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USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY TOOLS FOR TRACTOR HIRE SERVICES IN AFRICA

OPPORTUNITIES AND CHALLENGES

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ABSTRACT

This publication discusses the role information and communications technology (ICT) plays in agricultural mechanization, which has the potential to transform and improve smallholder agriculture in sub-Saharan Africa. Although mechanization levels tend to be low in African countries, there is still evidence of demand for mechanization services from smallholder farmers, especially tractor hire services.

Where such demand exists, tractor owners have formed private hiring markets to provide the required services. The main challenge is related to high transaction costs – incurred by farmers due to information distortion concerning the availability of tractor hire services and how to access them, and by tractor owners due to the difficulties locating farmers in need of their services and aggregating demand over distant, scattered, smallholder farm plots.

The use of ICT tools in tractor hire services may help solve some of these challenges.

In recent years, many start–ups and companies have begun applying an ICT approach with the creation of a smart tractor network accessible via short message services (SMS) or mobile phone applications, either directly or indirectly. This paper seeks to identify the benefits and challenges of such approaches by examining three ICT based models in different African countries (Hello Tractor in Nigeria, Tinga Rentals Store in Kenya and TROTRO Tractor in Ghana).

CONTENTS

ACKNOWLEDGEMENTS

ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AUC	African Union Commission
FAO	Food and Agriculture Organization of the United Nations
GPS	global positioning system
ICT	information and communications technology
SMS	short message services
SSA	sub–Saharan Africa
TTL	TROTRO Tractor Limited

SUMMARY

Information and communications technology (ICT) has a vital role to play in agricultural mechanization, which has the potential to transform and improve smallholder agriculture in sub-Saharan Africa. Although mechanization levels tend to be low in African countries, there is still evidence of demand for mechanization services from smallholder farmers, especially tractor hire services. Where such demand exists, tractor owners have formed private hiring markets to provide the required services. However, problems arise in these privately controlled markets. The main challenge is related to high transaction costs – incurred by farmers due to information distortion concerning the availability of tractor hire services and how to access them, and by tractor owners due to the difficulties locating farmers in need of their services and aggregating demand over distant, scattered, smallholder farm plots.

The use of ICT tools in tractor hire services may help solve some of these challenges. In recent years, many start-ups and companies have begun applying an ICT approach with the creation of a smart tractor network accessible via Short Message Services (SMS) or mobile phone applications, either directly or indirectly. This paper seeks to identify the benefits and challenges of such approaches by examining three ICT-based models in different African countries (Hello Tractor in Nigeria, Tinga Rentals Store in Kenya and TROTRO Tractor in Ghana). For the Nigeria and Kenya models, stakeholder interviews were conducted during a research study carried out in 2018; for the Ghana model, a review of documentation was performed. The process net map tool was also used to analyse and describe the mechanization process in the different models.

The results show that the most common ICT technologies adopted across all three models are SMS (where farmers can request services) and global positioning system (GPS) tracking devices (where tractor owners can monitor their tractors). While mobile phone applications exist and are increasing in popularity, most farmers do not use such apps directly; in Nigeria, booking agents help aggregate farmer demand and send requests via mobile apps. Overall, the use of ICT tools can: improve the functioning of the tractor hire market by aggregating demand from farmers and ensuring better access to services; reduce the idle time of tractors; help tractor owners to monitor their tractors and operators; and reduce discrimination against and cheating of small farmers (thanks to a mobile interface that protects the identity of the farmer).

However, ICT approaches also face challenges related to language barriers, the education level of farmers and access to mobile phone or internet services, all of which reduce the effective use of SMS or mobile apps. Other challenges include the complexity of the process of adopting ICTs and the rigidity in the use of mobile apps. Finding feasible solutions to these challenges and uncovering ways to improve the overall functioning of ICT-based models can help improve their adoption and use. Recommended solutions include increasing internet access in remote areas, encouraging the direct use of mobile apps by making them more user friendly, and improving the functioning of tracking devices to prevent damage. Government has a role to play in the creation of an enabling environment by improving rural infrastructure, investing in capacity development programmes for stakeholders, and partnering with the private sector to find ways to improve the use of ICT tools for tractor hire services.

1. INTRODUCTION AND BACKGROUND

Information and communications technology (ICT) can complement agricultural mechanization in transforming African agriculture. Mechanization can help improve agricultural productivity, increase production and reduce the time required to complete a farm operation (FAO and AUC, 2018). Mechanization – with its capacity to eliminate drudgery – also has the potential to encourage interest in farming activities, in particular among youth by changing the way they view agricultural practices (Diao, Silver and Takeshima, 2016; Malabo Montpellier Panel, 2018). The use and adoption of mechanized technologies also affects labour, on the one hand helping to replace scarce rural labour and thus maintain or even increase productivity, on the other releasing labour for use in other on–farm and off–farm activities (Diao, Silver and Takeshima, 2016).

Although the advantages of agricultural mechanization are well known and documented, the rate of use and adoption of mechanization, especially tractor services, is lower in sub–Saharan Africa (SSA) than in other regions of the world (Diao, Silver and Takeshima, 2016; FAO and AUC, 2018). SSA is yet to fully invest in tractors and currently has the lowest tractor numbers in the world (Malabo Montpellier Panel, 2018). The rate of tractor use is an important indicator of mechanization level and it is much lower in SSA than in other developing regions such as Asia and Latin America. Therefore, mechanization has either declined or stagnated in many African countries, especially during the last decade (FAO and AUC, 2018).

There is however evidence of increasing demand for mechanization services from smallholder farmers in SSA as they become aware of the potential benefits. Other factors contributing to growing demand include increasing rural labour wages, scarcity of rural labour as a result of urbanization (Diao, Silver and Takeshima, 2017) and the need to extend the cultivated area, especially in land–abundant regions. Therefore, in order to encourage production, it is important to understand how the mechanization needs of smallholder farmers can be addressed.

Smallholder farmers – who carry out most agricultural activity in sub–Saharan Africa – cannot afford to buy mechanized technologies such as tractors, which have a high cost while farmers have low economic status and lack access to credit services (Zhou, 2016; FAO and AUC, 2018). On the other hand, the renting/hiring of services creates access for small– and medium–scale farmers (FAO and AUC, 2018). Accordingly, tractor owners, identifying a gap for agribusiness and driven by the need to make profits, have formed hiring markets through a range of supply channels (Diao, Silver and Takeshima, 2016). Following the lack of success achieved with government efforts and interventions, privately controlled markets have demonstrated that they are well equipped and in a good position to effectively and sustainably target the mechanization needs of smallholder farmers (Diao, Silver and Takeshima, 2016). Indeed, the private sector does not need to deal with the governance challenges faced by the public sector in mechanization service delivery (Daum and Birner, 2017).

However, certain challenges do still exist, even in privately controlled markets. When seeking tractor services in hiring markets, smallholder farmers face high transaction costs arising from lack of information – or sometimes distortion of information – about the availability of service providers and equipment and how to access them

(Diao, Silver and Takeshima, 2016). Tractor owners themselves also incur high information costs and face difficulties locating and aggregating demand over small and scattered farms. These information costs can create a barrier for smallholder farmers; as a result, there is poor connectivity between smallholders and tractor owners, leading to market failure in the provision of mechanization services (Diao, Silver and Takeshima, 2016).

ICT offers great potential for ensuring effective linkage between demand and supply actors. Innovative ICT tools can lower transaction costs for the provision of tractor hire services, thus improving access (FAO and AUC, 2018). ICT tools can be valuable for input distribution, improving targeting efficiency to make service delivery to farmers cost effective (AfDB, 2016). Furthermore, they can help tractor owners better monitor and manage their tractors (Malabo Montpellier Panel, 2018). However, there is a gap in the literature on the use of this approach and the application of such models, especially in developing countries.

The objective of this paper is to highlight and examine the features and characteristics of ICT–based models for tractor hire services in Africa. It identifies the potential of ICT tools for tractor hire services and highlights the challenges faced when adopting ICT–based models in service provision. The paper describes three different models used in different African countries (Nigeria, Kenya and Ghana). For the models in Nigeria and Kenya, interviews were conducted with stakeholders involved in the mechanization process during a research study conducted in 2018[1]. A process net map using the procedures explained in Schiffer and Hauck (2010) was used to understand the process of tractor hiring using ICT–based models. The description of the model in Ghana is based on a review of documentation.

[1] Two of the authors of this paper conducted this study as part of their Master's thesis field project.

2. INFORMATION AND COMMUNICATIONS TECHNOLOGY USE IN AGRICULTURE

In recent years, there has been an increase in the use and adoption of mobile/ICT tools in developing countries for the provision of agricultural services crucial for improving the livelihood of smallholder farmers. This development has been possible due to the increased use of mobile phone services in African countries (Baumüller, 2013). Thanks to such technologies, many African farmers can improve and monitor agricultural activities, and have access to vital information on agricultural inputs and technologies (Aker, 2011; Baumüller, 2013). ICT can also be useful for other value chain actors in their daily activities.

Similarly, mobile technology offers great potential for the provision of mechanization services (e.g. tractor hire) as it strengthens the linkage between demand and supply (Malabo Montpellier Panel, 2018). While some existing ICT-based service delivery systems rely on Short Message Services (SMS), the use of mobile applications for tractor service delivery is beginning to develop. These ICT tools are examples of innovative solutions causing a shift in the operational mechanism for the provision of mechanization services; moreover, there is an overall development of African agriculture with increasing access to information for actors using mobile technology (FAO and AUC, 2018).

Numerous start-ups and agricultural companies are already applying this innovative approach across many countries in Africa. Their operational model is based mostly on a smart tractor network where tractors are hired through SMS or app-based communication systems (Zhou, 2016), whereby information and request services are available as and when needed, improving farmer access to services. The model can also affect the economic feasibility of the tractor owners providing services, thanks to demand aggregation, tractor monitoring and a potential increase in use of equipment (Zhou, 2016). For these reasons, mobile technology could be useful for reducing transaction costs in machinery hiring services (Zhou, 2016) and improving access to hire services.

3. INFORMATION AND COMMUNICATIONS TECHNOLOGY BASED MODELS FOR TRACTOR HIRE SERVICES IN AFRICA

This section examines three different examples of the use of ICT tools for the provision of tractor hire services to smallholder farmers in three African countries: Nigeria, Kenya and Ghana.

Model 1: Hello Tractor, Nigeria

Hello Tractor is a technological start–up with a platform linking smallholder farmers to tractor owners. The operational model involves a booking platform to request tractor services and a global positioning system (GPS) tracking device to monitor equipment. The booking platform comprises a mobile app and a booking agent[2] who aggregates demand from farmers in a given location and makes bookings. In order to make a request, there must be sufficient demand from farmers in a particular location, and if necessary bookings from nearby communities may be merged together. The tracking device does not only perform monitoring functions – it also gives access to data and information on machinery use and provides information on maintenance requirements (e.g. fuel level). Furthermore, data on machinery use provide proof of usage and can be used by farmers to access credit services.

Process for mechanization service provision under the Hello Tractor model:

1. The booking agent makes initial contact with the farming community[3].
2. The booking agent uses the booking app to aggregate farmer demand.
3. The farmer pays a commitment fee.
4. The request is routed to Hello Tractor with detailed information on each transaction.
5. The request is linked with the nearest tractor owner.
6. The tractor owner approves the transaction and releases/dispatches the equipment.
7. The operator provides the requested service to the farmer[4].
8. Services are monitored to ensure satisfaction and to keep track of payments.
9. Final payments for services are rendered to the operator or tractor owner.

Figure 1 shows an aggregated process net map illustrating the step–by–step process of mechanization service provision under the Hello Tractor model.

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[2] Booking agents are usually recruited and trained by Hello Tractor. However, there are other booking agents, not trained by Hello Tractor but who work for tractor associations/organizations.

[3] This process usually requires booking agents to scout new communities in search of farmers requiring tractor services. However, in some cases, the farmers contact the booking agent personally, especially when the agent lives within the community.

[4] In some cases, the tractor owner may also be the operator.

Figure 1. Process net map for provision of tractor hire services (Hello Tractor)
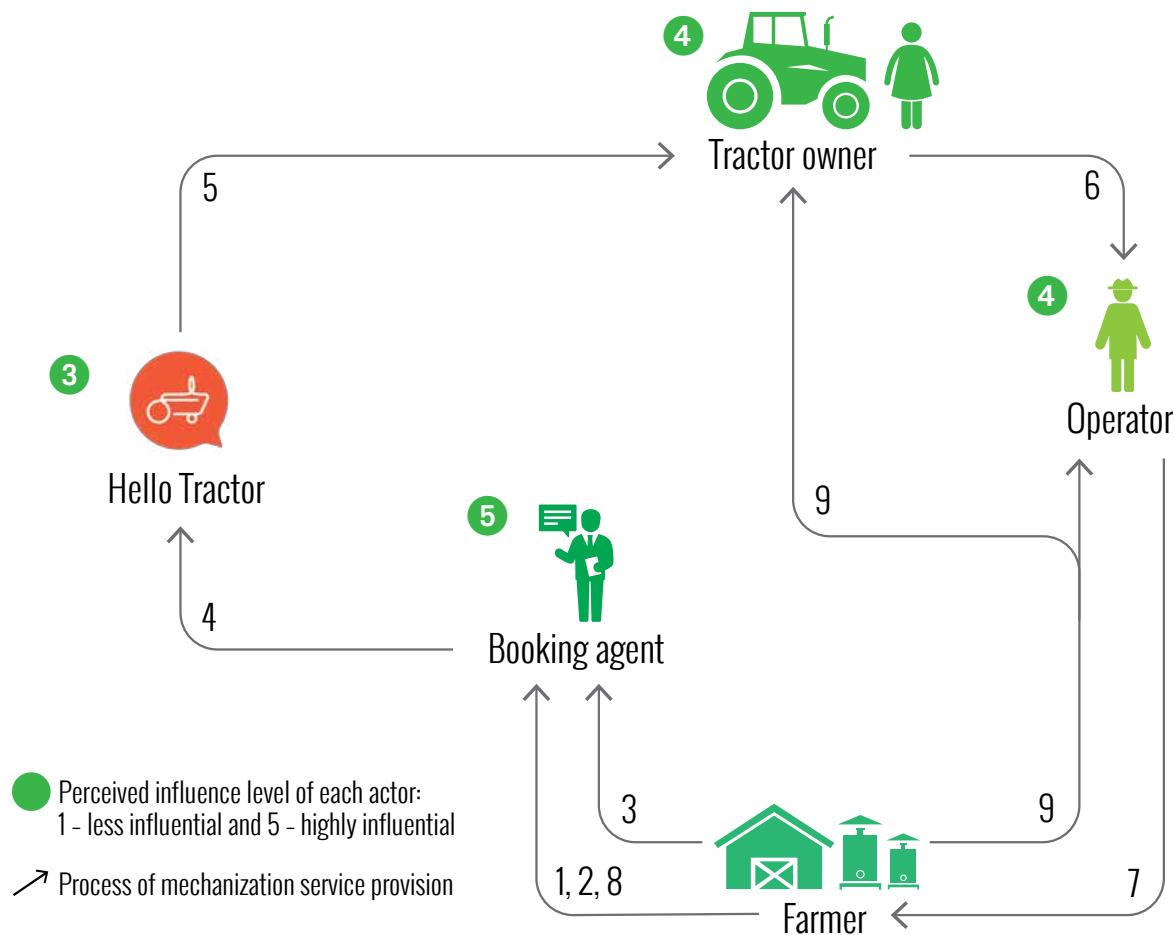
Model 2: TROTRO Tractor, Ghana

TROTRO Tractor Limited (TTL) was founded in 2016. An agricultural technology company that acts as a bridge between farmers and tractor operators, it is an on-demand platform where farmers can obtain services from a network of tractor owners/operators via SMS. The platform allows farmers to request, plan and pre-pay for tractor services, giving them access to services as and when needed. A GPS device allows tractor owners to monitor the movement of their equipment and enables the closest tractors to be located easily for service delivery. TROTRO Tractor helps farmers improve productivity while helping owners/operators increase their income (TTL,

2020). Currently there are over 15 000 farmers registered on the platform and 400 registered tractors[5]. Income is generated from a 10 percent commission on all ploughed hectares as well as from sales of GPS devices for tractor monitoring and safety.

The mobile platform allows farmers to connect with tractor owners through an Unstructured Supplementary Service Data (USSD) dial code.

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[5]   The registered tractors do not necessarily belong to TROTRO Tractor.

Process for mechanization service provision under the TROTRO Tractor model[6]:

1. The farmer dials *714*85#.
2. A prompt appears for the farmer to input their details stating the location in which they reside and the land area for which the service is requested.
3. The farmer makes a mobile payment for the service.
4. The request reaches TROTRO Tractor and is compared with pre-existing requests in order to aggregate demand.
5. The request is matched with a tractor owner in the vicinity based on GPS location.
6. A field agent is sent to confirm the area size and suitability for ploughing.
7. If there is sufficient demand from the same area, a tractor is dispatched to provide the service.

8. If demand is insufficient after 24 hours, the request is cancelled and the farmer receives a full refund. The farmer can make another request for the tractor service.

Figure 2 shows an aggregated process net map illustrating the step-by-step process of mechanization service provision under the TROTRO Tractor model.

Unlike Hello Tractor, TROTRO Tractor does not use booking agents; instead, it creates awareness through communication tools such as community radio station (playing jingles) and community centres (holding educational activities). TROTRO Tractor sometimes works closely with Ministry of Food and Agriculture district officers to sensitize farmers and sets up location-based agents to support local farmers to access tractor and mechanization services.

6 For further information, see TTL (2019).

Figure 2. Process net map for provision of tractor hire services (TROTRO Tractor)

↗ Process of mechanization service provision
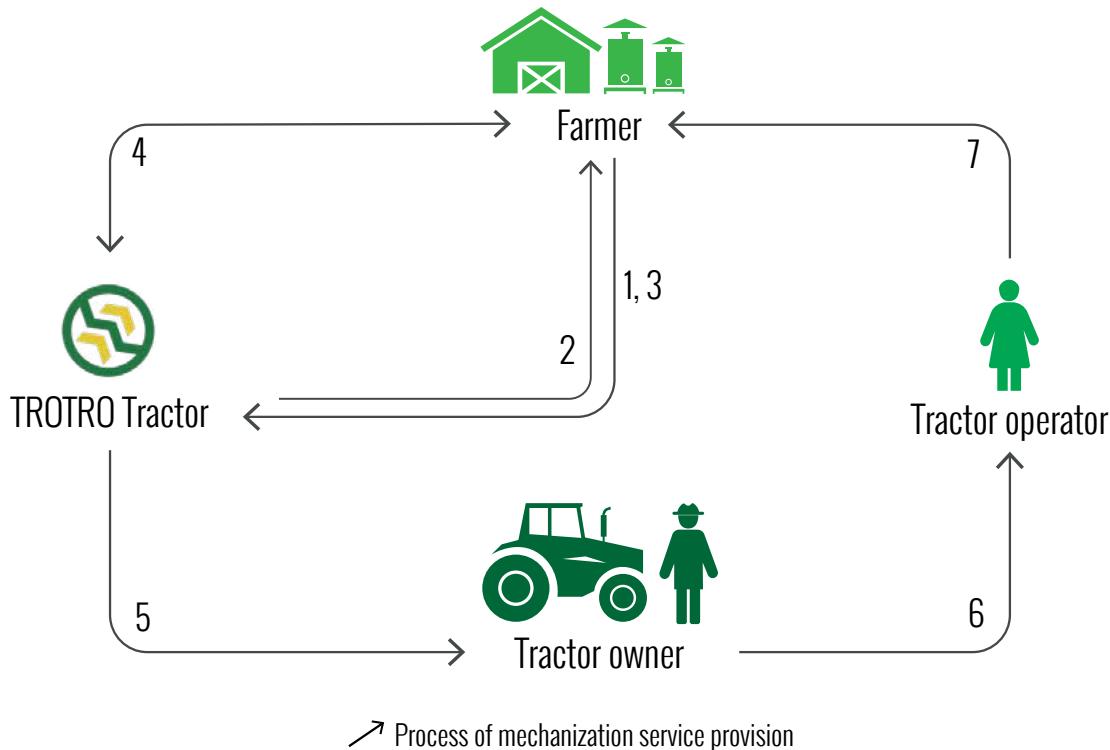
Model 3: Tinga Rentals Store, Kenya

Vehicle and Equipment Leasing Limited uses a mobile app to access farmers in need of agricultural machinery services. Established in 2006, the company has a long-standing reputation in Kenya as a machinery leasing company. The company has a subsidiary – Tinga Rentals Store – that deals specifically with farm equipment. Initially, their operational model involved simply the use of GPS attached to the equipment for tracking purposes, but with the advancement of technology, they created an app called "TingA" to link up farmers and tractors. Unlike Hello Tractor and TROTRO Tractor, the TingA platform only uses company-owned tractors.

Tinga Rentals Store has opened franchises in three counties in Kenya (Meru, Naivasha and Thika) and has a presence in several other counties where tractors are dispatched on request. The rate of adoption of the mobile app is still very low and most customers prefer to use SMS to request a tractor – indeed, SMS account for approximately 95 percent of requests (Tinga Rentals Store interviewee, personal communication, 2020). Marketing initiatives to encourage the use and adoption of the mobile app include roadshows and field days, sometimes involving ministry officials.

Figure 3 is a process net map of tractor hire service delivery within Tinga Rentals Store. The most important person is the farmer who initiates the process – an observation based on ratings by respondents.

Process for mechanization service provision under the Tinga Rentals Store model:

1. The farmer contacts Tinga Rentals Store via either the mobile app or the free SMS line.
2. Tinga contacts the farmer to verify the details.
3. The order control team contacts the officer in charge of the zone where the order came from.
4. The field officer makes a field visit to physically verify the order.
5. The field officer contacts head office to seek approval for the contract.
6. The field officer plans the order with the operator.
7. The farmer pays for the service requested.
8. A tractor is dispatched to the farm.
9. Upon successful completion of the contract, Tinga pays the operator.

Figure 3. Process net map for provision of tractor hire services (Tinga Rentals Store)

Perceived influence level of each actor: 1 - less influential and 5 - highly influential

Process of mechanization service provision
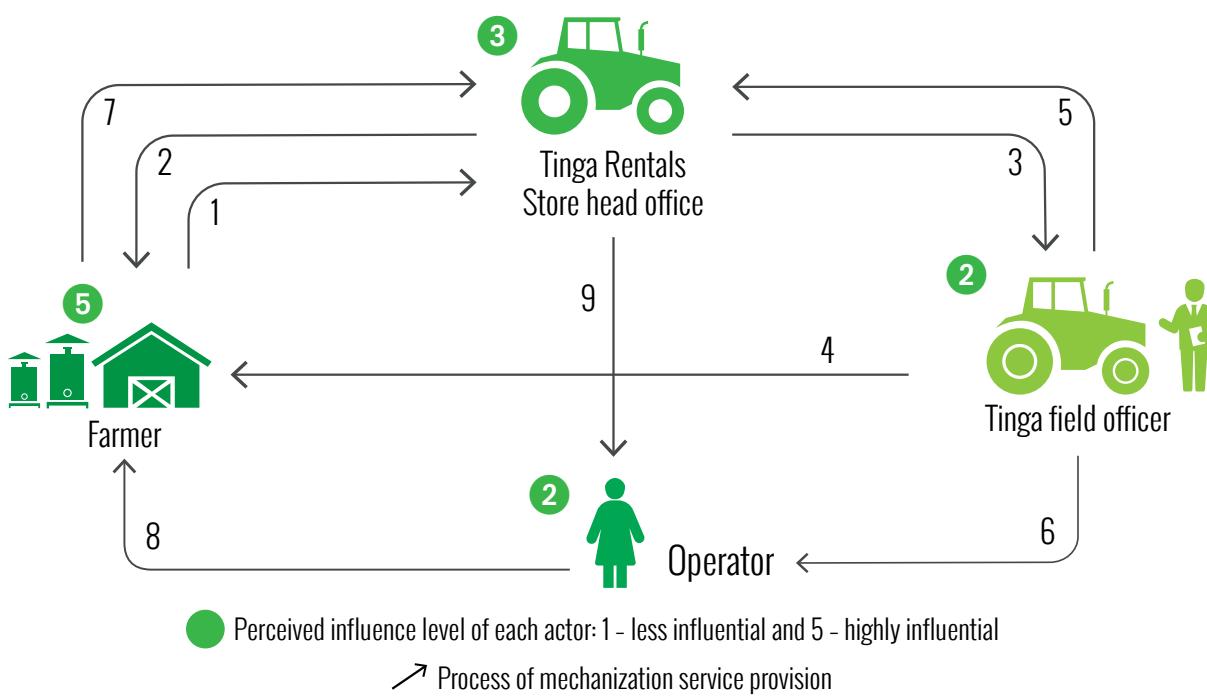
4. OPPORTUNITIES AND CHALLENGES

Opportunities and potential benefits

The use of ICT tools such as SMS and mobile apps for the provision of tractor hiring services offers potential benefits for both the farmer and the tractor owner:

▶ **Aggregated demand and provision of detailed information.** Aggregating demand from smallholders allows for optimization of service provision. In addition, access to detailed information about the operation requested can be useful for service providers and other interested stakeholders. For example, detailed information about farmers and their mechanization requirements in a given region can serve as an incentive for service providers to engage in service migration and provide mechanization services in other regions.

▶ **Improved access to services.** Use of a technological interface/medium enables transactions to take place without facial contact, reducing discrimination and improving access to mechanization services – particularly important for female farmers. Furthermore, farmers can quickly access the information they need regarding when, where and how to access services. Moreover, the use of a technological interface/medium can ensure farmers' continuous access to mechanization services even in uncommon situations like the COVID-19 pandemic.

▶ **Reduced idle time for the tractor.** Increased customer access and enhanced service migration reduce the time that equipment lies idle. With proper planning, a tractor can be active for more time, thus increasing the labour productivity level of the tractor and its implements.

▶ **Increased coverage for the machinery.** By improving service providers' access to farmers in need of agricultural machinery services – including cross-border movement of tractors between neighbouring countries such as Kenya and the United Republic of Tanzania – the coverage of a single tractor is increased. This earns the tractor owner more income, ensuring a quicker return on investment and opening avenues for expansion of the tractor service business through purchase of new implements or more tractors. It can also reduce the transaction costs of accessing and offering mechanization services, allowing more smallholder farmers to mechanize their farms. One tractor can serve different farms, which increases the number of farms mechanized per 1 000 ha.

▶ **Access to credit services**. Increased use of machinery results in greater availability of data and information, which can improve the standing of potential borrowers for accessing loans for farm machinery from financial institutions. The higher income earned from greater machinery use can then be used to repay the loans.

▶ **Land size measurement.** The Hello Tractor booking app helps small farmers obtain an accurate measurement of their farm thanks to the in-built feature designed to measure land size. Most farmers do not know the size in hectares of their farmland, using instead informal measurements such as "the size of a football field", and are thus easily taken advantage of as payment for services is typically per hectare of land and the service provider can easily cheat.

▶ **Monitoring and tracking of equipment.** The adoption of GPS/tracking devices enables the tractor owner to monitor the business thanks to the availability of information on where and what the tractor is doing at any given time. These devices can collect in real time useful data (e.g. distance covered, location of farm plots) valuable for the tractor owner and other stakeholders, reducing risks and improving efficiency. Tracking devices can also improve the relationship between tractor owners and operators, with fewer issues arising from lack of trust.

Challenges faced

The adoption of mobile tools for the provision of tractor hire services not only provides opportunities but also faces challenges:

▶ **Level of education.** A farmer's level of education affects their ability to understand and use the app or even to send an SMS. Lack of formal education may have a negative influence on the adoption of technologies in agriculture; indeed, during interviews, it was observed that educated farmers were more receptive to the idea of using mobile technology in hiring services.

▶ **Language barrier.** The language of operation of a mobile app is English, which is not widely understood in rural areas of Africa where most smallholder farmers live. ICT innovations often require that farmers request assistance from their educated children or neighbours.

▶ **Complexity of the process.** When using a mobile app or SMS line for the first time, the process can be long and complex, discouraging many farmers, especially the older generation. Farmers commented that making a phone call is faster and the response is immediate.

▶ **Lack of smartphones.** Despite the increased use of mobile phones, the high cost of smartphones means that they are owned by only a small proportion of the rural population. The majority of farmers use phones with basic multimedia functions and they cannot use mobile apps even if they want to.

▶ **Rigidity of the request process.** Farmers requesting a tractor may wish to ask the service provider questions. They want to be sure of the services required and need all the information surrounding the operation in order to understand their precise needs. Mobile app or SMS services do not usually provide this option and many farmers are thus reluctant to use them.

▶ **Poor internet access.** Although access to mobile phone services is increasing, many rural/farming communities still have no access to the internet. In some areas, the internet is slow and unreliable; loading of apps might take several minutes or fail completely.

5. WAY FORWARD

ICT–based models for the provision of tractor hire services require further improvement to ensure their continuous use. At present, the use of SMS is more prevalent and is the preferred option, but the advantages offered by mobile apps will increase their adoption and use. Nevertheless, local conditions and farmer preference continue to determine the choice of which tool to use. Changes in policy can also enable the efficient functionality of ICT tools for tractor hire services. It is important to note that some proposals are specific to certain models while others are applicable generally.

Opportunities for ensuring sustainability

▶ **Improving the user interface of the app.** Farmers, as the end users of mechanization services, are most likely to determine the sustainability of ICT models. It is therefore imperative to improve the usability of the mobile app, making it user friendly to ensure future continuous use. Greater user friendliness will also enable booking agents to perform their role and functions more rapidly. Frequent field visits allow field agents/supervisors to collect valuable information and hear suggestions from farmers and operators; the data collected are then used for regular updates of the app and ensure that the app is adapted to local conditions.

▶ **Recruiting more booking agents.** Recruiting and increasing the presence/activity of booking agents in the service value chain ensures the sustainability of models that involve the use of such agents. Recruitment can be promoted within local farming communities by raising

awareness of the value and benefits of being an agent. Increased recruitment can create job opportunities for rural youth and provide an additional source of income. Furthermore, youts can be drawn into agriculture, as they become involved in the business of mechanization service provision. For example, some of the booking agents interviewed were motivated to cultivate more land due to their activity as an agent, while booking agents belonging to a youth group encouraged their members to go into agriculture with the promise of providing mechanization services. Recruiting more booking agents will help to increase competition, leading to a wider range of options for farmers and improved efficiency among booking agents.

▶ **Improving the functionality of the tracking device.** Improving the tracking device can improve monitoring efficiency, providing the tractor owner with more valuable information for their operation. For example, the tracking device can be improved to provide more adequate maintenance information, even signalling the need for maintenance or repair of a damaged part. Improved tracking devices can also be valuable for operators in their work. For example, the use of GPS–enabled devices can provide tractor operators with access to critical information about location and equipment, helping them to operate equipment requiring a high level of technical expertise (often lacking in operators in SSA).

▶ **Implementing service ratings.** A function can be included to allow farmers to rate the services delivered. A rating function can also be adopted in models using SMS. Such functions can include open text responses, where farmers can state specific issues and give suggestions. Rating of services provides

valuable feedback to service providers about how to improve the services they offer and it can also help them identify the most effective operators.

Policy requirements and an enabling environment

Governments can implement policies to create an enabling environment for the adoption and use of mobile technology tools for the provision of tractor hiring services. Potential policies:

▶ **Improvement of rural infrastructure.**
Important infrastructure interventions include building new roads and improving access to ICT services in order to access communities and aggregate demand, especially in remote farming areas. In addition, improved infrastructure will enable the service provision business, by making it easier for operators to drive equipment and avoid equipment breakdown or damage.

▶ **Investment in capacity development.**
Government and other interested stakeholders should support and facilitate training for actors within the mechanization chain (e.g. farmers, tractor owners and operators). Farmers can be better educated through agricultural training schools or through experimental demonstration in farmer field schools. Tractor owners and operators can also benefit from training focused on good practices in machinery use and maintenance to increase the shelf life of equipment and reduce the number of tractors out of operation due to breakdown or damage.

▶ **Fostering of public–private partnerships.**
The public sector can collaborate with the private sector to improve the adoption and use of ICT tools in tractor hire services. The government can use extension services or demonstration field days to make smallholder farmers aware of new opportunities in the use of mobile technology in hiring mechanization services. The government can also facilitate cross–border movement of tractor hire services in order to increase coverage of tractors by introducing legislation to improve collaboration between neighbouring countries.

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