

Comparative analysis of power tiller and tractor rental services market as part of the Agricultural Machinery Development in Bangladesh: Farmers' evaluation using service quality based on SERVPERF

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Abstract

The use of farm machinery has increased rapidly in Bangladesh in the past two decades. As a result, Bangladesh's agricultural operations are performed with more intensity of use of farm machinery than that of India and several other South Asian countries. Currently, more than 700,000 power tillers and 40,000 pieces of the tractor are operating in Bangladesh. Over 90% of these farm machinery is used under locally grown rental services systems, also called farmer-to-farmer services provision or local service provider (LSP) based service provision, if the farm machinery is owned by a rural entrepreneur who provides rental services of farm machinery to a large number of fellow farmers to capture scale economy-related profit in uses of the farm machinery. The scenario was quite different in the early 1970s, with almost failed agricultural and rural development scenarios. No one would have even foreseen in the early 1970s that the country would, in 2010, become one of the most mechanised agricultural economies in South Asia. Significantly, about 80 per cent of all land preparation and other primary tillage operations are mechanised, with more penetration of farm machinery than in India and other countries in South Asia. It has happened due to the effective development of farm machinery rental market services across rural Bangladesh, done by individually operating LSPs. In this context, this paper analyses the performances of rental services of two

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major agricultural types of machinery widely used in Bangladesh such as power tiller (2WT) and tractor (4WT). Using the specially targeted information from 149 sample surveyed farmers from three districts of Bangladesh (Dinajpur, Jessore, and Mymensingh), this study evaluates the performance service quality of rental service of farm machinery as perceived by the farmers. This is done by adapting the famous “SERVPERF” methodology of measuring service quality to the specific content of machinery used in rural Bangladesh. Seven different dimensions of the services measured the performances of the rental services. They are tangibility, reliability, responsiveness, assurance, empathy of LSP, cost-effectiveness and social accessibility factors. The results indicate that the non-availability of an adequate number of machines in peak season was a critical problem in Bangladesh for both types of machinery studied. Likewise, low recording of service orders by the LSP causes lower reliability of the LSP services. The service providers in the study sites have been providing overall good quality services concerning tangibility, reliability except for STW, responsiveness except for thresher, assurance, empathy, accessibility, etc. Moreover, the LSPs services were medium quality regarding the dimension of cost-effectiveness on service rates. Farmers have difficulty getting reliable services, despite Bangladesh’s massive growth in farm machinery. It suggests a further vast scope of expansion of machinery uses in the country. The farm mechanisation process among smallholding farmers can be effectively speed up by the public support without distorting the function of the locally grown private markets. This detailed assessment of the service market and assessment of over 27 indicators and seven dimensions of the service performance of rental services of farm machinery, as done here, would provide valuable policy implications for targeting public support to the specific areas where the performance of the services are poor or inadequate level of services are available now after having COVID-19 pandemic in Bangladesh like any other country.

Keywords *SERPERF analysis · Service quality dimensions · Service performance · Rental services · Smallholding farm mechanisation · Bangladesh*

1. Introduction

Bangladesh has achieved an impressive average GDP growth rate of 6.3 per cent from 2011- to 2015, which has surpassed growth rates in India, Thailand, Indonesia and other developing countries and is only a little behind China with 7.8 per cent growth (Planning Commission, 2015). It aims to achieve middle-income status with a per capita income rise to US\$ 2000 by 2021 from US\$ 1190 in 2014 (Ministry of Finance, 2016). The country’s economy is also diversifying at a reasonable pace with readymade garments, shrimp and an annual remittance income of about US\$ 15 billion. The agricultural gross domestic product growth rate has been around 3.5 per cent, with clear signs of reduced instability in rice production, decreased rice import dependency, increased food security and significant poverty reduction. Bangladesh also has a long history of smaller-scale rural mechanisation in which small engines in rural areas have powered boat and road transportation, pump sets,

and 2WTs, among other usages. In the year 2005, the total agricultural population of Bangladesh was 50.12 per cent of the total population (153.122 million), while in 2009, it was 46.33 per cent of the total population. It is predicted that the total agricultural population will soon decrease to 36.09 per cent of the total population. It clearly shows the need for agricultural mechanisation in the country since human labour forces are reducing daily (FAOSTAT, 2010). Currently, people are using machines at every level of operation. Another thing is that the agricultural labourers are shifting to non-farm activities and are migrating to urban areas for a better scope of work with a high wage rate. This has forced farmers to use machines for performing agricultural activities.

The use of farm machinery has increased rapidly in Bangladesh over the past three decades. More than 7,00,000 power tillers, 15,49,711 irrigation pumps (STW), and 3,70,000 threshers are operating in the country (AMRM, 2016). Hossain does another study, et al. 2017 mentioned that number of tractors, DTW and LLP were 40,000, 33700 and 140,000, respectively, in Bangladesh. The scenario was quite different in the early 1970s when some influential people in policy circles characterised Bangladesh as a basket case, and no one could have foreseen that the country would, in 2010, have one of the most mechanised agricultural economies in South Asia (Mandal, 2002). About 80 per cent of all land preparation and other primary tillage operations are largely mechanised (Islam, 2009).

The number of farm machinery increased tremendously in Bangladesh over the years. Marginal and small farmers still face problems accessing machinery due to a shortage of capital and training in those machinery. Resource endowment farmers have more scope to use AM for producing crops (Alam, 2014). Few AM is available almost everywhere in Bangladesh, but capital-intensive AM is not available everywhere, particularly tractors and combined harvesters. Group effort service markets of tractor and combined harvester need to be grown more to avoid the burden of marginal and small farmers. A rental market for machinery services has developed to provide access to services to small and marginal farmers who cannot afford to own the machines. Machine services rented to others were 76%, 91% and 75% for STW, PT and power thresher in Bangladesh, but these rental service markets are very informal and irregular (Hossain et al. 2017). This will help increase the annual use of this equipment, thereby making farming economical. Thus, custom hiring specialised farm equipment for replacement crops can greatly facilitate diversification of production of agriculture as well as generate jobs for the unemployed youth in the villages (Tewari, 2017).

2. Major Issues and Problems with Smallholding Farm Mechanisation in Bangladesh

Significant problems in rental services of farm machinery used in Bangladesh are asymmetric information, lack of awareness, small farm size, fragmented land, unavailability of appropriate machinery, lack of training to the farmers, deficiency

of capital for smallholding farmers to purchase the costly farm machinery from their nearest market place. Interested farmers are looking for reapers and mini-combined harvesters during the harvesting season but are not getting them. In recent years, the government has started providing subsidies on agricultural machines to 25 to 60 per cent depending on the type of machinery (DAE, 2016). The government declared price subsidies of up to 70 per cent on mini-combined harvesters and reapers in the Haor and coastal areas (other case is 50 per cent). Still, insignificant farmers are getting that facility (DAE, 2016). In rural areas, LSP doesn't have to maintain formal commitment since they are not registered organisations. The government has no database about this LSP, and individual farmers are operating this service market in their own ways. Since there is no regulating authority, few progressive farmers manage this service market. Small farmers who are resource-poor need to ensure service for an extended period so that the users can easily rely on it.

The individual LSP performances as perceived by the farmers

LSP is visible everywhere in the rural areas, but their service market is not well established and not known by that formal name. Individual farmers are coming into this service market for a short time and can't continue in the long run due to their personal choice since they do not feel interested in doing that. It is due to the shortage of capital, the higher price of inputs, other local farmers who think they can provide this service quickly, etc. That is why farmers cannot entirely depend on them, and they always are in doubt about getting service in future. Farmers will be happy if they have a quality service provider with a solid long-term commitment. It is found that farmers wanted to be ensured that they would receive service on time from a well-known source, and they also wanted to see the LSPs have all the AMs in good condition well before starting the respective season. Small farmers wish to depend on LSP entirely throughout their year-round activities, and equipped service-providing centres can only make them satisfied truly.

3. Problems With Evaluations of Farm Mechanisation and its Performances

Past studies reported that small land holdings and fragmented were severe drawbacks for adopting machinery, and extensive mechanisation of farming would lead to unemployment in the rural population (Ahmed, 1965; Alim, 1974). In the early 1970s, there was an apprehension that widespread unemployment in Bangladesh might even lead to social upheavals (Alim, 1974). Still, Bangladesh's development path has been completely reversed within the last 30 years. Small and medium farmers also buy irrigation pumps and power tillers primarily for their cultivation and then for hiring out their machines' services to other farmers under various contractual arrangements. As a result, a vibrant market for local service providers or rural entrepreneurs has developed to perform a whole range

of operations in Bangladesh and elsewhere, i.e., ploughing, land preparation, transplanting, seeding, irrigation, weeding, spraying, harvesting, threshing and drying (Mandal, 2002; Alam et al. 2004). The history of agricultural mechanisation is replete with rich literature about the nature and institutional pathways through which machinery development and its expansion took place in different socio-economic settings (Biggs et al., 2011; Krupnik, 2013;). It is also found that technology adoption always needs local motivation and has regional cultural practices (Justice and Biggs, 2013; Ahmed, 2014). But empirical measurements of these issues are not an easy task.

In this context, this paper measures farmers perceived performances of rental services on various dimensions of service quality of AMs.

4. Objectives and Scope of the Study

This study aims to evaluate farmers' perceived performance of alternates form of rental service market of power tillers and tractors in Bangladesh.

4.1 Specific Objectives (are)

- a. To compare and assess the salient feature of rental market services of widely used power tillers and tractors in Bangladesh;
- b. To analyse farmers' constraints and perspectives in rental uses of power tillers and tractors in Bangladesh;
- c. To assess service quality and performance across rental services of two different farm machinery (Power tiller and Tractor, STW and POT) in meeting farmers' demand for the services.;
- d. To analyse component-wise service qualities of the rental service of two selected implements and options to enhance the selected CHS-AM service quality studied.

4.2 Scope of Assessment

This study relates the expected and perceived services of AM users of AMs. The study is mainly done on the users' perception of the AMs services. Most primary information has been collected through a questionnaire survey, and also cautious to relate the experience with that of other service providers through observation. This study briefly highlights the various rental services of different agricultural types of machinery from 149 HHs of 3 districts in Bangladesh. There is scope to study more by taking more time and more samples of respective machines.

5. Literature Concerning CHS of AMs

One may wonder if there is any evidence that mechanisation benefits mainly the large farmers who can afford to buy machines and have larger farm areas to utilise machine capacity fully. Earlier studies showed evidence of higher control and benefits of DTWs, LLPs and power tiller mechanisation by the large farmers (Alam,

1974; Boyce, 1987; Jabbar et al., 1983). As the liberalisation of machinery import flooded the market in the late eighties and early nineties, small and marginal farmers' access to and benefits from STW irrigation and also from power tillers' use increased significantly (Hasan et al., 1991; Hakim et al., 1996; Mandal, 2002; Alam, 2000; In the flat land areas, where road connectivity exists and farm sizes are larger, relatively large size machinery (e.g. combine harvesters, and mobile threshers) will be the best technology and custom hiring of such expensive machinery will be a viable economic option for the vast majority of farmers (Gauchan et al. 2017). The cropping intensity and production of food crops have increased significantly in Bangladesh due to the adoption of mechanised tillage, irrigation, and spraying operations (Sarker, 2000). Although mechanisation has proliferated, most machines concentrate on irrigation and land preparation (ploughing) services (Ahmed, 2017).

Likewise, Alam et al. (2004) reported that 60 per cent of power tiller owners and almost all of the power tiller users in the Keshabpur area of Jessore district were small farmers cultivating up to 2.5 acres and that investment in PTs proved profitable in terms of gross margin as well as financial analysis. The same study also revealed that the expansion of PT technology had increased the incomes of a wide range of actors, i.e., PT owners, operators, mechanics, spare parts suppliers, and input and output traders through an extensive array of backward and forward linkages created in the rural economy. More recent results of the IFPRI study presented by Ahmed in chapter 5 show that small and medium farmers used power tillers and tractors as much as large farmers through the spread of the machine rental service market (Mandal, 2017).

Service marketing was the precursor leading to the study of service quality. Pioneer research in this area (George and Barksdale, 1974) identified several distinct differences between the marketing of "service" firms and "manufacturing" firms. Shostack's (1977) research brought the specific nature of services marketing. She noted that services were intangible, rendered, experienced, and unable to be stored. Consequently, she concluded that services should be marketed differently from tangible products. Her early work gave equal weight to "service" components as it did to "product." Enis and Roering (1970 & 1984) were unconvinced that there is a distinction between service marketing and manufacturing marketing. They concluded that the strategies used for all products are strictly a "bundle of benefits" regardless of whether tangible or intangible.

6. Methodology and Data

In this study, data have been taken from 3 areas where rice crops are prominent, and the farmers use machinery on a rental basis since all of them cannot own it. These three areas cover villages from 3 districts, i.e. Jessore, Mymensingh and Dinajpur. Two Upazila (sub-district) are selected with the consultation of the agriculture department of each particular district. Villages are selected based on the availability of targeted technologies, i.e. power tiller, tractor, and others.

6.1 Conceptual design of the study

This study first documented major typologies (models) of CHS-AM practising in Bangladesh. For this purpose, the study team consulted with stakeholders of the agro-machinery sub-sector in Bangladesh. Then, reviewed and assessed available literature on the topics. Then, key features of each type of rental machinery service have been analysed, and the findings have been summarised as needed.

The study used qualitative and quantitative data to meet the study objectives. For example, information on organisational structures, their functioning, and performances of each of the models of CHS-AM have been compiled by adopting the primary survey (household-level survey and group-level survey) in each of the targeted areas, where the specific model of CHS-AM is functioning well. The study team prepared necessary checklists for the FGD and survey instruments (household survey) for the survey. The prepared tools were pre-tested with the stakeholders before starting the survey and FGD. The detailed survey plan is mentioned in the following table.

6.2 Analytical tools and techniques

It is defined that the evaluation standard independent of any particular service context has stimulated the setting up of several methodologies (Firdaus, 2005). In the last decade, the emergence of diverse instruments of measurement such as SERVQUAL (Parasuraman et al., 1988), SERVPERF (Cronin and Taylor, 1992) and evaluated performance (EP) (Teas, 1993a, b) has contributed enormously to the development in the study of service quality. SERVQUAL operationalises service quality by comparing the perceptions of the service received with expectations, while SERVPERF maintains only the perceptions of service quality. On the other hand, the EP scale measures the gap between perceived performance and the ideal feature amount rather than the customer's expectations. Diverse studies using these scales have demonstrated the difficulties resulting from the conceptual or theoretical component as much as from the empirical part.

Nevertheless, many authors concur those customers' assessments of continuously provided services may depend solely on performance, thereby suggesting that performance-based measure explains more of the variance in an overall measure of service quality (Oliver, 1989; Bolton and Drew, 1991a, b; Cronin and Taylor, 1992; Boulding et al., 1993; Quester et al., 1995). These findings are consistent with other research that has compared these methods in the scope of service activities, thus confirming that SERVPERF (performance-only) results in more reliable estimations, greater convergent and discriminant validity, greater explained variance, and consequently less bias than the SERVQUAL and EP scales (Cronin and Taylor, 1992; Parasuraman et al., 1994; Quester et al., 1995; Lusaar and Zornoza, 2000). Whilst its impact in the service quality domain is undeniable, SERVPERF, a generic measure of service quality, may not be an excellent instrument to assess the perceived quality in the rental service markets of AMs

but will be sufficient for measuring service performances. Service performance analysis was done using data from 149 HHs from 3 districts and secondary sources under this study.

6.3 Data collection and data sources

This study is based on survey data, and secondary data are also used to compare for a better explanation of the existing situation where necessary. Collected data were compiled and analysed using STATA. Both descriptive and inferential statistics were used to elaborate socio-economic profiles of the survey location, households and stakeholders. Rental rate and mode of rental services were also explained by using surveyed data in summary form.

7. Results and Discussions

7.1 Summary statistics of the households' survey

Table 1: Average family member per household (Including with children) according to land category of farmers

Land Class	Dinajpur			Jessore			Mymensingh			All Sample House Hold	Average no. of Family member/HH	Total no. of family member
	Total no. of Household	Average no. of family member/HH	Total no of family member	Total no. of household	Average no. of family member/HH	Total no. of family member	Total no. of Household	Average no. of family member/HH	Total no. of family member			
Large	3	5.0	15							3	5.00	15
Medium	28	5.0	139	8	4.6	37	6	5.3	32	42	4.95	208
Small Holding	27	4.9	132	31	4.3	133	46	5.0	229	104	4.75	494
Grand Total	58	4.9	286	39	4.4	170	52	5.0	261	149	4.81	717

Note: Land Category is Large-<750 Decimal, Medium-250> to <749, Small holding -<249

From Table 1, it was observed that the average number of family members in large land holdings households was 5.0 in the Dinajpur district. No large land holdings households were in this survey sample in Jessore and Mymensingh districts.

In the case of medium land holding, the average number of family members per household was 5.0, 4.6 and 5.3 in Dinajpur, Jessore and Mymensingh districts, respectively. Considering these three districts, the average number of family

members was 4.95 per household of medium land holding and higher than small land holdings (4.75/household). For small land holdings, the average number of family members per household was 4.9, 4.3 and 5.0 in Dinajpur, Jessore and Mymensingh districts, respectively. So, in this case, the number of family members per household was higher in the Mymensingh district. Considering all locations, the average number of family members was 4.75 per household of small land holdings, which is lower than the other two land holding groups. So it is clear from the above observation that small land holdings households were in small family size.

Considering all land holding classes, the average number of family members per household was 4.9, 4.4 and 5.0 in Dinajpur, Jessore and Mymensingh districts, respectively. So per household number of family members is higher in the Mymensingh district than other two districts. And it was estimated that the average number of family members per household was 4.81, which is close to the national average (4.35) in Bangladesh (BBS, 2012).

Table 2: Distribution of household according to their house quality

Cast Group	RCC	Bricks wall & tin roof	Mud wall, thatched roof	Mud wall with normal roof	Luxury building	Sample: All
	%	%	%	%	%	%
Forward (n = 24)	53	38	4	6	0	100
Medium (n= 67)	58	26	0	13	0	100
Lower (n= 58)	44	44	0	22	0	100
Total (n= 149)	54	36	3	8	0	100

Note: We consider the Cost category as follows -Forward -Miah, Mondol; Medium-Sheikh, Morol; Lower- Sardar, Gazi, Sarker

Type of House: 1=Luxury Building, 2=RCC wall and tin roof, 3= Bricks wall and tin roof, 4= Mud wall with thatched roof, 5=Mud wall with any normal roof.

The households' types are also proxies for household wealth and available assets.

Table 2 reveals that 53 per cent, 38 per cent, 4 per cent and 6 per cent of the household was built with RCC wall and tin roof, bricks wall and tin roof, mud wall with thatched roof and mud wall with any typical roof, respectively. For the medium cast, 58 per cent, 26 per cent and 13 per cent of the household was built with RCC wall and tin roof, bricks wall and tin roof, and mud wall with any normal roof, respectively. And in the lower cast, 44 per cent of households were built with RCC walls, and 44 per cent, 22 per cent of households were constructed with bricks and tin roofs and mud walls with normal roofs, respectively. There was no

luxury Building in any caste group. Considering all cast, 54 per cent, 36 per cent, 3 per cent and 8 per cent it was estimated that household was built with RCC wall and tin roof, bricks wall and tin roof, mud wall with thatched roof and mud wall with any normal roof respectively.

7.2 Service quality of rental services of two machinery types

Due to a severe shortage of draft animals, 2WT was used to till the land. Mechanised harvesting started in the 1990s, and thresher was used in Bangladesh agriculture (Alam, 2014). The study used data from services provided on custom hiring of farm equipment to assess the service quality of the providers on the service dimensions such as tangibility, reliability, responsiveness, assurance, empathy, cost-effectiveness and accessibility. To compare and contrast the quality of services delivered by different service providers, the construct construction of mean is used to understand the differences in the quality.

7.2.1 Tangibility dimension of service quality

The “tangibility dimension” on quality had five questions which were basically to understand the adequacy of equipment and their quality apart from space for display of equipment for customer convenience, sufficient space for farm implements, professionalism of the employees, machines conditions and the locations of the service centre (establishment) in the service area (Table 3). The results in Table 3 suggest that there is no significant difference among the attributes availability of adequate no of machines of tangibility dimension in case of power tiller, tractor and power thresher and it represents non-availability (2.0) of the services. There is a substantial difference between the machinery’s good physical condition and tangibility dimension. The rest of the dimensions vary significantly among the dimensions of services in Bangladesh. This number also indicates that the availability of said machinery is inadequate during the respective seasons. It also shows the necessity of service providers at the local level.

The transaction cost issue is built with this service market. Any negotiation between two parties incurred hidden costs in time consumption, monetary, relationship, future assurance, etc. Both parties need to accept it. An example is if a service provider wants to keep all machinery equipped all the time, he has to invest more capital over the years, which has costs, and the renting rate will be higher. For this, if he fixed a service centre instead of his own house which also incurred cost, etc.

Table 3: Tangibility as a quality of services provider of farm equipment across the machinery services

Level of Tangibility	Model		
	Power tiller Mean	Tractor Mean	Sample All Mean
T1. Availability of adequate no. of machines	2.0 _a	2.0 _a	2.2
T2. Good physical condition of machinery	6.4 _a	6.3 _a	6.1
T3. Enough space available to keep machine	6.7 _a	6.5 _a	6.4
T4. The machinery are new and good quality	6.3 _{a,b}	6.6 _b	6.3
T5. Location of service provider (centre)	6.6 _a	6.9 _a	6.3
Sub-total	5.1 _{a,b}	5.0 _b	5.5

Note 1. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

Table 3 shows that the availability of machines is very inadequate, particularly in the peak period of the respective activities. It indicates that there is a scope to provide more to users with increasing relevant machines in the study areas. It is also revealed that the physical condition of machines, particularly STW and thresher, is not so good. The service provider of STW needs to improve their movement across the village so that the farmers can get irrigation smoothly.

The tangibility score is relatively low for all types of machinery used here. The main reason behind this is the service market is not well established and well known. Sometimes, the machine owner does not have enough money to buy a new machine, and new service providers are coming to the market with no experience and training. Even they don't know the service market in agricultural machinery. They don't have a specific service centre location from where they can provide service and information regularly to the users. If it were a formal market known to all, it would have a higher score on the survey. This service market has demand, and it is growing over time. The tangibility score will increase if all relevant issues are adequately addressed.

7.2.2 Reliability dimension of rental service markets

The "reliability dimension" on quality had five questions which were basically to understand timeliness and high level of dependency with confidence, provide the implements with high reliability, be sympathetic and reassuring in problem-solving to the client, keep financial order records of users on the custom hire centres for their services. The ability to perform the promised service dependably and accurately is reliable. The empirical results indicate significant differences among the mean scores on reliability in the case of four services. The power tiller and tractor mean scores are the same for their services. In the case of dependable

service by LSP, the mean value is high; 6.8 represent almost strongly agree. The dimensions the service orders are recorded well shows mean three near to disagree. The rest of the questions vary significantly among the dimensions of services in Bangladesh.

Table 4: Reliability quality of services provider of farm equipment across the machinery types

Degree of reliability	Model		
	Power tiller Mean	Tractor Mean	Sample All Mean
R1. Reliable service performance of the LSP	6.8 _a	6.6 _a	6.2
R2. Dependable service by LSP	6.8 _a	7.1 _a	6.8
R3. The Service orders are recorded well.	2.9 _{a,b}	3.2 _b	3.0
R4. LSP provides services to individual needs	5.0 _a	4.9 _a	4.8
R5. Convenient operating hours/scheduled by LSP	6.6 _a	6.4 _a	6.2
Sub-total	5.6 _a	5.6 _a	5.4

Note 2. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

The reliability of the service order is not recorded well. The farmers usually talk with the service provider for the said service or make phone calls. Since there is no permanent agent, the individual service providers are not used to keeping a record. Another thing is that the providers are not well educated and don't have training for this type of work. If agent service is available, the reliability would be more as desired by the users. It is good that service performance, assurance and operating hours are more or less standard, but they need improvement.

7.2.3 Responsiveness dimension of rental services

The "responsiveness dimension" on quality had three questions which primarily pertained to the attributes including promptness of service, willingness to help customers, never being too busy to respond to farmer's request, informing farmers in advance when the service will be performed, providing information or services which are easily obtainable to the farmers. Results on the responsiveness dimension also indicate significant differences in mean scores among the services of PT, TR, STW and TH, representing medium response. There is no significant difference among the attributes of willingness to help farmers in the case of the power tiller and tractor. The service provider is not dedicated or committed to providing service, but it is a highly informal and first-come basis for getting assistance.

Table 5: Responsiveness quality of services provider of farm equipment across the machinery types

Degree of Responsiveness	Power tiller Mean	Model Tractor Mean	Sample All Mean
Res1. Prompt Services are provided by LSP	4.5 _a	4.7 _a	5.0
Res2. Genuine willingness to help farmers	6.7 _a	6.6 _a	6.5
Res3. Service information is provided to farmers in advance.	3.9 _a	3.7 _a	4.0
Sub-total	5.1 _a	5.0 _a	5.2

Note 3. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

It is noted that the responsiveness of the service providers is limited in all cases due to an unorganised service market and poor quality market. At the village level, the service providers are not that will maintain a well-accepted system and inform farmers about their services in advance. Many have cell phones, but both responsiveness and performance need improvement.

7.2.4 Assurance dimension of service quality.

The “assurance dimension” on quality had three questions which indicate the employees’ trust, safety in their transaction, politeness in dealing with farmers, knowledge and courtesy of employees and their ability to convey trust and confidence. The empirical results reveal no significant difference among the attributes farmers can trust on LSP for quality assurance services in the case of power tiller and thresher. The dimension LSP/driver is knowledgeable in operating machines also had the same result in the case of PT and TR services, except these the mean score had significant variation.

Table 6: Assurance dimension of the services across the machinery types

Degree of assurance	Power tiller Mean	Model Tractor Mean	Sample All Mean
As 1. Farmers can trust LSP for quality services	6.1 _a	6.5 _b	6.3
As. 2. Farmers can feel safe while dealing with the LSP.	6.8 _{a,c}	7.0 _c	6.7
As. 3. LSP/driver is knowledgeable in operating machines	3.8 _a	3.8 _a	4.3
Sub-total	5.6 _a	5.8 _{a,b}	5.8

Note 4. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

In the study areas, the LSPs are very informal, and mainly machine operator or driver operates the machine. The driver doesn’t have any good training in 2WT and 4WT operation. It usually happens that the machines go out of order and don’t have sufficient knowledge to fix or repair them instantly. This unwanted issue makes the user’s work assurance vulnerable. The drivers of the machines need to

have adequate knowledge about machines.

7.2.5 Empathy dimension of service quality

The “empathy dimension” on quality had five questions which indicate the provision of caring, individualised attention to customers, having their customer’s best interest at their heart, understanding the farmers’ specific needs, and operating hours convenient to all a good rapport with farmers. The results reveal that there is no significant difference among the attributes of the individual dimension attention is given to farmers in the case of TR, STW and TH. In contrast, there were substantial differences among the mean scores of other dimensions except for PT and TR in the third dimension, LSP provides the best services from their heart. The overall empathy dimensions for the farmers represent a high score.

Table 7: Empathy quality score of services provider of farm equipment

Level of empathy	Model		
	Power tiller	Tractor	Sample All
	Mean	Mean	Mean
Em 1. Individual attention is given to farmers	5.1 _a	5.0 _a	5.0
Em. 2. Politeness in dealing with farmers by LSP	7.0 _a	6.7 _a	6.6
Em. 3. LSP provides best services from their heart	6.6 _a	6.6 _a	6.4
Em 4. LSP are sympathetic to farmers’ problems	6.4 _a	6.5 _a	6.3
Em 5. LSP make good rapport with farmers.	7.7 _a	7.4 _a	7.0
Sub-total	6.5 _a	6.5 _a	6.3

Note 5. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

Individual-level attention to the farmers is a critical issue in the service market. The table above shows that the LSPs are careful about politeness, service quality, sympathy and rapport building for all cases. Individual farmer level attention is below standard for 2WT, 4WT, STW and thresher. It is because of awareness problems and a lack of motivation among the service providers at the field level.

7.2.6 Cost-effectiveness dimension of service quality

The three questions of “cost-effectiveness dimension” on quality, which indicates the rental charge for the renting of the machinery and flexible payment system of rental fees, payments to be allowed even after harvest of the crops had the similar mean scores, with only minor variation was found in case of TH in the dimension rental payment to LSP is a flexible mode of payments. And finally, there were significant differences in the cost-effectiveness dimension of services as the mean scores differ significantly among all machinery services except PT and STW.

Table 8: Cost-effective dimensions of service quality across service providers

Level of cost-effectiveness	Model		
	Power tiller Mean	Tractor Mean	Sample All Mean
Cost1. Rental service charges are fairly okay	5.0 _a	5.0 _a	5.0
Cost2. The rental payment to LSP is flexible	6.0 _a	6.0 _a	6.0
Sub-total	4.3 _a	4.4 _a	5.5

Note 6. A detailed statement of questions asked for Cost1 to Cost5 is provided in the Appendix note

Here the flexible mode of payments scores under the level of cost-effectiveness is meagre, but this is not the actual score. It is mainly the average number of choices (choice code 2) where they pay cash just after service. There were five options. So the average score here will be six or more in all services cases.

7.2.7 Accessibility dimension of service quality

The “accessibility dimension” on time to assist farmers on machine uses, contact the service provider quickly without any delay, and should not be any exclusion on service provision by caste or religion basis. Results on the dimension of accessibility also indicate significant differences in mean scores among the services of PT, TR, STW and TH.

Table 9: Accessibility dimensions of service performance across the farm equipment providers

Degree of accessibility	Model		
	Power tiller Mean	Tractor Mean	Sample All Mean
Acces1. The LSP is available for service all the time.	4.7 _a	4.6 _a	4.9
Acces2. The LSP is approachable to the farmers (client)	6.2 _{a,b}	6.0 _b	6.1
Acces3. LSP does not do any form of exclusion on service provision by caste, gender or religion basis	4.5 _a	4.4 _a	4.4
Sub-total	5.1 _{a,b}	5.0 _b	5.1

Note 7. A detailed statement of questions asked for T1 to T5 is provided in the Appendix note

The LSPs are not supposed to do any form of exclusion from their services. Still, some negligence on quality of service might have happened for lower caste and minority people since their monitoring system is poor. They don't exercise sufficient bargaining power to get the service. In the case of STW, the score is very low and indicates that the female and minority people don't follow up on the water supply in their plots. For example, the STW service provider delivers sufficient water on a timely basis to the influential users or rice farmers since they can make

problems quickly if they do not get irrigation. It is a widespread phenomenon in rural areas in Bangladesh. It also depends on the social status of the service provider in the same society. It cannot be generalised easily, but it is happening silently.

7.3 Overall service quality as perceived by uses across the schemes-

The service quality of AMs is not the same in terms of performance. Farmers are happy with tillage and irrigation performance. They want those services from the local provider regularly and granted services.

Table 10: Overall Service quality scores across service providers' machinery hiring by machinery types

Level of different service quality	Power tiller Mean	Model Tractor Mean	All Mean
Tangibles	5.1 _{a,b}	5.0 _b	5.2
Reliability	5.6 _a	5.6 _a	5.3
Responsiveness	5.1 _a	5.0 _a	5.2
Assurance	5.6 _a	5.8 _{a,b}	5.8
Empathy	6.5 _a	6.5 _a	6.2
Cost effectiveness	4.3 _a	4.4 _a	4.3
Accessibility	5.1 _{a,b}	5.0 _b	5.2

Note: Values in the same row and sub-table not sharing the same subscript are significantly different at $p < 0.05$ in the two-sided equality test for column means. Cells with no subscript are not included in the test. Tests assume equal variances.

In this table, the score is also lower for cost-effectiveness, indicating the users are not getting effective service from the LSP. It is because the service centre employee is reluctant to provide services to the farmers. LSP has a lot of things to do to improve the service performance at the farmers' level.

7.4 Farmers' weightage rank across the dimensions of rental services

This section will explain the relative weightage of any particular service. The calculated summary table showed the current status of the service performance. It can be easily assessed that the service quality varies among the technologies. Types of services are also factors in this comparison. As already mentioned, service markets for agricultural machinery are still under development, and in some cases, it is very insufficient.

Table 11 is used to show the picture of the service market in Bangladesh agriculture. It can be easily explained that the tangibles, reliability and empathy rank for PT, STW, TH and TR are higher than any other types of service performance. It indicates the poor performance in terms of cost-effectiveness, accessibility, responsiveness and assurance, and these ranks are almost similar by

types of technologies or models. Service performance studies of AMs are very limited in Bangladesh, but it is essential to see and evaluate them over the years. That can give thoughts to improve service performance sufficiently.

Table 11: Farmers' weightage ranks across the dimensions of services by rental service of farm machineries in Bangladesh, 2016.

SERVPRF: Survey dimension of the performance of services Rank of Importance (Weight rank)			
SERVPRF	Power tiller Mean	Model Tractor Mean	Sample All Mean
Tangibles	6 _a	6 _a	6
Reliability	6 _a	5 _{a,c}	5
Responsiveness	3 _{a,c}	3 _c	3
Assurance	4 _a	5 _b	4
Empathy	6 _a	6 _{a,b}	6
Cost effectiveness	1 _a	1 _a	1
Accessibility	2 _a	2 _a	2

Note: Values in the same row and sub-table not sharing the same subscript are significantly different at $p < 0.05$ in the two-sided equality test for column means. Cells with no subscript are not included in the test. Tests assume equal variances.

8. Conclusions and Implications

The above empirical findings suggested that the empathy quality of the service provider of farm machinery is a prerequisite to effectively speed up rental market services of agricultural machinery among smallholding farmers in Bangladesh, which consequently develop the rural agricultural machinery service provision. It is also suggested that data related to each machine's quality service provision arrangement should be included in future agricultural censuses, which will help evaluate particular government policies. To enhance the service quality of CHS-AM, credit service with a low-interest rate and insurance for agricultural machinery have to be ensured. Further training on operating agricultural machines and technical support for repairing and maintenance is needed. The government should voluntarily reduce import restrictions and tariffs on farm machinery to facilitate this process and develop sufficient subsidies to offset fixed costs.

The government of Bangladesh has encouraged agricultural intensification and mechanisation as an avenue to increase productivity with cost-effectiveness and move towards rice self-sufficiency for ensuring food and nutrition security. The increasing trend of custom hiring services of agricultural machinery (CHS-AM) not only improves access to the machinery reach to many smallholding and marginal farmers but also provides better services to farmers due to better management and timely fashion. The use of agricultural machinery yearly is

deficient, as it is used only on a seasonal basis, so small farmers cannot use it by owning farm equipment due to their capital shortage. Resource endowment farmers have more scope to use AMs for producing crops. Group efforts have to be used to manage potential services in the agriculture sector. Few AM is available almost everywhere in Bangladesh, but capital-intensive AMs are not available everywhere, particularly tractor, reaper and combined harvester.

Rural roads must be developed for easy movement, and the institutional link between the public and private sectors must accelerate the service provision arrangements. The good physical condition of the machinery of tangibility dimension except for STW and TH, good quality service in respect to the good physical condition of machinery, enough space available to keep the machine, new machinery and good quality and the locations of the established service centre in the study area, dependable services by LSP, recording of service orders, good quality services from the aspect of tangibility, reliability, responsiveness, assurance, empathy and medium quality services in respect to effectiveness and accessibility are the critical factors in this service markets. Finally, it is believed that expanding this service market will bring them under some regulation for long-run sustainability, which may ensure higher quality performance of the rental service market.

Finally, the rental service market study of AMs provides new information on this service market's scope, potential and shortcomings. This assessment study of rental market service will bring our small holding farmers into using newly adopted technologies in the near future by adopting new policy support by the government. AMs' service market providers will come forward with integrated service through a local-based organisation, and farmers of a locality will have more access to using new technologies with lower prices that will ensure sustainable agricultural production, particularly after having this COVID-19 pandemic. The policy of making agricultural technologies available to the farmers at a lower price will be replaced by a policy of establishing a centre or agent with equipped agricultural rental service market. Since this service market will be locally grown, farmers will accept it independently.

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Appendix A

Table A1. Bangladesh dimension of services in decimal

Dimension of services	Model		
	Power	Tractor	Sample All
	Mean	Mean	Mean
Trangibles1	2.0 _a	2.0 _a	2.2
Trangibles2	6.4 _a	6.3 _a	6.1
Trangibles3	6.7 _a	6.5 _a	6.4
Trangibles4	6.3 _{a,b}	6.6 _b	6.3
Trangibles5	6.6 _a	6.9 _a	6.3
Reliability1	6.8 _a	6.6 _a	6.2
Reliability2	6.8 _a	7.1 _a	6.8
Reliability3	2.9 _{a,b}	3.2 _b	3.0
Reliability4	5.0 _a	4.9 _a	4.8
Reliability5	6.6 _a	6.4 _a	6.2
Responsiveness1	4.5 _a	4.7 _a	5.0
Responsiveness2	6.7 _a	6.6 _a	6.5
Responsiveness3	3.9 _a	3.7 _a	4.0
Assurance1	6.1 _a	6.5 _b	6.3
Assurance2	6.8 _{a,c}	7.0 _c	6.7
Assurance3	3.8 _a	3.8 _a	4.3
Empathy1	5.1 _a	5.0 _a	5.0
Empathy2	7.0 _a	6.7 _a	6.6
Empathy3	6.6 _a	6.6 _a	6.4
Empathy4	6.4 _a	6.5 _a	6.3
Empathy5	7.7 _a	7.4 _a	7.0
Costeffectiveness1	5.0 _a	5.0 _a	5.0
Costeffectiveness2	6.0 _a	6.0 _a	6.0
Costeffectiveness3	2.0 _a	2.0 _a	2.0
Accessibility1	4.7 _a	4.6 _a	4.9
Accessibility2	6.2 _{a,b}	6.0 _b	6.1
Accessibility3	4.5 _a	4.4 _a	4.4

Note: Values in the same row and sub-table not sharing the same subscript are significantly different at $p < 0.05$ in the two-sided equality test for column means. Cells with no subscript are not included in the test. Tests assume equal variances.