Farm Mechanization for Sustainable Agriculture in Bangladesh: Problems and Prospects

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Introduction

Bangladesh is predominately an agricultural country. To feed her 150 million people from 8.2 million hectares of cultivable land is a tough task (Hossain, 2009). Every year almost 0.20 million people are being added to the total population whereas the estimated annual shrinkage of agricultural land is about 0.08 million hectares due to various non-agricultural activities like constructions of houses, offices, roads, mills, factories etc. (BRRI, 2009). The contribution to GDP by agriculture is about 21.11% (Fig. 1) of which crops, fisheries, livestock and forestry account for 11.72, 4.73, 2.90 and 1.76%, respectively (BBS, 2007).

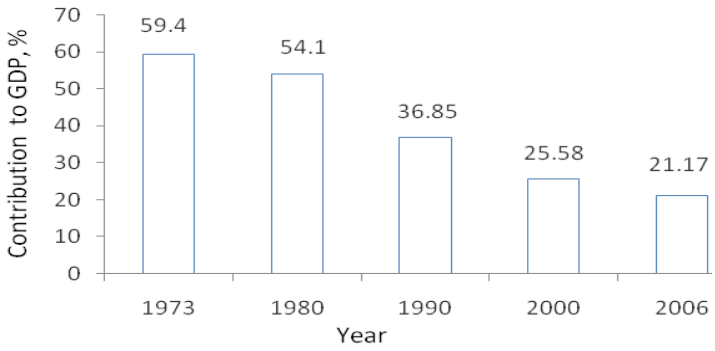

Fig.1 Contribution of agricultural to GDP over years

The country's food production has increased from 11.0 million tons in 1971 to about 30 million tons in 2007 (Hossain, 2009). The country is, at present, about to achieve self sufficiency in cereal production. This is due to irrigation development and partial mechanization in other agricultural operations. But to meet up the food requirements of the ever growing population of the country in 2015, an additional 5 million tons of food grain need to be produced from the continuously decreasing agricultural lands. To

achieve this target, there is no other better option than to increase production per unit of land as well as cropping intensity.

Thus, to increase production and cropping intensity, the most important gain will be the faster development of agricultural mechanization as well as variety development. Replacing the traditional inefficient agricultural tools, efficient mechanized cultivation must be introduced and extended. The good news is that the government has already attributed due importance to agricultural mechanization in the National Agricultural Policy (MoA, 2009). In the Policy (Draft 5) it is included that "The Government will encourage production and manufacturing of agricultural machinery adaptive to our socio-economic context. Manufacturing workshops and industries engaged in agricultural mechanization activities will be provided with appropriate support."

In 2000, the land preparation was done almost 70% by machine (Farouk et al, 2007) which has now been raised to about 80%. But, bed makers, seeders, weeders, harvesters and winnowers- all have limited uses. However, threshing of maize is accomplished almost 100% by power and hand maize shellers and those of paddy and wheat, over 80%, by both power and manual threshers. Efforts are being continued by the researchers to improve the machine performance.

In 2007-2008, the irrigated area coverage by different irrigation equipment was about 61% of the net cultivable area (8.29 million hectares). During the period, the associated mechanized equipments were 1339198 which were 10.13% higher than those of the previous year. Though irrigation is done in a substantial area, the efficiency of irrigation schemes is very low (about 25-40% for rice and 50-55% for non- rice crops). About 80% irrigation is done by ground water and the rest by surface water (BADC, 2008). In Fig.2 is shown the irrigation development of the country.

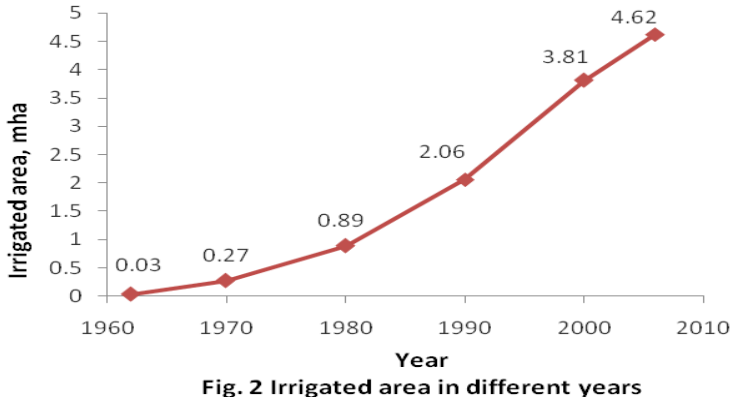

Fig. 2 Irrigated area in different years

In addition, limited efforts to utilize solar energy for supply of household electricity for lighting and household water supply in the rural areas have been taken by NGOs. The

possibility to use solar energy for pumping water for irrigation and use of vermi-compost for crop production are also under study. About 60,000 bio-gas plants are in operation to produce gas and fertilizers.

Mechanization is an important tool for profitable and competitive agriculture. The need for mechanization is increasing fast with the decrease of draft power. Without mechanization it will not be possible to maintain multiple cropping patterns, which need quick land preparation, planting, weeding, harvesting, processing etc. (MoA, 2009).

This paper includes the overall insight of farm mechanization in Bangladesh outlining some developments made so far depicting the associated problems and also the development prospects in different farming operations.

Problems in Mechanization

Mechanization in the country is always associated with some inherent drawbacks like, fragmented lands, poor buying capacity of farmers, lack of quality machines for farm operation, inadequate knowledge of the users about machines and insufficient awareness building activities.

Fragmented lands

In 1980, the average farm holding was 0.91 ha which decreased in 2000 to 0.68 ha (Roy, 2008). It has been found that many farmers cultivate only about 1.0 decimal land by traditional method. Further, the total holding of land is not located in one place, rather, it is found in split plots in several places. This restricts power operated tilling, seeding and harvesting machines to perform at optimal efficiency. Even two wheel tractors, reapers and combines face tremendous problems from frequent turnings in such fragmented lands.

Poor buying capacity of farmers

The rural people are mostly poor and hardly can buy a costly machine individually. Some moneyed farmers having a large quantity of agricultural lands possess some costly machines like, tractors, power tillers, power tiller operated seeders, combines etc. They use these machines in their own lands and also operate them on hiring basis in others' lands and earn a substantial return. But, the number of such farmers is very limited.

Lack of quality machines

Due importance was not given to farm mechanization until the beginning of the century. Earlier, only a few manufacturers came up to fabricate simple manually operated machinery like weeder, thresher, winnower etc. With the growing needs for foods, the decision makers got the realization that Bangladesh agriculture will have no other alternative than to adopt mechanized cultivation to feed her ever growing population. This helped grow some agricultural manufacturing workshops in the country. Presently, more than 40,000 small and medium sized local metal working workshops have grown up to manufacture agricultural machinery all over the country (Farouq et al., 2007). Many small workshops are manufacturing sub-standard machinery creating adverse impact among the farmers. These small workshop owners, in general, do not use jigs and fixtures and produce different standard machines. They get the prototype from the designers/researchers and multiply them. While copying these machines, they do not use exact quality materials and specifications thus producing low quality machines.

Lac of knowledge and skill of users, artisans and traders

The machine users, artisans and traders are mostly illiterate and don't have substantial knowledge and skill about machine operation, repair and maintenance. The manufacturers do not provide 'after sale service' to the users. From field experience it has been found that machines are left without working for minor and easily repairable faults. On availability of an artisan or a mechanic, the farmers get them repaired at the expense of high charges. But in other cases, where mechanics are not readily available, they leave the machine without operation. The village artisans are rarely trained and lack adequate knowledge and skill about machines.

Tariff difference on machines and spare parts

Low tariff on imported machines and high tariff on spare parts and materials have discouraged the local manufacturers. Since, there is no quality control system of the imported machinery, a huge number of machines are being imported and distributed directly by the local importers to the users. Also, many of the imported low quality machines have already made the farmers reluctant to use them. Once these farmers decide not to use the machines, it becomes hard to convince them for a new machine. Further, the high tariff has restricted the imports of spare parts making them unavailable in the local market.

Present Status of Machinery Use

a. Power use

Level of energy input is one of the key indicators for measuring the state of mechanization. In Fig.3, the available power in agriculture is seen to increase gradually

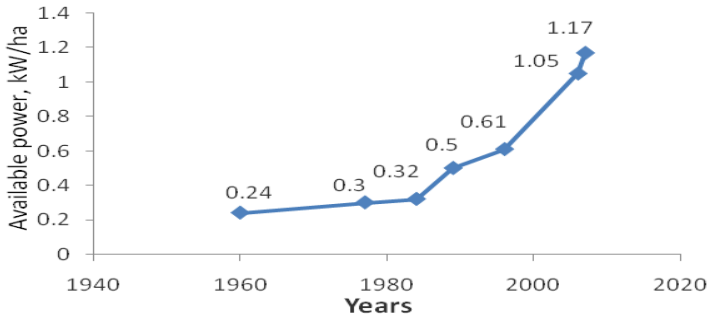

Fig. 3 Available power in agriculture over times

from 0.25 in 1960 to 0.32 kW/ha in 1984 wherefrom it increased very sharply to 1.17 kW/ha in 2007 with only a bit higher rate of increase in 1989. The rate was the highest between 2006 and 2007. Compared to Bangladesh, India used higher power in agriculture during this time (about 0.70 kW/ha in 1984 and 1.5 kW/ha in 2007). Farm power availability in major industrialized countries such as, Japan, Italy, France and UK are 8.75, 3.01, 2.65, and 2.50 kW/ha, respectively (Tandon, 2004).

b. Agricultural machinery use in Bangladesh

Virtually, mechanization in Bangladesh agriculture started in 1960s with the introduction of tractor, power tiller, deep tube well, shallow tube well and low lift pumps on a very limited quantities. After independence in 1971, it gained pace, especially, in irrigation development. Though, tractors, power tillers, and other farm machinery like threshers and weeders increased with time, irrigation equipment increased much faster rates (Table 1).

Table 1 Population of different farm machinery over years

Name of machine	Year				
	1977	1984	1989	1996	2006
Tractor	300	400	1,000	2000	12500
Power tiller	200	500	5,000	100,000	300,000
Maize sheller	-	-	-	100	850

Thresher(open drum)	-	500	3,000	10,000	130,000
Thresher(closed drum)	-	100	1,000	5,000	45,000
Deep tube well	4,461	15,519	22,448	24,506	28,289
Shallow tube well	3,045	67,103	223,588	325,360	1,182,525
Low lift pump	28,361	43,651	57,200	41,816	119,135

Source: Roy and Singh, 2008.

In addition to machines listed in Table 1, some other equipment are also used for farm operations. About 250 power tiller operated seeders are in use. Both power tiller operated seeder for dry land crops and manually operated plastic drum seeders for rice are expected to expand soon. Besides, manually operated sprayers are being used for a long time. Farm machinery, such as, weeders, threshers, winnowers, centrifugal pumps etc. are developed and manufactured locally with locally available materials. Manually operated weeders and sprayers are used widely and amounts to about 200,000 and 1,000,000, respectively. A few hundred pedal and power operated winnowers are also being used in the country (Roy and Singh, 2008).

With the increase in crop diversification, postharvest loss of perishable foods has increased. The postharvest loss of grains in the country is about 12-15% of total production and that for fruits and vegetables is around 25-40% (Shajahan, 2008). Causes of postharvest losses of fruits and vegetables include mechanical injury, physiological deterioration, and insect and disease infestation. Present status of postharvest losses of foods is shown in Table 2. It is seen from the table that post harvest loss in agriculture amounts over 4000 million US$ a year. Proper grading, packing, pre-cooling, refrigerated storage and transportation can reduce these losses and maintain the quality.

Table 2. Annual production status and postharvest losses of foods

Food item	Quantity produced, Mton	Postharvest loss, Mton	Postharvest loss, %	Market price, US$/Kg	Monetary loss $x10^6$ US $
Rice	29.79	2.68	9.0	0.17	453.0
Wheat	0.96	0.07	7.5	0.21	14.8
Maize	2.36	0.25	10.5	0.14	35.2
Pulses	0.54	0.07	12.5	0.99	69.0
Oilseeds	0.93	0.12	12.5	0.28	33.8
Fruits	9.03	2.26	25.0	0.56	1273.`2
Vegetables	8.91	2.23	25.0	0.21	471.1
Potato	9.23	2.31	25.0	0.21	488.0
Sweet potato	0.87	0.22	25.0	0.14	31.0

Sugarcane	3.56	0.71	20.0	0.07	50.0
Spices	2.30	0.58	25.0	0.70	408.5
Fish	2.05	0.46	22.5	1.41	647.9
Meat	1.04	0.10	10.0	2.82	28.2
Milk	2.28	0.23	10.0	0.56	129.6
Eggs	5369 Mnos.	805 Mnos.	10.0	0.08	45.4
Total					4178.7

Source: BBS (2007), DAE (2008), Shajahan (2008), Author's calculation

c. Agricultural machinery testing

Prior to 1988, there were two committees- National Technical Committee (NTC) and Technical Sub Committee (TSC) to test country made and imported agricultural machinery. The latter tested the machines submitted by the manufacturers or importers both at field and laboratory levels and sent the results to the technical committee with some recommendations for good ones. The TSC in return claimed fees for testing the machines which the manufacturers or importers would have to pay at the time of submitting the machines. The TSC finally approved the suitable machines for use in the country. But after 1988, to encourage faster mechanization, the binding of testing agricultural machines was waved. This was specially done to encourage quick development of irrigation in the country. As a result, low graded engines and pumps were sold and imported at cheaper rates and expanded very rapidly. But these machines failed to perform well and went out of order in a season or two making the farmers disappointed.

d. Quality control of agricultural machinery

Already some alarming information regarding quality of machines have been received from the root levels. The Department of Agricultural Extension (DAE) purchased agricultural machinery from the suppliers and distributed among the farmers but the field performance of these machines was very much discouraging. Many of these machines are now lying idle because the farmers are reluctant to use them. But at research level these machines were found to perform well in the fields.

According to present official rules, tenders are called, bidding amounts are compared and supply order is placed in favour of the lowest bidder. The suppliers always think of higher profits and thus tend to supply low quality machines. Since there is no Standardization Committee or Cell to judge the quality of machines, inferior quality machines are usually received by the purchasers.

In the draft (No.5) National Agriculture Policy, proposal in favour of prevailing system of waiving testing and standardization has been retained. But many of the machinery researchers and manufacturers are demanding re-activation of the technical committees

to regulate quality of machines. To review the draft National Agriculture Policy, the MoA has invited comments from all over the country to finalize the issue.

Some success stories in farm mechanization

Bangladesh has produced a remarkable progress in producing cereal grains (rice, wheat and maize) and to some extent, vegetables (tomato, cauliflower, cabbage, egg plants, beans etc.) by introducing farm mechanization. Mechanization in the country started with the pumping of water for irrigation. Introduction of high yielding variety of rice triggered the rapid expansion of irrigated area (about 61% of cultivable area). Though, mostly the existing conveyance and distribution systems are traditional earthen channels, some organizations like Barind Multipurpose Development Authority (BMDA), Bangladesh Agricultural Development Corporation (BADC), Bangladesh Water Development Board (BWDB), Local Government and Engineering Department (LGED), Bangladesh Academy for Rural Development (BARD) are trying to improve the existing water distribution systems. The BMDA, BADC and BARD have installed a number of buried pipe water distribution systems, mainly, under the management of agricultural engineers. The BADC and LGED have constructed rubber dams to trap river water for irrigation. The most successful mission has been accomplished by BMDA. This organization is working in the Barind Area of Rajshahi and Dinajpur Region. These areas have erratic climatic conditions and are mostly very dry compared to rest part of the country. Earlier, no other crop except rain fed Aman rice (grown in wet season) could be grown in the area due to crisis of water. BMDA has installed DTWs for irrigation in the region and is now producing Boro rice, wheat and winter vegetables in the dry season. Also the intensity of dryness of the area has come down with the introduction of irrigation facility and has improved the local environmental conditions.

In many areas of Rajbari, Faridpur, Magura, Rajshahi and Dinajpur districts, the farmers are using tilling and seeding machinery extensively. Some large farmers have purchased high speed rotary tillers and power tiller operated seeders and using them commercially among other farmers. From field visits to Rajbari and Dinajpur, it was learnt that the farmers who have purchased agricultural machinery have shifted from subsistence agriculture to commercial agriculture using the machines. It was informed that using a high speed rotary tiller a farmer got the capital (US$ 1200.00) returned he afforded for the machine only in one season using it on hiring basis. The high speed rotary tillers consist of 42-48 rotary tines instead of 18-20 tines and the rotating speed is 500-600 in place of 300-400 in normal rotary tine arrangements. This enhances quick land preparation as well as smooth land preparation by reducing the ploughings from 4-5 to only 2-3. The agricultural engineers of Bangladesh Agricultural Research Institute (BARI) have made this improvement on the normal two wheel tractor.

Almost 100% maize shelling is done by BARI developed maize sheller. Prior to development of maize sheller, the maize cultivation was very limited due to shelling problem and low market demand. But, after BARI developed the machine, the area under maize cultivation rapidly increased (0.38 million ha in 2007-2008) all over Bangladesh and the demand also increased rapidly. Earlier, maize shelling was a great problem to the farmers.

BARI has also developed bed maker cum seeder. The machine is set behind a power tiller. It can form bed both in ploughed and unploughed soils. In normal and conservation tillage, this machine can be used to form beds and sowing seeds. For planting maize, wheat, vegetable seeds in beds, the machine can fairly be used. In some areas of Rajshahi and Dinajpur districts, this machine is being used.

Another success is the recent development of a Urea Super Granule (USG) Applicator by BARI. This machine is only used to apply USG in transplanted rice fields. It can place the granules at a depth of 6-7 cm into the muddy soil. The present government strongly emphasized on the development of a USG applicator for saving application time and cost of labour for USG application in rice cultivation.

Beside these, BRRI has developed rice-wheat thresher, open-drum thresher, wetland weeder and winnower. These machines are being used in many parts of the country. BRRI is trying to popularize these machines in other parts of the country through Popularization of Agricultural Machinery Project.

Bangladesh Agricultural University has also developed some machinery but these are not disseminated to farmers' level.

Agricultural machinery testing

The research institutions like BARI, Bangladesh Rice Research Institute (BRRI), Bangladesh Sugarcane Research Institute (BSRI) and universities do research on agricultural machinery development but these organizations are not mandated to fabricate the machines for commercial use. The developed machines from these organizations are given to private manufacturers for multiplication and sales. But, unfortunately, many of the manufacturers produce inferior quality machines for higher profit and the machines give a lot of troubles to the farmers. Till 1988, it was mandatory for the manufacturers of agricultural machinery to obtain a certificate of clearance from farm power and machinery department of Bangladesh Agricultural University and farm machinery division of BARI, and subsequently recognition of concerned National Committee. But later, this system of obtaining certificate was waived. Now, for local and imported machines, the existing facility of waving testing and standardization of agricultural machinery has been proposed to retain in the draft national agricultural

policy (MoA, 2009). Presently, there is no institute or cell to control the qualities of imported and locally made agricultural machinery. Now time has come to review that whether this decision has ensured the maintaining of proper quality of agro machinery by the local manufacturer or importer from abroad and looking the interest of consumers of such products.

Technological challenges and gaps

Presently, there is no big problem in weeding, threshing, winnowing and husking as there are simple machines for these operations. The machines are being manufactured by the rural workshops maintaining good quality. But tilling, harvesting and drying operations are associated with a number of problems.

After Aman rice harvest, in many areas of the country, practically, there remains only 15-20 days turnaround time between Aman rice and wheat, winter vegetables or potato. Traditional ploughing takes a lot of time and very often the farmers fail to go for the next crop in time resulting in reduced yields. For example, in the Barind area of the country the soil moisture reduces very rapidly after Aman rice harvest and the farmers have to hurry for the establishment of the next crop. Sometimes, the Aman rice is harvested at the end of November and the farmers take 15-20 days for land preparation by traditional method. As learnt from the scientists of Wheat Research Centre of BARI, the yield of wheat decreases at the rate of about 44 Kg/day/ha if it is sown after 30 November. So, it is very important to complete land preparation in a very short time. BARI developed high speed rotary tiller is a useful machine for the purpose but extension of the machine at farmers' level is very slow because of poor buying capacity of the farmers as well as insufficient extension works.

Similarly, at the full ripening stage of rice, in both Boro (January-May) and Aman (July-November) seasons, the labour charge goes very high. In addition, during April-May, the weather, sometimes, becomes rough with storm and hails. Since, manual harvesting is costlier and takes a long time to complete the operation it causes heavy damage to rice crop. Also, in the haor (extensive marshy lands) areas of the country, sudden flash flood damages the ripened paddy fields almost every year because the farmers cannot complete harvesting manually in time. In such situation, small mechanical harvesters become essential. BARI, BRRI and BAU have self propelled reapers but all have limitations in use. The BARI machine is very suitable in plain non-muddy soils for paddy and wheat. Since, the harvesters are still under modification and the price is somewhat higher compared to other extensively used simple machines, it will take some time for adoption of the harvesters at the users' level.

After harvesting crops in March to June, many times, the weather remains bad continuously for days together thus making it difficult to dry the harvested grains. But there is no simple drying machine suitable for individual farmer's use. BARI has developed a hybrid-dryer that can utilize solar energy and electric power. As long as the solar energy is available, the electric system is kept off. In absence of sun light, the electric power is used. A maximum of 62^0C temperature can be generated in the dryer by solar power. But, this machine is still to be extended to the farm levels.

In addition to these, there is demand for simple and effective machines for rice transplantation, conservation agriculture, postharvest equipment for fruit and vegetables. BARI has fabricated a hot water mango treatment plant which is being used in Chapainawabgonj and Chuadanga districts by the farmers as test cases. This machine needs rapid extension among the mango growers to treat mangoes for higher shelf life. Rice transplanters, this or that reason, could not be popularized in the root levels.

Financial and institutional constraints

Presently, the government has given emphasis on farm mechanization and is funding for rapid agricultural mechanization. This has mitigated, partly, the financial crisis for design and development of agricultural machinery. But the problem lies with the development of expertise and skills of the researchers and the manufacturers. Both researchers and manufacturers need appropriate and adequate trainings on improved farm mechanization and associated machines so that they can design and develop better machinery. Further, the existing institutes do not have adequate modern facilities for fabricating and testing these machines. So, funds are required from donors for these purposes in addition to research and development.

Priority areas of technical cooperation

Skill development of researchers

Development of skill and knowledge of the researchers working for the improvement of agricultural machinery is of immense importance. This can be achieved through training and visit to countries having updated technologies. Such training and visit will enable them to work with improved skills and adequate confidence.

Capacity building of manufacturers

Most of the small and medium sized metal workshops are doing reverse engineering and manufacturing spare parts of agricultural machinery. Also 15 medium and large manufacturers are producing machines developed within the country. These

manufacturers are engaged in fabrication of agricultural machinery (Farouk et al., 2007). In many cases these workshops do not have requisite precision machines and thus, the workmanship and quality are often sub-standard. The technicians involved in agro machinery have very little knowledge on quality except what they had acquired engineering knowledge and skill through apprenticeship at different engineering workshops. Therefore, regarding design, drawing and quality control, they have very limited perception and not aware of the performance of their products except a few entrepreneurs who are solely manufacturing agricultural machines as per design and trying to improve the quality standard.

Small and medium sized entrepreneurs in agri-subsector have mostly emerged from repair and maintenance service sector and have little experience and technical knowledge related to manufacturing of sophisticated agricultural machines and equipment. Moreover, they are lacking information about suitable machines and equipment for the country. Most of the manufacturers are using outdated machines though there are a very few manufacturers who have machines of foreign origin (Alam et al., 2007). Services to address this problem are almost nonexistent in public and private sectors. Hence, the capacity building of these workshops/manufacturers is very important to get good machines from them.

Ways and means to address the challenges

A. Bangladesh perspective

Formation of strong farmers group

As mentioned earlier, most of the farmers have little capacity to own a costly machine. Even many of them cannot afford for a simple manually operated threshing machine. Also they cannot use power machines in fragmented small lands. But these drawbacks can be eliminated by forming farmers groups. A group of farmers having their fragmented lands in an area can form bigger lands by combining more than one plot together. Also they can get bank loan or loans from non-government organizations to buy agricultural machines easily through these farmers group.

Strengthening custom-hire services of agri-machinery

Farmers capable of purchasing costly machines should be convinced to own such machines and use them for custom-hire services. Evidence of success stories should be brought in to their knowledge and if possible, they should be made to communicate to those who have already got the machines and earned remarkable financial benefits from using the machines. This can also be done through strong farmers groups.

Formulation of agricultural mechanization policy

A healthy agricultural mechanization policy must be formulated immediately including machine development and manufacturing, quality protection by standardization of machines, skill development of researchers, farmers, mechanics and machine operators and marketing system improvement.

Establishment of a National Centre for Agricultural Machinery

The centre will provide services for development of agricultural mechanization through drawings, designs, testing, certification and training, specialized services like heat treatment in collaboration with National Agricultural Research System institutes, universities and manufacturers. The centre may be administratively attached with Bangladesh Agricultural Research Council with separate operational budget along with provision for cost sharing by beneficiary organizations like manufacturers and traders (Alam et al., 2007).

Special fund for machinery research

Funds for relevant machinery research, development and extension are to be provided to the capable institutions including selected Agricultural Research Institutes and Universities on competitive basis. This will stimulate quality research to produce new machines within possible shortest time. Also it will enhance farm activities and agricultural machinery industries.

Reactivation of National Standardization Committee

To maintain the quality product a testing and standardization cell should be created. The cell will be responsible for thorough testing of machines and certifying about the fitness of machines. Beside field performance, the cell should conduct durability test to determine quality of manufacturing and to identify the practical problems that may arise after long time operation in the real field conditions. The tested results should be fed back to the research institutes, universities, manufacturers and importers for further tuning of the machines.

Review and rationalization of current tariff rates

The existing tariff rates are affecting the import of agricultural machines, spare parts and raw materials needed to manufacture those machines and spare parts so that local manufacturers feel encouraged to work on competitive basis. This will reduce the import dependency and increase the capacity of the local manufacturers and the employment opportunity in non-farm sectors.

B. Regional perspective

Among numerous problems of mechanization in the countries of the region, some are very common and acute. Of these, absence of mechanization strategy, lack of appropriate machinery, insufficient equipment support services, ineffective machinery extension services, inadequate farm credit and shortage of qualified personnel are the main. Many of these can be solved to a large extent by mutual cooperation, visit, imparting training to researchers and manufacturers, and technology exchange among the countries. However, due to various quality of testing rigs, the standard of the machines vary widely in the region. In order to maintain equal standard of machinery and safety measures for the Asia-pacific region, the testing and standardization stations should have uniform testing facility. Thus, before setting such a station, unique standard should be maintained so that the tested machines have quality for use regionally and globally.

Prospects of agricultural mechanization in Bangladesh

Though mechanization is quite less in Bangladesh compared to other neighbouring countries, it is gaining pace with time. Since Bangladesh is an agro-based country and a considerable share of her GDP comes from agriculture, this sector is always given due importance. With the use of limited mechanization in crop and other sub-sectors the output from agriculture is increasing. Most importantly, the farmers are getting the realization that to save time and cost of operation and to do profitable agriculture, there is no other better option than to go for mechanized agriculture. This creates the hope of better mechanization in the years to come. Now, proper planning and positive intension from the higher authority is required. Nevertheless, Bangladesh hopes of further development in the sector with the modern mechanization technologies.

Conclusion

Despite all the developments and constraints, manual labour claims the highest input cost in rice production of the country, as it is still essential for transporting, weeding, harvesting, threshing, drying and many other related activities. The farmers and rural entrepreneurs are trying to further mechanize some of these operations to reduce cost of production and time of operation. Highly coordinated research and extension among GO, NGO and private agricultural machinery manufacturers are required to support this process of mechanization and for better understanding of the impact process on the livelihood of the rural poor such as marginal farmers, agricultural labourers and rural artisans. Further, in order to maintain equal standard of machinery and safety measures for the Asia-pacific region, the testing and standardization stations should have uniform testing facility.

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