

COUNTRY REPORT – BANGLADESH¹

STATUS OF RESEARCH AND DEVELOPMENT INSTITUTES ON AGRICULTURAL ENGINEERING IN BANGLADESH

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1. Introduction

Bangladesh agriculture played a vital role in economy in terms of food security, value addition, employment and export earning, like many other Asian countries. Agricultural contribution to the economy has been declining over the decade. It decreased from 30 percent in 90s to 23.50 percent recently to the GDP (at constant price of 2004/05), while the manufacturing and other sectors are growing. Crop (more particularly, rice) contributes 13.44 percent, followed by fisheries at 5 percent. The GDP grew at 5.33 percent during last year while agriculture grew at 5.5%. The per capita GDP has been 444 US dollars.

Bangladesh achieved success in food grain production equivalent to 28.40 million tons during 2004 in a net cropped area of more than 14 million hectares. Most of the production gain came from winter irrigated HYV rice and to some extent wheat. However, the profitability of rice or wheat is low. The increased production of food adds little to the rural income, as rice price remains stagnant. Moreover, considering the projected income growth, future growth requirement for rice will be less while food of animal origin will increase substantially. Thus, future growth in agriculture thus demands for agricultural diversification with the intensification of present production trend. The major crops grown are rice, wheat, jute, maize, sugarcane, pulses & oilseeds, potato, vegetables and fruits.

The production for pulse, oilseed, vegetables and fruits are in deficit to the national requirement. The production of those crops has been increasing slowly during last few years. The high value crops like vegetables and fruits are also termed as risky due to its perishable nature and the producers devote less area in those crops compared to rice and wheat.

In order to increase crop production, yield of crops need to be increased and losses need to be minimized (pre-harvest, harvest and post-harvest). It is now well established that crop production can not be increased without increasing the power input for different farm yield

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reduction. Therefore, for increasing crop production, selective farm mechanization is a must. Bangladesh government has given top priority to agriculture development in order to increase operations. Though 62 percent work forces are engaged in agriculture, acute labour shortage occurs during some of the agricultural operations like sowing/transplanting, harvesting and threshing. Due to labour shortage, timeliness of operation can not be maintained, resulting in crop production, rural employment generation and poverty alleviation. In the government policy in respect of farm mechanization, emphasis has been given on:

- to increase irrigation coverage
- to maintain current waiver on all kind of taxes for agricultural machinery
- to promote appropriate farm machinery and agricultural processing
- to educate and train farmers and dealers on the use of agricultural inputs including farm machinery.

2. Mechanical Technology

Mechanization has been taken place in Bangladesh agriculture in the backdrop of fragmented and decreasing farm size, from 0.81 during 80s to 0.61 ha per head, recently. Occurrence of small and marginal farmers has been increasing while the large farms being decreased.

About 8.2 million ha of the total cultivable area have already been brought under cultivation. Triple cropped area of the country is only 1.0 million ha which is 12.50 % of the total cultivated area. Double-cropped area is 4.0 million ha and rest is single cropped. Total cropped area of the country is 14.00 million ha (with a cropping intensity of 180 %).

Mechanization in agricultural production process has been recognized as a potential contributor for rural development through rural income generation. Moreover, under the higher income and literacy rate, drudgery reduction became an important issue towards mechanization. The energy available is 0.388 kilowatt/hectare.

Fragmented approach to mechanization and lack of coordination within and between government and private sector in R & D have been found to be major reasons for not being successful in mechanization efforts.

Most of the farmers use machine power for land preparation of potato (72%) followed by boro (dry winter) rice (65%) and then aman (monsoon) rice (56%). Irrigation is mainly dependent on the power-operated pumps.

The transformation towards mechanization is taking place for:

- ◆ Increase yield per unit of land and hence to increase cropping intensity through timeliness of cropping
- ◆ Increase yield through improved water control, better soil preparation, better weed and insect control and better harvesting and post harvest processing
- ◆ To promote agro-based industries to generate employment and save crops from spoilage and value addition.
- ◆ Reduce cost of cultivation and add value to the produce

Following operations of the agricultural production and processing have been mechanized to a greater extent in the country.

- Land preparations -Tillage
- Irrigation
- Chemical spraying
- Threshing of paddy and wheat
- Husking and Milling

2.1. Design and Development

2.1.1 Agricultural Machinery Developed In The National Agricultural Research System (NARS) Institutes

The following machines have been developed or adapted from local and foreign designs and tested by the R & D institutes. Mass productions is done by the private workshops / manufacturers.

- Power tiller (also imported)
- Hydro tiller
- Weeder
- Turbine and submersible pump
- Centrifugal suction lift pumps
- Treadle pumps, suction lift and reciprocating
- Sprayers, hand, foot and power operated
- Seed drill

- Power tiller (PT) Operated planter for Maize and Wheat
- PT Operated and Self-propelled Reaper (rice & wheat)
- PT Operated Bed former and Ridger
- Maize sheller
- Power thresher and manual thresher
- Rice huller (also imported)

The R&D institutes are the constituent parts of Bangladesh Agricultural Research Council, the national research co-ordinating body. The institutes are:

- Bangladesh Rice Research Institute (BRRI)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Sugarcane Research Institute (BSRI)
- Bangladesh Agricultural University (BAU)

2.1.2 Promotion of the Machinery

Under the National Network, the National Research Institutes, such as BRRI and BARI have established linkages with a good number of manufacturers, capable for fabrication and manufacturing of agricultural machinery. These private manufacturers receive technical assistance i.e., prototypes, drawings and expert services from these national research institutes. NGOs are also promoting machines by organizing landless farmers as a poverty reduction campaign.

The machinery have been tested in different locations of the country and found suitable for specific socio-economic condition of the farmers. The machinery have been put into special efforts for wider extension, adaptation through different specialized projects.

2.1.3 Present Trend of Research and Development in Agri-machinery

- Development and evaluation of Chinese hand tractor planter / seeder for Maize and wheat
- Design and Development of PT Operated potato planter
- Design and Development of PT Operated potato digger
- Performance and comparative study of PT Operated and Self-propelled reaper for paddy and wheat
- Test and evaluation of locally made fixed bed drier

- Local paddy seed storage techniques
- Development of multi-crop power thresher
- Storage structure
- Improvement of power operated maize sheller
- Milling and processing technology development through PT Operated mobile rice huller
- Development of power thresher for pulse
- Development of Chula (burner) and pan for cost effective gur (sugarcane juice) production
- Development of crusher for high juice extraction and sugar extraction efficiency in sugar mills.

2.1.4 Farm Machinery used in Agricultural Production

Land preparation / Tillage Operation

Public sector effort to introduce tractor during 1970s could not succeed due to lack of spare parts and technicians, poor management and various other reasons. In 1997-78, the public sector involvement in tillage operation was abandoned. During the devastating flood of 1988, a huge number of draft animal, mainly bullocks, died. Due to shortage of draft power, land preparation was greatly hampered. Government waived all kind of taxes on farm machinery. As a result a lot of power tillers have been imported. Now power tillers do most of the tillage operations.

About 65-70 percent of the land preparation is done by the power tiller and marginal farmers have access to the tilling machine through hiring service. Traditional country plough, power tiller and four-wheel tractors are used for land preparation.

Apart from soil preparation, PT engines are frequently used to power irrigation pumps and boats, hullers, shellers and oil expellers and transport vehicles. Use of PTs in this mode is not widespread yet and constitutes fertile ground for expansion. Bangladesh imports 10,000 power tiller every year.

Sowing/Planting/Transplanting

Sowing of seeds for all the field crops is almost entirely done by hand broadcasting method. Recently a manually-operated seed-cum-fertilizer distributor has been developed, which is yet to become popular. Transplanting of paddy is entirely done by hand. No rice transplanter is used in Bangladesh. Research and development work on power tiller operated minimum tillage seeder/planter has been going on for last few years. Use of this seeder/planter enables sowing

wheat immediately after aman harvest. Efforts are being made to popularize this technology to farmers through GO and NGOs. Quite a good number of farmers have started using this technology. It is expected that use of PT-operated seeders will increase in near future.

For sowing/planting paddy, wheat, maize, pulses and oilseeds, PT-operated seeders/planters have been developed by BARI. Similarly a potato planter has been developed. These newly developed machinery need extensive field trials.

Intercultural Operation

In line sowing crops, hand-operated weeders for dry land and wet land conditions are used for weeding. Line sowing and use of weeders is increasing in the recent years.

Spraying

Spraying is commonly done by locally made knapsack sprayers. There are many manufacturers who are producing and selling their products. Use of power sprayers is not very common and most of these are imported.

Harvesting

Labour shortage occurs during this period, resulting in substantial loss during harvesting and transportation. It is estimated that for paddy 2.2 per cent and 0.5 percent are lost during harvesting and transportation, respectively. For wheat, harvesting and transportation losses are 0.8 and 0.38 percent, respectively. Research and development works on both PT-operated and self-propelled reaper are going on. At present five manufacturers are fabricating and testing reapers and they are able to commercialize their production. BARI developed a potato digger a self-propelled reaper for paddy and wheat that needs extensive field trials and demonstration.

Threshing/Shelling

Traditionally paddy is threshed by hand beating and bullock treading. In many parts of the country, pedal operated threshers are used. With the increase of rice production, capacity of pedal operated threshers became too low. Therefore, power operated threshers are becoming popular. Quite a good number of small manufacturers are producing both open drum and closed drum power threshers. These threshers are used for own use as well as on rental basis. Owners are making good business by renting them out. Within a year or two, owners can get their money back. As a result, their uses are increasing at a rapid rate and new manufacturers are coming up in the business.

For wheat threshing, power-operated threshers have been developed and being manufactured by a few manufacturers in wheat growing areas. Power threshers for both paddy and wheat have been developed. For shelling maize, both hand and power operated shellers have been developed by BARI and their performance are quite satisfactorily. More than 500 BARI developed power shellers are purchased by the farmers.

Winnower

In recent years, hand, pedal and power operated winnowers have been developed for paddy, wheat, maize, pulses and oilseeds. They are working quite satisfactorily. In some areas, this technology has been demonstrated to farmers and they liked it. It needs to be popularized through special programme.

Drying

For drying crops sun drying is used for all the crops. Efforts have been made to develop mechanical dryers, but its demand has not been created. Present market price, most of the time, does not pay back the additional cost involved in mechanical drying. However, with the rise of economic level of people, demand for quality product has increased. Also due to boost of poultry industry, demand for maize has increased tremendously (total annual requirement is 450,000 ton, whereas local annual production is 260,000 ton). Without mechanical drying, quality of maize can not be maintained. Therefore, demand for mechanical dryers has increased. A few prototypes have been imported and are locally manufactured on demand basis.

Natural and forced convection solar dryers have been developed and tested for drying vegetables, fruits and fish. They could not be commercialized yet.

Storage

Cereal grains, pulses and oilseeds are stored in traditional bamboo structures, earthen and metal bins at farmers home. Potatoes are stored in more than 300 cold storages having individual capacity of five to ten thousand ton. In recent year, a few mini cold storages have been installed for storing vegetables, fruits and fish.

Milling

Most of the rice milling is done by Engleberg milling in which quality of rice is very low. About 300 semi-automatic rice mills have been installed so far.

Testing and Certifying

During 1970s and 1980s, there was a national committee in the Ministry of Agriculture for the standardization of agricultural machinery. At that time demands for centrifugal pumps, engines for pumps and sprayers were very high. The committee used to test the machines through a technical sub-committee. Based on the test result, machinery were standardized. Only certified engines and tractors were allowed to import. Pumps for irrigation and sprayers are all locally made. At that time most of the procurement of these machinery was done by public sectors. Govt. didn't allow importation of machinery without certificate. The procedure of obtaining govt. certificate on standard used to take a long time. In 1988, govt. allowed importation of agricultural machinery without the testing certificate. As a result, a huge number of power tillers and engines for irrigation pumps were imported and this rule is still continuing.

Extension Activity

Bangladesh Agriculture Development Corporation (BADC) was responsible for installation of deep tubewell, shallow tubewells and power pumps. These irrigation machinery have been extended to almost all the villages of the country. Now the private sector is looking after the irrigation machinery. BADC didn't have any mandate to extend seeders, sprayers, reapers, threshers, winnowers etc. The Department of Agricultural Extension (DAE) has a plant protection wing to extend sprayers. The DAE has officials up to the village level. This government organization mainly extends all the crops to farmers. Through small projects, a few NGOs are working to extend promising farm machinery in a limited area. Through their activities in limited areas, some agricultural machinery became popular among farmers. BRRI has a small project, financed by the govt. to popularize BRRI-developed farm machinery to a limited area of the country. Similarly Bangladesh Agricultural University recently completed a Department For International Development (DFID)-financed project to extend farm machinery. BARI also had a small project to extend BARI-developed farm machinery to a limited area of the country.

2.2 Local Manufacture

There has been more than 40,000 small and medium sized local metal working workshop spread all over the country. These workshops are doing reverse engineering and manufacturing spare parts of all kinds including agri-machinery.

Policy of open market and privatisation is being practiced regarding import, marketing and utilization of agricultural machinery and equipment in the country. Under this situation,

practice of standardization of agricultural machinery has also been eliminated. Any agricultural machinery and equipment can be freely imported now in Bangladesh. With this liberalization of import policy including withdrawal of taxes and standardization, cheap equipment with inadequate standard and performance are randomly imported into the country. Free import system is detrimental to the effect that it allows to import agricultural machinery at a much lower rate of import duty compared to a much higher rate in case of raw materials to be used for the local manufacturing of the agricultural machinery. This makes local manufacturing of the machinery much costlier than the imported ones and farmers are obviously attracted to buy imported equipment for its low price. This situation has impeded flourishing of local manufacturing of agricultural machinery.

As many as 200 manufacturers are involved in producing these machines developed in Bangladesh. The manufacturers are engaged in manufacturing and fabrication of agricultural machinery. Major products being locally manufactured are:

- Power tiller (two-wheel tractor) with 3 bottom disc plough
- Hydro Tiller
- IJO Jute Seed Drill
- PTO planter / seeder for maize and wheat
- Spraying Machines of different types and capacities
- Pedal and power Threshers
- Sugarcane Crushers
- Manual and power Maize Sheller
- Husking and Grinding machine
- Pumps

All the above equipment are completely fabricated in the country; only the prime-movers, such as electric motors and IC engines are imported. Electric motors are also manufactured in the country to a large extent.

3. Poverty Reduction Through Selective Farm Mechanization

In Bangladesh, small-scale mechanization has proved to be appropriate for the socio-economic condition. The application of farm machinery is likely to increase the land and labour productivity about 10 per cent.

Most of the areas tillage operation has been mechanized. Farm mechanization has helped establishing a number of backward industries such as engine repairing and spare parts making workshops that created better income generating employment. Different forward industries like paddy parboiling and husking mills, flour mills, oil mills, spices grinding mills, and poultry feed mills have been established due to increased crop production. A lot of non-farm employment has been generated after the initiation of farm mechanization and average annual working days of rural labourers have increased by 35 per cent and wage rate by 88 per cent. As a result of farm mechanization, the annual household incomes of different labourers have increased from 75 to 113 per cent. All these indicate that use of farm machinery can alleviate the poverty in rural areas and does not create unemployment in rural areas, rather it creates employment.

Intermediate Technology Development Group (ITDG), an international NGO has taken up a programme to promote locally-made farm machinery for poverty reduction. Their target group is large number of smaller farmers. They have tried to popularize, among others, a few BARI-developed farm machinery including multi-crop power thresher, winnower and weeder in Faridpur and Gaibandha districts. Poor and marginal farmers were more interested in adopting farm machinery than rich farmers. Latter group expressed management problems of owning machinery and were interested in getting services from enterprises. On the other hand, poor and marginal farmers bought power threshers at Tk 15,000 to 18,000 (without engine) through credit and by renting the service earned more than the cost of power thresher in one season. Winnower was not as popular as power thresher and needs some time to become popular.

At present tillage operation, power maize shelling and power threshing of paddy and wheat has been mechanized to a large extent. Threshing operation has been mechanized in some areas and need massive extension in other areas. At present 62 per cent labour forces is engaged in agriculture, which is very high compared to developing and developed countries. Increased use of farm machinery will free many farm labourers for non-farm activities, which is essential to increase income for rural labourers. It is well known that non-farm labourers earn significantly

more than farm labourers. Total cost of production of dry season paddy in Bangladesh is US \$ 418.87/ha compared to US \$ 336.28/ha in West Bengal, \$ 253.17/ha in Punjab, 223.65/ha in Thailand and \$ 274.45/ha in Vietnam. The highest cost in Bangladesh is due to the highest cost of irrigation and fertilizer and second highest cost (West Bengal highest) in human labour. Increasing the irrigation efficiency and use of more farm machinery can reduce the cost of production to a great extent.

Research and development work have been going on to develop reaper (harvester) for paddy and wheat, potato digger, seeder, planter etc. Some of these machinery are in commercial production, it will take care of to increase land and labour productivity, reduce cost of production and income generation for poor and marginal farmers in farm and non-farm sector, all of which will ultimately reduce poverty in rural areas.

4. Focus of the National Institute

- i) Testing (if not standardization) of all imported agricultural machinery should be made and the test results should be published and made available to the buyers.
- ii) Establish an agricultural machinery development and testing center drawing physical and other resources scattered in different agencies.
- iii) In order to encourage the manufacturing of agricultural machinery locally, import duty on raw materials should be fixed such that the finished goods can comfortably compete in price with the imported ones.
- iv) Short and long term policies for agricultural mechanization. Prioritisation of specific operation to be mechanized and R&D.
- v) Extensive extension program to popularise the successful machines and process.

5. Future collaboration of APCAEM into the thrust area of development in Bangladesh

On behalf of my Agency (BARC), I welcome the establishment of APCAEM in this 4th session TC/GC meeting in Delhi, India. We are sure the center is emerging with a great hope and aspiration to the region to eliminate poverty and hunger by promoting agro-industry, where we possess advantage. We hope the center will be more organized now to serve the nation. We also hope future collaboration may be made in:

- Facilitate promoting appropriate technology of agricultural engineering and machinery including biotechnology from successful country(ies), (Procurement of blue-prints and prototypes and technical know-how).

- Capacity building of the R & D institutes, manufacturing, processing, and servicing units in specific areas of mechanization and processing.
- Strengthen standardization and testing facilities.
- Monitoring agricultural mechanization trend, census of machinery in certain interval.
- Support to the research and development of the machinery and post harvest processing machinery including policy research on mechanization and agro processing industries.