

# Manufacturing of agricultural machinery in Bangladesh: opportunities and constraints

M. M. Alam<sup>1\*</sup>, M. I. N. Khan<sup>2</sup>, C. K. Saha<sup>1</sup>, A. Rahman<sup>1</sup>, M. G. K. Bhuyian<sup>3</sup>

(1. Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh;

2. AgroMech, House # 817 (2<sup>nd</sup> floor), Road # 04, Baitul Aman Housing, Adabor, Dhaka 1207, Bangladesh;

3. Bangladesh Rice Research Institute (BRRI), Gazipur, Dhaka)

**Abstract:** Despite numerous limitations, agricultural machinery (AM) manufacturing sub-sector in Bangladesh is growing quite satisfactorily and has potential to make substantial contribution to much needed non-farm economic growth, employment generation, mechanization of on and off-farm agricultural activities, and as a whole orientation in the national development. This study made an attempt to take account of AM manufacturers, importers, traders/wholesalers and retailers, their associations, assess market potential and identify serious bottlenecks associated with this sub-sector. Stratified random sampling technique was used for identifying respondents in quantitative survey, while focus group discussions (FGDs) and Key Informant Interviews (KIIs) were conducted for qualitative investigation. In recent years, there are about 70 foundries, 800 agricultural machinery manufacturing industries and workshops, 1,500 spare parts manufacturing workshops, and about 20,000 repair and maintenance workshops are engaged in AM sub-sector of the country. The annual estimated market size of AM and spare parts in the country is about US\$ 802.3 million with an US\$ 105.2 million annual repair and maintenance service market, estimating an annual total AM market size of about US\$ 907.5 million of which local production market share is about US\$ 402.7 million. The spare parts market size in the country is about US\$ 309.3 million of which domestic production of spare parts is estimated US\$ 237.9 million. The significant shift in the supply of spare parts in the country underlines the growth potential of the local spare parts manufacturing sub-sector and potential for substitution of imported spare parts. Bogra has emerged as the center of manufacturing AM and spare parts especially for irrigation pumps, threshers, maize shellers, piston, liner and numerous spare parts of small diesel engines and machines, casting of machine components etc. and contributing about 80% of the local production in the country. However, infrastructures for production of AM and spare parts in Bogra and elsewhere in the country are still inadequate. The study recommends declaration of Bogra and Jessore as 'Agri-machinery districts' and establishment of special 'Agri-machinery Production Zones (APZ)' in these areas. To promote export market to Indian subcontinent and other developing countries, tariff and non-tariff restrictions would be waved on AM through bilateral negotiations and border markets (hats) with India to be allowed for AM sales.

**Keywords:** agricultural machinery, spare parts, manufacturing, supply chain, marketing, import vs local quality, constraints

**Citation:** Alam, M. M., M. I. N. Khan, C. K. Saha, A. Rahman, and M. G. K. Bhuyian. 2017. Manufacturing of agricultural machinery in Bangladesh: opportunities and constraints. *Agricultural Engineering International: CIGR Journal*, 19(1): 122–135.

## 1 Introduction

Agriculture is one of the major sectors contributed 20.24% to the GDP of Bangladesh with a growth rate of 4.12% in 2010-11 (BBS, 2011). Within this sector AM is

emerged as a potential agribusiness sub-sector. Agricultural sector generated 43.6% of total national employment. In contrast, non-agriculture sector contributed 56.4% of total employment in 2008-09 (BBS, 2009).

Bangladesh agriculture was absolutely dependent on tradition and nature until the introduction of Mechanized Cultivation and Power Pump Irrigation (MCPPI) scheme in 1950-51 by the Agricultural Directorate, which was the first known attempt of using machines in the field of

---

**Received date:** 2016-01-28    **Accepted date:** 2016-12-23

\* **Corresponding author:** Dr. Md. Monjurul Alam, Professor, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Email: mmalam.bau@gmail.com.

agriculture in the country. During 1960-65, the government distributed 2,238 power pumps, 200 tractors, 13,828 sprayers and dusters, and established two workshops at government level. Later in 1970, international charitable organizations provided 138 MF-135 tractors and 569 power tillers to the affected farmers to cope with the draught power shortage caused by the devastating cyclone at the coastal areas of the country. Local engineering workshops that were engaged in repair and maintenance of the imported machinery gradually emerged in the market and soon started producing small spare parts with the limited resources and skills. That was the landmark for manufacturing of agricultural spare parts and equipment in the country.

The introduction of HYV rice in early 1960s had triggered changes in the application of fertilizer, insecticides, timely irrigation, land preparation and improved crop management practices. In 1970s, the changes in cropping pattern and cropping intensity due to introduction of HYV rice crop increased a demand for mechanized irrigation, tillage, pest management and post-harvest processing of crops to attain timeliness of operations. The power pumps and power tillers gradually gained popularity in spite of difficulties encountered with after sales services, repair facilities and training of operators. Although, switching over to mechanical power from animal and human muscle power was marginal during this period.

In the same period, the Ministry of Agriculture formed an 'Agricultural Machinery Standardization Committee' for testing and standardization of farm machines, so that only high quality standardized machines and equipment suitable for using and maintaining in Bangladesh condition were imported and used in the country. This practice restricted the market to a limited makes and models of high quality and relatively high priced imported equipment. However, local manufacturers of agricultural equipment were encouraged to compete and allowed to market items with slightly relaxed specification for a limited period.

Later, in the year 1988, there was a devastating flood in the country, caused a heavy loss of livestock and created a serious shortage of draught power. At that situation, the

government promptly liberalized machinery import policy, such as tax exemption on AM import, waiver of standardization certification and ends the monopoly of public sector import and distribution of AM, which resulted in huge influx of imported AM in the country, such as power tillers, diesel engines and motors.

As a result of this policy change, in 1990s, agricultural machinery sub-sector had gone through a remarkable diversification of activities like repair, maintenance and manufacturing of farm implements, machines and spare parts for irrigation pumps, engines/motors, power tillers, sprayers, pedal and engine operated paddy and wheat threshers, maize-shellers, rice hullers, poultry and dairy equipments etc. There are about 2000 small to medium size AM manufacturing entrepreneurs in the country, providing immense contribution to this sector. Alongside of these manufacturing workshops, repair & maintenance of AM and equipments were provided by 10,000 small engineering workshops and approximately 500,000 mechanics (Alam, 2005).

Policy guidelines and assistance from the government and the public sector services however, remained absent to this sub-sector. The sub-sector mainly grew on private sector efforts only. The private sector gradually became confident to manufacture various AMs and equipment and rendered repair & maintenance services to sustain these machines at farmers' level.

This study made an attempt to take account of AM and spare parts manufacturers, importers, traders/wholesalers and retailers and their associations, assess market potential for AM and spare parts workshops and identify serious bottlenecks associated with this sub-sector.

## 2 Methodology

The study was designed to make an assessment of the AM and spare parts workshops in the country through survey of manufacturers, Focus Group Discussions (FGDs) with business associations and Key Informant Interviews (KIIs) with relevant experts. The survey on manufacturers was conducted based on stratified random sampling technique. Appropriate tools for FGDs, KIIs

and survey instruments were developed to conduct the study.

**2.1 Selection of the study Site**

This research identified AM and spare parts manufacturers, importers, traders/wholesalers, retailers, and their associations as respondents. Based on the growth and concentration of agricultural machinery and spare parts manufacturing workshops (clusters), the study was conducted in 3 districts of Bangladesh. The districts were: Dhaka, Bogra and Jessore (Figure 1).

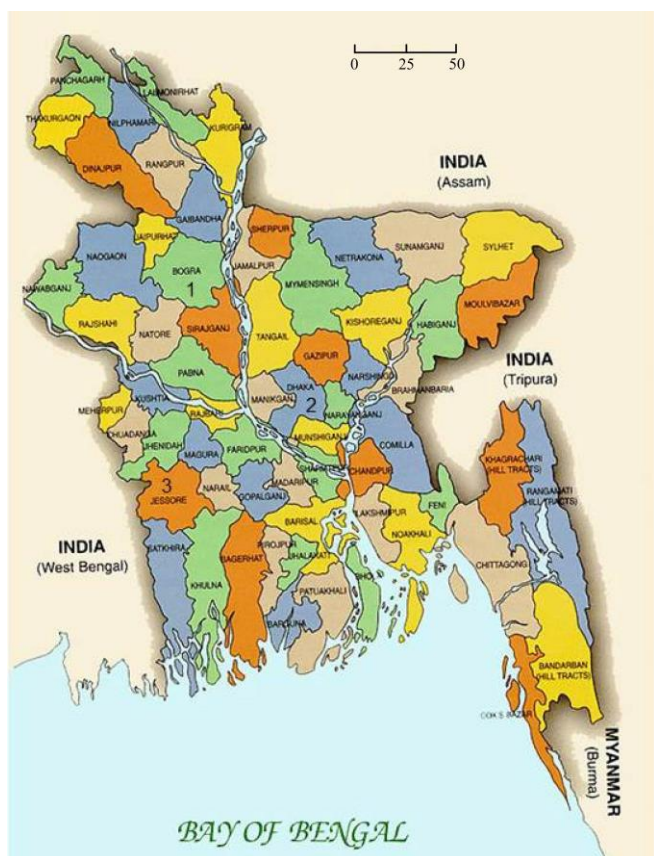


Figure 1 Map of Bangladesh. Numbers 1, 2, and 3 showed the districts Bogra, Dhaka and Jessore, respectively (SASNET, 2013)

**2.2 Sampling Technique**

The AM and spare parts sub-sector in Bangladesh involves multi-level stakeholders including importers of whole machines and raw materials, assemblers, foundries, manufacturers, wholesalers, retailers, operators, mechanics, and their associations. Considering all actors, a systematic sampling distribution was followed during the study.

1) Clustered multi-stage stratified random sampling technique was used for sampling of foundry, centrifugal pump, thresher, sprayer, maize sheller and spare parts manufacturers. Cluster sampling technique was used for

selecting actors like, wholesaler, retailer etc.

2) The samples were drawn using a systematic pattern from an arbitrarily designated point within each sample area.

3) Qualitative data were collected through FGDs and KIIs.

**2.3 Sample Distribution**

**2.3.1 Quantitative survey with agricultural machineries supply side**

For selection of sample size for enterprise (foundry, manufacturer, wholesaler, retailer of AM) of known population (N), the Equation (1) (Cochran, 1977) was used:

$$n = \frac{z^2 pqN}{e^2 (N - 1) + z^2 pq} X \cdot d_{eff} \tag{1}$$

where, *n* is desired sample size; *z* is standard normal deviation usually set at 95% confidence interval (*z*=1.96); *p* is the probability of success (*p*=0.5); *q* is the probability of failure (*q* = 1.0 – *p*); *e* is the degree of accuracy desired set at 0.5 at 95% confidence level; *N* is population in the cluster, and *d<sub>eff</sub>* is the design effect, 2.

As multi-level stakeholders involved in the AM sub-sector in Bangladesh including manufacturer, foundry, wholesaler, retailer, etc., considering all actors, the following sample distribution was followed during the study (Table 1).

**Table 1 Sample distribution of enterprise survey**

Inform ant/Actor	# covered			Total
	Dhaka (Nowabpur)	Bogra	Jessore	
Centrifugal Pump manufacturer (Dhaka, N=37; Bogra, N=41)	8	8		16
Spare parts manufacturer (Bogra, N=410)		8		8
Foundry (Bogra, N=50)		8		8
Sprayer manufacturer (Jessore, N=19)			7	7
Thresher manufacturer (Bogra, N=89)		8		8
Corn-sheller manufacturer (Bogra, N=35)		8		8
Input trader/importers (Bogra, N=21)		7		7
Importer of spare parts (Dhaka, N=121, Bogra, N=69)	8	8		16
Wholesaler (Bogra, N=17)		7		7
Retailers (Bogra, N=81)		8		8
<b>Total</b>	<b>16</b>	<b>77</b>		<b>93</b>

**2.4 Survey Questionnaire**

Semi-structured questionnaires were prepared according to the objectives of the research with active consultation with key informants, researchers, experts

from the relevant fields and secondary information. Furthermore, check lists were developed for KII and FGD. The draft questionnaires and check list were pre-tested and necessary corrections, modification and alterations were made accordingly.

The data on present status of AM was collected through semi-structured questionnaire. Data were collected from actors of the AM sub-sector on types of business, ownership status, existing products/services, price, promotion, types of machineries used in the manufacturing section, total cost of commissioning of the workshop/service ventures. Data were also collected on the process and capacity utilization of manufacturing machines/spare parts such as casting, cutting & machining, fabricating, etc. Marketing information of AM & spare parts from importers, wholesalers to retailers were also collected. Key Informant Interview (KII) with large corporate/assembler of AM, research, policy level actors and promising investors were rigorously undertaken.

### 3 Results and discussion

#### 3.1 Present status of manufacturing and marketing of agricultural machinery in Bangladesh

In recent past, significant improvements have been made in the production and marketing of locally made AM in the country. Eventually, almost all centrifugal pumps being used in Shallow Tube Wells (STW) and Low Lift Pumps (LLP) are manufactured in the country. Similarly, paddy and wheat threshers, maize shellers, hand and foot-pump sprayers, weeders, engine and machine spare parts are also being manufactured locally. However, this sub-sector is still recognized as non-formal sector and very limited effort has been made to assess the sub-sector market demand and supply, and potential for export of AM. Available information on present market demand and supply status, and export potential of selected AM are presented in the following sections.

In recent years, there are about 70 foundries, 800 AM manufacturing workshops, 1,500 spare parts manufacturing workshops and about 20,000 repair and maintenance workshops are engaged in AM sub-sector of the country.

The machinery need for production and post-harvest processing of crops has increased significantly in recent time. Despite limitations, the sub-sector is growing quite satisfactorily and has potential to grow faster. Table 2 depicts the existing annual market size of some selected AM. The annual estimated market size of AM and spare parts in the country is about US\$ 802.3 million with an US\$ 105.2 million annual repair and maintenance service market, estimating an annual total AM market size of about US\$ 907.5 million of which local production and repair & maintenance market share is about US\$ 402.7 million.

**Table 2 Annual market size (in million US\$) of agricultural machinery in 2011**

Agricultural machineries	Market size/yr
Power Tiller (Imported)	50.0
Tractor (Imported)	80.1
Engine (Imported)	256.9
Tillage machinery	9.7
Centrifugal Pump (STW & LLP)	16.7
Spare parts (Local)	237.9
Spare parts (Imported)	71.4
Sprayer (local)	1.5
Sprayer (imported)	0.4
Thresher (Open & Close drum)	39.5
Maize Sheller	1.3
Weeder	0.6
Harvesting equipment (Imported)	1.2
Rice milling machinery (Imported)	35.1
Sub-total	802.3
Repair & Maintenance	105.2
Total market size	907.5

Note: 1 US \$ = BDT 80.0.

Since early nineties, the demand for AM in the country is increasing and the market grew rapidly in recent years. In the last five years, the market grew more than three folds from US\$ 273.6 million annually in 2006 to US\$ 802.3 million in 2011 (Figure 2). This trend provided significant boost to the local production of AM and spares parts significantly, and decreased dependency on import.

The supply of power tiller (PT) solely depends on import. There are about 550,000 PTs operating in the country. During 2004 to 2007 about 55,000 to 60,000 PTs were imported annually, later the import trend slowed down gradually and during 2010-11 about 42,000 PTs were imported annually worth US\$ 50.0 million

(Figure 3a). The supply chain of power tiller involves importers, wholesalers and retailers. Five Dhaka based large importers are the major sources of supply of PTs to district wholesale and retail markets. About 95% of the PTs are wholesaled to district wholesalers and retailers and 5% being retailed by the importers itself. On the other hand, district wholesalers and retailers are retailing 70% at district market and 30% to other districts and upazila level markets.

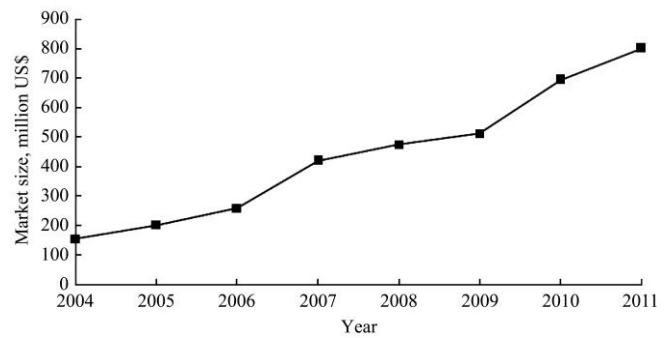


Figure 2 Agricultural machinery market trends in Bangladesh

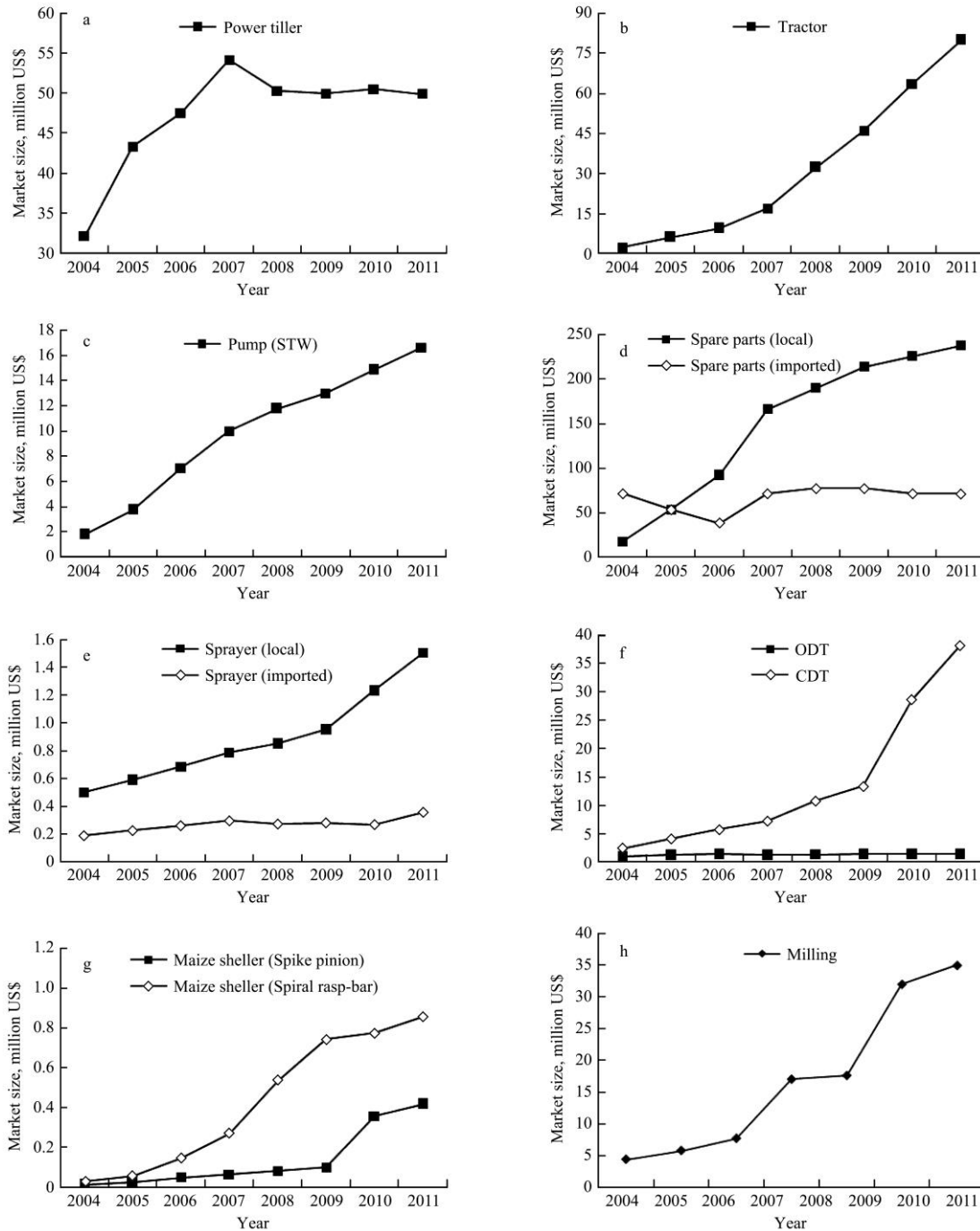


Figure 3 Trends of different agricultural machineries market in Bangladesh

The supply of tractors in the country totally depends on import. At present, there are about 35,000 tractors

operating in agricultural sector, mainly in tilling and transportation purposes. In the year 2002, the number of

tractors operating in the county was about 5,530 (FAO, 2002). Since then, the number of tractor import is increasing rapidly and gradually replacing the power tillers in agricultural sector. Presently, on an average 6200 tractors worth US\$ 80.1 million are being imported annually in the country mostly from Indian origin (Figure 3b). The supply chain of tractor involves importers and retailers. Few private sector companies like The Metal, ACI Motors Ltd., Mahindra, Corona, etc. are importing majority of the tractors and marketing through its dealers and own showrooms at different district towns and business centers. Most of the tractor companies are providing after sales services to the buyers.

The supply of centrifugal pumps for Shallow Tube Well (STW) and Low Lift Pump (LLP) depends on local production. At present, there are about 1,425,136 STWs and 150,613 LLPs operating in Bangladesh (BADC, 2010) with an annual demand of 850,000 centrifugal pumps. However, the present production volume of centrifugal pump is about 560,000 units with an annual turnover of US\$ 16.6 million (Figure 3c). Based on unmet demand a potential market size of US\$ 5.6 million is remaining unexplored. Bogra district alone is producing about 90% of the centrifugal pumps and its accessories followed by Dhaka and Jessore districts. However, the manufacturing of centrifugal pump is facing many odds. The major constraints are the use of age-old machineries and technologies result in quality-compromised products, high price of raw materials, poor quality of raw materials, lack of skill and technical knowledge related to metal casting, heat treatment, lack of testing facilities for maintaining quality of products, inadequate working capital, lack of non-interrupted supply of electricity, inadequate spaces for the manufacturing industries, inappropriate tariff policies on import of spare parts and raw materials.

Spare parts of power tiller, diesel engine and centrifugal pump are both imported and locally produced. A significant amount of spare parts is being produced in the country, especially in Bogra, Dhaka and Jessore districts. The estimated market size of spare parts in the country during 2004-05 was about US\$ 89.2 million of which local production size was about US\$ 1.78 million (Alam, 2005). In contrast, the market size of spare parts

in the country during 2011 was about US\$ 309.3 million of which the share of local production was about US\$ 237.9 million (Figure 3d) (BAMMA, FOAB and BSMS, 2011). This significant shift in the supply of spare parts in the country underlines the growth potential of the local spare parts manufacturing sub-sector and potential for substitution of imported spare parts. This saves a huge amount of foreign currency and decrease dependency on import. Bogra alone has produced about 80% of the local spare parts, rest 20% is being produced in Dhaka and Jessore districts. The spare parts sub-sector is employing a significant number of skilled and semi-skilled labour forces, and creates opportunities for further employment. However, this sub-sector is still lacking the attention of the policy planners of the country.

The import channel of spare parts involves importers, district wholesalers and retailers. On the other hand, local spare parts production channel has two sub-channels. One, an integrated foundry and spare parts machining unit and the other is independent foundry and machine shop units. The market trend shows that the integrated sub-channel has got major market share compared to non-integrated sub-channel (Figure 4).

Among spare parts, piston & liner production has a significant share in the domestic market as well as export market in Nepal, Bhutan and India. A comparative scenario of price and quality of major local and imported spare parts is shown in Table 3. Some locally produced spare parts such as, centrifugal pump, impeller, fuel filter, rocker arm, PT chain cover, pulley etc. are very good in quality and captured the local market by replacing imported China spare parts. Among many local spare parts piston, liner, clutch bush, governor bush, housing, silencer, chain cover, bush guide, etc. are cheaper in price and good in quality compared to imported spare parts and have good market potential in the country. In competing with the imported spare parts, the sub-sector faces many constraints, the main constraints are high price and lack of supply of raw materials, lack of modern capital machinery, lack of skill and knowledge related to production, lack of market and technical information, inappropriate policy related to custom duties, VAT etc. for imported raw materials.

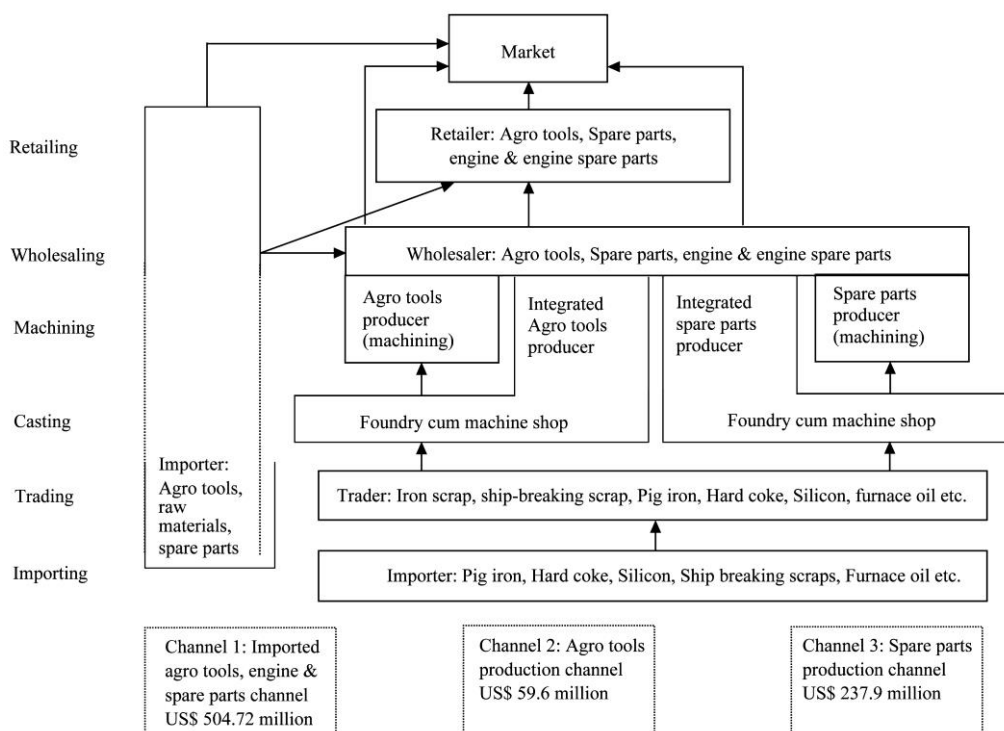


Figure 4 Common supply chain of agricultural machinery sub-sector

Table 3 Comparative quality and price (in US\$) of few selected spare parts

Item	Local spare parts		Imported spare parts		
	Quality	Price	Quality	Price	Country
Liner (C-25)	Good	6.19	Not good	8.92	China
Liner (C-20)	Good	5.35	Not good	8.33	China
Liner (C-12)	Good	5.35	Not good	7.73	China
Piston (C-25)	Good	5.95	Good	6.66	China
Piston (C-20)	Good	5.35	Good	5.47	China
Piston (C-12)	Good	3.81	Good	4.28	China
Gudgeon pin (C-25/24/20)	Very good	1.55	Good	1.43	China
Gudgeon bush (C-25/24/20)	Very good	0.71	Good	0.59	China
Head Gasket (C-25)	Good	0.71	Very good	1.07	China
Head Gasket (C-20)	Good	0.59	Very good	0.83	China
Head Gasket (C-12)	Good	0.36	Very good	0.42	China
Head set	Very good	0.24	Good	0.24	China
Valve guide	Very good	0.36	Good	0.30	China
Fuel Filter	Very good	0.18		No import	
Racer arm	Very good	0.42		No import	
Pump 3"	Very good	26.17		No import	
Pump 4"	Very good	34.50		No import	
Pump 5"	Very good	39.26		No import	
Impeller 3"	Very good	143		No import	
Impeller 4"	Very good	2.97		No import	
Impeller 5"	Very good	3.81		No import	
Oil seal (50×80×12)	Good	0.30	Very good	0.42	China
Air cleaner 12/16 hp engine	Good	3.57	Very good	7.14	China
Air cleaner 8.5 hp engine	Good	2.14	Very good	4.76	China
Air cleaner 6 hp engine	Good	1.19	Very good	3.57	China
Silencer 12/16 hp engine	Good	3.09	Good	4.16	China
Silencer 8.5 hp engine	Good	1.90	Good	3.33	China

Item	Local spare parts		Imported spare parts		
	Quality	Price	Quality	Price	Country
Silencer 6 hp engine	Very good	1.78	Good	2.97	China
Chain cover	Very good	5.95	Good	7.14	China
Bush guide	Excellent	0.24	Good	0.18	China
Washer	Good	0.18	Not good	0.08	China
PT tine nut	Good	0.30	Very good	0.36	China
PT chain cover	Good	6.54		No import	
PT pulley	Good	4.52		No import	
V-pulley	Very good	2.38		No import	
Fuel key	Excellent	0.89		No import	
Fuel pipe	Good	0.48	Very good	0.71	China
Oil catcher (Kubuta-900/600/550/90)	Very good	0.83		No import	
Oil catcher (Mitsubishi-110/90/75)	Very good	4.16		No import	
Clutch bush	Very good	0.30	Good	0.30	China
Governor bush (big)	Very good	0.95	Good	0.83	China
Governor bush (small)	Very good	0.24	Good	0.18	China
SF arm pipe	Very good	2.38		No import	
SF pulley tension set	Very good	1.90		No import	
6209 housing	Very good	1.55	Good	1.49	China
6207 housing	Very good	1.55	Good	1.49	China
6307 housing	Very good	1.19	Good	1.49	China
6311 housing C/6	Very good	2.97		No import	
Fuel tank 8.5 hp engine	Very good	12.49		No import	
Fuel tank 6 hp engine	Very good	10.71		No import	
Fuel tank 4 hp engine	Very good	10.71		No import	

Note: Price list is based on a survey in 2011.

All types of hand and foot sprayers are produced locally. Only knapsack sprayers are imported from China,

Korea, Brazil and India. The local manufacturers collect raw materials from Dhaka market and sell 30% product to own district market and 70% to other districts. The annual demand of locally produced hand and foot sprayers is about 300,000 pieces worth US\$ 1.5 million (Figure 3e). The market size of imported knapsack sprayer is about US\$ 0.4 million per annum. The sprayer production units are facing some constraints such as high price and lack of quality raw materials, inadequate skill and knowledge related to production, lack of market information etc.

The supply of paddy and wheat threshers depends on local manufacture. The manufacturers collect raw materials mostly from local market and sell, on an average, 30% at local market and 70% to other district and upazila markets. The numbers of open and closed drum threshers in the country already exceeded 150,000 and 220,000, respectively. The annual demands of open and closed drum threshers are about 20,000 and 80,000 units worth US\$ 39.5 million (Figure 3f).

The demand of thresher is increasing and its production does not face any competition from import. The production of threshers are facing some constraints, the most common are inadequate skill and knowledge related to production, high price and inadequate supply of raw materials, lack of market and technical information, inappropriate policy related to duties on imported raw materials etc.

The supply of maize sheller also depends on local manufacture. The manufacturers collect their raw materials mostly from local market and sell on an average 25% at local market and 75% to northern districts of Bangladesh. The unit price of spike-pinion type maize sheller is about US\$ 119 and the price of spiral rasp-bar cylinder type maize sheller ranges between US\$ 309.3 to US\$ 380.6. The present population of maize sheller in the country is about 18,100 with an annual demand of 6,500. The present market size of maize sheller is estimated about US\$ 1.3 million per annum (Figure 3g).

The demand of maize shellers is increasing rapidly with the increase in maize crop area and increased production in the country. The main constraints faced by maize sheller manufacturing are high price and

inadequate supply of raw materials, inadequate skill and knowledge related to production, lack of market and technical information, inappropriate policies related to duties, VAT etc. on imported raw materials. The quality of manufacturing and the profit margin may further improve by introducing automation in drilling holes on cylinder concave, cutting and bending of metal sheets and plates with scale up production practice and management.

In order to overcome scarcity of labour in harvesting and planting seasons of paddy and wheat, rice transplanter, self-propelled reaper and medium size combine harvester have high demand among the farmers. Few importers namely ACI motors, The Metal etc. have started importing rice transplanter and combine harvester from Korea and popularizing among the farmers. The present import market size of harvesting machines is about US\$ 1.2 million. Two engineering workshops namely Janata machine tools Ltd. of Jessore and Mahubub engineering workshop of Jamalpur fabricated few units of BAU model (Hossain, 2002) self-propelled reaper for commercial purposes each costing US\$ 892. Field capacity and efficiency of this machine are 0.21 ha/hr and 81%, respectively with a cost saving of US\$ 17.5/ha over manual harvesting of paddy. There is a huge demand of reaper in the country but the local manufacturers are facing difficulties in maintaining the precisions needed in manufacturing and thereby unable to meet the standard required for marketing of the reaper.

Rice milling in the country is overwhelmingly mechanical and there are about 15,239 husking mills, 650 semi-automatic and 350 automatic rice mills in the country (Rice miller association, 2012). In addition there are about 100,000 traditional Engleberg type rice hullers in the country. Recent studies identified that the number of husking rice mills are shrinking and the businesses are being shifted either to semi-automatic or to automatic rice mills. These modern rice mills are using mechanical technologies, like pre-cleaning, parboiling, drying, milling, paddy separating, polishing, de-stoning, fine polishing (silking), colour sorting, aerating, bagging, weighing & sewing etc. The annual import market size of these machines is estimated as US\$ 35.1 million



(Figure 3h).

Besides most common AM and spare parts production, a few items like drum seeder, push-pull weeder, potato harvester, potato grader, fish and poultry feed machine, rice grader, rice polisher, auto crusher machine, auto mixture machine, oil mill, chira/puffed rice mill, rice huller, hot mixture machine, cereal dryer machine etc. are being manufactured in the country. This sub-sector remains unexplored and there is a huge potential for growth and employment generation.

Alongside of manufacturing of AM and spare parts, there are about 20,000 repair and maintenance workshops and about 500,000 mechanics are involved in repair and maintenance of engines and machines used in agricultural activities worth of about US\$ 105.2 million service market annually.

### **3.2 Supply chain of agricultural machinery sub-sector**

A common supply chain of AM sub-sector in Bangladesh is delineated in Figure 4, which involves importers, raw material traders, foundry or foundry cum AM manufacturers, spare parts manufacturers, wholesalers and retailers. The channels are identified based on the core business unit, i.e., the producers. In forward linkage, the channels are up to the consumers i.e., the farmers. On the other hand, in backward linkage the channels go down to the importers. The core business unit is fragmented and small. In general, the more integrated (foundry and machine shop under the same shed/factory) the units, the more capital-intensive they are. The integrated units also have fewer intermediaries. It was recognized that the integrated units mostly have their own outlets for both wholesaling and retailing.

### **3.3 Constraints of agricultural machinery manufacturing and business development service (BDS) provisions to address it**

As an emerging sub-sector, AM manufacturing faces many constraints. However, few major constraints that have grave implications on the growth of the sub-sector are illustrated in this section.

3.3.1 Lack of modern capital machinery at producers' level resulted in low productivity and poor quality of products

Agricultural machinery sub-sector is comprised of small and medium size enterprises. They emerged mostly from repair and maintenance service sector and lacking in experience and technical knowledge related to manufacturing of sophisticated AM and equipment. The enterprises are also lacking of information about appropriate capital machines and equipment suitable for production of quality machines and spare parts; lacking of appropriate design, drawing and manufacturing processes; and lacking of knowledge about the sources of these technical information. Mostly, the enterprises are depending on age-old outdated machineries for manufacturing AMs and spare parts. As a result, these enterprises produce quality compromised products and face tough competition with the imported machines and spare parts from abroad, especially products from China. Awareness building program along with formulation of policies for soft credit facility and zero tariffs on modern capital machinery import are urgently needed for a break-through in this sub-sector.

3.3.2 Inadequate supply of quality raw materials to the foundries and manufacturing workshops hampers production and increases production cost

Foundries, pump and spare parts manufacturers solely depend on the supply of imported raw material such as pig iron, ship breaking scraps and local scrap iron, steel, brass etc. The enterprises also depend on imported hard coke and furnace oil. The supply of old ships for ship breaking industries decreases in recent years due to international competition, especially with China and India. Moreover, syndicate of few importers' based in Chittagong and Dhaka controls the import of these raw materials. Most entrepreneurs strongly believe that these syndicates are manipulating the supplies of ship breaking scraps and hard coke, and responsible for price hike. In 2010, the prices of ship breaking scraps and coal were increased to US\$ 0.54/kg and US\$ 0.74/kg, respectively that generated sensation among the business communities. The crisis intensifies with multiple VAT on raw materials and finished products at different stages of sales. The use of local iron scraps also reduces the quality of product. Furnace oil supply in border districts such as Jessore, Dinajpur is restricted by rationing ('kota') system. As a

result, small foundries are hard hit at peak demand, as they are unable to stockpile the furnace oil in time due to inadequate working capital. The high price and unavailability of raw materials poses a great threat to the domestic AM and spare parts production in terms of production cost and quality as compared with the imported machines and spare parts, especially imported from China.

3.3.3 Lack of skill related to fabrication; iron, alloy steel and brass casting; heat treatment; repair & maintenance of AM; and management & accounting at the producers' level resulting in low productivity of the sub-sector

Most of the AM entrepreneurs are lacking of appropriate knowledge and skill on heat treatment, metal casting and fabrication of AM products. Qualified engineers, even diploma engineers are scarce in the sub-sector and therefore, lacking of knowledge and skill related to design, drawing, manufacturing process and quality control. The scarcity of skilled and competent personnel in the sub-sector has increased the tendency of migration of such workforce from one enterprise to another. There are some, who join an enterprise strictly for gaining experience. They eventually leave the organization, with a view to start their own operation with the limited capital at their disposal. The growth of mostly inexperienced small enterprises is causing serious financial repercussions in the enterprises, e.g., low quality output, low productivity, non-delivery of products in scheduled time, increased wastage of raw materials etc. These in fact, inflicted with poor profitability and low quality outputs of the enterprises and as a whole slow down the growth of the sub-sector.

3.3.4 Lack of steady supply and rationing of electricity restricts the production and business at producers and farmers level

Frequent load shading of electricity causes a severe problem in production and marketing of products. Machines used in manufacturing of machines and spare parts are mostly operated by electricity. Any disruption in supply of electricity restricts the production capacity of the enterprise. In recent time, a significant number of pumps used in irrigation are also operated by electricity

and frequent load shading in peak hours causing a significant loss in crop production. In the 2011 irrigation season, the government had issued mandatory shut down of commercial places and markets including AM and spare parts manufacturing industries and workshops after 8:00 pm, this is done to save on electricity and to allow the irrigation pumps to operate unhindered. The electricity rationing policy also included Mondays as the weekly holiday in industrial sector instead of Fridays in Bogra. This virtually reduced the industrial working days into five in a week, as workers like to have holiday on Fridays for saying 'Jumma' prayer. No doubt it is a national priority. However, the uninterrupted supply of irrigation water to the Boro crop does not only demand electricity but also the steady supply of pumps and engine spare parts. Therefore, the production units of AM and spare parts must be kept beyond these restrictions for the sake of uninterrupted production of pumps and spare parts for irrigation equipment. Moreover, the AM manufacturers have to pay at the industrial rate for electrical energy. As a priority sector the energy rates must be subsidized to keep the market price of the AM and spare parts within the purchase ability of the farmers.

3.3.5 Lack of testing and standardization facility hinders production of quality AM and spare parts

The existing AM and spare parts industries and workshops in the country do not have standardized quality control facilities to ensure quality of products. Inexpensive quality control measures are being introduced in some agricultural industries but some expensive quality test and operation facilities such as, testing of metals and alloys, performance test of pumps, heat treatment of metals and alloys etc. cannot be owned by small agricultural industries and workshops. There should be a common facility in every major public and private center of AM and spare parts production, either in public or private sector initiatives.

3.3.6 Inadequate working capital hinders production of agricultural machinery and spare parts industries and workshops

The demand of AM is mostly seasonal. To meet the machinery demand in season, the AM manufacturers must have sufficient working capital in off-season to

manufacture machine and spare parts in sufficient quantity, so that it can meet the demand in season. However, most of the enterprises in this sub-sector are very small in size and lacking sufficient working capital for production in off-season and stockpile for the peak season. Only in centrifugal pump production sub-sector in Bogra has US\$ 5.65 million unmet market size because of limited supply in peak demand. This sub-sector needs medium term soft credit facility from govt. and private sector banks, financial institutions and cooperatives. Recently, Bangladesh Bank has allocated US\$ 4.76 million with a 10% interest as an incentive to Bogra AM sub-sector. However, the commercial banks disbursed this incentive only to their clients, who have reputation as AM producer.

### 3.3.7 Lack of space and infrastructural facilities hinder growth of this sub-sector in Bogra

Bogra has identified as the center of AM and spare parts production and marketing. Almost 80% of the AM and spare parts production in the country is concentrated in Bogra. However, the industries have been grown scattered in Bogra town, especially in BSCIC industrial area, Goail road, Railway market etc. BSCIC industrial area is too small to accommodate the number of AM and spare parts industries established in and around Bogra town. In Railway market and Goail road the manufacturing workshops have hardly any infrastructural facilities and spaces favorable for production. The workshops do usually operate in very congested and unhealthy locations. It is suggested that these workshops must be shifted to a specialized zone called 'Agri-machinery Production Zone (APZ)', similar to Export Processing Zone (EPZ) at the outskirts of Bogra town.

### 3.3.8 Lack of market information at producers' and sellers' level resulting in slow growth of the sub-sector

Most of the enterprises of the sub-sector are small and have limited capacity for gathering market information such as size of market, cluster of market and potential for export. The promotional efforts on the part of the producers and sellers are generally confined to personal relationship. As a result, the sub-sector registered a slow growth, although there is a huge unexplored potential for

expansion of the market. The producers estimate their production size depending on the sale of previous year and little information gathered through their customers at different districts and Upazilas. Formal market survey is beyond most enterprises financial and logistics ability. Marketing of most of the agricultural machines and spare parts are localized. However, pump, piston and liner manufacturers have developed few non-formal channels throughout the district towns of the country. Few piston and liner producers have non-formal channels for export to Nepal and Bhutan. However, huge potential for export of piston, liner, pumps, sprayers and spare parts etc. still remains unexplored. In recent time, few potential manufacturers are trying to explore the export market of pumps and spare parts to India. Removal of tariff and non-tariff barriers from Indian side through state negotiation can create a favorable condition for export and growth of this sub-sector along with capacity building of the enterprises regarding market information and expansion of the market. Recently, Bangladesh and India have established border markets (hats) for the benefits of the people of both the countries. Allowing formal trading of agricultural machinery and spare parts at these markets may further strengthen border trade and expansion of AM market to India.

### 3.3.9 Lack of ability to collectively safeguard the interest of the sub-sector, resulting in inadequate reflection of the needs and expectation of the sub-sector in the policies and regulations

The development and growth of the sub-sector is comparatively new and mostly comprises of small to medium enterprises. As a result, coordination among the sub-sector actors is practically nonexistent. In recent time, Foundry Owners' Association of Bangladesh (FOAB), Bangladesh Shilpa Malik Samity (BSMS) and Bangladesh Agricultural Machinery Manufacturers Association (BAMMA) are in action in the sub-sector, but a small portion of the actors are actively associated with the activities of the associations; which limiting the lobbying and advocacy activities of the associations to influence various policy formulating bodies. Capacity building of the associations is an urgent need for the growth and development of this sub-sector.

### 3.4 Business Development Service (BDS) provisions and potential service providers

Business Development Service (BDS) provisions and potential service providers are illustrated in Table 4.

The major constraints of AM sub-sector along with

**Table 4 Major constraints of agricultural machinery sub-sector along with business development services (BDS) provisions and potential providers**

BDS	Constraints	Business Development Services	Service Providers
Skill development	<ul style="list-style-type: none"> <li>Lack of skill related to iron, alloy and brass casting, heat treatment; fabrication and machining; R &amp; M of AM; and marketing and financial management training at the producers as well as service providers level</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for skill development on iron, brass and alloy casting, and heat treatment of metals to workshop and foundry technicians</li> </ul>	Public sector training institutes: BITAK, BUET, BMTF, Development partners
		<ul style="list-style-type: none"> <li>Provisions for skill development on machine fabrication and machine operation to workshop technicians</li> <li>Provisions for knowledge and information on basic operation, repair and maintenance to farmers, custom-hire service providers and mechanics</li> <li>Provisions for skill development on marketing and financial management to management personnel</li> </ul>	Public and private training institutes; Manufacturing workshops; DFPM of BAU Private training institutes; Manufacturing workshops; DFPM of BAU Public and private training institutes
	<ul style="list-style-type: none"> <li>Lack of ability to collectively safeguard the interest of the sub-sector</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for strengthening capacity of Foundry Owners' Association of Bangladesh (FOAB), Bangladesh Shilpa Malik Samity (BSMS) and Bangladesh Agricultural Machinery Manufacturers Association (BAMMA)</li> </ul>	Business associations, Development partners, NGOs
Information services	<ul style="list-style-type: none"> <li>Lack of information related to market size and cluster, and production technology at producers' level</li> <li>Lack of Bangla operation and maintenance manual of AM for mechanics, custom-hire service providers and farmers</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for access to market information about market size, clusters of market and potential for export market to producers and sellers</li> </ul>	AM business associations, GO (Ministry of information and foreign affairs), Development partners
		<ul style="list-style-type: none"> <li>Provisions for easy access to Bangla operation and maintenance manual to mechanics, custom-hire service providers and farmers</li> </ul>	Private firms, NGOs
Product development	<ul style="list-style-type: none"> <li>Lack of modern capital machinery</li> <li>Lack of testing and standardization facilities in Bogra and Jessore</li> <li>Lack of innovation and continuation of AM</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for access to information on modern technology and capital machinery</li> </ul>	BUET, BAU, BRRI, BARI, GO, NGO, Development partners
		<ul style="list-style-type: none"> <li>Provisions for establishing common facility centers for testing and standardization in Bogra and Jessore</li> </ul>	GO, Private sector, Development partners
		<ul style="list-style-type: none"> <li>Provisions for establishing 'Central Institute of Agricultural Engineering (CIAE)' for continuation of innovation through R&amp;D</li> </ul>	Government, Development partners
Input supply	<ul style="list-style-type: none"> <li>Lack of supply of quality raw materials</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for uninterrupted supply of quality raw materials to manufacturers</li> </ul>	Business associations, GO
Business development	<ul style="list-style-type: none"> <li>Lack of uninterrupted supply of electricity</li> <li>Lack of space and infrastructural facilities for AM manufacturers</li> <li>Lack of scope for export in SAARC and developing countries</li> <li>Lack of working capital and finance for capital machinery</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for preferential treatment for supply of electricity to AM manufacturers</li> </ul>	PDB, PBS, Ministry of Energy
		<ul style="list-style-type: none"> <li>Establishment of 'Agri-machinery Production Zones' in Bogra and Jessore</li> </ul>	GO (Ministry of Industries, foreign affairs), Business associations, Development partners
		<ul style="list-style-type: none"> <li>Provisions for duty free access to SAARC and developing countries, and formal trading of AM at border markets (hats) with India</li> </ul>	
		<ul style="list-style-type: none"> <li>Provisions for easy access to soft and flexible long and mid-term credit facilities</li> </ul>	Public and private sector banks, GO policy support
Policy advocacy	<ul style="list-style-type: none"> <li>Lack of appropriate policies and regulations on mechanization, importation of capital machinery and multiple VAT on imported raw materials</li> </ul>	<ul style="list-style-type: none"> <li>Provisions for appropriate policies and regulations on mechanization, preferential treatment on capital machinery importation and multiple VAT on imported raw materials</li> </ul>	Business associations

### 3.5 Potential centers for agricultural machinery and spare parts manufacturing

Light engineering was the key for many developing nations for acquiring skill and technical knowledge for manufacturing endeavor. The sub-sector begins with the light engineering production activities and eventually ends up with heavy industry. Japan, China, South Korea are the examples. Once, Dholaikhal and Nowabpur of Dhaka were the main production and marketing centers of

AM and spare parts along with other light engineering production activities in the country. However, because of the high concentration of businesses in these areas, AM and spare parts production become expensive and gradually shifted to other potential districts of the country such as Bogra, Jessore, Sylhet etc. Among these potential areas, Bogra emerged as the most potential center of AM and spare parts production.

Bogra is the key business center in the North Bengal

because of its central location and well-established road communication network with the northern districts of Bangladesh. After the construction of Jamuna multipurpose bridge, road communication with the capital Dhaka through Bogra becomes easier for these districts. Eventually, Bogra has been emerged as the business capital of North Bengal. The Bangladesh railway regional workshop at Syedpur contributed much in producing skill mechanics and technicians in this region. After the declining of this workshop, these skilled personnel started establishing private sector repair and maintenance workshops in the northern region of the country, especially in Bogra and later on, started production of AM and spare parts, as there was a demand of these services in this region.

On the other hand, after independence, Jessore became the largest business center of spare parts of Indian built automotive vehicles and its repair & maintenance. Later, these maintenance workshops turn into production units for spare parts of engines and agricultural machines.

Recently, the government of Bangladesh has been encouraging specialized zones for specific products. This would increase the productivity of the industries and quality of product through creating skilled work force for fulfilling the domestic demand as well creating potential for export. At present, Bogra is producing major share of AM, small engine and machinery spares in the country and Jessore emerged as second largest producer of such products. Although major shift has been taken place from Dholaikhal of Dhaka to Bogra and Jessore districts for the production of AM and spare parts, the services related to production, such as quality test of products, heat treatment facility and metallurgical test are still not available in these districts. For sustainability, this sub-sector needs preferential treatment from the government. At this end, declaration of Bogra and Jessore as the centers of agricultural machinery and spare parts manufacturing followed by creation of at least one 'Agri-machinery Production Zone (APZ)' in each districts is an urgent need. Provisions for infrastructural facilities such as gas, electricity, testing of products, road, sanitation, water supply etc. are also to be made available

in these APZs. The APZs must provide spaces for shifting of the existing production units from town centers and potential new production units. The shifting of the existing production units from the town centers may potentially reduce the environmental pollution. In Bogra, the potential area for the APZ may be the land acquired by the government for the establishment of heavy industrial zone near the Shahid Ziaur Rahman medical college.

#### 4 Recommendations

Based on above discussion the following priority recommendations are made for intervention by competent authorities:

- Bogra and Jessore can be declared as 'Agri-machinery districts' to ensure infrastructural facilities such as non-interrupted supply of electricity, gas, water etc. for AM and spare parts production units;
- Establishment of 'Agri-machinery Production Zones (APZ)' on the outskirts of Bogra and Jessore towns to accommodate existing and potential AM industries and workshops;
- Establishment of 'Common Facility Centre' at each APZ to facilitate quality services related to heat treatment, material testing, test and standardization, advisory services etc. on public, private and development partners initiative;
- Provisions should be made for duty free access to SAARC and developing countries, and formal trading of AM at border markets (hats) through bilateral negotiations with India;
- Establishment of a 'Central Institute of Agricultural Engineering (CIAE)' for continuation of innovation through R&D on GO and development partners initiative;
- Formulation and updating of National Agricultural Mechanization Policy;
- Establishment of National Standardization Committee for AM and spare parts can be thought of;
- Modernization of local foundries through collaboration and experience sharing activities among SAARC and industrialized countries;
- Strengthening capacity of AM entrepreneurs through transfer of proto-type machines and technologies

among SAARC and industrialized countries should be promoted;

- Access to soft and flexible long and mid-term credit facilities for capital machinery and working capital needs to be considered;

- Policy options should be considered for removal of multiple VAT on imported raw materials and strengthen rules and regulations against illegal hoarding of raw materials for the growth and development of AM sub-sector;

- Policy options should be rationalized for zero tariff/nominal tariff on modern capital machinery import for agricultural machinery sub-sector;

- BBS data base should include agricultural machinery sub-sector;

- Strengthening capacity of Foundry Owners' Association of Bangladesh (FOAB), Bangladesh Shilpa Malik Samity (BSMS) and Bangladesh Agricultural Machinery Manufacturers Association (BAMMA) should be strengthened to safeguard the interest of the sub-sector.

## References

- Alam, M. M. 2005. *Identification of SMEs and BDS Providers and Analysis of Supply and Value Chain in Agri-machinery Sub-sector of Bangladesh*. Sponsored by South Asia Enterprise Development Facility (SEDF), United House, 10 Gulshan Avenue, Dhaka 1212, Bangladesh.
- BADC. 2010. *Minor Irrigation Survey Report 2010*. Dhaka, Bangladesh: Bangladesh Agricultural Development Corporation (BADC).
- BAMMA, FOAB, BSMS, 2011. Bangladesh Agricultural Machinery Manufacturers Association (BAMMA), Foundry Owners' Association of Bangladesh (FOAB) and Bangladesh Shilpa Malik Samity (BSMS) participated policy workshop at Rural Development Academy (RDA). Bogra, Bangladesh.
- Bangladesh Rice Mills Owners Association. 2012. K. M. Layek Ali, Convener, 22, Motijheel C/A (2<sup>nd</sup> floor), Dhaka-1000.
- BBS. 2009. *Report on Monitoring of Employment Survey 2009*. Bangladesh Bureau of Statistics, Statistical Division. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- BBS. 2011. *Statistical Year Book of Bangladesh – 2011*. Bangladesh Bureau of Statistics, Statistical Division. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- Cochran, W. H. 1977. *Sampling Techniques, Third Edition*. John Wiley & Sons, 605 Third Avenue, New York 10016, USA.
- FAO, 2002. *FAO Hand Book 2002*.
- Hossain, M. M. 2002. *Modification and Adoption of Power Tiller Mounted and Self-Propelled Cereal Reaper in Two Selected Upazillas*. A final report, submitted to the Research and Extension in Farm Power Issues (REFPI) project, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh, Bangladesh.