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Status of rice farming mechanization in Bangladesh

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ABSTRACT

The change in agricultural sector such as migration of rural labor to urban areas, price hike of wage rate during peak period, attractive wage rate in off-farm activity, industrialization, government policies, distribution of farm machines through development assistance accelerated the farm mechanization in the country. The use of farm machinery not only depends on economic and policy matters but also social and psychological factors to the acceptance of modern machinery in the farming operation. Labor shortage and high labor wage rate compelled the farmers to accept farm mechanization. Power availability in farming sector increased at 8% rate due to intervention of government policy in mechanized cultivation. Tillage, spraying and rice threshing are almost fully mechanized, however little progression on mechanization were observed in other activities such as weeding, fertilizer application, harvesting and carrying crops. Adoption of mechanized cultivation increased rapidly due to active involvement of public, private, donors and non-government organization. Quality machinery and after sale service are necessary in successful implementation of farm mechanization program. Government intervention plays an important role in promoting farm mechanization. Power tiller, tractor, reaper and combine harvester are imported from Korea, India and China. The growth of manufacturing industry increased rapidly due to increase in market size. Sprayer, applicator, weeder, irrigation pumps and threshers are manufactured locally by using locally available material. Small and fragmented land restricts the farmers to use larger size of farm machinery. Present land tenure system does not permit the easy movement of farm machinery. The important aspect of farm mechanization is to enlargement of land size. Small size of plot decrease the field capacity of the farm machines. Accessibility of farm machinery in farm land is necessary. Government assistance in farming sector should be continued to procure selected farm machinery at farmer's level, exemption of import tax on some items, disbursement of fund on the machinery research, extension and capacity building. Government should formulate mechanization policy and promotion law on the production, supply and usage of farm machinery.

Key Words: Farm machinery, Power availability, Labor shortage, Wage rate and Policy

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I. Introduction

Rice (*Oryza sativa* L.) is grown in three distinct seasons- namely *boro* (Dec-April), *aus* (April-July) and *aman* (Aug-Nov). The country produced 34.5 million metric ton of cleaned rice in 10.61 million

hectares of land (BARRI, 2014). The yearly per-capita rice consumption is decreasing from 180 kg in 1977 (Ahmad and Hassan, 1983) to 148 kg in 2015. The population will reach 215.4 million in 2050 and the demand of cleaned rice would be 44.6 million ton (Kabir *et al.*, 2016). The land area is decreasing at the rate of 80,000 hectare annually due to construction of road, house and industry (BARRI, 2009). The farmers have to grow more food within the limited land resources to meet the growing demand. The country aims at increasing productivity in order to achieve food for raising demand and establish social security of this growing population (USDA, 2015). The country's labor force stood at 56.7 million on 2010 from whom 9.2% are already diverted to other professions by 2014 (BBS and SID, 2015). The agricultural labor force followed decreasing trend (48.3 % in 2002-03 and 45.1 % in 2013) due to shifting low productivity to high productivity sector (BBS, 2015). As a result, the availability of agricultural labor force become very scarce and cost of crop cultivation increase with the hike in the wages of labor leading to reduce profits to the farmers. Unavailability of laborers during cultivation period compelled the farmers to delay in harvesting which results in yield loss; sometimes incurred total loss of field crops due to natural disaster. It also hampers the land preparation and sowing operations for the next crop. On the other hand, rice cultivation was threatened by frequent northwester storm just at the time of harvesting. Farmers often lost paddy at the last stage of crop growth due to natural calamity and labor shortage. To keep economical consistency over the shifting of manpower from agriculture to service and industry, it requires filling up the labor gap in agricultural operations by mechanical interventions (Islam *et al.*, 2016a). There is a substantial contribution of mechanization in agricultural operations that made it possible to release agricultural laborers to get into other high income professions (i.e. business or service). Mechanization can help to increase the cropping intensity by reducing the turnaround time and faster operation of agricultural activities. In Bangladesh, rice is grown in 80% (11.27 mha) of the total cropped area (Kabir *et al.*, 2016). Therefore, the present paper is mostly focused on the constraints and prospects of mechanized rice cultivation in Bangladesh.

Why farm mechanization?

Transplanting, weeding, harvesting and threshing operations are considered as four major labor intensive operations in rice cultivation in Bangladesh condition. Table 01 presents the operation wise labor requirement in manual and mechanized rice cultivation. Mechanized cultivation substantially reduces the labor force than manual operation. Traditional method is incapable whereas adoption of mechanization is a way to meet such conditions with a burden of large investment. Emphasis should be given to mechanize these operations in order to reduce the labor requirement in rice cultivation. To increase crop security, faster transplanting and harvesting operation are ways that could only be established by mechanical intervention. Mechanization transform the labor intensive works to power intensive works and reduce the human drudgery. It has been proven that mechanization maximize the production, reduce the cost of cultivation and post harvest loss and made agriculture profitable.

Table 01. Labor requirements in manual and mechanized rice cultivation

Technology	Labor requirement		Remarks
	Manual man-hr ha ⁻¹	Machineman-hr ha ⁻¹	
Transplanter	123-150	9-11	Islam <i>et al.</i> (2016b)
Prilled urea applicator	4	4	Islam <i>et al.</i> (2015)
USG applicator	4	4	Islam <i>et al.</i> (2015)
Weeder	86	22	Islam <i>et al.</i> (2017)
Reaper	80-84	9-10	Alam <i>et al.</i> (2014a)
Open drum thresher	50-52	20-22	Islam (2006)
Close drum thresher	50-52	14-18	Islam (2006)
Winnower (man-hr t ⁻¹)	21	5	Ahiduzzaman <i>et al.</i> (2000)

Mechanization scenario

Table 02 presents the existing scenario of farm machinery available in Bangladesh. Mechanical intervention in crop production is gradually increasing from 1980s after massive introduction of two-wheel tractor and small engine due to liberalization of import tax and banning of standardization committee on farm machinery. Still power tiller is more popular than tractor due to low purchase

price and advantage in carrying, moving, hauling. Government assistance accelerates to power tiller farming. Now-a-days, land preparation is fully depended on either power tiller or tractor on custom hire basis. At present, 80% land is prepared by power tiller and 18% by tractor. Small diesel engine is not only used in crop production, it is also used in other commercial purposes like electricity generation, grain cleaning, boat, mobile huller, sugarcane crusher, irrigation pump, rural transport etc. Rice transplanting is done manually. Mechanized transplanting is being started recently using 4-row walking type transplanter through public and private sector intervention. Seedling raising is crucial part of mechanical transplanter. Farmers do not know how to raise seedlings suitable for mechanical rice transplanter. The seeder machine is used in some parts of the country to sow jute, lentil, mungbean and rarely paddy seeds. Fertilizer application is mostly done by hand and applicators are rarely used to place urea super granule and prilled urea in subsurface. Weeding operation is mostly done by hand and some parts of the country, farmers use weeder to control weed. Weedicide use is getting popularity due to minimize the weeding cost. Knapsack sprayers are extensively used in crop production purpose. Farmers irrigate the land using deep tubewell or shallow tubewell or low lift pump. Traditional devices are used in very few areas to supply water especially in vegetable cultivation. Harvesting operation is mostly done by sickle. Research institutes, department of agricultural extension, private sector and non-government organization are trying to promote local and imported reaper (self propelled or power tiller mounted) in the country. Due to limitation, this technology is not getting popular throughout the country. The adoption rate of rice transplanter, seeder, granular urea applicator, prilled urea applicator, reaper, combine harvester and dryer is low due to several constraints. Combine harvester is complicated and sophisticated machine and performs four operations i.e. cutting, threshing, cleaning and bagging in one pass travel.

Table 02. Present status of farm machinery in Bangladesh

Name of machine	Quantity, no.	Source
Diesel engine	25,00,000	MoA, 2016
Power tiller	7,00,000	Ahmed, 2014
Tractor	60,000	Ahmed, 2014; Kabir, 2014
Seeder	5,000	Wohab, 2012
Rice transplanter	300	Islam, 2016
Weeder	2,50,000	Ahmed, 2014
Granular urea applicator	800	Ahmed, 2014
Prilled urea applicator	18,000	MoA, 2016
Sprayer	13,00,000	Ahmed, 2014
Reaper	500	Ahmed, 2014
Combine harvester	130	Ahmed, 2014; Kabir, 2014
Open drum thresher	1,50,000	MoA, 2016
Closed drum thresher	2,20,000	MoA, 2016
Winnower	3000	Ahmed, 2014
Power driven pump	1,67,175	MoA, 2016
Deep tube well	35,566	MoA, 2016
Shallow tube well	15,48,711	MoA, 2016

Farm power availability

Power availability in agricultural operation indicated the intensity of mechanization. Farm power availability was calculated based on the energy input per unit area of cultivable land. Figure 01 shows the trend of farm power availability in agriculture over the period of 1960 to 2013. The power availability was very low before 1984. From 1960 to 1984, the rate of increment of farm power was observed 1.2%. The farming sector got momentum to use machinery after liberalization of import policy on power tiller in 1988. After 1995, government emphasized the importance of mechanization and taken different initiatives such as provided fund in research and extension on farm machinery, policy formulation, tax exemption on some important items and encouraged local manufacturing of farm machinery. Hence, power availability in farming sector sharply increased at 8% rate due to intervention of government policy in mechanized cultivation. The progression on the farm power availability in farming sector continued due to provide government assistance to procure selected

farm machinery at farmer's level, exemption of import tax on some items, disbursement of fund on the machinery research, extension and capacity building.

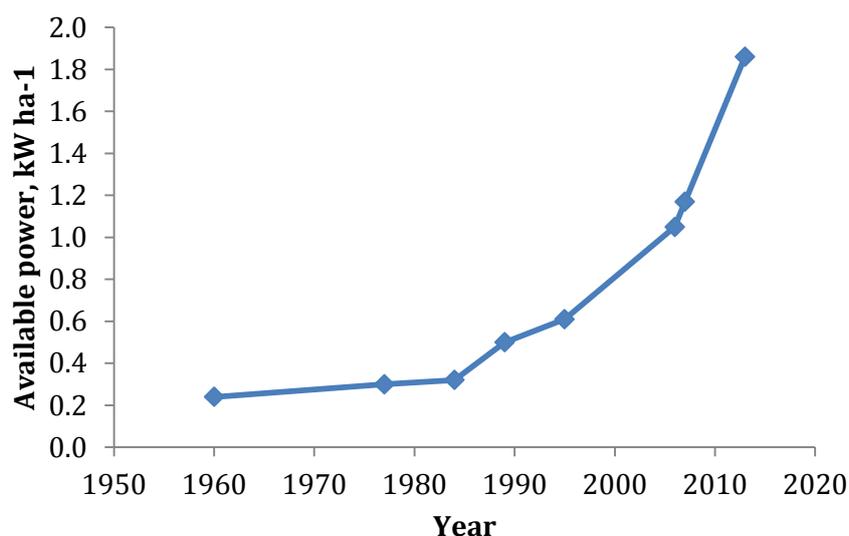


Figure 01. Farm power availability in agriculture sector (Adopted from Islam, 2010 and CSAM, 2015).

Import scenario of farm machinery

At the initial stage of mechanization, power tillers were imported from Japan and tractors were imported from Russia (Belarus model) and England (Messy Ferguson model). Now-a-days, most of the tractors are imported mainly from India. After liberation war, Kubota and Yanmar model power tillers were imported from Japan. Performance of those models were satisfactory however, price was beyond the purchasing power of our farmers. After devastating flood in 1988, government relaxed the import tax on power tiller and low cost power tillers were imported from China. Now, almost 100% power tillers are being imported from China. Two models of power tiller namely Dongfeng and Sifang are widely used in the country. Very few rice transplanters including walking and ride on types are operated in the country and all the transplanters are imported from Korea and China. CIMMYT introduced power tiller operated Chinese seeder (2BG-6A) in 1995. The use of seeder machine is increasing day by day, Most of the seeder machines are imported from China and very few are manufactured locally. Irrigation pumps and sprayers (either power or knapsack sprayer) were imported from Korea, China, Brazil, and India. Now, irrigation pumps and sprayers are manufactured locally. At present, reapers are imported from China, South Korea, Vietnam and India. Very few rice-wheat reapers were manufactured locally and sold to the farmers. The quality of reaper was not up to the mark. The local manufacturer was unable to manufacture good quality cutting blade which was the crucial part of the reaper due to lack of heat treatment facility. The demand of rice-wheat thresher and maize sheller are met up by the local manufacturer. Combine harvester of different makes and model are imported from India, South Korea and China.

Farm machinery manufacturing industry

Until the beginning of this century, Rahman Engineering Workshop, Kushtia; Alim Industries Limited, Sylhet; Comilla Cooperative Karkhana, Comilla; MAWTS, Dhaka; Mahboob Engineering, Jamalpur and Uttaran Engineering Workshop, Dinajpur played pioneering rule in manufacturing different kinds of farm machinery especially hydrotiller, weeder and thresher. There were also small manufacturers available in the country to fabricate threshers and irrigation pumps and sold directly to the farmers. Large manufacturers are establishing the research and development section, setting up marketing and testing facility, creating good environment for worker, installing modern capital machinery to start line production with maintaining quality of the product. Alam *et al.* (2014b) stated that the growth of farm machinery manufacturing and associated industries were about 70 foundries, 800 agro-machinery manufacturing workshop, 1,500 spare parts manufacturing industries and workshops and about 20,000 repair and maintenance workshops are engaged in agro-machinery subsector of the

country. The growth of local farm machinery manufacturing industry is expanding day by day. Knapsack sprayers, irrigation pump, seeder, thresher, corn sheller, rice milling equipment and spare parts of power tiller and engine are manufactured locally in different parts of the country and satisfy the local demand. Most of the farm machinery manufacturers considered machinery business as seasonal due to seasonal demand. Very few manufacturers got technical assistance from the research institutes. In general, small manufacturers do not use jigs and fixtures and produce different standard machines. On top of that, manufacturers do not use quality materials and follow the exact specifications consequently produce low quality machines. Manufacturers do not have heat treatment and foundry facility. Very few manufacturers have research and development section to modify the farm machinery according to the demand of the farmers. Manufacturers do not have the instrument to test the machine in off-load and load condition. Reverse engineering started in Dholaikhal and Nawabpur area in old Dhaka town. Later those factories were shifted to Bogra and Jessore areas. Bogra is the largest manufacturer of farm machinery and spare-parts in Bangladesh. Manufacturer face problems on capital, setting up infrastructure, skilled labor, complexity in bank loan, low quality of raw material and technical know-how of the worker. In the competitive market, many manufacturers produced sub-standard machinery and sold to the farmers at lowest price, which created a negative impact among the farmers.

Marketing network

The marketing channel of the imported farm machinery is the importer, wholesaler/dealer, sales employee and retailer. The traders have the good marketing network throughout the country and providing after sale service. They have set up show rooms in different districts where farmer/entrepreneur can watch the machine and purchase directly from the show rooms. Small manufacturers sold the product directly to the farmers in different parts of the country through their own manpower as well as dealership network. Most of the manufacturers have the limited access to collect information on the market size. Information on market size in each product helps the entrepreneur to make decision on production volume and establishment of sales network. Small manufacturers are unable to gather market information from different parts of the country due to resource constraints and sell the product in local areas only.

Research on farm machinery

Farm mechanization depends on the development of appropriate machinery suitable to our present land and socio-economic condition of the farmers. Bangladesh Rice Research Institute, Bangladesh Agricultural Research Institute, Bangladesh Sugar-crop Research Institute and Bangladesh Agricultural University are actively involved in the design, development, field testing, farm level evaluation, validation, dissemination, feedback collection and modification of the farm machinery and technology. Farm Machinery and Postharvest Technology Division, BIRRI has the prime responsibility to design, develop, test and validate the rice based machinery and technology. It has developed number of farm machinery and technology and disseminated to the farmers' field. Among them, seedlings raising technique for mechanical rice transplanter, BIRRI weeder, BIRRI USG applicator, BIRRI prilled urea applicator, BIRRI rice-wheat reaper, BIRRI open drum thresher, BIRRI panicle thresher, BIRRI rice-wheat thresher, BIRRI winnower and BIRRI chopper are the prominent farm machinery and technology. Those machines and technologies are widely used in the country. BIRRI is conducting research on the development and fabrication of farm machinery using locally available material under public private partnership approach. In the mean time, BIRRI worked on the manual rice transplanter and power weeder with Alam Engineering Workshop, Dhaka; chopper and combine harvester with Janata Engineering Workshop, Chuadanga and panicle thresher with Farida Engineering Workshop, Bogra. Local manufacturers modify the farm machinery according to the demand of the farmers. Research institutes offer technical assistance to the manufacturer by providing design, drawing, technical expertise, suggestion and field testing.

Extension of farm machinery

Demonstration is the strongest tool for creating awareness of the farmers. Department of Agricultural Extension (DAE) is the only one government owned extension agency providing advisory supports to the farmers on all types of technology related to the agriculture. Agricultural engineers of DAE are

conducting large scale demonstration program on different farm machinery and technology with the assistance of respective district and upazila agricultural extension office. In 1998, BIRRI for the first time of its history, got the small project named “Adaptive research and impact study agricultural machinery in some district of Bangladesh (ARISAM)” to disseminate the BIRRI developed farm machinery and technology in different villages of Thakurgaon and Dinajpur districts. BIRRI rice-wheat reaper, BIRRI rice-wheat thresher, BIRRI open drum thresher and BIRRI power winnower were demonstrated in the project locations. Local farm machinery manufacturers were enlisted to fabricate and market BIRRI machine to the farmers. After successful completion of ARISAM project, GoB provided fund to BIRRI on the project named “Popularizing Agricultural Machinery Project (PAMP)” for the research and extension of rice based machinery and technology. The project was executed in 21 districts in 2002-06. During the project period, farmers purchased more than 5000 BIRRI machines at their own cost and operated those machines on custom hire service. GoB also funded to BIRRI to execute the project named “Farm Machinery and Technology Development (FMTD)” to disseminate BIRRI farm machinery to the farmers through extensive field demonstration and training. During the project period, 5,375 BIRRI developed machinery were sold to the farmers at 60% subsidized price. All together, 4,220 numbers of farmers/operators were trained on the operation and maintenance of farm machinery during the project period. Fifteen new agricultural machinery were developed and six machinery were modernized in the project period, which were contributed to minimize production cost as well as postharvest loss. The Department of Farm Power and Machinery (DFPM) of Bangladesh Agricultural University, Mymensingh implemented the project named “Research and Extension in Farm Power Issues (REFPI)” in 2000-2003 under the financial and technical assistance of The Department for International Development (DFID) to improve the livelihoods of the rural poor through effective and efficient use of farm power and machinery by small farms and rural systems in Bangladesh. REFPI implemented their activity through providing competitive research fund to GO-NGOs. Those projects created tremendous impact on the spreading of mechanized cultivation in Bangladesh. Department of agricultural extension (DAE) executed GoB funded project named “Enhancement of Crop Production through Farm Mechanization Project Phase-I” during 2009-12 to disseminate the farm machinery throughout the country under subsidy program. Farmers got 25% government assistance to procure different types of farm machinery. Currently, DAE is also executing the GoB funded five-year project named “Enhancement of Crop Production through Farm Mechanization Project Phase-II” for 2013-2018 in all over the country and widen the subsidy program. Under this project, amount of assistance is increased and farmers get 50% government assistance to procure different kinds of farm machinery especially transplanter, seeder, thresher, reaper and mini combine harvester. The government also provided transplanter and reaper in *haor* (inundated by flash flood) areas under full assistance. The expansion of mechanization is the outcome of the combined efforts of different stakeholders involved in the process of mechanization i.e. government, research institute, extension agent, development partner, manufacturer, trader, dealer and farmer. Development partners like CIMMYT, IRRI, ACIAR, iDE, KOICA, JICA and NGOs are also involved in the spreading of farm machinery and technology through providing training and logistic support to the end users. Ministry of Agriculture, research institute, development partner and manufacturers organize seminar, workshop, motivational tour and field day to disseminate the research findings on the issues, constraints and opportunities of mechanized cultivation.

Market price of the farm machinery

The market of power tiller, tractor, irrigation pump, sprayer and thresher has been developed and their potential is well recognized by the entrepreneur due to the scope of rental service. However, the market potential of transplanter, reaper and combine harvester has not yet been developed due to limited annual use and less scope in providing rental service. [Table 03](#) presents the purchasing price of farm machinery of different makes and models available in the local market. Market price of paddy is the main determinant to regulate the rural economy. Paddy price appeared as another limiting factor to purchase the farm machinery. Therefore, paddy exchange rate is used to compare the market price of farm machinery. [Islam et al. \(2016a\)](#) compared the paddy exchange rate to purchase farm machines and mentioned that farmers have to sell 18 tons of paddy to procure a transplanter in Bangladesh, whereas, in Republic of South Korea farmers need to sell only 2.5 t of paddy to procure the same model of transplanter. Paddy exchange rate is higher in tractor compared to other farm machinery that does not restrain the entrepreneur to purchase the tractor due to versatile use. In off-season,

tractors are used to carry goods which enhance the rural economy. Farmers are getting good return by providing custom hire service in land preparation and other operations especially carrying goods. Although paddy exchange rate of BRRI weeder is very nominal, the farmers do not want to use it to control weeds in rice field due to expanding herbicide market rapidly. The limiting factor of weeder operation is to transplant seedlings in line, water level during weeder operation, soil type and weeding regime. Paddy exchange rate of larger size of head feed combine harvester is higher than other farm machines. The limited annual use, small fragmented land, inaccessibility of farm machinery to the plot, rural road condition, lower elevation of plots from the road, loading/unloading facility, unavailability of spare parts and extended payback period restrained the entrepreneur to buy combine harvester. Farmers showed keen interest to use combine harvester in harvesting rice and wheat as it performs four operations simultaneously i.e. harvesting, threshing, cleaning and bagging. However, entrepreneurs are unable to get profit by providing rental service to the farmers due to higher purchase price and seasonal use of the combine harvester. The paddy exchange rate of reaper is lower than other harvesting equipment. Farmers were hesitant to use reaper in harvesting crops due to problems of gathering crops after harvesting and carrying crops from field to homestead for threshing that needs extra labor. The reaper has also the limitation to harvest lodged crops and unable to operate in muddy field. Reaper performed well in harvesting wheat due to land became dry during harvesting time. Therefore, market potential of reaper is limited and the entrepreneurs are not enthusiastic to buy reaper due to same reasons as mentioned in case of combine harvester. There is a market potential of mini combine harvester due to cheap price and performs the same operation like larger size of combine harvester.

Table 03. Market price farm machinery with paddy exchange rate

Name of the farm machinery	Power	Import/local	Price, Tk unit ⁻¹	Paddy exchange rate, t unit ⁻¹
Power tiller	12 hp, 18 blade	Imported	1,14,000	4.75
Tractor	45 hp	Imported	9,75,000	40.63
Transplanter	4 hp 4-row	Imported	4,00,000	16.67
	6-row	Imported	16,00,000	66.67
Seeder	12-16 hp	Imported	60,000	2.50
	12-16 hp	Local	60,000	2.50
Sprayer	16 L	Local	1,800	0.08
USG applicator	Push type	Local	5,000	0.21
Prilled urea applicator	Push type	Local	5,000	0.21
Weeder	Push type	Local	800	0.03
Power weeder	-	Local	60,000	2.50
Irrigation pump	LLP	Local	15,000	0.63
	STW	Local	1,00,000	4.15
	DTW	Imported	52,000	2.17
Reaper	6.5 hp	Imported	1,70,000	7.08
	12-16 hp	Local	60,000	2.50
Thresher	20 hp	Local	2,00,000	8.33
	16 hp	Local	1,05,000	4.38
Combine harvester	62 hp	Imported	26,00,000	108.33
	12 hp	Imported	5,55,000	23.13

Source: Field survey 2017, paddy price: Tk 24,000 per ton

Impacts of agricultural mechanization

Before 1990s, economist and policy makers thought that mechanization displaced the labor and ultimately lead to unemployment in the rural areas, which will disrupt the social system. Earlier literature suggested that mechanization was not possible in the small and fragmented land (Ahmed, 1965; Alim, 1974). The situation has been changing rapidly as the country faces acute shortage of agricultural labor force especially in peak transplanting and harvesting time and farmers are compelled to adopt mechanization. Now, it has been proven that mechanization creates an employment opportunity in rural areas through diversifying the business especially development of skilled manpower and growth of spare parts shops in the village level. More labors are engaged in

manufacturing different types of farm machine. Repair and maintenance workshops have been established in the rural areas. It helps in poverty reduction and better livelihood of the rural poor people. Everybody realizes the urgency of mechanical intervention in crop production to minimize the labor demand and increase the crop productivity. Farm machinery contributes to increase cropping intensity by reducing turnaround time between two crops. It reduces the burden of labor shortage during peak periods, increase the labor productivity and encourages the off-peak employment of labor in rural non-farm activities especially postharvest activities i.e. drying, bagging, cleaning are basically done by the female farmers.

Constraints of mechanization

The major constraint in adoption of mechanical cultivation is the lack of appropriate farm machine suitable in our land condition, low purchasing power of small holder farmers, smaller size of plot, absence of farm road, unskilled operator etc. Inadequate infrastructural development on the research, development, manufacturing, quality control, extension and usage of farm machine are of another constraints on the expansion of mechanization activity. Farmers are not aware about the benefit of mechanized cultivation due to inadequacy of extension activity involving farm machinery or mechanization. Scarcity of quality spare parts, replaceable tools, accessories and inadequate after-sales services restricted the adoption of mechanical devices. Skilled mechanics and operators are needed for efficient operation, proper maintenance and repair of machinery. After abolishing of standardization committee, some manufacturers are fabricating the sub-standard farm machine as there is no law to maintain the quality product. Local manufacturers are not getting proper design and drawing, standard material, fabrication guidelines, skilled manpower, technical assistance and credit facility. There is a variation in tariff system i.e. low tariff on imported machines and high tariff on materials for local fabrication (especially carbon steel).

Mechanization road map

The Government of Bangladesh realized the importance of mechanized cultivation and formulated mechanization road map 2021, 2031 and 2041 in 2016. The road map committee identified the challenges, which hindered the mechanization activities in Bangladesh. The challenges mentioned in the road map were the reduction of farm labor at an increasing rate, reduction of agricultural land, climate change, land fragmentation, manufacturing inferior quality farm machinery, suitability of farm machine in local condition, lack of farm road, high price of the farm machinery, low purchasing power of the farmer and depletion of ground water. Mechanization road map also encouraged the development partners to be involved actively in achieving the mechanization goal. The road map proposed the implementation strategy to reach the target of mechanized cultivation. The concerned authority should take the relevant steps to achieve the goal. It is impossible to achieve the mechanization goal by government intervention alone. It would be a holistic approach through inclusion of different stakeholders especially public, private, development partners, extension agents, traders, manufacturers, local elites, taxation department, media partners etc. The next step of mechanization road map is to prepare action plan and execute the plan accordingly. The government is trying to develop congenial atmosphere to spread the mechanization activity in faster way.

Policy Issues

Sustainability of mechanization need holistic approach through intervention of public and private organization. Every stakeholder should come forward to make plan on mechanization. National mechanization policy and promotion law which aimed to supply and effective utilization of agricultural machines should be formulated. Government assistance to the manufacturer to manufacture and farmer to purchase farm machinery should be continued to make the available of quality farm machine. Research institutes must have the sufficient manpower with infrastructural facility to conduct research on the machinery and technology suitable to our country condition. Insufficient manpower having knowledge on farm machinery and technology existed in the department of agricultural extension. Opportunity should be created in DAE to employ agricultural engineer with operator and mechanic at upazila level. Long-term credit facilities at low interest can be provided to the individual farmers, manufacturer and local service providers to accelerate supply and demand of farm machines. Proper monitoring is needed to maintain the quality of the farm machinery

produced in different engineering workshops in the country. Machinery testing center should be developed in each zone to test the farm machinery, quality control, training and demonstration. Standardization committee should be revitalized for controlling quality of the local or imported machine and certification should be given to the quality product for getting import facility. Government intervention is needed to improve the land size and shape for better field performance and create farm road for accessibility of farm machines. Extensive training on the operation and maintenance of farm machinery should be provided to the government, non-government and private level extension workers, operators, farmers etc. Government assistance on the procurement of farm machinery should be continued for faster upscaling the service of modern machinery. Bogra and Jessore districts are treated as the central hub of manufacturing farm machinery and spare-parts with limited foundry and heat treatment facility. Agri-machinery production zone (APZ) may be set up in Bogra and Jessore districts where all facilities will be available.

IV. Conclusion

Bangladesh needs unique mechanization model which should be developed by its own way. It is important to develop good manufacturing infrastructures. Expansion of steel manufacturing industries indicate a good sign to produce different graded steel and rod. These industries could be a base to supply different graded material to the local farm machinery manufacturing industries to manufacture quality farm machinery that can suit to our country condition. Agricultural mechanization planning should be prepared by considering many parameters including level of industries status, localization schemes of various parts in different machines, demand of farmers, improve the educational facilities, research and extension of farm machinery, socio-economic effects of mechanization, petroleum resources and climate change impacts.

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