

Present Status of Farm Power and Machinery Usage in Bangladesh

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Abstract

Mechanization level in terms of usage of farm machinery and farm power in 22 Upazillas and 2 Unions of 13 districts were ascertained. Farm level recent data on machinery and power usage had been collected through questionnaire survey in addition to the previous data from secondary sources. The trend of population of most of the farm machinery continues to rise which got a boost up since late 80s with an increasing demand. Population of tractor, PT, open and close drum thresher, and irrigation pumps has been increased tremendously since then. Population of tractor, PT, seeder, combine harvester, and reaper almost doubled in 2014 over that in 2011. Other machineries such as high-speed rotary tiller, weeder, seeder, sprayer, maize sheller, winnower, USG applicator also got a hike (12% - 50%) in population during this period. Farm machinery like reaper, combine harvester, winnower, USG applicator, and seeder had been observed to be introduced during the recent years. Availability of farm power varied widely among the Upazillas under study and Upazilla wise average value of farm power usage was found to be 1.21 kW/ha. Considering accumulated cultivated area and power usage of all the selected areas, the present study showed that available power further escalated to 1.23 kW/ha by 2014 with an increasing annual average rate of 0.052 kW/ha/yr since 1998 followed by a slower rate (0.021 kW/ha/yr) since 2007. The share of mechanical power was found to be prominent over human and animal power in almost all the study areas followed by animal and human power sources. A major portion, about 60 – 97% of the total farm power used in the study area was supplied by the mechanical source.

Key words: Farm machinery, Farm power, Bangladesh status.

1. Introduction

As a country of agrarian economy Bangladesh needs to feed her 160 million people from 8.2 million hectares of cultivable land which is a challenging task. 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). Agricultural sector of the country is so important that it contributes about 15.5% to GDP and provides exclusively or substantially livelihood of virtually all of approximately 82% of the country's population living in rural areas (BBS, 2016). To increase the agricultural production is therefore of prime importance. Increased use of farm machineries as well as power is one of the key elements to achieve this goal. Rice, wheat, potato, maize, pulses, vegetables etc. are the main crops in our agriculture. The Agricultural Machinery sub-sector is extremely

important for the growth and sustainability of the agricultural sector, as well as national economy. The sub-sector is contributing directly to the employment, food security and poverty alleviation of the country. Farm machineries are being used for tillage, weeding, irrigating, applying fertilizer, weeding, harvesting, threshing, carrying out post harvest operations, and transporting operations in the country. The main agricultural machineries used are power tiller, weeder, different types of pumps for irrigation, pedal thresher/power thresher, reaper, winnower etc. The power and capacity of different machineries varies with make and models. Power is needed on the farm for operating different tools, implements and performing various farm operations. While mobile power is used for doing different field jobs, the stationary power is used for operating irrigation equipment, threshers, shellers/decorticators, cleaners, graders and for other post harvest operations. The mobile farm power comes from human, draught animals, power tillers, tractors

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and self-propelled machines, whereas the stationary power is obtained from oil engines (diesel, petrol, kerosene) and electric motors. Utilization of appropriate machinery is very essential for the betterment of cropping pattern and attracting the newer generation to farming sector. Use of agricultural machinery can increase around 20% productivity of cropping system which is not yet well introduced among farmers for a sustainable agriculture. Different research organizations like BARI, BRRI & BAU has developed improved machineries but a few of them are at the reach of the farmers.. During the devastating flood of 1988, death of a huge number of draft animal, mainly bullocks, caused shortage of draft power which greatly hampered land preparation. Government waived all kind of taxes on farm machinery and as a result a lot of power tillers were imported. Now power tillers do most of the tillage operations (Kabir and Ahmmed, 2005). About 85-90 percent of the land preparation is done by the power tiller and tractor and marginal farmers have access to the tilling machine through hiring service (Farouk, *et al.*, 2007). However, traditional country plough, power tiller and four-wheel tractors are used for land preparation. Sowing of seeds for all the field crops is almost entirely done by hand broadcasting method. Couple of years back a manually-operated seed-cum-fertilizer distributor was developed, which is yet to become popular. 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. In line sowing crops, hand-operated weeders for dry land and wet land conditions are used for weeding. Line sowing and use of weeder is increasing since couple of years. Spraying is commonly done by locally made manually operated knapsack sprayers. Labour shortage occurring during harvesting and transportation results in substantial loss. In order to reduce huge post harvest loss different post harvest machinery were developed. In recent years, hand, pedal and power operated winnowers have been developed for paddy, wheat, maize, pulses and oilseeds working quite satisfactorily.

Despite limited capacity and skill, the agricultural machinery sub-sector has displayed a remarkable advancement in recent time. Starting long back in 1960s, agricultural mechanization scenario in

Bangladesh is rapidly changing with an increasing rate in the recent years. Machineries and mechanical power are taking control of almost each of the agricultural operations to various extents. Country's agriculture is getting rid of tedious, time consuming, primitive state of manual tasks. Therefore, although there is earlier study, it is important to measure the recent level of agricultural mechanization all over the country. Hence, this study was carried out to ascertain the present status of agricultural mechanization in terms of population of farm machineries available as well as the extent of farm power usage in Bangladesh.

2. Methodology

Selection of study area

The availability of human resources and different productivity groups in villages of different agro-climatic zones were considered for the study. The technology and machinery selection of the present investigation was based on important crops grown in Bangladesh. In accordance with the objectives of this study, detailed survey of the selected Upazillas and Unions covered the following:

- Net cultivated area of land and total cultivated area of land;
- Power used (manual, animal and mechanical/ electrical) in each of the farm operation such as tillage, seeding, irrigation, harvesting, threshing, winnowing, post-harvest operations;
- Nature of machines used in farm operations and their sources (country of origin/made);
- Status of maintenance service provider such as own, local mechanic, Upazilla mechanic; and
- Adoption rate of farm machinery.

Considering the accessibility of farm machinery, labor availability and irrigation facility twenty four Upazillas were selected for the study (Table 1). Information related to farm machineries in the respective blocks under a Union were collected from different farmers with assistance of Union Agricultural Officers and SAAO of DAE. Locations of the selected Upazillas are also shown in the Geological map of Bangladesh in Fig. 1.

Table 1: Selected areas under the study

District	Upazilla	District	Upazilla
Lalmonirhat	Lalmonirhat	Tangail	Madhupur
Rangpur	Gangachara	Mymensingh	Trisal
	Betgari		Muktagasa
Gaibandha	Godadhap		Fulbaria
	Gobindagonj		Khagdahor (Union)
	Sadar		Dapunia (Union)
Bogra	Bogra Sador	Netrokona	Purbodhola
	Kahaloo	Narshindi	Karimpur
Sirajgonj	Sirajgonj Sadar		Nazerpur
	Raigonj		Alokbali
Natore	Baraigram	Rajbari	Baharpur
Rajshahi	Godagari	Barisal	Pirojpur



Fig. 1: Study areas shown in the Map of Bangladesh

Survey technique/Methods

Field survey

The quantitative data were collected during 2014 through household survey considering the representative sample. Sample households were selected following multi-stage sampling design. The rationale behind selecting multi-stage sampling is its principle of simplicity, low cost and ease of operation.

At the first and second stages, all districts and Upazillas were selected purposively. At third stage, list of villages were collected from Upazilla Offices of DAE and two or three villages were drawn from each Upazilla in consultation with DAE personnel. Households/ respondents were selected randomly (or purposively based on farmer category) taking 5 respondents from each village at fourth stage of sampling.

Data collection method

A survey questionnaire was developed and used for collection of data. The data/information was primarily collected through household survey method. A certain percentage (about 10%) of the respondents was also interviewed, independent of the enumerators in order to check and compare the information obtained from the field. This was done as quality check to prevent the interviewer's biasness, if any. Data was also collected from SAAO of respective Upazilla.

Data analysis

Once the field investigators started to feed questionnaires to the team leader, the data processing started with coding of questionnaire. Data input was done as per output tables prepared by the study team followed by intensive processing, synthesizing and analysis of data in the light of the objectives of the study. MS Access software package was used for processing the information collected. Data of net cultivable area and total cultivable area were collected from the respondent and SAAO. Dividing total cultivable area by net cultivable area the cropping intensity was obtained. Availability of total power per hectare was calculated on the basis of total area cultivated and the total

power available to the farm from human, animal and mechanical sources. Engagement of total number of human labour, draft animals and machinery in a Upazilla were taken into account to calculate the amount of power used in that Upazilla. Rated power of the machine was considered as a basis to find out the share of mechanical power while 0.0746 kW and 0.35 kW was considered as unit power of human and animal (pair of bullocks) sources to find out their shares, respectively.

3. Results and Discussion

Present status of agricultural machinery usage

Mechanization in Bangladesh agriculture started practically in 1960s during the green revolution campaign with the introduction of tractor, power tiller, deep tube well, shallow tube well and low lift pumps on a very limited quantities under the BADC. It started speeding up during '80s especially in irrigation development. Though the number of tractors, power tillers, and other farm machinery like thresher and weeder increased over the time, irrigation equipment increased in much faster rates (Table 2). Population of most of the farm machinery got a hike since late 80s and the trend still continues with an increasing rate. Since 80s, population of tractor, PT, open and close drum thresher, and irrigation pumps has been increased tremendously. Population of tractor, PT, seeder, combine harvester, and reaper became almost double in 2014 over that in 2011. Other machineries such as high-speed rotary tiller, weeder, seeder, sprayer, maize sheller, winnower, USG applicator also got a hike (12 – 50%) in population during this period. Although quite a low in population, use of farm machinery like reaper, combine harvester, winnower, USG applicator, and seeder have been in practice since the recent years. In addition to the import of farm machinery, growth of local repair facilities and manufacture are contributing towards the augmentation of their usage. Local manufacturers of farm machinery are also availing existing opportunities of technical assistance from research institutions (BRRI and BARI), the Bangladesh Agricultural University (BAU) and some larger NGOs regarding development, lab-testing and on-farm trial of their products (BARI, 2011).

Table 2: Population dynamics of different farm machinery over the years in Bangladesh

Name of machine	Year						
	1977*	1984*	1989*	1996*	2006*	2011**	2014***
Tractor	300	400	1,000	2000	12500	> 30,000	60,000
Power tiller	200	500	5,000	100,000	300,000	4,50,000	7,00,000
High-speed rotary tiller						>3000	>4,000
Weeder						> 2,00,000	2,50,000
Seeder						> 500	1000
Sprayer						12,50,000	12,50,000
Combine harvester						About 60	130
Reaper						About 60	500
Maize sheller	-	-	-	100	850	12,000	14,500
Thresher (open drum)		500	3000	10000	130000	>250,000	2,80,000
Thresher (closed drum)		100	1000	5000	45000	>40,000	50,000
Winnower						> 2,000	3000
USG applicator						>12,000	16,000
Deep tube well	4,461	15,519	22,448	24,506	28,289	>33670	
Shallow tube well	3,045	67,107	223,588	325,360	1,182,525	>1549149	
Low lift pump	28,361	43,651	57,200	41,816	119,135	>1756488	

Source: *Roy and Singh, 2008; ** BARI, 2011; ***Ahmmed, S., 2014

Table 3: Total power available per hectare in the selected Upazillas

District	Upazilla	Net cultivated area, ha	Cropping intensity, %	Total cultivated area, ha	Total power, kW/ha
Lalmonirhat	Lalmonirhat	98875	1.8	177975	0.05
Rangpur	Gangachara	16799	2.05	34437.95	0.64
	Betgari	5967	1.67	9964.89	0.97
	Godadharpur	7324.91	1.16	8496.86	0.14
Gaibandha	Gobindagonj	37800	2.32	87696	0.92
	Sadar	5214	2.22	11575	7.09
Bogra	Bogra Sadar	500	1.6	800	6.79
	Kahaloo	19374	2.54	49209.96	2.42
Sirajgong	Sirajgonj Sadar	23194	2.55	59144.7	0.67
	Raigonj	26158	2.1	54931.8	0.48
Natore	Baraigram	22730	2	45460	0.47
Rajshahi	Godagari	17778	1.26	22,400	1.52
Tangail	Madhupur	27560	2	55120	0.19
Mymensingh	Trisal	26412	1.4	36976.8	0.95
	Muktagasa	3684	1.6	5895	1.11
	Fulbaria	7246	1.38	10000	0.23
	Khagdahor	1800	1.5	2700	0.46
	Dapunia	1750	1.5	2625	0.49
Netrokona	Purbodhola	20000	2.8	56000	0.10
Narshindi	Karimpur	1580	1.5	2370	1.19
	Nazerpur	1650	1.5	2475	1.10
	Alokbali	1300	1.5	1950	0.87
Rajbari	Baharpur	3908	1.1	8206	0.12
Barisal	Pirojpur	14538	2.2	31983.6	0.17
Total				32433.07	29.14

Present status of availability of power per hectare

Table 3 shows the availability of farm power per hectare in the selected study areas. Results are based on the machineries available in the study areas. Average Cropping Intensity (CI) of the respondent household farms in ten districts was 1.843, which was slightly higher than the national average (1.8). Farm power usage varied widely among the Upazillas under the study. Average value of farm power available was found to be 1.21 (sd $\pm$ 1.84) kW/ha with a median of 0.66 kW/ha. Unusual high values at Bogra Sadar and Gaibandha Sadar were attributed to higher use of farm power coupled with the availability of the least net cultivated area.

Growth rate of power use

Level of power input in agriculture is one of the key indicators for measuring the state of mechanization. Fig. 2 depicts the trend of available power in agriculture which increased gradually from 0.25 kW/ha in 1960 to 0.32 kW/ha in 1986. Use of mechanical power, in other words, the rate of mechanization was very slow during this spell. Remarkably, afterwards the rate of available power in agriculture experienced a very sharp rise to 1.17 kW/ha upto 2010 (Hassan, 2013). This manifestation might be attributed to the national policy favorable to import agricultural machineries, spare parts along with the growth of local private manufacturing and repairing facilities. In addition to those factors, recent addition of labour shortage coupled with high wage rate is forcing the use of mechanical power in

agriculture. Considering accumulated cultivated area and power usage of the entire study areas, the present study shows that available power further escalated to 1.23 kW/ha by the year 2014 with an annual increasing rate since 2011. The available farm power escalated sharply with an annual average rate of 0.052 kW/ha/yr since 1998 upto 2007. The rate of increment was found to be slower (0.021 kW/ha/yr) after that period.

Farm power availability in India was 1.5 kW/ha while in major industrialized countries such as, Japan, Italy, France and UK were reported to be 8.75, 3.01, 2.65, and 2.50 kW/ha, respectively (Tandon, 2004).

Share of farm power usage by source at the Upazilla level

Sources of farm power in Bangladesh agriculture comprise of human, animal and mechanical/electrical power. A measure of the share of mechanical power among the total power used in agriculture is an indicator of the status of mechanization. Source wise shares of farm power usage in the selected Upazillas are depicted in Fig. 3. The share of mechanical power dominates over human and animal power in all the areas. A major portion, about 60 – 97% of the total farm power used, was supplied from the mechanical source. This indicates shifting of agriculture from traditional human and animal power dependency.

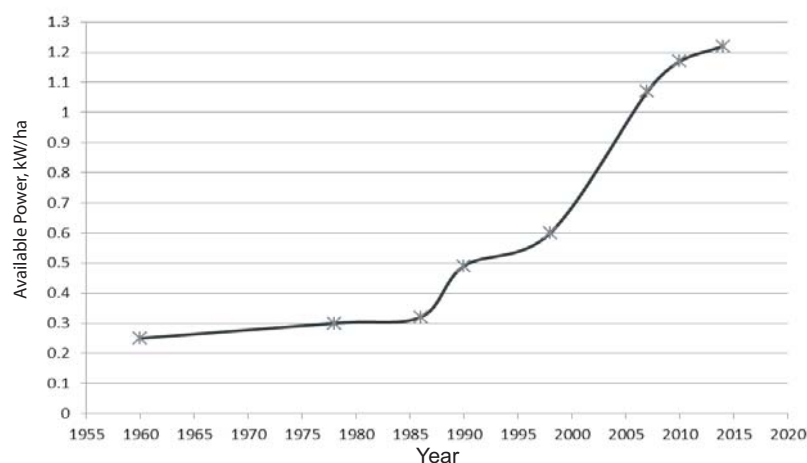


Fig. 2: Available power in agriculture over times

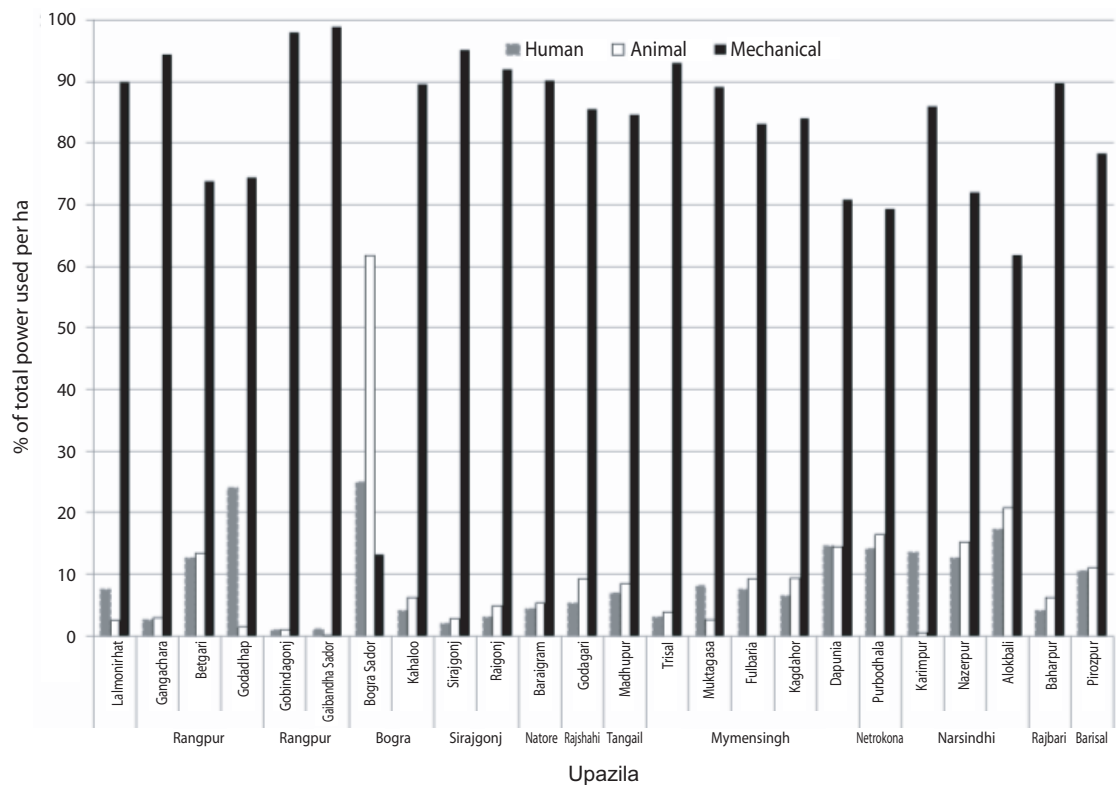


Fig. 3: Share of different power sources used in the selected Upazillas

Combined effect of several aspects like, Government incentives in purchasing farm machineries, shortage of labour during peak periods, huge import of machineries, rise of local manufacturers, availability of spare parts and repair & maintenance facilities, road communication facilities with the district headquarters where the dealers of farm machineries provide their service and definitely positive change in farmers' perceptions regarding use of farm machineries had contributed towards this situation. Yet small, animal and human power sources were found still exist in all the areas covered by this study. Animal power source ranked second ranging from about 2 – 20% followed by human power running closely with animal power. Only exception was found in Bogra Sador where animal and human power usage exceeded mechanical power. Being mostly an industrial area, availability of the least amount of total cultivated land and fragmented small plots might have influenced on this unusual behavior.

4. Conclusion

Intense use of farm machineries and power is one of the most essential inputs to raise the agricultural production by maintaining timeliness and quality of farm operations. This is specifically important in a country like Bangladesh with decreasing cultivable land coupled with ever increasing population. Since late 80s population of most of the farm machinery got acceleration and continued to rise over the years. Since then, population of tractor, PT, open and close drum thresher, and irrigation pumps has been increased tremendously. Population of tractor, PT, seeder, combine harvester, and reaper became almost doubled in 2014 over that in 2011. Other machineries such as high-speed rotary tiller, weeder, seeder, sprayer, maize sheller, winnower, USG applicator also got 12 – 50% increase in population during this period. Uses of farm machinery like reaper, combine harvester, winnower, USG applicator, and seeder have been started since the recent years. A wide variation in farm power usage

was found among the study areas and its value at Upazilla level was 1.21 kW/ha (sd. $\pm$ 1.84, median 0.66). However, considering accumulated cultivated area and power usage of the entire study areas, available farm power further escalated to 1.23 kW/ha by the year 2014 over 1.07 kW/ha in 1998. Usage of farm power is increasing with an annual average rate of 0.021 kW/ha/yr since 2007. The share of mechanical power was found to be prominent (60 – 97%) over human and animal power in almost all the study areas followed by animal and human power sources. Findings of the study reveal that Bangladesh agriculture is coming out of the realm of predominating manual and animal power sources gradually.

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