Kong et al., 2016). As part of this initiative, two no-till versatile planters (i.e., capable of sowing maize, pulses, rice, and other crops) mounted on four-wheel tractors were proposed as a paying service to farmers. Farmers could use these no-till planters in two ways. First, they could be used as 'precision' seeding equipment, enabling the use of less seed, reduced tillage, better crop establishment, and higher yields compared with a conventional planter. Second, the planters could be used without ploughing, especially once supporting conditions were met (e.g., use of cover crops, levelled fields). Farmers expressed interest in using these planters and, between 2013 and 2018, each no-till planter was used for an average of 116 ha per year to sow maize and a few hectares of pulses and cover crops. In addition, Montgomery et al. (2017b) showed that many smallholder farmers in Battambang and Pailin Provinces were interested in shifting towards conservation agriculture.

Studies on the profitability of custom-hire services have generally focused on existing service providers (e.g., Miah and Haque, 2015; Takeshima et al., 2015). Fewer studies have reported ex-ante assessment of custom-hiring services. In one example of the latter, Kahan et al. (2018) showed that services based on two-wheel tractors could be profitable in East Africa. Sims and Heney (2017) and Tallis et al. (2017) called for such ex-ante assessment to support service providers' decision to invest in equipment for conservation agriculture. These assessments can also produce the evidence needed to explore the type of support that could be provided to encourage the supply and demand for such equipment. However, there have been few such assessments in the case of equipment designed for conservation agriculture (e.g., Sidhu et al., 2015). Moreover, to date, there have been few studies of the diversity of service providers' characteristics and strategies and how these could affect their purchase of a no-till planter and the possible profitability of selling new services using it (e.g. Takeshima et al., 2015). This article reports on an ex-ante assessment of the advantages service providers in Battambang Province may have in investing in a no-till maize, rice, or cassava planter, taking into account the diversity of their profiles.

The profitability of custom-hire services in the agricultural sector

Services based on the use of agricultural machinery are common throughout South and Southeast Asia. For instance, in Thailand, 93.6% of farmers use four-wheel tractors hired from custom-hire services (Soni, 2016). These businesses are usually run by farmers who have quite big farms (Diao et al., 2016) either because, as farmers, they had enough capital to invest in agricultural machinery (Takeshima, 2016) or because they invested the income from service provision in their own farm (Diao et al., 2016; Houssou et al., 2015, Yamauchi, 2016). Diao et al. (2012) describes three stylized types of service providers in Asia: individuals using two-wheel tractors in Bangladesh, individuals using four-wheel tractors in India, and specialised enterprises in China. In India, some service providers have invested in machinery enabling conservation agriculture. In the wheat-rice farming systems of the northwestern plains of India, no-till systems have been designed for wheat (Kassam et al., 2009) and some service providers operate no-till seeders (Sidhu et al., 2015).

Farmers' demand is a key factor in the profitability of custom-hire services. Providers operating in a small area may not break even, resulting in under-used machines and debt (Chhim et al., 2015; Kumar and Mahadevaiah, 2018). Thus, before purchasing agricultural equipment, service providers need to prepare a business plan that adequately matches investment costs and expected demand and income. Building such a business plan is not an easy task as service providers may not have sufficient information on the real demand for new equipment (Groot et al., 2019). Moreover, service providers need business and marketing skills, as well as knowledge of the use and maintenance of the equipment (Diao et al., 2016; Sims and Kienzle, 2015).

Public policies can also affect the profitability of custom-hire services. On the one hand, taxes or import regulations can increase investment and operating costs (Diao et al., 2016; Houssou et al., 2015). Conversely, financial support from public institutions through subsidies or tax exemption can help service providers buy new equipment (Erenstein et al., 2012; Sims and Kienzle, 2017). For instance, in some states in India, subsidies cover 75% of the cost of no-till planters for individual farmers (Singh, 2017). However, the impacts of this type of support have sometimes been disappointing (Groot et al., 2019). For instance, Diao et al. (2012) showed that in Ghana, subsidies to service providing companies led to an inflated supply that did not match demand. Thus, if subsidies are planned, they should be designed in such a way that the market for agricultural mechanisation services is not upset (Baudron et al., 2015). Technical support can be given to service providers by different agents (e.g., extension officers, retailers) to ensure the successful start of the business (Groot et al., 2019; Haque et al., 2017).

Only a few of the ex-ante or ex-post assessments of the profitability of service providers' business paid attention to the diverse characteristics and orientations of the service providers. One such study by Takeshima et al. (2015) showed that service providers in Nigeria who benefitted from external support (from the government or NGOs) to purchase agricultural equipment invested less effort in offering services and their business was less profitable than that of service providers who obtained their equipment with no outside support.

Agricultural practices in Battambang Province

The present study was conducted in three districts of Battambang Province: Banon, Rattanak Mondoul and Samlout (Figure 1). Service providers use four-wheel tractors, so the situation in these three districts resembles that in India, according to the typology proposed by Diao et al. (2012). Banon District is located in the lowland area where farmers mainly grow rice. The main tractor services offered are ploughing, use of a rotary tiller, and land levelling using a blade placed in front of the tractor. Generally, the first ploughing is done with a four-wheel tractor operated by a service provider. The second ploughing is done either by the farmers themselves using their own power tillers or also increasingly by a service provider (Chhun et al., 2020). A few rice seeders have been used in the area since 2018. Due to the scarcity of labour, rice is mainly harvested using a combine harvester.

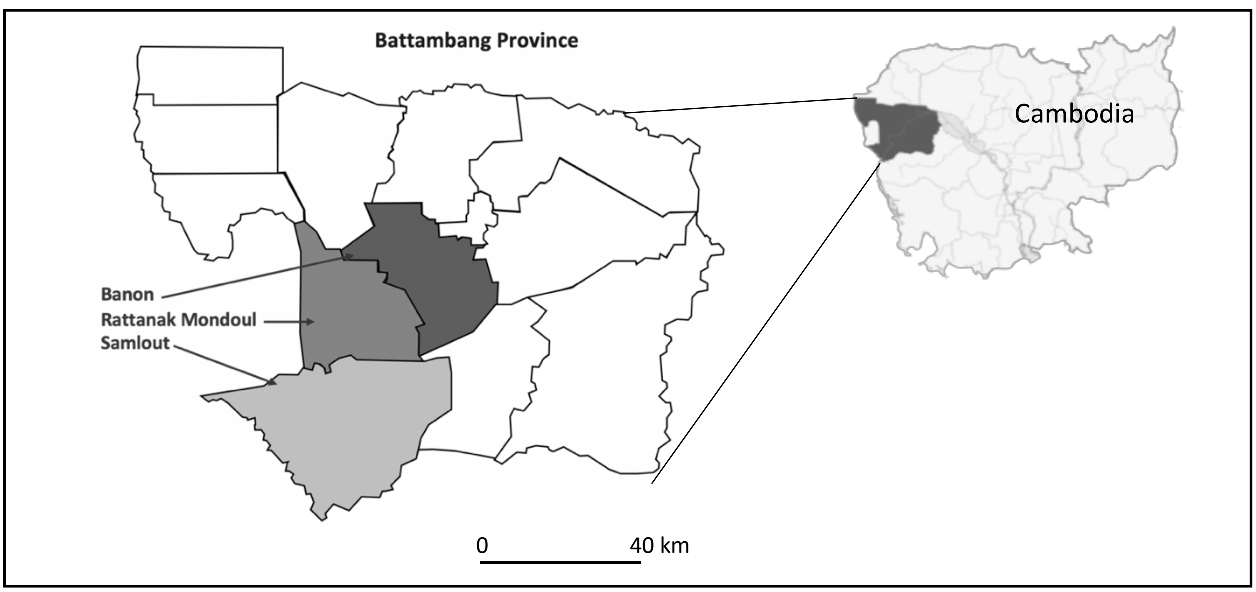

Figure 1. Study area.

Rattanak Mondoul and Samlout Districts are located in upland areas, where an agrarian transition began in 1998. Most farming systems went through three periods (Kong, 2019). In the first period (1998 – 2004), subsistence farming was associated with cash crops such as soybean, peanut, and sesame. In the second period (2005 – 2014), the production of boom crops (mainly maize and cassava) expanded rapidly. Living conditions and households' assets improved significantly during that period but farmers faced soil fertility depletion, decreasing crop productivity, debt, and rising production costs. In the third period (from 2014 on), some farmers began to shift to fruit tree production, mainly mango and longan.

In upland areas, four-wheel tractors driven by service providers are widely used for land preparation, especially for maize, cassava, and intercropping during the immature stage of orchards. Farmers generally pay for one to three ploughing operations between each crop cycle. The main objective is to bury the residues of the former crop, to minimize risks of fire in the dry season, and to break up the soil before the following crop is sown. Maize is mainly sown with a conventional maize planter. For cassava, operations are done with a six-disc plough, a two-row ridger, and a one-disc cassava digger. Cassava stems are planted by hand on the ridges.

Methods

Our ex-ante analysis of the advantages of investing in a no-till planter for service providers was two-pronged. One axis focused on the characteristics of the service providers and of their custom-hire business. The second axis assessed to what extent, if service providers continued to serve the same clients with a no-till planter as they were doing at the time of the interview, it would be profitable for them to invest in this equipment. Here, we use the term 'no-till planter' in a generic way for rice, maize, and cassava crops, although for rice the machine is also called a 'rice seeder'.

Data were collected in two stages. In the first stage, 35 service providers located in the study areas were interviewed in August and December 2018 (26 in upland areas and nine in lowland areas). They were identified by village chiefs and farmers using no particular selection criteria. All owned and cultivated their farmland and were interviewed in their homestead. First, interviewees were asked for general information about their household and farm, the creation of their business, agricultural equipment, and the investment costs of their machinery. Second, they were asked about the services they had provided between August 2017 and July 2018. An assessment of their net annual income from their service provision business was completed during the interview based on the costs (excluding paying back loans) and the profits declared by the interviewee. Profits included the income from service provision but not the benefit of using the agricultural machinery on their own farm. Costs included annual expenses related to service provision but not investment costs. This assessment was discussed with and validated by the interviewees. Third, interviewees were invited to comment on the profitability of their business and to tell us about the main difficulties they faced in running their business.

A typology of service providers was then created, based on the proportion of their own land on which they used their tractor, and on the income they obtained from providing services (all types of services included) to other farmers between August 2017 and July 2018). The profitability of a no-till maize planter, a no-till cassava planter, and a no-till rice seeders were then assessed. Net annual income was calculated as turnover minus variable costs. The break-even point was defined as the minimum surface area served annually above which investment in a no-till planter would be profitable (without differentiating between the area planted as a service provider and the area planted on the operator's own farm). The break-even point was calculated for each no-till and conventional planter as follows:

Break-even point (ha per year) = Fixed cost of the implement/(service fee per ha – operating costs per ha)

Fixed costs were calculated as the initial investment (calculated on a per year basis) plus costs of shedding and workshops. Service providers did not know the total lifespan of the equipment and its possible residual value. The service providers we interviewed wanted to be sure that after a certain period (here considered as 5 years), their business would have allowed them to get back their initial investment. To get a per year value, the initial investment was divided by 5.

Table 1 provides a summary of the breakdown of costs used to estimate break-even points. Overall operating costs (Khairo and Davies, 2009) include fuel, the costs of the drivers and operators (maize and cassava no-till planters), maintenance of both tractor and planter, and ownership cost of the tractor (Table 1 and supplementary data). All calculations were made considering only one type of tractor: a 75 HP John Deere 5610, used for 1,000 hours per year. The ownership cost of the tractor was based on a depreciation period of five years with a trade-in value representing 30% of the purchase price; interest on the loan was calculated based on the average value of the tractor (see supplementary data).

Operating costs of the planters were calculated on an hourly basis. The costs of maintenance and repair represent 10% of the purchase price divided by the yearly working hours for all planters. The operating costs were calculated on a per hectare basis, based on the characteristics of the planters. The proportion of time spent actually doing the operation is called field efficiency (Khairo and Davies, 2009). This percentage (80%) account the fact that not all the time spent is useful, for example the time spent turning around at the end of each passage, getting fuel, starting up and cooling down the tractor, checking the implement. One operator is needed on the back platform of the maize and two on the back of a cassava no-till planter.

Annual turnover was calculated for a maize no-till planter based on two assumed service fees: one of US$35/ha and one of US$40/ha. The R4D team had been offering no-till service for maize sowing for US$35/ha since 2013 and the farmers had no problem in paying this amount; the team told the farmers that the real service fee should be US$40/ha and that an in-kind support of US$5/ha would be provided. The investment cost of a maize no-till planter was set at US$8,700, which was the retail price of a second-hand no-till planter imported by a local manufacturer. Finally, the profitability of purchasing and operating a no-till maize planter (under various assumptions concerning farmer demand) was compared with that of a conventional maize planter (which costs an average of US$1,500 and for which farmers in the study area paid from US$25.0 to US$32.5/ha).

The profitability of purchasing and operating a no-till seeder for rice and a no-till planter for cassava was also estimated. The purchase price of a no-till rice seeder was set at US$7,000 corresponding to the retail price. The analysis assumed a service fee of US$40/ha. Service providers who had started operating conventional rice seeders (which cost around US$6,000) offered services ranging from US$37.5 - 42.5/ha. For cassava, the retail price of a no-till planter was estimated to be around US$10,800. In the study area, no service provider offered cassava planting services under conventional plough-based management. Land preparation and planting costs in the study area represented US$100/ha and US$40/ha, respectively. For the present analysis, the price of cassava planting using a no-till planter was set at US$75/ha.

Table 1. Main characteristics of seeders and planters.

	Conventional maize planter	**2nd hand NT maize planter**	**2nd hand rice seeder**	**2nd hand NT cassava planter**
Fixed costs				
Investment costs per year (US$/yr)	300	1,740	1,400	2,160
Workshop and shedding costs (US$/yr)	38	218	175	270
Fixed costs (US$/yr)	338	1,958	1,575	2,430
Technical characteristics of planters				
Maximum yearly working hours	480	480	320	400
Width of machine (m)	2.4	2.4	2.1	1.8
Speed (km/h)	5	5	6	4
Work rate (ha/h)	1.2	1.2	1.26	0.72
Efficiency rate (%)	80%	80%	80%	80%
Area actually served per hour (ha/h)	0.96	0.96	1.01	0.58
Full costs of tractor				
Tractor horsepower (John Deere 5610) (hp)		75		
Yearly working hours tractor (h)		1,000		
Ownership costs of tractor (US$/h)		7.7		
Operating costs of tractor (fuel, oil, filter, tires, etc.) (US$/h)		8.2		
Full costs of tractor (US$/h)		15.9		
Operating costs of implement				
Labour required (US$1.0/h) (n° of people)	1	2	1	3
Machine repairs and maintenance rate (% of purchase cost/yearly hours)	10%	10%	10%	10%
Machine repairs and maintenance rate (US$/h)	0.3	1.8	2.2	2.7
Operating costs (plus labor) (US$/h)	17.2	19.7	19.1	21.6
Operating costs (US$/ha)	17.9	20.5	18.9	37.5

Table 2. Service providers' main activities and service fees.

Crop	Activity	Service fee (US$/ha) (min - mean - max)	Number of providers offering the service	Average surface area covered by those offering the service (ha per year)
Maize (upland)	Ploughing (6-disc plough)	30.0 - 32.5 - 37.5	30	57
	Sowing	25.0 - 27.0 - 32.5	15	77
Cassava (upland)	Ploughing (3-disc plough)	50.0 - 59.0 - 62.5	27	42
	Ridging	25.0 - 44.0 - 57.5	27	49
Rice (lowland)	Ploughing (6-disc plough)	27.5 - 30.0 - 37.5	18	27
	Levelling ($/hr)	17.5 - 18.3 - 20.0	12	12
Other (mung bean, inter-row management of orchard)	Ploughing (6-disc plough)	30.0 - 32.5 - 37.5	10	7

During the second stage, a workshop was organised in Rattanak Mondoul District in March 2019, attended by 23 service providers, 15 representatives of local public authorities and one representative of a company that imported agricultural machinery. First, the economic assessment of the 35 service providers interviewed was presented by the R4D team and validated by the service providers. Second, detailed presentations of rice, maize, and cassava no-till planters were given. The participants then discussed the hypotheses and results of scenarios of the use and profitability of no-till planters prepared by the R4D team. In particular, the assumption of a US$40/ha service fee for a maize no-till planter was presented to service providers, who considered that this amount would not significantly reduce farmer demand. The participants analysed the opportunities for and challenges to investing in and using a no-till planter for different crops. One week after the workshop, interviews were conducted with 19 service providers who had attended the workshop (four could not be reached). These service providers were asked about their interest in purchasing a rice, maize, or cassava no-till planter and the reasons for their interest or lack of interest.

Results

Organisation of service providers' activities

Interviewees were generally owners of large farms, average 19.8 ha. Service providers cropped on average 16.8 ha of annual crops on their own farms. These annual crops were maize (41% of the area under annual crops), cassava (39%) and rice (20%). The service providers had been offering services for an average of six years. To purchase a tractor and associated agricultural equipment, 21 service providers had obtained a loan from a bank or a microfinance institution, generally for two to four years. Service providers who did not take a loan from a bank or a microfinance institution (14 out of 35) had big farms, additional on- or off-farm income-generating activities, or, with their family or relatives, had invested using shared capital with a low or no interest rate.

Service providers purchased different types of equipment based on the crops grown by farmers in their operating area and on their own investment capacity. All the service providers owned ploughing equipment, but less than half owned a conventional maize planter or a cassava digger. In the uplands, due to the rapid changes in cropping systems over the last decade, service providers had also been obliged to adapt and had purchased new equipment in response to changing farmer demands.

All the service providers interviewed said ploughing was the main service they sold (Table 2). In the lowlands, levelling was the second most frequently requested service, while ridging for cassava and sowing for maize were the most requested in the uplands. Tractors were also used for transport if the service provider had invested in a trailer. On average, service providers serviced 316 ha per year (if they serviced a field more than once, this was taken into account). Service providers in upland areas serviced, on average, almost double the area (371 ha) than service providers in the lowlands (196 ha). All the clients of service providers we interviewed were individual farmers.

The tractor businesses in the lowlands generated, on average, 60% less annual income (US$3,260 per year) than the businesses located in the uplands (US$8,040 per year). Service provision in the uplands tended to be more profitable due to the higher and more diversified demand received by each service provider. Moreover, the fields in the lowlands were more fragmented than in the uplands, so lowland service providers spent more time travelling between fields.

The interviewees mentioned a decline in the demand from farmers demand beginning approximately in 2014. The main reason given for the reduced demand was the increase in the number of four-wheel tractors in the area, especially since interest rates of loans were regulated in 2017. In the uplands, many farmers shifted from annual crops to fruit trees. Three service providers declared they had lost up to 70% of their regular customers between 2015 and 2018. Service providers usually worked within a range of 10 km from their home. To adapt to the decrease in farmer demand, some service providers had started to look for new customers located up to 40 km from their home (meaning increased transport costs).

A typology of service providers

Service providers were grouped in four categories. Category 1 farmed at least 30 ha of annual crops on their own farm and earned less than US$6,000 of net income annually from service provision. For these service providers, their own farm represented a high proportion (but not the majority) of the fields they worked. Category 2 cultivated less than 30 ha of annual crops on their own farms and earned an annual net income of more than US$6,000 from service provision. Their agricultural equipment was mainly used outside their farm. Category 3 cultivated at least 30 ha of annual crops on their own farm and earned more than US$6,000 net annually from service provision. These service providers made intensive use of their agricultural equipment. Finally, Category 4 farmed less than 30 ha of annual crops on their own farm and earned less than US$6,000 net from service provision. Their tractors were not being used to their full capacity. Table 3 lists average characteristics of the service providers in each category.

Service providers in Categories 2 and 3 operated in the uplands and had the most profitable service provision business. Service providers in Category 4 underused their agricultural machinery for two reasons. First, they had started their business later than service providers in Categories 1, 2 and 3, so they had to build a network of customers in a situation where many farmers already used other service providers. Second, they were mainly located in the lowlands and the range of services that could be provided was smaller than in the uplands.

Calendar of activities

Based on interviews with the 35 service providers, Figure 2 shows how they used their tractor over the year. From February to June, the demand for tractor services is high, and some of the service providers cannot meet the demand. The demand for farming operations is closely linked to the weather, for instance, once the first rain falls, farmers often all request tractor services at the same time. From mid-August to mid-December, the demand for tractor services is low and tractors are generally kept in sheds.

Based on tests conducted by the R4D team from 2009 on, Figure 2 also shows the potential periods for the use of maize, cassava, and rice no-till planters (Kong et al., 2016). No-till planters could replace conventional sowing services. Moreover, from August to October, maize, cassava, and rice no-till planters can be used for other crops. After early maize crops harvested in August or September, pulse crops, sunflower, sorghum, or cover crops can be sown directly on the maize residues. This enables timely sowing and greater efficiency than plough-based management. The use of a no-till planter reduces production costs and improves water-use efficiency at the end of the rainy season for secondary crops such as pulse or cover crop seed production, as practiced by a group of seed producers in Rattanak Mondoul District. The cassava no-till planter can be used to plant cassava at the end of the wet season after an early maize harvest and to transplant perennial legume cover crops in the inter-row of orchards.

Table 3. Main characteristics of the four categories of service providers.

Category	Category 1	Category 2	Category 3	Category 4	All respondents
Orientation	Focus on own farm	Focus on service provision	Intensive use of equipment on own farm and in providing services	Under-used equipment	
Number of service providers (upland/lowland)	2 / 1	8 / 0	6 / 0	8 / 10	24 / 11
Average area of their own farm (ha)	44.7	17.1	34.8	11.4	19.8
Average annual area serviced, all services included – excluding their own farm (ha)*	229	353	458	128	254
Average total area ploughed (ha) per year *	83	236	164	71	104
Annual net income as service provider (US$)	4,870	10,310	11,100	2,440	5,900

Service providers often worked the same field several times (e.g., ploughed it twice). In rows with an asterisk, even when a service provider intervened several times in one field, the field was only counted once.*

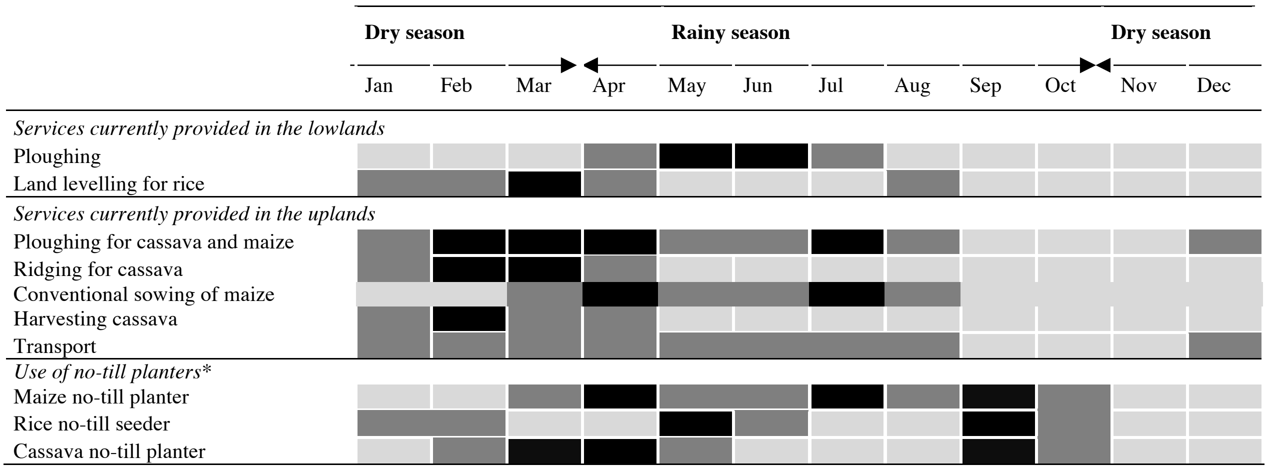

Figure 2. Calendar of services provided plus periods for potential use of no-till planters in Battambang Province.
The black cells represent periods during which the demand from farmers is high. The dark grey cells represent months with less demand and during which even active service providers typically work less than 10 days a month. The light grey cells represent periods with no demand from farmers.
**The black cells in September refer to the use of no-till planters for diversification purposes with secondary crops (pulse, sunflower, pearl millet, sorghum), planting of cassava after early maize and transplanting perennial legume cover crops to the inter-rows of orchards.*

Profitability of no-till planter as an additional service

Figure 3 shows the profitability of purchasing a no-till or a conventional maize planter for a service provider based on farmer demand. Over a five-year period, purchasing a maize no-till planter is more profitable than purchasing a conventional one, if the service provider sows at least 131 ha of maize annually (based on a fee of US$40/ha). The total area could also be reached by sowing relay crops such as mungbean, sunflower and cover crops before or after maize (Fig. 2).

Table 4 lists the break-even points for a maize, rice, and cassava no-till planter in terms of the area sown or planted annually. It also shows how many of the service providers interviewed would break even based on the assumption they continued to deliver the service to an area equivalent to the one they already served for each crop: sowing for maize, ploughing for rice and ridging for cassava. The only service providers to reach the break-even point for maize and cassava were those in Categories 2 and 3, while the two operators who reached the break-even point for rice were in Categories 1 and 2. Four service providers provided maize sowing services in an area of more than 131 ha. Consequently, for them, investing in a maize no-till planter would be more profitable than investing in a conventional maize planter at a fee of 40 US$/ha. If the fee were only 35 US$/ha, investing in a no-till planter would not be more profitable than investing in a conventional maize planter for any of these service providers, to be profitable, they would need to service at least 219 ha, Fig. 3). However, and as emphasized above, the cost of owning a tractor is based on the purchase of a new tractor whereas a large number of service providers (60% of those we interviewed) use a second-hand tractor, with lower ownership costs.

The service providers who attended the workshop agreed that the assumptions concerning the service fee were reasonable, although they pointed out that uncertainty was high. During the interviews conducted after the workshop, 17 of the 19 interviewees said that farmers located in the area in which they operate would be interested in using no-till planters, mainly to sow maize and rice. Out of the 17, 10 said they were interested in purchasing the equipment in the short term and seven wanted to see more demonstrations on the use of the no-till planters and to make sure farmer demand was real. The service providers interviewed expressed less interest in the cassava no-till planter, as they thought the machine was too new and too expensive (both for them to purchase and for farmers to pay for the service) and farmer demand would consequently probably be too low.

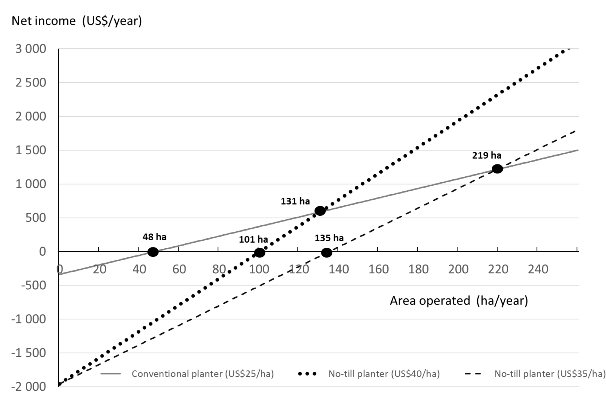

Figure 3. Profitability of conventional and no-till maize planters.

Table 4. Break-even points for different no-till planters.

Type of planter	Conventional maize planter	No-till maize planter		No-till rice seeder	No-till cassava planter
Assumed service fee (US$/ha)	25	35	40	40	75
Operating cost ($/ha)	17.9	20.5		18.9	37.5
Purchase price of the planter (US$)	1,500	8,700		7,000	10,800
Break-even point (ha)	48	135	101	75	65
Number of service providers offering their services for a given crop.	30	30		18	27
Number of service providers already covering a larger area[1] than the break-even point (including the area planted on the operator's own farm).	8	4	6	2	7

[1] Surface area sown with maize, surface area ploughed for rice and ridged for cassava. Operating cost ($/ha) = operating cost ($/hr)/Actual operating (ha/hr), Table 1.

Discussion

Varying interests but also varying capacity to purchase a no-till planter

The analysis showed that, under the above assumptions, investing in a no-till planter would be profitable for all three crops (maize, rice, cassava) only for certain service providers. The break-even point of a no-till maize planter is higher than that of a conventional planter. However, the versatile nature (multi-crops) of the no-till planter is an advantage and should allow a larger area to be worked at different periods over the cropping season. The service providers for whom the investment would be profitable were generally in Categories 2 and 3. These service providers generally had sufficient financial capacity to invest in a new planter in the short term. Their average annual net income from service provision was higher than the investment cost of any of the three no-till planters. As their business was profitable and well established, they could take more investment risks than other service providers. They made intensive use of their machines, at least in certain periods of the year. However, in the context of rapidly increasing competition among service providers, some may find it advantageous to invest in a no-till planter, to diversify the services they offer, and to extend the period during which their tractors can be used.

Category 4 service providers may be more motivated to invest in a no-till planter as they were not using their tractors to full capacity. Thanks to the no-till planter, they would be able to extend the services they offer and hence their network of clients. However, their investment capacities were much lower than the service providers in Categories 2 and 3. Many of them still had loans to reimburse and their earnings were on average four times lower than the average earnings of service providers in Categories 2 and 3. Moreover, their network of clients was smaller than that of service providers in Categories 2 and 3.

Implications for support actions

Support to service providers could include building their capacity to write a business plan and to enable them to identify the minimum area to be serviced with a no-till planter (depending on the fee they choose to apply) to ensure their investment is profitable. Support could also involve helping service providers access loans, especially Category 4 service providers who showed interest in purchasing a no-till planter. More generally, actions to support the increased use of no-till planters could focus on triggering farmers' demand (e.g., through field demonstrations that bring together service providers and farmers) and on improving the service providers' environment.

Finally, farmer demand is not only currently uncertain, but may also change in future. Demand may increase once farmers see the advantages of using a no-till planter, or because the planters realise they can sow a wider range of crops over a longer period of the year. Moreover, farming systems in uplands are very dynamic. In the lowlands, agronomic constraints make it difficult for farmers to grow other crops than rice, so farmer demand for no-till seeders would be more stable. Thus, specific support should be designed based on the service provider's category and agroecosystem. In the short term, support could target rice no-till seeders in the lowlands. At the same time, support could explore the use of versatile no-till planters in the uplands. This would enable more adaptability to changes in the market and related changes in farmer demand.

Conclusion

The profitability of new no-till planter services was assessed under varying assumptions that were discussed with service providers who were already operating in Battambang Province. Under these assumptions, for each crop (maize, cassava, and rice) considered in the study, investing in a no-till planter would only be profitable for a few service providers, mainly those in Categories 2 and 3. Thanks to their annual income, most of these service providers should not have too many problems finding the funds they need to purchase a no-till planter and they could use their relatively large network of customers to promote farmer demand. The main risk for these service providers is being sure there will be enough demand from farmers.

Our ex-ante assessment of the diversity of service providers' profiles and the profitability of no-till planters enabled identification of key challenges and opportunities to ensure an adequate supply of no-till planters. We recommend the use of such ex-ante assessments in studies on how to support the development of supply and demand for no-till planters in South and Southeast Asia, as a key component in the transition to conservation agriculture.

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