Quality and reliability of tiller spare parts supply system

by

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Introduction

Agriculture is a cornerstone of Bhutan's economy, playing a pivotal role in the country's socio-economic development and stability. Central to the growth and modernization of Bhutanese agriculture is the adoption of mechanization, particularly the use of power tillers. These machines have transformed farming practices by significantly boosting productivity, reducing the reliance on manual labor, and enabling farmers to cultivate larger areas more efficiently and cost-effectively. Power tillers have thus become indispensable tools for farmers, facilitating higher yields and contributing to the overall advancement of the agricultural sector.

Despite their benefits, power tillers come with the challenge of maintenance. Like all machinery, they require regular upkeep and the replacement of worn-out parts to ensure optimal performance. The availability of reliable, quality spare parts is crucial for maintaining these machines in working condition. In Bhutan, spare parts for agricultural machinery are primarily supplied by a network of private dealers. However, the efficiency and reliability of these suppliers can vary, creating potential barriers for farmers who depend on timely access to spare parts.

One of the key challenges is the geographical remoteness of many rural farming areas from urban centers, where spare parts dealers are typically concentrated. This distance can lead to delays and increased costs in obtaining necessary parts. Furthermore, the quality of available spare parts often fluctuates, and substandard components can lead to prolonged machinery downtime. This, in turn, negatively impacts farm operations, reducing productivity and profitability.

The aim of this study is to assess the reliability and effectiveness of Bhutan's spare parts supply chain for tillers. This research seeks to identify gaps in the existing system and propose solutions that could enhance the efficiency and sustainability of the supply chain.

Methods & Methodology

The research focused on 14 authorized power tiller distributors in the Thimphu and Paro Dzongkhags, including the state-owned Farm Machinery Corporation Ltd. (FMCL). A structured questionnaire was electronically distributed to these dealers to gather detailed information on their procurement practices, inventory management, and spare parts delivery systems.

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Subsequent site visits were conducted by a team from the Competition & Consumer Affairs Authority (CCAA) and the Agriculture Machinery & Training Centre (AMTC) to observe the operations of these distributors firsthand. During these visits, samples of available spare parts were collected for quality analysis by the AMTC. This mixed-method approach provided both quantitative and qualitative data on the spare parts supply system.

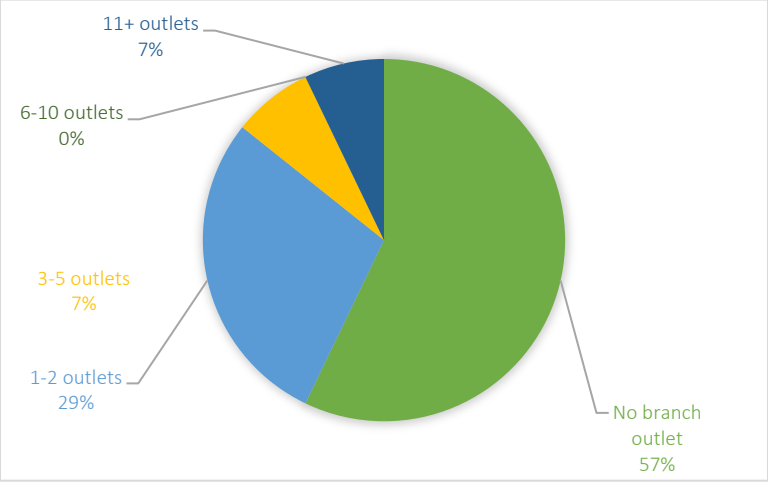
Results

Out of the 14 dealers surveyed, 10 responded to the study, providing valuable insights into the functioning of the spare parts supply system.

i. Number of branches

The availability of spare parts and service for parts replacement is directly influenced by the number of branches a company has. A significant portion—57% of dealers—do not have any branch offices, while only 7% (one company) operates more than 10 branches across the country (Fig. I). Moreover, the distribution of the dealers is uneven, with most concentrated in the western regions. This geographic imbalance could affect the speed and quality of service in other areas.

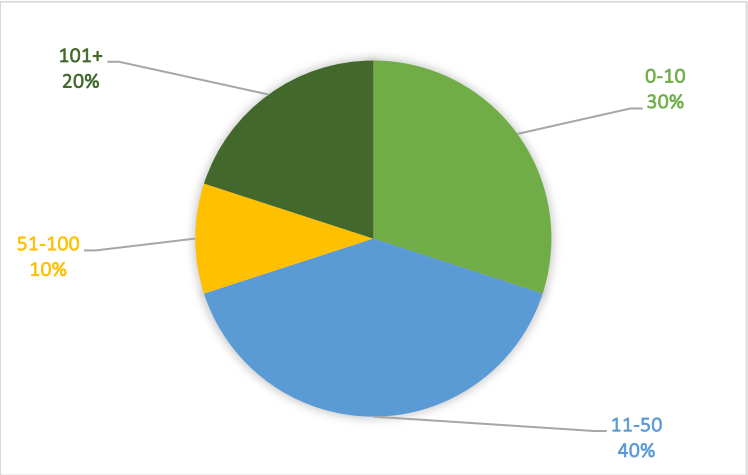
Fig. I: Percentage of business firms by number of branches



ii. Rate of business

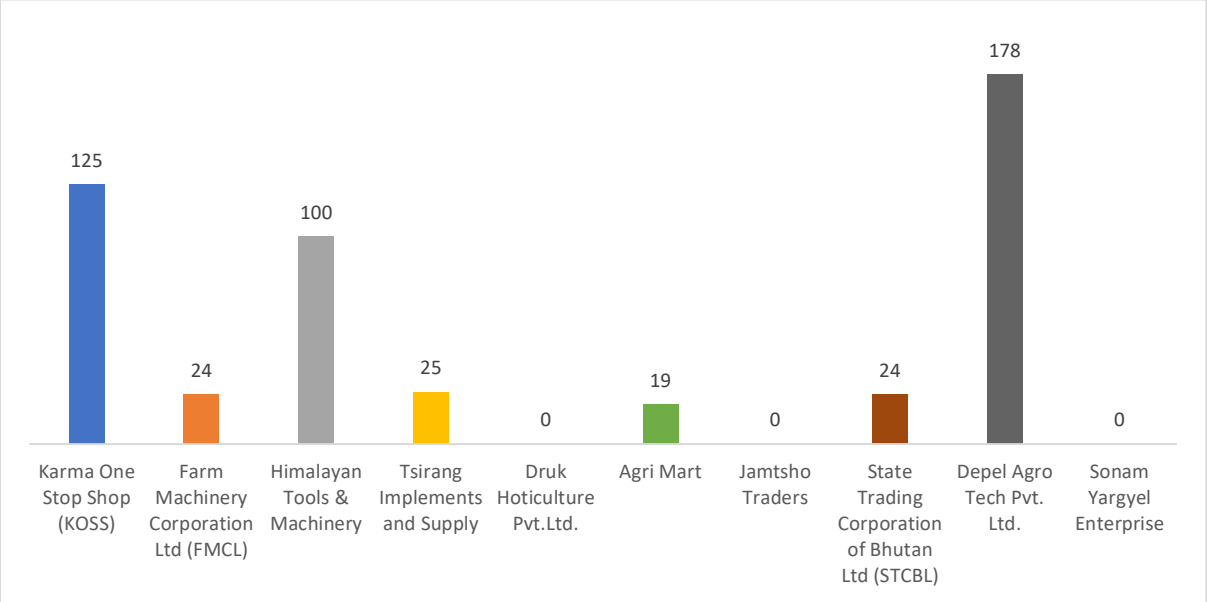
The survey revealed a wide disparity in the sales volumes of distributors. Approximately 40% of the dealers sold between 11 and 50 tillers over the past six months, while only 10% sold more than 51 tillers (Fig. II). Higher sales volumes generally correlate with better economies of scale, which can lead to improved inventory management and more efficient after-sales service, particularly in spare parts provision.

Fig. II: Percentage of business firms by sale of tillers



When compared to FMCL, a state-owned enterprise (SOE), nearly half of the private dealers have reported higher sales over the past six months (Fig. III). At the other end, some private dealers have not sold a single tiller during this period.

Fig. III: Sale of tillers in the last six months by business firms



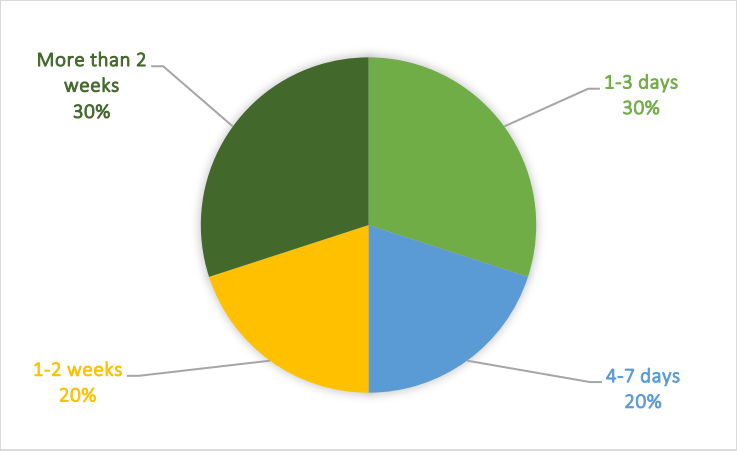
iii. Spare parts inventory

Approximately 90% of the dealers reported maintaining an inventory of commonly needed spare parts. The remaining placed orders only upon customer request. The dealers who did not maintain stock were more likely to experience delays in fulfilling customer orders, which can disrupt farming operations and lead to customer dissatisfaction.

iv. Spare parts delivery time

The delivery times for spare parts varied significantly. While 50% of the dealers reported that they could deliver parts within a reasonable timeframe, 30% of the dealers indicated that some parts could take more than two weeks to arrive. These delays are a major concern, as they can lead to extended downtimes for farmers and increased operational costs.

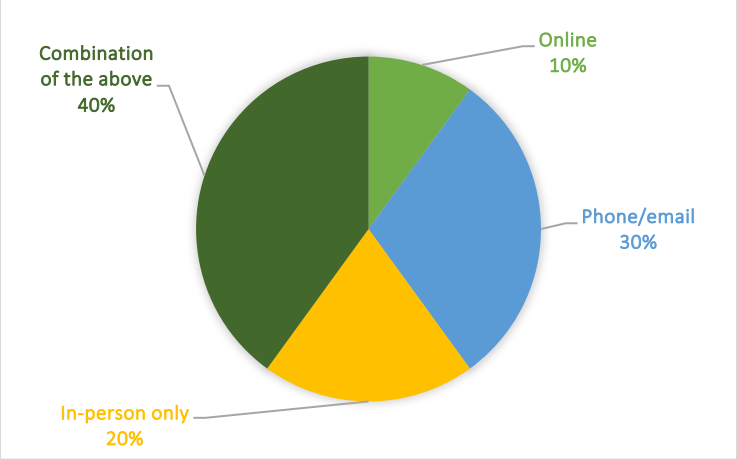
Fig. IV: Percentage of business firms by time of delivery of spare parts



v. Order placement modality

Most dealers (80%) offered flexibility in order placement, allowing customers to place orders via telephone or email. However, 20% of dealers still required customers to place orders in person, which can be an inconvenience, particularly for those in remote areas.

Fig. V: Percentage of business firms by order placement modality



vi. Advance payment for orders

For dealers who did not stock parts but were willing to source them on demand, 20% required advance payments. Of these, 50% requested an advance of 21-50%, while the remaining 50% required a 51-100% advance. This practice may deter some farmers, especially those with limited cash flow.

vii. Compensation for delays

Half of the surveyed dealers offered some form of compensation for delayed deliveries. Most of these dealers attributed delays to factors beyond their control, such as sourcing parts from distant manufacturers. For those offering compensation, 80% provided free delivery on future purchases, while 20% offered discounts on subsequent purchases. While these compensations provide some relief to customers, they do not address the underlying supply chain inefficiencies.

viii. Quality of spare parts and quality control

Tillage implements are among the most critical components in farming machinery, and most are locally fabricated. Given their importance, locally fabricated key tillage implements such as plough shares, rotary blades, and tines were sourced from various dealers and tested for material composition and hardness. For spare parts sourced from original equipment manufacturers (OEMs), testing is generally considered less critical due to the quality assurance processes implemented by these manufacturers.

Table I: Material composition & hardness of different tillage implements

	Spare Part Sample	**Chemical Element Composition**					**Remarks**	**Hardness Value (HBW)**
		Carbon	**Silicon**	**Manganese**	**Sulphur**	**Phosphorus**		
1	PTPS1	0.45 ± 0.01	0.18 ± 0	0.59 ± 0.00	0 ± 0	0.02 ± 0	Medium carbon steel	47.77
2	PTPS2	0.14 ± 0.01	0.11 ± 0	0.89 ± 0.01	0.01 ± 0	0.02 ± 0	Low Carbon steel	59.69
3	PTRB1	0.62 ± 0.01	2.58 ± 0.01	0.84 ± 0	0.01 ± 0	0.02 ± 0	High carbon steel	59.69
4	PTRB2	0.6 ± 0.01	2.58 ± 0.01	0.89 ± 0.01	0 ± 0	0.02 ± 0	High carbon steel	47.77
5	PTRB3	0.31 ± 0.01	0.22 ± 0	1.31 ± 0.01	0.01 ± 0	0.01 ± 0	Medium carbon steel	59.69
6	MTRB1	0.31 ± 0.02	0.25 ± 0	1.3 ± 0.02	0.02 ± 0	0.03 ± 0	Medium carbon steel	47.77
7	MTRB2	0.31 ± 0.01	0.22 ± 0	1.31 ± 0.01	0.02 ± 0	0.03 ± 0	Medium carbon steel	165.34
8	MTRB3	0.68 ± 0.02	0.49 ± 0.01	1.05 ± 0.02	0.02 ± 0	0.01 ± 0	High carbon steel	47.77
9	MTRB4	0.71 ± 0.01	0.89 ± 0.01	0.88 ± 0.02	0.01 ± 0	0.02 ± 0	High carbon steel	59.69
10	MTRB5	0.75 ± 0	0.3 ± 0	0.76 ± 0.01	0.01 ± 0	0.01 ± 0	High carbon steel	59.69
11	MTRB6	0.61 ± 0.02	0.18 ± 0.01	1.19 ± 0.02	0.01 ± 0	0.01 ± 0	High carbon steel	47.77
12	MTRB7	0.72 ± 0.01	0.86 ± 0	0.93 ± 0.01	0.01 ± 0	0.02 ± 0	High carbon steel	47.77
13	MTT1	0.27 ± 0	0.64 ± 0	1.45 ± 0.01	0.05 ± 0	0.03 ± 0	Low Carbon steel	59.69
14	MTT2	0.45 ± 0.01	0.19 ± 0.01	0.68 ± 0	0.01 ± 0	0.02 ± 0	Medium carbon steel	59.69
15	MTT3	0.29 ± 0.01	0.25 ± 0.01	1.27 ± 0	0.02 ± 0	0.03 ± 0	Low Carbon steel	47.77
16	MTT4	0.33 ± 0.12	2.39 ± 0.01	0.85 ± 0	0.01 ± 0	0.01 ± 0	Medium carbon steel	47.77
17	MTT6	0.69 ± 0.01	0.3 ± 0	1.3 ± 0	0.01 ± 0	0.03 ± 0	High carbon steel	75.04
18	MTT7	0.55 ± 0.02	2.45 ± 0.03	0.73 ± 0.01	0 ± 0	0.03 ± 0	Medium carbon steel	59.69

There is variability in the chemical composition and the Hardness Value of the materials used (Tab. I). The material composition of the tillage implements tested was as follows: 44.4% were made from high-carbon steel, 38.9% from medium-carbon steel, and 16.7% from low-carbon steel. Low-carbon steel (mild steel) is known for its moderate strength but higher malleability and ductility, making it cost-effective. However, its performance in wear resistance is limited compared to higher-carbon steels. In contrast, high-carbon steel is characterized by exceptional hardness, tensile strength, and wear resistance, making it suitable for demanding applications like tillage. The trade-off is that high-carbon steel is more brittle, which increases the likelihood of cracking under certain conditions.

While the AMTC has drawn up quality standards for certain spare parts—such as plough shares and rotary blades—compliance with these standards is not mandatory. AMTC does, however, issue provisional certificates for parts that meet its standards.

Discussions

The current supply system remains an obstacle to farm mechanization in Bhutan. This is especially true in areas with low demand for machinery and spare parts, where private businesses are hesitant to invest in improvements due to perceived insufficient demand.

The government has taken positive steps by establishing a state-owned enterprise (SOE) to address some of these supply chain issues, particularly in remote areas. However, there is still a need for further intervention to strengthen both public and private sector roles in improving availability, affordability, and reliability of machinery and spare parts.

To encourage businesses to improve supply chain efficiency, the government could offer tax incentives or credits to private firms willing to expand their inventories or establish outlets in rural areas. Government-backed loans with favorable terms could help these businesses manage inventory costs or cash flow issues, allowing them to keep higher stock levels without affecting day-to-day operations.

A key issue is the lack of technical standards for spare parts, particularly those that are critical and need regular repair or replacement. While enforcing compliance with standards may not be feasible immediately, it's essential to expand the scope and frequency of quality tests for a broader range of components. Issuing certificates of quality or fitness for use would ensure transparency, helping buyers make more informed purchasing decisions.

Increasing consumer awareness about the quality and value for money of machinery and spare parts can create market pressure for dealers to source higher-quality products. As a result, businesses will be incentivized to improve their offerings in order to remain competitive and capture a larger share of the market.

Finally, a more robust regulatory framework would improve market quality by reducing the frequency of equipment breakdowns, lowering repair costs, and enhancing overall farm productivity.

Conclusion

To overcome the supply chain barriers to farm mechanization in Bhutan, a combination of government intervention and private sector incentives is necessary. This could include expanding inventories of machinery and spare parts, improving quality standards, and raising consumer awareness about product value. Together, these steps would contribute to a more efficient, reliable, and affordable supply system, fostering greater adoption of farm mechanization and ultimately improving agricultural productivity in Bhutan.

Acknowledgement

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