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Review Article

Farm Machinery Testing and Standardization in Bangladesh: A Policy Review

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ABSTRACT

Farm mechanization in Bangladesh is exponentially growing which has led to timeliness of farm operation and increased crop productivity and farm income. For shifting of farm labour to non-farm sectors, sustainable crop production, efficient management of farm inputs, doubling the productivity and enhancing 4AR (Four Agricultural Revolution) dictating the use of appropriate and quality farm machinery. Different types of local and imported farm machinery are used in crop production. There was no legal authority functioning for testing and certification of these farm machinery in Bangladesh since 1989 to 2024. So, the farmers are not always getting quality and standard farm machinery although they have to pay good price to purchase machines. The farm machinery manufacturers are also suffering from proper marketing of machines due to unavailable of legal testing and certification facilities. Testing and certification of farm machinery are crucially essential to assess their functional suitability and performance reliability so that it will help farmers and other users in determining the comparative performance of machines available in market. Earlier, there was a Farm Machinery Testing and Certification System in Bangladesh but it was abolished in 1989 for rapid expansion of farm mechanization. Some experts opined that testing and certification system may restrict the abandoned uses of different farm machinery which may slow down the rapid speed of farm mechanization. So, the policy makers are confused about introducing the testing and standardization of farm machinery in Bangladesh, although there is a provision for Farm Machinery Testing and Certification System in National Agricultural Mechanization Policy 2020 and National Agricultural Mechanization Action Plan 2023. Recently, (February, 2025) National Standardization Committee (NSC) and Technical Sub-committee (TSC) have been formed. This paper explores the past and current states of farm machinery testing and standardization in Bangladesh, discussing existing challenges and potential solutions.

Keywords: Farm machinery, machine performance, safety, test certification, testing code

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1. Introduction

Bangladesh is a predominantly agricultural country with fertile land and a seasonal climatic variability produces diversified crops. Agriculture has long been the backbone of Bangladesh's economy, providing livelihoods for a significant portion of the population and making a major contribution to the country's food and nutrition security. Crop production has increased several folds although GDP has decreased compared to other sectors. Agriculture has contributed 11.38% to the country's total GDP in 2022-23 with 5.51% coming from crop sector [1]. In 2022, 36.86% of the employees in Bangladesh were active in the agricultural sector, 21.88% in industry and 41.26% in the service sector [2]. On top of that, most farmers in Bangladesh come from lower-income segments, which makes strengthening the agricultural value chain a crucial step for fostering inclusive growth.

Agri-mechanization is the process of integrating modern machines and equipment in farming to increase productivity and reduce farmers' vulnerability to labor shortages and natural calamities [3]. Agricultural

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mechanization generates higher productivity, efficiency and prevents the loss of crops. Bangladesh is a semi-mechanized agricultural country. The nature of agricultural land is fragmented, alluvial, hilly, and there are no roads suitable for transporting large agricultural machinery. Therefore, small and light-weight machinery is used in agriculture. Almost 100% of the engines, power tillers, tractors, rice transporters, reapers, and combine harvesters used in the country are imported. About 85% of other agricultural machinery (Thresher, maize sheller, seeder, bed planter, sprayer, etc.) and spare parts are produced locally [4]. Most of the locally manufactured agricultural machinery is diesel-powered and not quality controlled. As a result, the quality, functionality, and efficiency of the same machinery manufactured by different manufacturers vary, creating problems for the farmers [5].

During 1960-65, as a part of mechanization program, the government distributed 2,238 power pumps, 200 tractors, 13,828 sprayers among the farmers. At that time irrigation pumps were popularized and adopted with high yielding varieties and chemical fertilizers [6]. But other machinery could not get momentum due to high import costs of quality machines. After the devastating flood in the year 1988, which caused a serious shortage of animal draught power and then the government exemption of tax on imported tilling machines, small diesel engines and dissolved the 'National Standardization Committee' in 1989. As a result, since 90s, a huge influx of Chinese and Indian made power tillers, tractors, diesel engines and other agricultural equipment in the country [7].

The annual market size for agricultural machinery in Bangladesh is US$ 2461.26 of which 72% is imported and 28% is locally produced (in terms of money). On the other hand, about 77% of spare parts are locally produced and 23% are imported. There are about 400 foundries, 1500 spare parts manufacturers and 40000 retailers engaged in manufacturing and marketing of machines and spare parts [8]. The product portfolio of local foundries and agricultural machinery manufacturing industries majorly consists of spare parts and small machines like rice milling machines, sprayer machines, threshers, and irrigation pumps. The quality of both imported and locally produced machinery and spare parts seems to be fair to good. There is no mechanism for testing and standardization of both imported and locally produced machinery and spare parts. So, the farmers are not always getting quality and standard farm machinery although they invest good prices to purchase machines. The farm machinery manufacturers are also suffering due to unavailability of manufacturing codes and legal testing and certification facilities.

The adoption of modern farm machinery is essential for improving efficiency and productivity. However, the efficacy of this machinery is contingent upon rigorous testing and standardization processes. Currently, the lack of legal framework for testing and standardization poses risks to both safety and performance. This paper aims to analyze the existing landscape of farm machinery testing in Bangladesh, identify key challenges, and propose actionable recommendations for stakeholders.

2. Current status of farm mechanization

Farm mechanization is defined as the use of all means of machinery and equipment, from simple and basic hand tools to more sophisticated and motorized machinery, in agricultural operations. Simply the use of machines and tools in agricultural operation is agricultural of farm mechanization. Farm mechanization is essential in agriculture to mitigate labor shortage for agricultural production, timeliness of operations and efficient use of agricultural inputs. Farm mechanization contributes about 15% higher productivity, 20% cropping intensity and reduces 30% labour, 30% time, 20% seed and 20% fertilizer [9]. Farm mechanization in Bangladesh (The then East Pakistan) was formally started through Mechanized Cultivation and Power Pump Irrigation (MCPP) scheme during 1950-51 executed by Directorate of Agriculture. It gained momentum during nineties due to the government exemption of tax on imported farm machinery and small diesel engines and dissolved the 'National Standardization Committee' in 1989. Then a huge inflexed of Chinese and Indian made power tillers, tractors, diesel engines and other agricultural equipment in the country [5]. About 96% of the land is cultivated by about 750,000 power tillers and 65,000 tractors. About 20% of the crop is harvested by reaper or combine harvester, including paddy and wheat. About 97% of the irrigation and 89% of the crop is harvested by threshing machines. On the other hand, about 100% of the horticultural crops are harvested by hand. Only 5% of the field crops are sown or planted by machinery. Now about 36.6% labour is involved in agriculture and farm power input is about 3.61 kW/ha. At present about 2.6 million farm machinery are in the farmers' fields for various farm operations [10]. Among them, the quality of farm machinery is often low due to a lack of quality control systems. It is often said that locally manufactured farm machinery is not as good as imported machines. This is due to the lack of skillness of manufacturing technicians, outdated fabrication machinery and technology and lack of quality raw materials available in the market.

3. Testing and standardization

3.1 Standardization

Standardization of Farm Machinery refers to the process of establishing and implementing uniform technical specifications, procedures, and guidelines for the design, manufacturing, testing, and operation. This ensures consistency, safety, efficiency, and interchangeability of machinery parts across different brands and manufacturers. Key aspects of standardization are uniform specifications and development or adoption of standard codes. Uniform specifications are creating technical criteria that all manufacturers must adhere to quality machine design and fabrication with specific materials and procedures [11]. On the other hand, development or adoption of standard codes are essential for manufacturing and testing of farm machinery and spare parts ensuring quality and safety suitable for local conditions.

3.2 Testing

The term testing is usually an analysis of the behaviour of a machine compared with standards under ideal conditions [11]. According to ASABE (American Society of Agricultural and Biological Engineers), farm machinery testing involves a systematic approach to evaluate the performance of agricultural equipment under defined conditions to ensure it meets specified operational criteria and safety standards [12]. Testing is an infinite process of comparing the invisible to the ambiguous in order to avoid the unthinkable happening to the anonymous [13]. So, testing is an important part of a machine after fabrication to check whether it is fabricated as per design and drawing or deviated. Also, it is essential to know whether it is workable as per expectation of the users.

3.3 Certification

Certification is the test-based document issued for a machine whether it is suitable for certain safe farm operations. Farm machinery testing and certification are done by legal technical committee for its legality and acceptability. The testing and certification should include checking physical parameters (Specification/manufacturer's details), testing as per standard testing code or protocol (Laboratory test, performance or field test, endurance or durability test, ergonomic test, safety test and environment compliance test) data analysis, preparation of test report, approval of test report and issuing test certificate) [14].

4. Purposes of standardization and testing

The rapid demand for farm machinery has promoted many manufacturers to produce and traders to import farm machinery. With high investment in farm machinery, it is necessary to have some means of assessing the performance of machines being brought out by the various manufacturers and importers. Also, the farmers or users should know the suitability of farm machinery before purchasing [13]. The following purposes are listed for testing of farm machinery manufactured within the country or imported.

- Serve as a basis to decide the type of machine, best suited for different locations of Bangladesh which could be encouraged for import, production and popularization.
- Help the farmers and other prospective purchasers in determining the comparative performance of machines available in market.
- Provide information to engineers and extension workers for guiding farmers and other purchasers in proper selection of equipment.
- Form the basis for standard specification to be used by the manufacturers and distributors.
- Help financial institutions in recommending financial assistance both to the manufacturers as well as farmers.
- To carry out trials on machines and implements which have proved successful in other regions of the world intending to examine the possibility of export to other countries.
- To assist the manufacturers in the overall product improvement and facilities in updating the specifications based on the test conducted on latest model.

- To promote, export of agricultural machines through testing in accordance with the international standards.
- To carry out research and development on selected farm machinery and implements for its improvement.

5. Global and Regional Testing and Standard Organizations (SDOs)

ISO: The International Organization for Standardization is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. The International Organization for Standardization was founded in 1947. It has over 800 TCs and SCs. Bangladesh is an ISO member since 1974 [15].

OECD: The Organization for Economic Co-operation and Development (OECD) recognized the benefits of transparency in the development of agricultural tractor testing procedures. OECD developed first Standard Code for the testing of tractors in 1959. Now, ISO/TC 23/SC 2 and OECD have established a bilateral relationship in an effort to create dual designated ISO/OECD standards that can be used globally [13].

NTTL: Nebraska Tractor Test Laboratories (NTTL) the initial SDO (Standard Development Organization) for the performance standards of tractors in the United States was the Nebraska Department of Agriculture and the University of Nebraska, USA. Nebraska tractor test law was effective from July 15, 1919 and the first successful test was in 1920 [13].

ASABE: ASABE (American Society of Agricultural and Biological Engineers) was founded in 1907 recognized worldwide as a standards developing organization for food, agricultural, and biological systems approved by the American National Standards Institute. ASAE Standards are consensus documents developed and adopted by the American Society of Agricultural Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management [12].

RNAM: The Regional Network for Agricultural Machinery (RNAM) was established by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in cooperation with the United Nations Industrial Development Organization (UNIDO) and the Food and Agriculture Organization (FAO) in 1977. In 2002, RNAM was upgraded to a Centre known as the Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM). APCAEM then adopted its current name as Centre for Sustainable Agricultural Machinery (CSAM) in 2012. In the 1980s RNAM produced very successful sets of Codes that are still used in the Asia Pacific region [16].

ANTAM: Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) was formed at the Roundtable Forum for the Regional Agricultural Machinery Manufacturers/Distributors Associations held by CSAM (then called UNAPCAEM) in Seoul, Korea in 2006. Bangladesh is an active member of ANTAM. ANTAM aims to promote harmonization of testing standards of agricultural machinery amongst 19 participating countries including Bangladesh in the Asia-Pacific region in order to enhance the quality, performance, occupational safety and environmental dimensions of the machinery. ANTAM developed Standard Codes for Testing of Power Tiller, Tractor, Mini Tiller, Combine Harvester, Rice Transplanter, Sprayers, etc [17].

ENTAM: European Network for Testing of Agricultural Machines (ENTAM) was founded in 1999 to carry out voluntary testing of performances, safety and environment protection and animal welfare requirements of animal husbandry, horticultural, agricultural and forestry machines and equipment based on national and international standards [18].

Different countries have their own Agricultural Machinery Testing Centre e.g. China Agricultural Machinery Testing Centre (CAMTC), Beijing, China; Central Farm Machinery Training and Testing Institute (CFMTTI), Budni, India, etc. But there is no such organization in Bangladesh.

6. Past Testing System in Bangladesh

There was a Committee for Standardization of Agriculture Machinery before independence of Bangladesh. After independence of Bangladesh in 1972, The Ministry of Agriculture formed a committee 'Standardization of Agriculture Machinery' [19]. In 1983, the Ministry of Agriculture reformed the committee as 'National Standardization Committee for Agriculture Machinery' [20]. In 1989, the above committee was suspended for private sector by a government order due to sudden death of draft animal by devastating flood in 1988 and for rapid expansion of farm mechanization without considering quality assurance.

7. Present Testing System in Bangladesh

The Bangladesh Standards and Testing Institution (BSTI) is mandated for formulating and implementing national standards to ensure the quality of products and services. In accordance with an ordinance passed on July 1985, the agency was set up at Tejgaon in Dhaka. It became a member of International Organization for Standardization (ISO) in 1974. There are standards, testing and certification systems for Agricultural and Food Products and other Engineering Materials but there is no such system for Agricultural Machinery. There is a 'Pump Engine and Agricultural Implements Sub-Committee' under Mechanical Engineering Division in BSTI, but no standardization, testing and certification system is available for agricultural machinery in BSTI [21]. DAE (Department of Agricultural Extension) built an Agricultural Machinery Testing and Training Centre in Gazipur but testing has not been functioning till now due to lack of legal framework, manpower and equipment. No specific code is followed in Bangladesh. Some cases, RNAM and ANTAM test codes are used but this is not mandatory as there was no legal controlling authority.

Recently (10 February 2025) Ministry of Agriculture, Government of the People's Republic of Bangladesh has officially formed two committees-National standardization committee (NSC) and technical sub-committee (TSC) for standardization, testing and certification of farm machinery in Bangladesh. The list of NSC and TSC are given in Table 1 [22] and Table 2 [23], respectively.

Table 1. National standardization committee for farm machinery

SI No.	Name and designation	Position
1	Additional Secretary, PPC Wing, Ministry of Agriculture	Chairman
2	Additional Director (Inputs), Field Service Wing, Department of Agricultural Extension	Member
3	Head, Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute	Member
4	Head, Farm Machinery and Postharvest Technology Division, Bangladesh Rice Research Institute	Member
5	Head, Department of Mechanical Engineering, Bangladesh University of Engineering and Technology	Member
6	Head, Department of Farm Power and Machinery, Faculty of Agricultural Engineering and Technology, Bangladesh Agricultural University	Member
7	Additional Chief Engineer (Minor Irrigation), Bangladesh Agricultural Development Corporation	Member
8	Additional Chief Engineer, Agricultural Engineering Wing/ Agricultural Engineer, Field Service Wing, Department of Agricultural Extension	Member
9	Deputy Secretary/ Senior Assistant Secretary, Planning Wing-5, Ministry of Agriculture	Member
10	Representative, Agricultural Credit Division, Bangladesh Bank	Member
11	Representative, Bangladesh Standard and Testing Institute	Member
12	President, Agricultural Machinery Manufacturers' Association, Bangladesh	Member
13	President, Bangladesh Agricultural Machinery Merchants' Association	Member
14	Chairman, Technical Sub-Committee	Member-Secretary

Table 2. Technical sub-committee (TSC) for standardization, testing and certification of farm machinery

Sl No.	Name and designation	Position
1	Chief Scientific Officer, Agricultural Engineering Unit, Bangladesh Agricultural Research Council	Chairman
2	Representative, Department of Farm Power and Machinery, Faculty of Agricultural Engineering and Technology, Bangladesh Agricultural University	Member
3	Deputy Secretary/ Senior Assistant Secretary, Planning Wing-5, Ministry of Agriculture	Member
4	Representative (Agricultural Engineering), Department of Agricultural Extension	Member
5	Head, Agricultural Machinery Testing and Training Centre, Department of Agricultural Extension	Member
6	Representative, Farm Machinery and Postharvest Technology Division, Bangladesh Rice Research Institute	Member
7	Representative (Agricultural Engineering), Bangladesh Agricultural Development Corporation	Member
8	Head, Agricultural Engineering Division, Bangladesh Sugar Crop Research Institute	Member
9	Principal Scientific Officer, Agricultural Engineering Unit, Bangladesh Agricultural Research Council	Member
10	Head, Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute	Member-Secretary

8. Diverse Perspectives

Some experts emphasize the necessity for quality assurance to protect farmers and sustainable farm mechanization. Others argue testing may slow down farm mechanization. Lengthy testing and bureaucratic approval processes can slow down the introduction of farm machinery to the market, impacting local manufacturing farmers' access. If the standards set by the committees are unrealistic or not aligned with local needs, it can create a barrier for manufacturers looking to produce affordable, suitable machinery. The pace of farm mechanization is also affected by farmers' ability to invest high price for good quality machine. However, there is no alternative for quality assurance of farm machinery in the world for its production, marketing, uses and safety. There are a numbers of good quality machines and spare parts produced in the country [8]. There are demands for these machines and spare parts in the neighbouring countries. Without testing and certification system these machines and spare parts could not be exported. Good numbers of machines are now in the farmers' fields. Many of the locally produced machines and spare parts are superior to imported ones. So, there should be obviously quality control system so that inferior farm machinery and spare parts cannot be imported.

9. Policy Framework

In Article 11 of the National Agricultural Mechanization Policy 2020 provides the provision for the quality testing and certification of agricultural machinery. Article 11.1 states that assistance will be provided to create infrastructure and make equipment readily available for the quality determination of agricultural machinery, and to create skilled manpower. In 11.2 Government service providers will provide quality determination services according to the needs of agricultural machinery manufacturers, importers and users, while research and educational institutions will increase laboratory facilities and take measures to test quality. In this regard, initiatives will be taken to formulate necessary laws, rules and procedures for quality determination and certification. 11.3 Campaigning and awareness-raising measures will be taken among all stakeholders to increase awareness at the level of agricultural machinery manufacturers, suppliers and users about the need, benefits and advantages of quality determination [24]. In National Agricultural Mechanization Action Plan 2023, necessary targets have been fixed within time frames for execution of the policy [25].

10. Challenges

- There is no organization or institute for testing and standardization of farm machinery
- Inadequate testing laboratory and equipment

- There are no national standard codes and protocols for testing and standardization of farm machinery
- Lack of access to finance from traditional financial institutions in the agriculture machinery market
- Inadequate skill manpower
- Inadequate market availability of quality machines
- Farmer's accessibility to quality farm machinery
- Lack of awareness of farm machinery stakeholders for testing and standardization
- Lack of quality raw materials for producing quality farm machinery
- Inadequate branding system for marking and marketing farm machinery.

11. The Way forward

- Establishment of a national institute for testing and standardization of farm machinery
- Easy access to the testing and standardization secretariate for quick testing and certification system
- The BDS Codes (Bangladesh codes) draw upon major international guidelines and standards formulated by ISO and OECD, ANTAM, and merge popular Codes and practices that are widely used by the country
- As NSC and TSC are legally formed, testing of agricultural machinery may be started now utilizing the existing testing facilities prevailing in BAU, BARI, BRRI and DAE.
- Strengthening the linkages with regional and international Testing and Standard Organizations (SDOs)
- Provide long term soft loan system for establishment of modern farm machinery manufacturing plant with modern fabrication machinery
- Testing and standardization should be adopted step by step (First for public sector then industry and private sector) and easier to harder
- Capacity building of testing laboratory and manpower
- Engagement of farm machinery stakeholders
- Continuing government support in the form of subsidies to the farmers for purchasing quality farm machinery
- Gradually computer and sensor-based precise testing methods and data acquisition should be introduced.

12. Conclusion

Advancing farm machinery testing and standardization in Bangladesh is imperative for enhancing agricultural productivity and sustainability. By implementing comprehensive testing methodologies and establishing a robust standardization framework, stakeholders can address current challenges and unlock the full potential of modern agricultural machinery. The government should establish a National Institute for Testing and Standardization of Agricultural Machinery with modern facilities to accelerate testing and certification of farm machinery with global standards. Collaborative efforts among government bodies, agricultural organizations, and the private sector will be essential to drive these initiatives forward. Investing in testing and standardization is not only a pathway to increased agricultural efficiency but also a crucial step toward ensuring food security in Bangladesh.

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